Bridge Geometry System (BGS) v9.1 User Guide

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Texas Department of Transportation

TABLE OF CONTENTS

TABLE OF CARDS

TABLE OF FIGURES

TABLE OF TABLES

CHAPTER 1: INTRODUCTION

The Texas Department of Transportation (TxDOT) Bridge Geometry System (BGS) software was deployed in 2007 to replace the legacy TxDOT Roadway Design System (RDS) software as the department's principal tool for the geometric design of bridge structures.

RDS was used as a basis in the development of BGS. All non-bridge related program features were removed from RDS and various enhancements were applied. The result of these changes is BGS, a "scaled down" implementation of RDS that focuses on bridge geometrics.

An experienced RDS user will be able to begin using BGS immediately as BGS operates in the same way as RDS. The BGS input data, output computations, reports and CAD plots are presented in the same manner as RDS when applied to bridge geometric design although enhancements to the system have been made since RDS went into the public domain.

PURPOSE OF THIS GUIDE

The BGS User Guide describes in detail how to use the BGS software to perform bridge geometric design and serves as a reference document for coding input data sets.

ORGANIZATION OF THIS GUIDE

The BGS User Guide is organized in the following Chapters and Appendices:

CHAPTERS

Chapter 1: Introduction provides an introduction to BGS including the program's history and relation to RDS, the organization of this user guide and listing of other BGS related documentation.

Chapter 2: Getting Started targets the new user by providing an overview of how to begin using BGS. Subsequent chapters provide additional detailed information about the various topics and concepts that are introduced in this chapter.

Chapter 3: General Information and Terminology describes some aspects of BGS input forms which are common to more than one form. Terminology, concepts and topics which apply to the system in general are also addressed.

Chapter 4: System Card describes the ***Card 1*** - SYSTEM Card input in detail.

Chapter 5: Roadway Design Data describes how to use roadway design data to define the bridge roadway surface in three dimensions.

Chapter 6: Command Structured Input – General Geometry, Chapter 7: Command Structured Input – Bridge Geometry and Chapter 8: Command Structured Input – Plotting Command Structured Input give detailed information on the input of general roadway geometry, bridge geometry and the plotting capabilities of BGS, respectively. This includes information that describes each of the BGS commands that may be issued using command structured input. The commands are organized and presented in groups of related functionality. In particular, the bridge geometry commands are used to compute the geometric aspects of a bridge structure.

Chapter 9: Running BGS to Process the Input File describes how to invoke the BGS program and interface to process the prepared BGS input data file.

Chapter 10: BGS Output describes the various output files generated by BGS.

Chapter 11: Using BGS Project Work Files ***is a place holder Chapter to be considered for a future edition of this user guide***. If provided it will describe how to use the optional BGS project work file program feature. This program feature is normally only employed by experienced users on large complex bridge projects.

Chapter 12: Example Bridge Projects ***is a place holder Chapter to be considered for a future edition of this user guide*** and is intended to include sample projects that describe how BGS is used to establish the geometric design of bridge structures.

APPENDICES

Appendix A: BGS Input Forms provides short to images of each BGS input card.

This is a place holder Appendix to be considered for a future edition of this user guide.

Appendix B: Example BGS Log File provides an example BGS output Log file and includes a discussion of messages found in the various sections of the file.

Appendix C: Example BGS Report Output provides samples of various BGS text output reports.

Appendix D: Example BGS Plot Output provides samples of various BGS output plots.

PROGRAM DESCRIPTION

BGS: A BRIDGE GEOMETRY SYSTEM

The Bridge Design System (BGS) is an integrated combination of over 300 computer processes (subroutines) that can be used to perform geometric calculations and generate plots for a wide variety of bridge superstructure types. The Roadway Design System (RDS) from which BGS is derived contained additional processes that gave RDS geodetic control, earthwork design, and earthwork plotting functionality. These additional processes were not retained in BGS because they are not needed for bridge geometrics.

BGS has been developed from RDS to provide bridge design engineers with a robust computational tool to model bridge geometrics. BGS considers all pertinent geometric features of the roadway and bridge and to provide all the reports and plots needed to design and detail bridge features of highways. Within certain limits the user may arrange the computer processes (functions) in any combination or sequence, depending upon the size and scope of the project, to achieve the desired results.

Although the system is quite comprehensive in scope, the user and BGS roles listed in **Table 1 - User and BGS Roles** highlight the User-BGS partnership's general capabilities.

Under the direction of the user via a simple text input file the system can perform a very broad range of functions and generate a similarly broad range of text and graphic output. It is important to note that the user will not employ the entire range of possible functions at any one time. The system performs any functions for which sufficient and properly structured input has been provided by the user. Therefore, within certain limits functions may be called in any sequence.

Table 1 - User and BGS Roles

USER (Bridge Design Engineer)	*Bridge Geometry System*
The user must: 1. *Understand basic roadway and bridge geometrics and be able to collect this information from the bridge layout.* 2. *Know how to input data and commands to BGS.* 3. *Know how to interpret the output of BGS.* 4. *Know how to incorporate the output into bridge plans.*	*The system can:* 1. *Read the roadway and bridge geometry data supplied by the user or from storage, and execute the commands issued by the user.* 2. *Follow the programmed processes for interpreting and operating on user supplied data.* 3. *Perform geometric computations.* 4. *Store data for future runs.* 5. *Produce text and graphics output and generate a log of completed processes and error messages.*

OTHER DOCUMENTATION

The following additional documentation is available to the BGS user:

- Product README File
- Release Notes
- Online Support Information (requires Internet connection to access)
- BGS User Guide (requires Internet connection to access)

When the BGS software is installed, each of these documents may then be accessed from the BGS program folder as shown in **Figure 1 - BGS Program Folder**.

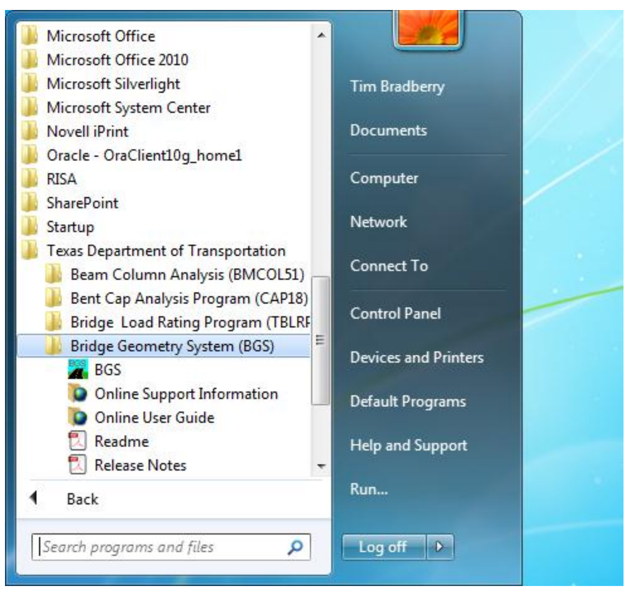


Figure 1 - BGS Program Folder

README FILE

The README file is included as part of the software installation. This document provides general information about the software application and targets the IT professional who installs to software.

RELEASE NOTES

The Release Notes file is included as part of the software installation. This document details the changes that have been applied to the software relative to previous releases.

ONLINE SUPPORT INFORMATION

The Support Information file is an Internet-based document that provides general support information. TxDOT may update this document periodically, as needed, to convey up-to-date support information to the BGS user. The user must have Internet access to download and view this file.

BGS USER GUIDE

The BGS User Guide (this document) provides the user with all the information needed to prepare input files and run BGS. It is the successor to the Roadway Design System (RDS) User Manual, which when RDS was a critical tool for both roadway and bridge design was maintained at the Deputy Executive Director level. The BGS User Guide is maintained below the Division Section level (a much lower level). Therefore, to facilitate deployment of BGS the BGS User Guide is not installed in the program folder but posted on TxDOT's ftp server with an Internet link to it placed in the program folder. This affords to OPR the opportunity to complete certain non-critical sections that are not currently completed or to otherwise revise the document and repost it as needed.

CHAPTER 2: GETTING STARTED

BEFORE THE USER STARTS

Before running BGS to obtain text and plotting output, the user must: (1) (to obtain text output) have properly installed the BGS application on a Windows-based computer, (2) (to in addition obtain plotting output) have properly installed a compatible version of Microstation on the same computer; and should: (3) have in hand a bridge layout (or at the least an alignment description) or other description of the alignment(s) and bridge dimensions, and (4) have ASCII (text) editing software, preferably with cursor coordinate location (row and column) capability, with which to prepare BGS input files. The file must be plain (ASCII) text free of any control characters such as the hidden characters that permeate word processor files.

To aid in the input file creation and editing task, users are encouraged to Google (or use their favorite Internet keyword search engine) on the keyword phrase "Programmer's File Editor" (PFE) to locate and install this freeware program. PFE displays the row and column coordinate location of the curser on the screen which is very useful for the "card based" (a.k.a. "flat file") input of fixed format FORTRAN based programs like BGS. As an alternative to using PFE or comparable text editing software, the user may insert a ruler line as follows in the input file where needed (this line may be left in the file or deleted prior to running the data through BGS):

$2345678900123456789**0123456789**0123456789**0123456789**0123456789**0123456789**01234567890

The bold characters are for illustrative purposes in this guide, making it easy to see that there are eight sets of ten characters each. The flat file will not support bold font.

USING BGS

CREATING THE BGS INPUT FILE

BGS actions are requested and controlled through the use of user specified commands and design data. These commands and design data must be coded into an ASCII (text) input file (flat file), each line of which contains a single command or a set of design data. A line of input is also referred to herein as a card. This convenient term is reflective of the punch card media once used for data input back when the parent program, RDS, was run on an early generation mainframe computer. Just as was the case for punch cards in the early days of mainframe automation, the input file must be prepared in advance of running BGS.

RUNNING BGS (PROCESSING THE BGS INPUT FILE)

An instance of the execution of the input data by BGS is often referred to as a "run." When a run of BGS is initiated the system operates on (i.e. processes) an input file (input data set) and generates text file output and, if instructed to do so by the input cards, plots graphics to a MicroStation dgn file.

REVIEWING BGS OUTPUT

BGS text output is formatted as ASCII text and is best viewed in a text editor such as PFE or in a Word processor using an equal-character-width font such as Courier. The output files have the following extensions (not all of these output files will be produced in every run):

- ls1—Mirror image of input data (optional) plus error and warning messages.

- ls2—Formal output; results of roadway design and bridge command calculations. A majority of the bridge geometry analysis results are in this file.
- ls3—Diaphragm Report.
- ls4—Alignment Plotting Data Report.
- ls5—Summary Bent and Beam Reports.
- ls6—Run Report.

  Note: ls1 and ls2 will always be created but ls3 thru ls6 will exist and contain the listed information to the extent that the elements of the reports are created by the BGS run. For example:

  (1) If no diaphragms are used in the BGS run, no Diaphragm Report file will be generated. In this instance, file ls3 will contain alignment plotting data, and the other reports will be shifted (Summary Bent and Beam Reports would be in ls4, and Run Report in ls5); and

  (2) If no diaphragms are used and no plot is requested, Summary Bent and Beam Reports will be in ls3, ls4 would contain the Run Report, and there would not be an ls5 or ls6 output file.

- lgc—BGS Log File. This file captures all the messages that are streamed to the console during program execution. [this log file will only be produced if the '-l' (lower case L) flag is used (as it is, by default) in the launch string (e.g., "C:\Program Files (x86)\TxDOT\BGS\bgs.exe" –l)]
- pch— Punch File (if required). BGS can alter the input file in several ways; for example, it can convert from English to metric units and vice versa. The Punch File is this altered input file.
- dgn—Graphics File (if required). The MicroStation graphics file containing the plot created.

The following files are output in the special case of debugging. This should only be done when needing to provide debug information for technical support (e.g., a run-time error has occurred) as running BGS in debug mode will slow the BGS run and produce unnecessary files in an otherwise a normal and successful run. If this information is needed, place 'DBUG' (without quotes) as the first four characters of the first line (i.e. on the ***Card 1*** - SYSTEM Card) of the '.dat' input file to run BGS in debug mode.

- lgf—BGS1 Log File. This file contains log messages generated while bridge geometry calculations are being executed by the FORTRAN routines of the program.
- dbc—BGS Debug File. This file contains debug messages generated during pre/post processing by the C+ part of the program.
- dbf—BGS1 Debug File. This file contains debug messages generated while bridge geometry calculations are being executed by the FORTRAN routines of the program.
- sbt—BGS1 Submit File. This file contains all lines of a temporary 'submit' file used to direct calculations in the FORTRAN component of the program.
- plt—BGS1 Plot File. This file contains all lines of a temporary 'plot' file created (when plotting is invoked) during calculations.

BGS INPUT FILE

This section is a discussion of the most common commands used in BGS when modeling bridge geometry and how the commands fit into the bridge design process. The section is divided into sub-sections based on the structure of the example BGS input file listings shown at the end of this chapter. Each sub-section represents a function performed by BGS and lists related commands needed to perform that function. The order of the sub-sections is significant in that it represents the order in which commands are typically entered into the BGS data file. Each sub-section, except in the case of the example input file listings, is divided into two parts: (1) a summary of the section and general description of how applicable commands work together, and (2) an input-file snippet from a representative bridge design example.

DEFINING ROADWAY GEOMETRY

INITIAL INPUT FILE SETUP

SUMMARY

For BGS to start processing an input file it must first "know" what processes are to be executed and where data is going to come from—previously stored data file or new data cards to be included in the "deck", as well as what to call the run (heading). The user must get the system's attention, so to speak. In the Roadway Design Systems Manual, this was represented by the image shown in **Figure 2 - May I Please Have Your Attention?**

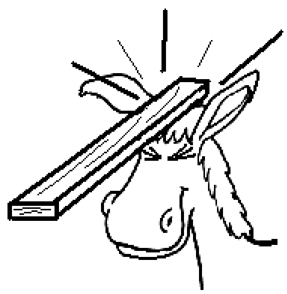


Figure 2 - May I Please Have Your Attention?

To "get the system's attention" a ***Card 1* - SYSTEM Card** must be the first card in the input file. It sets up the processes and I/O parameters within which the program will operate. If you fail to place a valid ***Card 1* - SYSTEM Card** as the very first card in the deck (very first line of input) you will see this message.

```
First Record in Input Data File is Not SYSTEM Record.
ERROR....Invalid SYSTEM Record in Input Data File.
```

The ***Card 1* - SYSTEM Card** is essential, but fortunately relatively easy to code. More involved are the input data that follow and the output that will be generated by the system from that data. Since this input and this output can be lengthy and complex, the user may wish to insert carefully crafted comments in the input file for explanation of portions of the input data. One type of comment will not be included in the output while the other will be included in the output file as explanation for certain parts of the output that need to be so annotated. Done carefully this can make interpretation by the user and others a bit easier, especially after some time has passed since the data file was prepared.

Throughout the input file, the user may include one or both of the two types of comments mentioned above. The first type is an input data file comment which will not appear in the output but is solely for the benefit of the user and others when they are "reading" the input file. These are indicated with a dollar sign ('$') in the first column of the input record (single line of input). When encountering '$' in column 1, the system disregards the rest of the line—none of the data on the line will be processed.

The second type of comment is one that will be included in the program output reports. These comments are entered one or more ***Card 13*** - **CMNT Argument Input Scheme Card**, which the system prints in the formal output. ***Card 13*** - **CMNT Argument Input Scheme Card** generated comments are useful for creating a clear, organized, and annotated output file.

EXAMPLE INPUT FILE SNIPPET

The following is an example of the ***Card*** 1 - SYSTEM Card, ***Card*** 13 - **CMNT Argument Input Scheme Card** cards and data file comments/annotations.

```
       SYSTEM X X      X   NEW NOYESYESYESYES   Example 1
$234567890123456789012345678901234567890123456789012345678901234567890
$      SYSTEM                                   Example 1
$  Comments such as this one are inserted throughout this example input file.
$  These comments will describe all following cards up to the next comment.
       RG   CMNT                    These comments will appear in the output
       RG   CMNT                    file since they are the arguments to these
       RG   CMNT                    CMNT cards. Such comments must be confined
       RG   CMNT                    to columns 37 to 80.
```

Note that the second listed ***Card 1*** **- SYSTEM Card** is “dollar signed” out. In BGS v8.1 the **Processes to be Executed** (input cols 14 thru 24) and the **Job Type** (input col 28-30), **Keep** (store data, input col 31-33) and the three **Data Initialization** fields (input col 34 thru 42) are not needed. This is because the three bridge related processes are the only processes that are necessary—since roadway design has been removed from the system—so these otherwise necessary processes were hard coded in v8.1. Also, the capability of storing parts of data from one run to be used by another run when doing complex multi-bridge geometry, such as for interchanges, was disabled in v8.1. This has all been reversed in BGS 9.1. So, when running an input file prepared for BGS v8.1 in BGS v9.1, the user must provide the corresponding input data to the ***Card 1*** - SYSTEM Card.

ESTABLISHING HORIZONTAL ALIGNMENT

SUMMARY

The first step in creating data for a bridge is to establish a reference roadway for the bridge. This is done by defining,

1. A horizontal alignment.
2. A vertical alignment.
3. Roadway templates.
4. Optionally, roadway widening.
5. Optionally, roadway superelevation.

A horizontal alignment consists of a connected string of elements, usually straight line segments and circular arcs. For some special cases (e.g., railroad bridges) it may also contain spiral elements.

Each entered point on the alignment has a station number. The user assigns the station number to the first point on the alignment. BGS then assigns a station number to every other point on the alignment, depending on the distance that point is from the first point. For example, in **Sample 1** below station number 79+90.00 is assigned by the user, and station number 80+64.20 is assigned by BGS, because the point that bears that station number is 74.20 feet from the point that bears the station number 79+90.00.

The horizontal alignment locates the bridge in a horizontal plane. The other elements of the reference roadway, the vertical alignment, the roadway templates, the widening (if given), and superelevation (if given), are all located on the reference roadway by the station numbers assigned to the horizontal alignment.

Below are three sample listings of alignments generated by BGS from Design Data coded by users in three different BGS input files:

* * * ALIGNMENT SAMPLE 1 * * *

ALIGNMENT ELEMENT NUMBER	ELEMENT TYPE	BEGINNING STATION OR STA. BACK	EAST (X) BEGINNING	NORTH (Y) BEGINNING	BEARING	RADIUS, SPIRAL LENGTH, STA. FORWARD
1	LINE	79+90.00	829089.1053	247927.3439	N 72 20 49.96 E	
2	ARC	80+64.20	829159.8179	247949.8469	N 72 20 49.96 E	1432.39
3	END STA	82+10.00	829300.7542	247986.9180	N 78 10 44.18 E	

* * * ALIGNMENT SAMPLE 2 * * *

ALIGNMENT ELEMENT NUMBER	ELEMENT TYPE	BEGINNING STATION OR STA. BACK	EAST (X) BEGINNING	NORTH (Y) BEGINNING	BEARING	RADIUS, SPIRAL LENGTH, STA. FORWARD
1	LINE	376+57.76	3144057.3564	707777.5235	N 82 59 0.82 E	
2	ARC	377+35.85	3144134.8648	707787.0629	N 82 59 0.82 E	5729.58
3	LINE	379+09.51	3144307.5181	707805.6610	N 84 43 12.54 E	
4	ARC	380+82.84	3144480.1183	707821.6114	N 84 43 12.54 E	5729.58
5	LINE	382+55.71	3144651.9846	707840.1127	N 82 59 29.37 E	
6	ARC	400+44.70	3146427.6096	708058.3997	N 82 59 29.37 E	1041.74
7	LINE	409+59.02	3147177.0986	708529.5076	N 32 42 13.87 E	
8	ARC	427+74.44	3148157.9642	710057.1369	N 32 42 13.87 E	5729.58
9	LINE	429+49.44	3148250.2514	710205.8136	N 30 57 13.96 E	
10	ARC	429+49.45	3148250.2596	710205.8273	N 30 57 13.96 E	2864.79
11	LINE	430+74.43	3148312.1804	710314.3677	N 28 27 16.06 E	
12	ARC	430+74.43	3148312.1833	710314.3730	N 28 27 16.06 E	1637.02
13	LINE	438+04.74	3148507.8549	711011.7125	N 2 53 36.61 E	
14	ARC	439+36.93	3148514.5278	711143.7328	N 2 53 36.61 E	2864.79
15	END STA	442+00.00	3148515.7343	711406.6994	N 2 22 3.84 W	

* * * ALIGNMENT SAMPLE 3 * * *

ALIGNMENT ELEMENT NUMBER	ELEMENT TYPE	BEGINNING STATION OR STA. BACK	EAST (X) BEGINNING	NORTH (Y) BEGINNING	BEARING	RADIUS, SPIRAL LENGTH, STA. FORWARD
1	LINE	690+00.00	3804194.1069	680167.9362	N 56 13 3.12 E	
2	IN SPIR	693+53.08	3804487.5752	680364.2661	N 56 13 3.12 E	227.50
3	ARC	695+80.58	3804674.5902	680493.7689	N 53 27 36.75 E	2363.67
4	OUT SPIR	711+05.13	3805533.5811	681721.3306	N 16 30 17.63 E	227.50
5	END STA	713+32.63	3805591.1771	681941.3949	N 13 44 51.26 E	

For data entry demonstration purposes, consider the two simplest categories of horizontal alignment: straight line or curved (circular arc). For the straight line alignment, BGS needs two points on the alignment to establish the line, and for a curved alignment BGS needs three points. The user can input these points by entering X and Y coordinates or by entering a distance and a bearing from a known point. The PONT and TRVS cards may be used to set and store the coordinates of the data points.

For a straight alignment, the user must identify two end-points on the RD05 cards, the command for horizontal alignment entry. The first point entered is a down (back) station point; the user specifies a station number for this point. In straight horizontal alignments or alignment segments, this point is called a 'point on tangent' (POT). The second point is the up (forward) station point. Its station number is assigned by BGS, as described above, as a function of its distance from the down station point.

Having these two points identified on the RD05 card causes BGS to establish a straight horizontal alignment between them. The resulting horizontal alignment must encompass the associated bridge by a large enough margin to contain all defined horizontal bridge elements. In other words, the beginning and ending stations of the horizontal alignment must be carefully chosen to provide sufficient margin between these stations and the bridge abutments such that no part of the abutment or approaching modeled element, such as a wing-wall or bridge approach slab, will approach these station lines.

For a curved alignment, the user must identify three points on the RD05 cards: two points of tangency and a point of intersection. The points must be entered in order of increasing stations. BGS designates these three points as follows: the first point is the POT with a station number provided by the user; the second is called the 'point of intersection' (PI); and the third is called the 'point of tangency' (PT). BGS uses these points and the entered degree of curvature or radius to establish the horizontal alignment with stationing. The beginning and ending stations of the horizontal alignment must be carefully chosen to provide sufficient margin between these stations and the bridge abutments such that no part of the abutment or approaching modeled element, such as a wing-wall or bridge approach slab, will approach these stations.

EXAMPLE INPUT FILE SNIPPET

The following is an example of a curved alignment. Three points are defined: points 1 and 3 are points of tangency and point 2 is a point of intersection. These points are entered on the RD05 cards and BGS uses this data to establishes the horizontal alignment.

```
$  The PONT and TRVS cards establish just enough points along the alignment to
$  define the curves, tangents, and the beginning and end of the alignment. The
$  TRVS command lays out each point at the proper bearing with each adjacent
$  point.
       RG   PONT   1                   6000.000    4000.00
       RG   TRVS   1   2                                   567.26    N 14183294W
       RG   TRVS   2   3                                   715.97    N 19210500E
       RG   TRVS   3   4                                   630.07    N  3355356W
$  The RD05H cards define the horizontal alignment and assign the station number
$  206+00.00 to the first point. The curve is defined by degree of curvature
$  which, in radians, is equivalent to 100 ft along the curve divided by the
$  radius in feet. The 7:32:20.11 degree curve here is not some kind of failure
$  to use an appropriate number of significant figures, but rather corresponds
$  exactly to a radius of 760 ft (a rather sharp curve). The points 1 thru 4 are
$  defined above using the PONT and TRVS commands and are both recalled and used
$  for storage here.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD05H 1  2060000POT                                                    1
       RD05H 2           7322011                                              2
       RD05H 3           7322011                                              3
       RD05H 4                                                                4
```

ESTABLISHING VERTICAL ALIGNMENT

SUMMARY

A vertical alignment consists of a connected string of elements, which are straight line segments and parabolas. For data entry demonstration purposes, consider the two simplest categories of vertical alignment: a straight alignment and a curved (parabolic) alignment. For the straight alignment BGS needs two points on the alignment to establish the line, and for the curved alignment BGS needs three points. The vertical alignment is also called the profile grade line (PGL). To calculate the straight alignment, the user must enter elevations and stations of two points on the roadway using the RD10 card. BGS uses these two points to establish a straight vertical alignment. Note that these stations must be present on the horizontal alignment, and as before they must be in ascending station order. The vertical alignment must capture any associated bridge by a large enough margin that all defined associated bridge elements are within the bounds of the alignment. In other words, the beginning and ending stations of the vertical alignment must be carefully chosen to provide a sufficient distance between these stations and the bridge abutments such that no part of the abutment or approaching modeled element, such as a wingwall or bridge approach slab, will exceed these station limits.

For the curved alignment, the user must input elevations and stations of three points: two end points and a point of intersection. The points must be provided in ascending station order. The first such point must be the point where the vertical curve begins, i.e. the point of vertical curvature, or any point on the back tangent to the curve prior to the point of vertical curvature. The second point must be the point of intersection of the forward and back tangents to the vertical curve. The third is the point where the vertical curve ends, the point of vertical tangency, or any point on the forward tangent beyond the point of vertical tangency.

BGS uses these points and a curve length to establish the vertical alignment as an equal tangent parabola centered about the point of intersection and situated between the two end points. The vertical alignment should capture any associated bridge by a large enough margin that all defined associated bridge elements are within the bounds of the alignment. But the vertical alignment must also be within the stationing established in the horizontal alignment. In other words, the beginning and ending stations of the vertical alignment should be carefully chosen to provide sufficient margin between these stations and the bridge abutments such that no part of the abutment or approaching modeled element, such as a wingwall or bridge approach slab, will exceed these station limits.

EXAMPLE INPUT FILE SNIPPET

The following example input cards establish a curved vertical alignment using three points: two end points and one vertical curve point of intersection (VPI).

```
$  These cards calculate the vertical alignment by assigning elevations to
$  stations 210+00.00, 21+55.00, and 22+30.00 of 2703.17, 2739.94 and 2713.49,
$  respectively. This vertical alignment has a curve length of 600 ft.
$234567890123456789012345678901234567890123456789012345678901234567890
       RD10H 1  2100000 270317
       RD10H 2  2155000 272994  600
       RD10H 3  2230000 271349
```

ESTABLISHING THE ROADWAY TEMPLATE

SUMMARY

Establishing the horizontal and vertical alignment defines the path of the roadway in three-dimensional space as a line with stationing. The next step to defining the roadway is to establish the surface of the roadway with respect to the profile grade line established with the RD05 and RD10 cards.

The roadway surface cross section at a station is defined by a series of up to sixteen segments, each with a distance and a slope, and is called a 'template.' The segment lengths and slopes of the template are entered on an RD30 card. Given a station, this RD30 card is the roadway surface at that station. The points where the segments meet are called ridge points. Because each segment has two ends, the number of ridge points will always be one more than the number of segments. Assigning a compatible template (RD30 card) to another station on the alignment defines the entire surface of the roadway between the two stations.

So, the roadway surface is defined by a series of RD30 cards. BGS takes this series of RD30 cards defined at different stations and connects the ridge points linearly to form the roadway surface. Note that it is necessary for consecutive RD30 cards to have the same number of segments in order to be connectable (this makes the adjacent templates compatible).

EXAMPLE INPUT FILE SNIPPET

The following example input cards establish a template with constant surface. The template is assigned a recall number ("1", in this case). Subsequent RD30 cards having the same template configuration need only specify the recall number.

```
$  These cards establish the roadway surface between stations 211+00.00 and
$  222+00.00. This surface is constant.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD30H  2110000 11F    2 2 2 2         -08   200   08   200
       RD30H  2132500 1
       RD30H  2177500 21F    2 2 2 2         -08   200   08   200
       RD30H  2220000 2
```

DEFINING BRIDGE GEOMETRY

PREPARING BGS FOR BRIDGE COMMANDS

SUMMARY

Much as the SYSTEM card prepared BGS for roadway geometry commands, the NAME card prepares BGS for bridge geometry commands. The NAME card must be entered before any other bridge command card. The NAME card creates a file for storing the data associated with the bridge including the stationing, number of bents, number of beams, and the loading type. BGS uses the information entered on the NAME card to allocate memory for use by the program in setting aside computer RAM for performing the various calculations associated with the bridge.

This NAME card is typically followed by the APLT card which establishes parameters for plot output. When RDS, the parent program to BGS, was developed, the APLT card was used to control plotting on paper having physical restraints, but since the target plot medium is now electronic space (a graphics file), the APLT card establishes parameters primarily for MicroStation plotting, though paper plotting is still supported.

EXAMPLE INPUT FILE SNIPPET

The following example input cards show how to prepare BGS to accept bridge commands and to establish plot parameters.

```
       RG   CMNT                 ********************************************
       RG   CMNT                                BRIDGE COMMANDS
       RG   CMNT                 ********************************************
$  The NAME card specifies roadway (alignment) H as the bridge reference roadway
$  and that the bridge will lie between stations 211+00.00 and 222+00.00
$  on roadway H
$234567890123456789012345678901234567890123456789012345678901234567890123456789
       RG   NAME   5  13HL93BRIG H     21100.0   22200.0  Example 1
$  The APLT cards specify that the segment of roadway H between stations
$  213+00.00 and 221+00.00 is to be plotted. The two APLT cards shown are for
$  BGS v8.x.x and v9.x.x, respectively. Either option can be used in v9.x.x, but
$  both alternatives are presented below, the commented out option being
$  necessary for plotting to paper. Note that the first APLT card is not used
$  here (it has a '$' in column 1). The NPEN command changes the color of the
$  bridge framing plot from the default white (or black if the default
$  background in BGS is white). The alignment will be the default color and the
$  bridge framing (actually all elements $ plotted after the NPEN command is
$  invoked) will be red.
$234567890123456789012345678901234567890123456789012345678901234567890123456789
$      RG   APLT 500   33  20  10 H  21300.0    22100.0     20.0
       RG   APLT   1       20 100 H  21300.0    22100.0
       RG   NPEN   4
```

ELEVATION CHECKS AT POINTS OF INTEREST

SUMMARY

The ZPNT command is used to retrieve and output the coordinates and roadway surface elevations at points of interest such as the beginning or end of the bridge. The PONT command is typically used to set points of interest along the bridge alignment. However, the ZPNT command can be used for any defined point on the roadway surface, not just points along the alignment.

EXAMPLE INPUT FILE SNIPPET

The following uses the PONT command to establish Point 100, at the beginning and Point 101 at end of the bridge and then uses the ZPNT command to instruct BGS to return the coordinates and elevation of these points.

```
$234567890123456789012345678901234567890123456789012345678901234567890123456789
       RG   PONT 100            H               21405.57  0.0
       RG   PONT 101            H               21725.57  0.0
       RG   CMNT                   BEGINNING OF BRIDGE
       RG   ZPNT 100            H
       RG   CMNT                   END OF BRIDGE
       RG   ZPNT 101            H
```

DEFINING BENT LINES AND SLAB DIMENSIONS

SUMMARY

Before slab dimensions can be calculated or beams framed, bent lines must be entered on the BENT card. Using this data BGS draws a line that represents the centerline of the bent transverse to the horizontal alignment. Once these bent lines have been established at the desired stations and with the appropriate skew, the slab dimensions can be defined. It is essential that the bent lines be established first because BGS needs these to define the slab, and later to frame the bridge (intersect bent lines with beam lines).

The slab boundaries are defined by two cards: the PSLB card, and the SLAB card. The PSLB card defines the slab edge parallel to the roadway alignment. The PSLB card may also be used to define broken slab edges associated with moderate and large skewed slab ends. The SLAB card defines the slab depth bounded by the given PSLB lines and the BENT lines, so there are typically as many SLAB cards as spans. Using these three cards, and specifying interior and overhang slab thicknesses on the SLAB card, we establish the slab boundaries in three dimensions. In other words, we have established the slab shape and volume.

EXAMPLE INPUT FILE SNIPPET

The following example defines five bent lines at various stations. It also defines four PSLB lines at different offsets from the bridge centerline—two to the left and two to the right. The slab shape and volume is then defined in the area bounded by the bent lines and PSLB lines. The bents in this example are define with a very large right-back skew of 54:15:53 (D:M:S). More typical are skews of 15 to 45 degrees.

```
$  The BENT cards define at what stations the bent lines should cross the bridge
$  alignment established above with the RD05 cards.  Additionally skew, which is
$  Right 54 Deg. 15 Min. 53 Sec. Back (an unusually large skew), and bent type
$  are defined.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BENT          10   1  AB              21405.57           R 54155300B
       RG   BENT          20   2  IN              21465.57           R 54155300B
       RG   BENT          30   3  IN              21565.57           R 54155300B
       RG   BENT          40   4  IN              21665.57           R 54155300B
       RG   BENT          50   5  AB              21725.57           R 54155300B
       RG   CMNT                    ********************************************
       RG   CMNT                    PSLB 1 = LEFT EDGE OF SLAB
       RG   CMNT                    PSLB 2 = LEFT BREAK LINE
       RG   CMNT                    PSLB 3 = RIGHT BREAK LINE
       RG   CMNT                    PSLB 4 = RIGHT EDGE OF SLAB
       RG   CMNT                    ********************************************
$  These cards define four lines parallel to the bridge alignment with offsets
$  of -9. -7, +17 and +19.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   PSLB   1                                        -9.000
       RG   PSLB   2                                        -7.000
       RG   PSLB   3                                        17.000
       RG   PSLB   4                                        19.000
$  These cards define the slab depth in the area bounded by the bent lines and
$  PSLB lines. A separate card is used for every span. Also the slab edges
$  are broken by PSLB lines 2 and 3 at the abutments and at Bent 3.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   SLAB   1   2   1   4 2 3      8.5       8.5              B BX
```

```
       RG   SLAB   2   3   1   4 2 3      8.5       8.5               BXB
       RG   SLAB   3   4   1   4 2 3      8.5       8.5               B BX
       RG   SLAB   4   5   1   4 2 3      8.5       8.5               BXB
```

ESTABLISHING BEARING SEAT CENTERLINES

SUMMARY

The BRNG card is used to establish the bearing seat centerline and depth below roadway surface at a particular bent. The card references the bent number and location in the span (FWD or BK) to identify the bearing seat. The distance to the centerline of the bearing and the distance to the end of the beam are entered on this card. The definition of these distances changes with the measurement option specified. The depth below the reference line must also be entered.

Note: A *Reference Line* is an imaginary horizontal line at a specified depth above or below a beam line and is convenient for establishing bearing seat elevations, determining clearances from roadway surfaces, and locating structural elements. Horizontally, the *Reference Line* always follows the actual position of the beam, but its vertical position is established by specifying the depth from the roadway surface. The user might choose to have the *Reference Line* represent the top of the rolled section or the top of the web for plate girders, or let the *Reference Line* follow the top of the beam. Whatever the case might be, the user enters the depth to the *Reference Line* on the BENT command or the depth below the *Reference Line* on the BRNG command.

Vertical clearance is measured from this line to a given roadway surface. In preliminary design it is helpful to set the depth to the *Reference Line* to a value of zero on the BENT card. Doing this yields a report of the distance of the roadway surface above or below a *Reference Line* intersecting the roadway surface between the locations of the back and forward bent bearing seats. The resulting profile for other than flat vertical curves is useful in the determination of beam haunches. Once beam haunches are set, the depth below the reference line (called here, *Bearing Seat Deduct*) should be corrected to reflect the true distance to the top of the bearing seat. This depth correction process is covered in the section on the VCLR card.

EXAMPLE INPUT FILE SNIPPET

Here are example BRNG cards used to establish the bearing lines and bearing seat deducts. Given bent, beam lines, and a specified frame option, these bearing lines and bearing seat deducts are used for calculating bearing seat locations and elevations.

```
$  This card series defines the bearing seat centerlines on all bents relative
$  to the bent line. There is a separate card for each bearing seat centerline
$  to be established.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BRNG                 1 4FD      12.0      3.0         5.5833
       RG   BRNG                 2 3BO      12.0      3.0         5.5833
       RG   BRNG                 3 3BO      12.0      3.0         5.5833
       RG   BRNG                 4 3BO      12.0      3.0         5.5833
       RG   BRNG                 5 4BK      12.0      3.0         5.5833
```

DEFINING BEAM LINES AND FRAME THE BRIDGE

SUMMARY

A *Beam Line* is an imaginary line running in the span direction of the bridge at a fixed or variable offset to the roadway alignment and is used to determine the intersection of the beams with bent and bearing lines. The centerlines of the beams may or may not coincide with the *Beam Lines*. The user may create *Beam Lines* as curves, straight lines, or combinations of curves and straight line segments, but for typical applications the Beam Lines simply run parallel to the roadway alignment. To define a *Beam Line* of this type only two pieces of data are needed: a *Beam Number* and an *Offset* from the alignment. The *Beam Line* established is parallel to the roadway alignment and at a fixed distance (the *Offset*) away (-ve to left, +ve to right).

The user has two options when framing the bridge (intersecting the beams with the bent and bearing lines); either define all the *Beam Lines*, explicitly choosing where all the beams should be placed, or define only the outside two *Beam Lines* and let BGS decide where the beams should be placed based on given criteria. These options are presented to the user as frame options via the FOPT card. Given one of these options and the correct number of Beam Lines, BGS will frame the bridge according to the criteria of the frame option.

EXAMPLE INPUT FILE SNIPPET

```
$  These cards define beam lines at an offset from the bridge alignment of plus
$  16 ft and minus 6 ft. Beams will be placed relative to these lines. Note that
$  a beam line need not be defined for every beam placed--the FOPT card will
$  automatically place beams if the correct frame option is used.
$234567890123456789012345678901234567890123456789012345678901234567890123456789 0
       RG   BEAM                 1                            -6.0
       RG   BEAM                 2                            16.0
$  This card frames the bridge from bents 1 to 5 between beam lines 1 and 2 with
$  frame option 5. This frame option automatically lays the specified number
$  of beams, 4 in this case, between the two beam lines.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   FOPT   1    5    1    2 5 4                                        1
```

FINDING VERTICAL CLEARANCE

SUMMARY

The vertical clearances can be found using the VCLR card which computes the clearance between a *Reference Line* of a bridge relative to a specified roadway. The alignment for the specified roadway(s) must be established with a series of RD05, RD10, and RD30 cards that are usually located at the beginning of the BGS input data file. When the VCLR card is executed, it will compute the difference in elevation between the specified roadway's profile grade line and the bridge's reference line. The vertical clearances can be used in two ways depending on which roadway is specified.

If the *Depth Below Reference Line* field is zero and the specified roadway is that of the bridge, the vertical clearance table tabulates the distances from the roadway to the reference beam line. This vertical clearance is part of the data needed to determine the distance from the top of the beam to the bottom of the slab at the bearing locations, otherwise known as beam haunch, needed to keep the beam top flange from encroaching into the slab (i.e., to keep the beam top flange below the bottom of the slab). Once the required haunch at a bearing line has been established, the bearing deduct can be determined. The bearing seat deduct must then be entered on the BRNG card as the *Depth Below Reference Line*, for BGS to determine the bearing seat elevations and the vertical clearance between the bridge and lower roadways.

Once the bearing seat deducts have been entered, the VCLR card can be used to find the vertical clearance between the structure and the lower roadway(s). The lower roadway(s) must be previously defined using a series of RD05, RD10, and RD30 cards. This roadway designation should be specified on the VCLR card.

EXAMPLE INPUT FILE SNIPPET

```
$ This series of VCLR cards calculates the distance between the bottom of the
$ beams and the profile grade line for roadway H at 5 equally spaced points.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   VCLR                 10  H  1
       RG   VCLR                 10  H  2
       RG   VCLR                 10  H  3
       RG   VCLR                 10  H  4
```

EXAMPLE INPUT FILES

Below are two example input files, the first of which is a compilation of the *Example Input File Snippets* previously listed. These input files may be run in BGS as is—just copy them into your text editor of choice. They are generously annotated for the benefit of the reader. The annotations which are preceded by a dollar sign ($) are not read by BGS and thus in no way affect BGS processing and output except that they are included in the (optional) BGS Input Listing on the LS1 output file. The comments entered next to CMNT commands are read by BGS and are included in the formal output (on the LS2 output file).

EXAMPLE 1

```
       SYSTEM X X      X   NEW NOYESYESYESYES   Example 1
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
$      SYSTEM                                   Example 1
$  Comments such as this one are inserted throughout this example input file.
$  These comments will describe all following cards up to the next comment.
       RG   CMNT                   ********************************************
       RG   CMNT                          ESTABLISH ROADWAY ALIGNMENT H
       RG   CMNT                   ********************************************
       RG   CMNT                   These comments will appear in the output
       RG   CMNT                   file since they are the arguments to these
       RG   CMNT                   CMNT cards. Such comments must be confined
       RG   CMNT                   to columns 37 to 80.
$  The PONT and TRVS cards establish just enough points along the alignment to
$  define the curves, tangents, and the beginning and end of the alignment. The
$  TRVS command lays out each point at the proper bearing with each adjacent
$  point.
       RG   PONT   1                  6000.000    4000.00
       RG   TRVS   1   2                                 567.26    N 14183294W
       RG   TRVS   2   3                                 715.97    N 19210500E
       RG   TRVS   3   4                                 630.07    N  3355356W
```

```
$  The RD05 cards below define the horizontal alignment and assign the station
$  number 206+00.00 to the first point of roadway H. The curve is defined by
$  degree of curvature which, in radians, is equivalent to 100 ft along the
$  curve divided by the radius in feet. The 7:32:20.11 degree curve here is not
$  some kind of failure to use an appropriate number of significant figures, but
$  rather corresponds exactly to a radius of 760 ft (a rather sharp curve). The
$  points 1 thru 4 are defined above using the PONT and TRVS commands and are
$  both recalled and used for storage here.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD05H 1  2060000POT                                                     1
       RD05H 2            7322011                                              2
       RD05H 3            7322011                                              3
       RD05H 4                                                                 4
$  These cards establish the roadway surface between stations 211+00.00 and
$  222+00.00. This surface is constant.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD30H  2110000 11F    2 2 2 2         -08  200  08  200
       RD30H  2132500 1
       RD30H  2177500 21F    2 2 2 2         -08  200  08  200
       RD30H  2220000 2
$  These cards calculate the vertical alignment by assigning elevations to
$  stations 210+00.00, 21+55.00, and 22+30.00 of 2703.17, 2739.94 and 2713.49,
$  respectively. This vertical alignment has a curve length of 600 ft.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD10H 1  2100000 270317
       RD10H 2  2155000 272994  600
       RD10H 3  2230000 271349
       RG   CMNT                  *******************************************
       RG   CMNT                                 BRIDGE COMMANDS
       RG   CMNT                  *******************************************
$  The NAME card specifies roadway (alignment) H as the bridge reference roadway
$  and that the bridge will lie between stations 211+00.00 and 222+00.00
$  on roadway H
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   NAME   5  13HL93BRIG H     21100.0   22200.0  Example 1
$  The APLT cards specify that the segment of roadway H between stations
$  213+00.00 and 221+00.00 is to be plotted. The two APLT cards shown are for
$  BGS v8.x.x and v9.x.x, respectively. Either option can be used in v9.x.x, but
$  both alternatives are presented below, the commented out option being
$  necessary for plotting to paper. Note that the first APLT card is not used
$  here (it has a '$' in column 1). The NPEN command changes the color of the
$  bridge framing plot from the default white (or black if the default
$  background in BGS is white). The alignment will be the default color and the
$  bridge framing (actually all elements plotted after the NPEN command is
$  invoked) will be red.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
$      RG   APLT 500  33  20  10 H  21300.0    22100.0     20.0
       RG   APLT   1      20 100 H  21300.0    22100.0
       RG   NPEN   4
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   PONT 100            H              21405.57  0.0
       RG   PONT 101            H              21725.57  0.0
       RG   CMNT                  BEGINNING OF BRIDGE
       RG   ZPNT 100            H
       RG   CMNT                  END OF BRIDGE
```

```
       RG   ZPNT 101             H
$  The BENT cards define at what stations the bent lines should cross the bridge
$  alignment established above with the RD05 cards.  Additionally skew, which is
$  Right 54 Deg. 15 Min. 53 Sec. Back (an unusually large skew), and bent type
$  are defined.
$234567890123456789012345678901234567890123456789012345678901234567890123456789 0
       RG   BENT          10   1  AB              21405.57          R 54155300B
       RG   BENT          20   2  IN              21465.57          R 54155300B
       RG   BENT          30   3  IN              21565.57          R 54155300B
       RG   BENT          40   4  IN              21665.57          R 54155300B
       RG   BENT          50   5  AB              21725.57          R 54155300B
       RG   CMNT                    ********************************************
       RG   CMNT                    PSLB 1 = LEFT EDGE OF SLAB
       RG   CMNT                    PSLB 2 = LEFT BREAK LINE
       RG   CMNT                    PSLB 3 = RIGHT BREAK LINE
       RG   CMNT                    PSLB 4 = RIGHT EDGE OF SLAB
       RG   CMNT                    ********************************************
$  These cards define four lines parallel to the bridge alignment with offsets
$  of -9. -7, +17 and +19.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   PSLB   1                                          -9.000
       RG   PSLB   2                                          -7.000
       RG   PSLB   3                                          17.000
       RG   PSLB   4                                          19.000
$  These cards define the slab depth in the area bounded by the bent lines and
$  PSLB lines. A separate card is used for every span. Also the slab edges
$  are broken by PSLB lines 2 and 3 at the abutments and at Bent 3.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   SLAB   1   2   1   4 2 3      8.5       8.5             B BX
       RG   SLAB   2   3   1   4 2 3      8.5       8.5             BXB
       RG   SLAB   3   4   1   4 2 3      8.5       8.5             B BX
       RG   SLAB   4   5   1   4 2 3      8.5       8.5             BXB
$  This card series defines the bearing seat centerlines on all bents relative
$  to the bent line. There is a separate card for each bearing seat centerline
$  to be established.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BRNG               1 4FD      12.0      3.0        5.5833
       RG   BRNG               2 3BO      12.0      3.0        5.5833
       RG   BRNG               3 3BO      12.0      3.0        5.5833
       RG   BRNG               4 3BO      12.0      3.0        5.5833
       RG   BRNG               5 4BK      12.0      3.0        5.5833
$  These cards define beam lines at an offset from the bridge alignment of plus
$  16 ft and minus 6 ft. Beams will be placed relative to these lines. Note that
$  a beam line need not be defined for every beam placed--the FOPT card will
$  automatically place beams if the correct frame option is used.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BEAM                  1                             -6.0
       RG   BEAM                  2                             16.0
$  This card frames the bridge from bents 1 to 5 between beam lines 1 and 2 with
$  Frame Option 5. This frame option automatically lays the specified number
$  of beams, 4 in this case, between the two beam lines.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   FOPT   1   5   1   2 5 4                                          1
$ This series of VCLR cards calculates the distance between the bottom of the
$ beams and the profile grade line for roadway H at 5 equally spaced points.
```

```
$234567890123456789012345678901234567890123456789012345678901234567890
       RG   VCLR              10 H 1
       RG   VCLR              10 H 2
       RG   VCLR              10 H 3
       RG   VCLR              10 H 4
```

EXAMPLE 2

```
       SYSTEM X X      X   NEW NOYESYESYESYES   Example 2
$234567890123456789012345678901234567890123456789012345678901234567890
$  Comments such as the following are inserted throughout this example input
$  file. These comments will describe following cards up to the next comment.
       RG   CMNT                    ********************************************
       RG   CMNT                           ESTABLISH ROADWAY ALIGNMENT H
       RG   CMNT                    ********************************************
$  The PONT and TRVS cards establish two points at the ends of the alignment
$  These are placed far enough apart to accommodate the bridge, 1000 ft. The
$  line traversed through the points is at a bearing of North 19 Deg. 12 Min.
$  11 Sec. East.
       RG   PONT   1                 6000000000 4000000000
       RG   TRVS   1   2                                       1000.00N019121100E
$  These cards are used to establish horizontal alignment H assigning the
   station 20+00.00 to the first point.
$234567890123456789012345678901234567890123456789012345678901234567890
       RD05H 1   200000POT                                                   1
       RD05H 2                                                               2
$  These cards are used calculate the vertical alignment by assigning elevations
$  to stations 20+55.67 and 28+47.13. This vertical alignment is straight.
$234567890123456789012345678901234567890123456789012345678901234567890
       RD10H 1   205567 665.82
       RD10H 2   284713 670.43
$  These cards establish the roadway surface between stations 20+55.67 and
$  28+47.13. This surface is sloped 0.08 ft/ft to the left for the first 122.5
$  ft. of the alignment, transitions from this left slope to 0.08 ft/ft slope
$  to the right of over 45 ft. is constant.
$234567890123456789012345678901234567890123456789012345678901234567890
       RD30H   211000 11F    2 2 2 2         -0800200 -0800200
       RD30H   213250 1
       RD30H   217750 21F    2 2 2 2          0800200  0800200
       RD30H   284713 2
       RG   CMNT                    ********************************************
       RG   CMNT                           ESTABLISH ROADWAY ALIGNMENT I
       RG   CMNT                    ********************************************
$  The following cards establish the points for the second roadway alignment.
$  The ZPNT card is used to place the beginning point of the second alignment
$  The point on tangent. The template does not extend out to this point from the
$  first alignment so the ZPNT command will not return an elevation for the
$  point. The TRVS cards set the next two points relative to the first. The
$  second point is the PI of the curve.
$234567890123456789012345678901234567890123456789012345678901234567890
       RG   ZPNT  10             H             2429.26    -210.44
       RG   TRVS  10  11                                  642.25     S070473100E
       RG   TRVS  11  12                                  542.25     S049211864E
$  The following cards establish the horizontal alignment and assign the station
```

```
$  287+55.78 to its beginning. The radius of the arc connecting the two tangents
$  is 28647.3 ft which determines the curvature.
       RD05I 1  2875578POT                                                    10
       RD05I 2                    28647300                                    11
       RD05I 3                                                                12
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
$  The following cards calculate the vertical alignment by assigning elevations
$  to stations 288+55.78 and 299+27.62. This vertical alignment is flat.
       RD10I 1  2885578 642.82
       RD10I 2  2992762 642.82
$  These cards establish the roadway surface between stations 288+55.78 and
$  299+27.62. This surface is complex having 6 segments with various lengths and
$  slopes.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RD30I  2885578 31F    4 4 4 4         +03  289 -0423700 +04  57  +04  57
       RD30I  2885578 32F    4 4 4 4         +0064749 -020 29
       RD30I  2992762 31
       RD30I  2992762 32
       RG   CMNT                    ********************************************
       RG   CMNT                                   BRIDGE COMMANDS
       RG   CMNT                    ********************************************
$  The NAME card specifies that the bridge will lie between stations 21+55.67
$  and 27+47.13 on alignment H.
       RG   NAME   5   2HS20BRIG H    2155.67    2747.13  EXAMPLE 2 BRIDGE
$  The APLT cards specify that the segment of roadway I between stations
$  288+10.00 and 292+00.00 and the segment of roadway H between stations
$  22+00 and 27+00 should be plotted. Using the set of options below will force
$  the roadways to be plotted on the same coordinate system.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   APLT          10 100 I     28810.00   29200.00
       RG   APLT          10 100 H      2200.00    2700.00
$  This CONT cards add elevation contour lines to roadway I between stations
$  289+10.00 and 290+00.00 and to roadway H from station 22+50 and 26+50 with
$  10 ft. horizontal distance between each line and elevation calculations every
$  0.5 ft.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   CONT                I     28910.00   29000.00       10.0        1.0
       RG   CONT                H      2250.00    2650.00       10.0        1.0
       RG   NPEN   4
$  These BENT card define what stations the bent lines cross the bridge alignment
$  established above. Additionally skew, which is Left 0 deg. forward and bent
$  type (Abutment or Interior Bent) are defined.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BENT              1  AB            2255.67             L000000000F
       RG   BENT              2  IN            2317.13             L000000000F
       RG   BENT              3  IN            2427.13             L000000000F
       RG   BENT              4  IN            2537.13             L000000000F
       RG   BENT              5  AB            2647.13             L000000000F
$  The PSLB cards define two lines parallel to the bridge alignment with an
$  offset of plus and minus 10.25 feet.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   PSLB  10                                          -10.25
       RG   PSLB  20                                          +10.25
       RG   CMNT                    ********************************************
       RG   CMNT                    PSLB 10 = LEFT EDGE OF SLAB
```

```
       RG   CMNT                    PSLB 20 = RIGHT EDGE OF SLAB
       RG   CMNT                    ********************************************
$  The SLAB cards define the slab depth in the area bounded by the bent lines and
$  PSLB lines. A separate card is used for every span.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   SLAB   1   2  10  20          24.0                    B B
       RG   SLAB   2   3  10  20          24.0                    B B
       RG   SLAB   3   4  10  20          24.0                    B B
       RG   SLAB   4   5  10  20          24.0                    B B
$  The BRNG card series defines the bearing seat centerlines on all bents
$  relative to the bent line. There is a separate card for each bearing seat
$  centerline to be established.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BRNG             1 4FD        8.5        2.0      5.375
       RG   BRNG             2 1BK        8.5        2.0      5.375
       RG   BRNG             2 1FD        8.5        2.0      5.375
       RG   BRNG             3 1BK        8.5        2.0      5.375
       RG   BRNG             3 1FD        8.5        2.0      5.375
       RG   BRNG             4 1BK        8.5        2.0      5.375
       RG   BRNG             4 1FD        8.5        2.0      5.375
       RG   BRNG             5 4BK        8.5        2.0      5.375
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
$  The BEAM cards define beam lines at an offset from the bridge alignment of
$  plus and minus 10.25. Beams will be placed relative to these lines.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   BEAM                1                          -10.25
       RG   BEAM                2                          +10.25
$  The FOPT card frames the bridge from bents 1 to 5 between beam lines 1 and 2
$  with Frame Option 5 having 6 beams.
$2345678901234567890123456789012345678901234567890123456789012345678901234567890
       RG   FOPT   1   5   1   2 5 6                                          1
$  The two series of VCLR cards, one for roadway H and one for roadway I,
$  calculate the distance between the bottom of the beams and the profile grade
$  line defined for the given roadway at 11 equally spaced points.
       RG   VCLR              10 H 1
       RG   VCLR              10 H 2
       RG   VCLR              10 H 3
       RG   VCLR              10 H 4
       RG   VCLR              10 I 1
       RG   VCLR              10 I 2
       RG   VCLR              10 I 3
       RG   VCLR              10 I 4
       RG   VCLR              10 H 2
       RG   VCLR              10 H 3
       RG   VCLR              10 H 4
```

CHAPTER 3: GENERAL INFORMATION AND TERMINOLOGY

This chapter covers general information common for much of the Bridge Geometry System (BGS) input. Subsequent chapters cover the specific commands available in the system.

INPUT FILE

The input file, also referred to as the data input file, is a fixed format text file (a.k.a. “flat file”) which defines various alignments, roadway surfaces, and bridge parameters. These features are created by the system using commands and/or design data and corresponding arguments which are specified by the user in predefined fields (ranges of columns) on individual lines (a.k.a “cards” or “records”) of the input file. Once this file is prepared, the user processes the input data by submitting it to BGS which in term generates text and plot output. The program execution process is discussed in Chapter 7.

CONTROL AND SECTION

The highway control and section numbers (which indicate the physical location of the project) may be used to identify the project to which the input data pertain. Seven spaces are set aside for this optional control and section identification. These seven spaces are allocated as follows: the first four are for the control number; the next two, for the section number; and the seventh, or last space, for an alphabetic character which is used only when more than one file is established for the same control and section number. If both the control and section number are input, they shall each be right justified within their allocated spaces. The alphabetic character space may be left blank if none is needed.

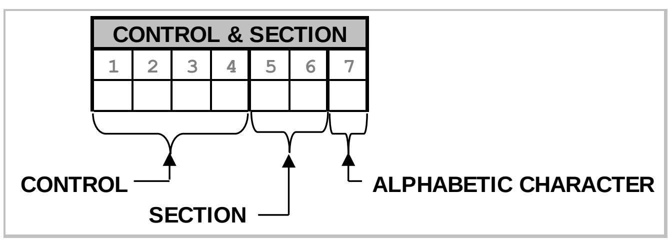


Figure 3 - Control and Section (optional)

Note: These optional input fields were used in input data sets for the Roadway Design System (RDS) from which BGS has been derived, but they are not needed for program execution and have limited value in BGS today.

ROADWAY

A roadway is defined as all of the geometric elements associated with a single horizontal and vertical alignment including the roadway template and related elements. A roadway may be referred to as a “roadway,” a “roadway alignment,” or as an “alignment.” Each bridge is associated with a particular roadway that defines the physical location of the bridge. This roadway is assigned to the bridge on the NAME card.

ROADWAY DESIGNATION

Each roadway alignment must be given an alphabetic letter designation from A through Z. This designation is used to refer to the alignment on all data inputs. See Chapter 5: Roadway Design Data for more information about alignments.

ROADWAY TEMPLATES

The roadway template defines the cross-section of a roadway from ridge point to ridge point (ridge points are the points on the roadway cross-section at which, in general, the slope of the roadway changes). The user supplies template criteria for the roadway. These criteria may be modified by widening specifications and/or superelevation specifications which the user also supplies. The horizontal positioning of a roadway template is determined by horizontal alignment data supplied by the user. The vertical position of the template is determined by vertical alignment data also supplied by the user.

DESIGN DATA

All user input which describes the bridge reference roadway and any related roadways are classified as design data. Design data include the definitions of the roadways, their horizontal and vertical alignments, and their templates, widths, and superelevations.

STATIONS

Every location on a horizontal alignment is identified by a station number. Each location on the alignment must have a unique station number. The difference between the station numbers of two locations on the alignment is a measure of the distance between the locations.

STATION EQUATIONS

Equations are necessary when horizontal alignments from two or more sources are combined to make one horizontal alignment. If the first alignment consists of stations from 1+00.00 to 21+76.20 and the second consists of stations from 25+00.00 to 70+00.00, the combined alignment would have an equation of 21+76.20 BACK = 25+00.00 FORWARD. This statement is known as a gap equation. On the combined alignment, the stations which originated from the second alignment would keep their original form, and each station number would be unique.

On the other hand, if the second alignment consists of stations from 19+00.00 to 70+00.00, the combined alignment would have an equation of 21+76.20 BACK = 19+00.00 FORWARD. Because the stations from 19+00.00 FORWARD to 21+76.20 BACK are not unique, the system adds 10,000 to all stations which are derived from the second alignment. This would change the equation to 21+76.20 BACK = 10019+00.00 FORWARD, and all stations on the combined alignment would be unique. This adjustment of station numbers has the effect of making a gap equation out of an overlapping equation.

The distance between two locations on the alignment is the difference between their station numbers, minus the sum of all equation gaps, if any, between them.

A uniform scheme for inputting stations is used in all phases of the Bridge Geometry System. Stations are entered to the nearest one-hundredth of a foot. The leftmost space of the station number is reserved for an overlapping equation number. This number becomes a part of the station number.

The use of one space for handling overlapping equations allows a maximum of nine overlapping equations in a station line. The number of gap equations is not limited. However, limitations are placed on the total number of equations allowed per alignment. These limitations are discussed in Chapter 5: Roadway Design Data.

ALPHABETIC ENTRIES

Any letter of the alphabet (case does not matter) may be used when alphabetic entries are made.

ALPHANUMERIC ENTRIES

Alphanumeric entries may be any letter of the alphabet, upper and lower case, the numbers 0 through 9, the symbols / + - . ( ) $ * , = # ‘ % @, or blank.

COMMENTS

When comments are allowed, they are to be alphanumeric entries in specified columns.

FIELD

A field is a fixed range of columns set aside on a card (line) of input data for a specific data entry. The various fields on data card images in this guide have titles indicating each field name (usage). The data entered in these fields constitute the function/commands invoked and the arguments required for BGS to perform these function/commands.

JUSTIFYING

Some data entries must be placed in specific positions within a field to be recognized correctly by the program. When “left justified” is specified, the data must be entered starting with the leftmost column or space of the field. When “right justified” is specified, the rightmost character of the input data must fall in the rightmost column or space of the field.

NUMERIC ENTRIES

Numeric entries consist of real (floating point) or integer numbers made up of digits 0 through 9. In the case of real data, numeric entries may include either an explicit or implicit decimal.

REAL (FLOATING POINT) NUMBERS

Real floating point numbers are numbers that contain floating decimal points. For example, the numbers 5.5, 0.001, and -2,345.6789 are floating point numbers. Such a real number can be entered without the decimal place when the input field contains an implied decimal. An integer can also be a real number but a floating point number with a non-zero digit to the right of the decimal cannot be represented as an integer. The number zero is both an integer and a real number.

INTEGER NUMBERS

An integer is a whole number (not a fraction) that can be positive, negative, or zero. Therefore, the numbers 10, 0, -25, and 5,148 are all integers. Unlike floating point numbers, integers cannot have decimal places.

EXPLICIT DECIMAL POINT

Explicit decimal points, when used (input by the user), occupy one column of a field. Thus, they reduce by one the maximum number of digits that could otherwise be entered in the field. If no decimal is input for real numeric input, one is implied in the location shown on the data input card for the specific command. Many fields have implied decimals that provide for four digits to the right of the decimal.

IMPLICIT DECIMAL POINT

An implicit (i.e. implied) decimal point will be shown on data input cards as a preprinted decimal between columns. Digits in columns to the left of the implied decimal will be read as the whole number portion of the numeric input while those to the right of the implied decimal will be read as the decimal or non-whole (i.e. fractional) number portion of the real number. Data must be entered in accordance with an implied decimal point unless the instructions indicate that the user may override it with an explicit decimal point. Unless explicit decimal points are allowed, implicit decimal point locations must be strictly followed due to the way BGS reads certain numeric input fields. BGS reads some numeric input fields as integer numbers and then converts them to real numbers based on how many digits are to the right of the implied decimal point.

PROCESS

A process refers to the instructions and subsequent computations involved in arriving at the resolution of to specific operations.

RUN

A run is one submission of a data set to the system as well as the processing and output that result from that submission.

DIAGNOSTIC MESSAGES

When the program identifies a problem, a diagnostic message will be printed along with the station number where the situation occurred or the station number nearest the location where the situation occurred. The messages alert the user to any problems encountered by the program. These messages are of varying degrees of severity. Some may simply serve to flag a condition that does not invalidate the computations. Others may indicate that an error was found and the system attempted to fix it in order for computations to continue and the user must validate that the fix resulted, or better yet the user should modify the input to avoid the error altogether. Lastly, some error messages indicate that a fatal error that prevents computations from being made has occurred.

The messages are printed before the first formal system output, in the LS1 file.

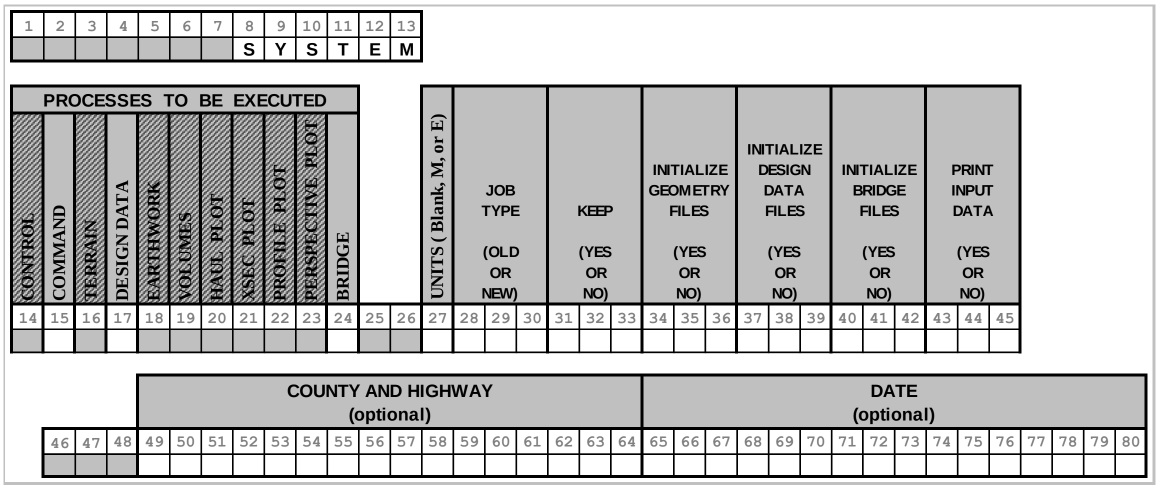
CHAPTER 4: SYSTEM CARD

INTRODUCTION

Every BGS input data file must contain one and only one SYSTEM card. This card provides control information for the current job/run. The SYSTEM card must be the very first record/card/line in the file. It is identified to BGS by its name "SYSTEM" in columns 8 thru 13.

SYSTEM CARD INPUT

The SYSTEM card is divided into a number of fixed length fields. The record format shown in the card image below shows the length and position of each field within the record.



Card 1 - SYSTEM Card

PROJECT ID FIELD

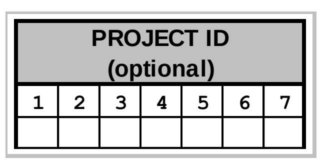


Figure 4 - PROJECT ID Field

Any entry made in the PROJECT ID field will be displayed in the page headings of all output report files. It will also appear in the legend of the output plot file. The field has no role in BGS other than the display of the PROJECT ID, so it may be left blank. It can be used for the identification of reports and projects, and has traditionally consisted of control and section numbers such as "0177-11".

PROCESSES TO BE EXECUTED FIELDS

The PROCESSES TO BE EXECUTED fields are divided into eleven one column width fields, most of which are not used in BGS. The excluded processes identified roadway design functions to be executed in RDS that are not needed in BGS and thus have been made non-functional. The three functional processes are COMMAND, DESIGN DATA and BRIDGE. The COMMAND process facilitates RG - Command Structured Input. The DESIGN DATA process handles the RD cards needed to define roadway data. And, the BRIDGE process is needed to invoke RG commands particular to bridge geometry.

METRIC, JOB TYPE, KEEP, INITIALIZE GEOMERY FILES, INITIALIZE DESIGN DATA FILES, INITIALIZE BRIDGE FILES, AND PRINT INPUT DATA FIELDS

The METRIC field is discussed under

UNIT Field below. The PRINT INPUT DATA field is discussed under **PRINT INPUT DATA Input** Field. The five fields between these two fields concern whether old data files, if any, saved from a previous run are to be accessed by the current run and, if so, which files are to be accessed.

Entering “OLD” in the JOB TYPE filed means that previously stored data files are required to execute this run, or previously stored data needs to be merged with the results of the current run. Enter “NEW” if all the data files are to be initialized and defined by the current (incoming) data. For more discussion of JOB TYPE see **JOB TYPE Field and SAVE RESULTS Field** below.

Enter ‘YES’ in the KEEP field if the resulting data files of the current run are to be stored. Otherwise, enter ‘NO’. For more discussion of this field see **JOB TYPE Field and SAVE RESULTS Field** below.

Enter ‘YES’ in the INITIALIZE GEOMERY FILES field if all previously stored points, lines and circles are to be initialized. Otherwise, enter ‘NO’. For more discussion of this field see below.

Enter ‘YES’ in the INITIALIZE DESIGN DATA FILES field if all previously stored design data (that on RD cards) is to be initialized. Otherwise, enter ‘NO’. For more discussion of this field see below.

Enter ‘YES’ in the INITIALIZE BRIDGE FILES field if all previously stored design data (data entered via RD cards) is to be initialized. Otherwise, enter ‘NO’. For more discussion of this field see below.

UNIT FIELD

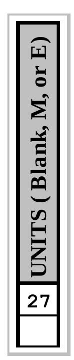


Figure 5 - UNIT Field

The UNIT field establishes two separate settings, the “Unit” setting and the “NAD 83” setting. The following table summarizes the valid UNIT field entries and the resulting Unit and NAD 83 settings:

Table 2 - UNIT Field Settings

UNIT Field	***UNIT Setting***	***NAD 83 Setting***
None (field is blank)	*English*	*Off*
E	*English*	*On*
M	*Metric*	*Off*

UNIT SETTING

BGS supports the use of both English and Metric units for distance measurements. The Unit setting controls whether the system will use English or Metric units.

When the Unit setting is English, distance measurements are in feet, except where inches are called for.

When the Unit setting is Metric, distance measurements are in meters, except where mm are called for.

NAD 83 SETTING

An alternate format for inputting X and Y coordinate values may be used instead of the standard (normal) input format. The NAD 83 setting controls whether or not the alternate input format will be used.

When the NAD 83 setting is disabled (off), the system will use the standard format for inputting X and Y coordinate values.

When the NAD 83 setting is enabled (on), the format for inputting X and Y coordinate values for horizontal alignment (RD05) and Command Structured (RG) input is modified as follows:

NAD 83 COORDINATES FORMAT FOR HORIZONTAL ALIGNMENT (RD05) INPUT DATA

The location of the implied decimal for both the X and Y input fields shifts to the right one column. The new location is between columns 60 and 61 for the X input field and between columns 71 and 72 for Y input field.

NAD 83 COORDINATES FORMAT FOR COMMAND STRUCTURED (RG) INPUT DATA

The location of the implied decimal for both the X and Y input fields shifts to the right one column. The new location is between columns 44 and 45 for the X input field and between columns 55 and 56 for the Y input field.

The term “NAD 83” is used for this setting because it supports the use of North American Datum 1983 (NAD 83) based Texas State Plane coordinates.

NAD 83 Y coordinate values can exceed 10,000,000 feet in some Texas State Plane zones. The largest coordinate value that may be entered using the implied decimal is 9,999,999.9999 feet for the standard input format and 99,999,999.999 feet when the NAD 83 setting is enabled.

Do not enable the NAD 83 setting unless both of the following conditions exist:

- Coordinate values exceed 9,999,999.9999 feet.
- Coordinate values will be input using the implied decimal.

JOB TYPE FIELD AND SAVE RESULTS FIELD

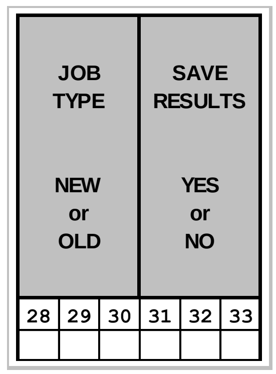


Figure 6 - JOB TYPE and SAVE RESULTS Fields

The JOB TYPE and SAVE RESULTS fields are required.

The BGS system optionally permits data that is input in one run to be stored in project work files for use in subsequent runs. This useful BGS feature is described in the **Chapter 11: Using BGS Project Work Files** (***This is place holder chapter to be considered for a future edition of this user guide***). The values specified for the JOB TYPE field and SAVE RESULTS field control the use of this project information.

JOB TYPE FIELD

BGS always uses the input data file when processing a job. However, in addition to the input data file, the system can use the data stored in existing project work files. The value entered for the JOB TYPE field answers the question, “Do you want to use existing project work files as input for this run?”

“NEW” specifies that existing project work files WILL NOT be used.

“OLD” specifies that existing project work files WILL be used.

When JOB TYPE is NEW, BGS will use only the input data file to process the job.

When JOB TYPE is OLD, BGS will use both project work files and the input data file to process the job.

Note: The system can be instructed to omit, that is, not use, specific categories (geometry, design and bridge) of project work file data. See the **OMIT STORED DATA FieldS** section for a description of this feature.

SAVE RESULTS FIELD

When job processing ends, the resulting project information can be saved or discarded. BGS saves project information by storing the data in project work files. The value entered for the SAVE RESULTS field answers the question, "Do you want to save the resulting project information?" "YES" specifies that the project information WILL be saved. "NO" specifies that the project information WILL NOT be saved. See **Table 3 - Fate of Project Information for JOB TYPE and SAVE RESULTS Combinations Chosen** for effects of entries in JOB TYPE and SAVE RESULTS fields.

Table 3 - Fate of Project Information for JOB TYPE and SAVE RESULTS Combinations Chosen

JOB TYPE	***SAVE RESULTS***	***FATE OF PROJECT INFORMATION***
NEW	*NO*	*DISCARDED—The project information is not saved.*
NEW	*YES*	*SAVED—The project information is stored in new project work files.*
OLD	*NO*	*DISCARDED—The project information is not saved. The data stored in the existing project work files is not modified.*
OLD	*YES*	*SAVED—The project information is stored in the existing project work files by overwriting the existing data.*

OMIT STORED DATA FIELDS

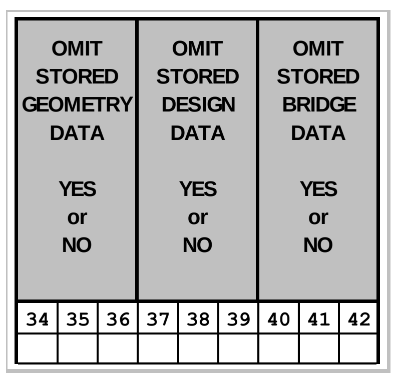


Figure 7 - Three OMIT Input Fields

The three OMIT input fields are required when JOB TYPE is OLD and are not applicable when JOB TYPE is NEW.

When JOB TYPE is OLD, BGS reads the geometry data, design data, and bridge data stored in the project work files before it reads the input data file. The OMIT fields give the user a way to use all, any two, or just one of the three categories of stored data in conjunction with the input data file.

For example, the user may answer the questions, "Omit Stored Geometry Data?" with "NO", "Omit Stored Design Data?" with "NO", and "Omit Stored Bridge Data?" with "YES". As a result, to process the job, the system will use the stored geometry and design data, but not the stored bridge data, along with the input data file. Note: This does NOT erase the stored bridge data; it only instructs the system to ignore it for the current run.

OMIT STORED GEOMETRY DATA FIELD

BGS geometry data includes points, lines and curves (circles).

"YES" specifies that the geometry data stored in the project work files WILL be omitted and thus, WILL NOT be used for the current run.

"NO" specifies that the stored geometry data WILL be used for the current run.

OMIT STORED DESIGN DATA FIELD

BGS design data includes horizontal alignment, vertical alignment, superelevation and widening information.

"YES" specifies that the design data stored in the project work files WILL be omitted and thus, WILL NOT be used for the current run.

"NO" specifies that the stored design data WILL be used for the current run.

OMIT STORED BRIDGE DATA FIELD

BGS bridge data includes bent, beam, parallel slab line, transverse slab line, bearing seat, diaphragm, slab data, and computed bridge configuration information.

"YES" specifies that the bridge data stored in the project work files WILL be omitted and thus, WILL NOT be used for the current run.

"NO" specifies that the stored bridge data WILL be used for the current run.

PRINT INPUT DATA INPUT FIELD

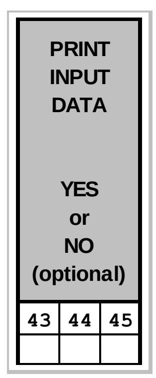


Figure 8 - PRINT INPUT DATA field

The PRINT INPUT DATA field specifies whether or not a listing of the current input data file will appear at the top of the first output report (.ls1) file. It answers the question, "Do you want a listing of the input data file to appear in the first BGS report file?" Note: This listing will not include data retrieved from the project work files.

"YES" generates a listing of the input data file at the top of the first report file.

"NO" does NOT generate a listing of the input data file.

Leaving the field blank is valid, and is the same as specifying "YES".

COMMENT INPUT FIELD

COMMENT (optional)																															
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Figure 9 - COMMENT Input Field

Any entry in the COMMENT field will be displayed in the page headings of all output report files. It will also appear in the legend of the output plot file. The field has no role in BGS other than display, so it may be left blank. Like the PROJECT ID field, the COMMENT field can be used for the identification of reports or projects. For example, the names of the county and highway associated with the project could be specified, such as "Harris, US-59".

CHAPTER 5: ROADWAY DESIGN DATA

INTRODUCTION

The Bridge Geometry System features a unique process for storing design data and making it available to the various processes in the system. Design data includes all of the various types of data which are necessary to describe the three-dimensional characteristics of the roadway and other parameters pertinent to bridge geometry and related roadway geometry computations. All of the cards for entry of design data are discussed in this chapter.

Design data is required for the following operations:

1. Offset geometry calculations – geometry that is related to the three-dimensional characteristics of the highway.
2. Determination of the roadway cross-section (a.k.a. "template") as it pertains to the bridge.

All data types are not required for each of these operations, but the user must specify the required data for the bridge being designed. **Table 4 - Design Data Card Usage** lists all of the data types and indicates their application.

Each of the data types shown in **Table 4 - Design Data Card Usage** are discussed in detail in this chapter. The user must have a clear understanding of how data is used, when it is required and how it fits together. In addition, the user must understand the schemes for stationing and station equations. These finer points and how to use and input program data are discussed in this chapter.

Table 4 - Design Data Card Usage

DESIGN ELEMENT	***DATA CARD***	***OFFSET GEOMETRY***
Alignments	*Horizontal Alignment*	*Required*
	Profile Grade	*Optional**
Template	*Template*	*Optional**
	Superelevation	*Optional*
	Widening	*Optional*

***Required when elevation computations are desired**

HOW ROADWAY DESIGN DATA IS USED

BGS establishes five (5) types of design data which can be used to define the three-dimensional aspects of the roadway surface. The user must input the appropriate data to define each roadway being used. These five types of data are the most extensively used in the system since they are applicable to offset geometry computations. Entry of complete roadway surface data using the five types of data described below will result in the roadway surface being stored for use in either offset geometry computations or roadway elevation computations.

HORIZONTAL ALIGNMENTS

Horizontal alignments consist of straight lines, spiral transitions and circular segments defined in a horizontal plane. The vertical surface in **Figure 10 - Horizontal Alignment**, extending upward from the horizontal alignment, serves to locate the roadway vertically while following the horizontal (XY) plane.

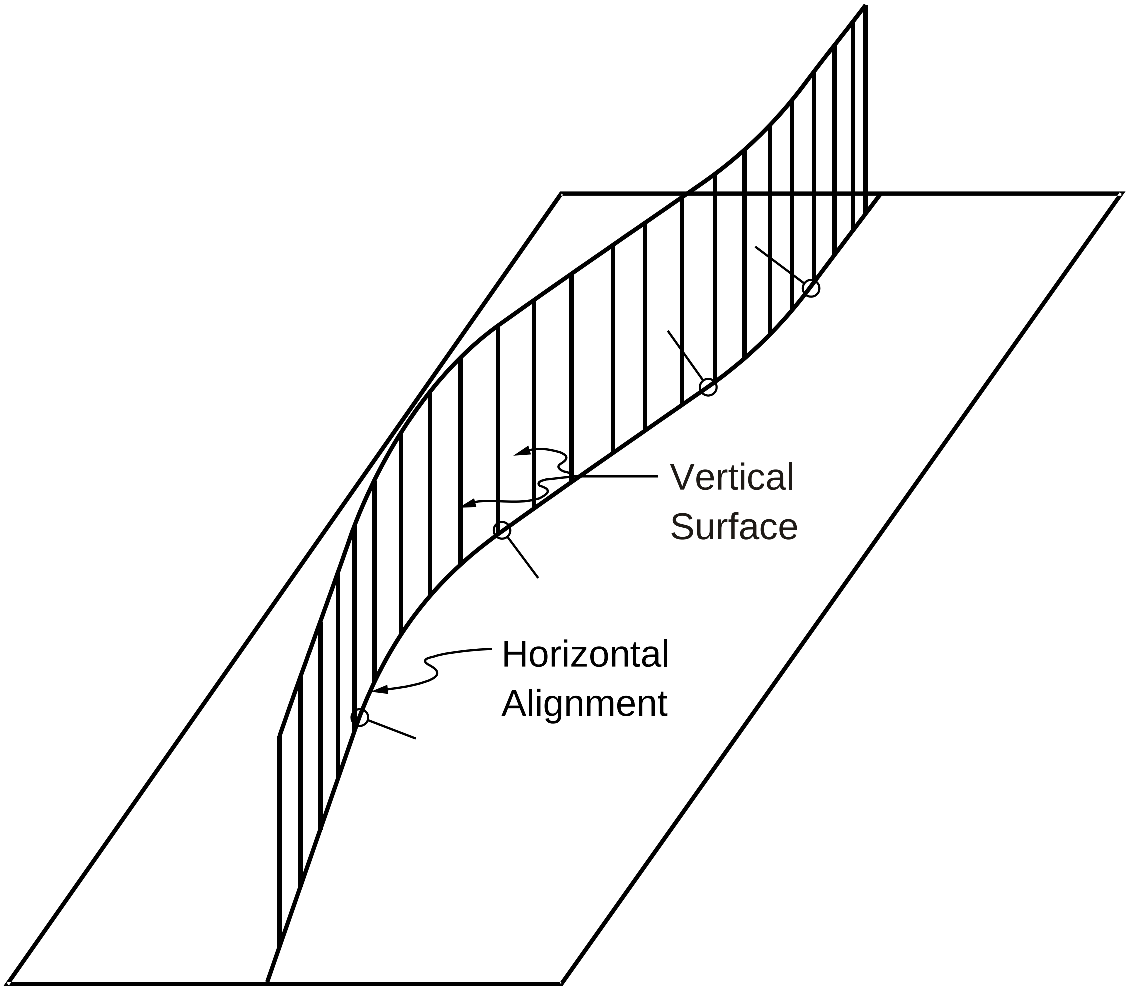


Figure 10 - Horizontal Alignment

VERTICAL ALIGNMENTS

Vertical Alignments consist of straight segments and parabolic curves laid out in a vertical plane.

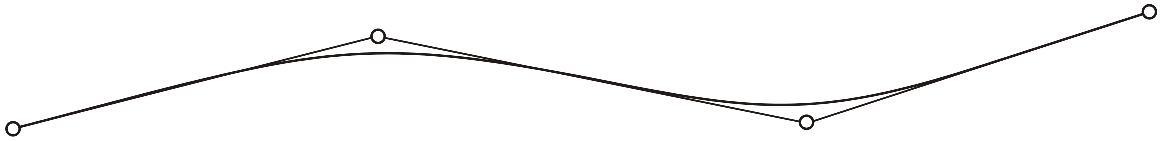


Figure 11 - Vertical Alignment Profile

The vertical alignment lies along a vertical surface which generally follows the horizontal alignment as illustrated in **Figure 12 - Vertical Alignment**.

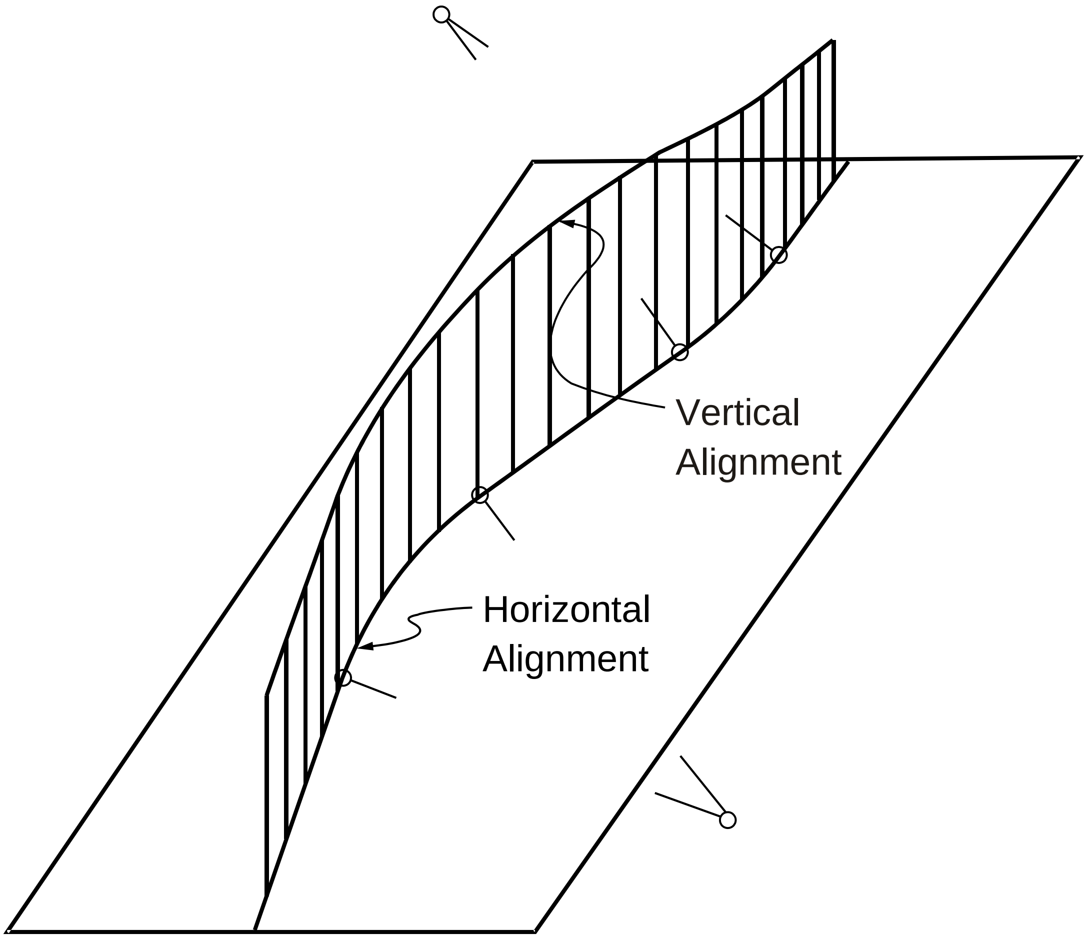


Figure 12 - Vertical Alignment

NOTE: The vertical alignment may not necessarily fall precisely along the vertical plane of the horizontal alignment.

TEMPLATE DATA

Template data is used to define the cross sectional shape of the roadway. The cross sectional shape of the roadway must be defined at desired points along the horizontal alignment. The system interpolates the shape of the roadway between the points specified by the user, thus defining the complete surface by giving the shape at the beginning and end and at any desired intermediate points. The Store/Recall feature may be used to reduce the amount of input data required.

The definition of the cross sectional shape includes locating the template point that is directly above the horizontal alignment and coincident with the vertical alignment. Horizontal alignment, vertical alignment and template data are thus combined to create a continuous roadway surface, as illustrated in **Figure 13 - Roadway Surface**.

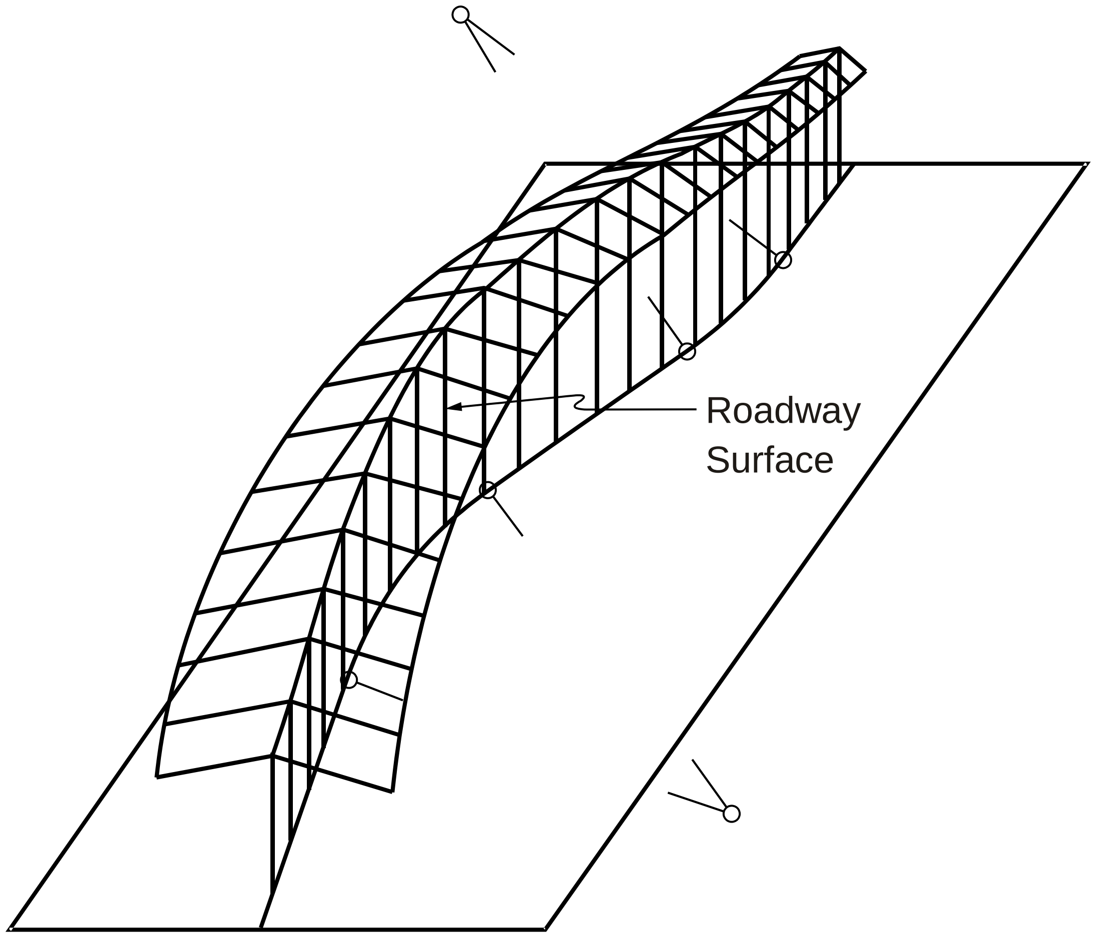


Figure 13 - Roadway Surface

A roadway template defines the roadway cross sectional shape at a given point. The user describes the roadway cross section by giving a series of slopes and distances. These slopes and distances are referred to as roadway or template segments. A typical template is shown in **Figure 14 - Typical Template Segments.**

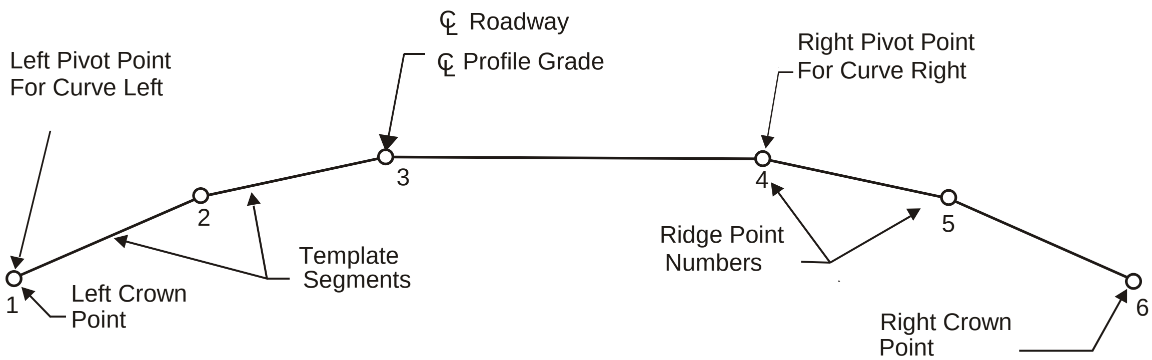


Figure 14 - Typical Template Segments

Each template may consist of 1 to 16 roadway cross section segments. The points at the beginning or end of the segment are called ridge points and are numbered consecutively from left to right. The first and last ridge points are called crown points. Ridge points determine the shape of the roadway surface at a cross section and are also used to indicate various conditions such as:

- Point coinciding with the horizontal alignment
- Point coinciding with the vertical alignment
- Left pivot point for superelevation
- Right pivot point for superelevation

The identification of these points is a part of the template description.

Since a template defines the cross sectional shape of a roadway at only one station, it takes two template descriptions to define a section of roadway. The system automatically transitions between the two templates to complete the surface. To accomplish this, *THE TWO TEMPLATES MUST ALWAYS HAVE THE SAME NUMBER OF ROADWAY SEGMENTS*. It is also essential to have the same ridge point numbers for the centerline, profile grade, and pivot points. The slopes and/or distances for any roadway segment may, however, vary as shown.

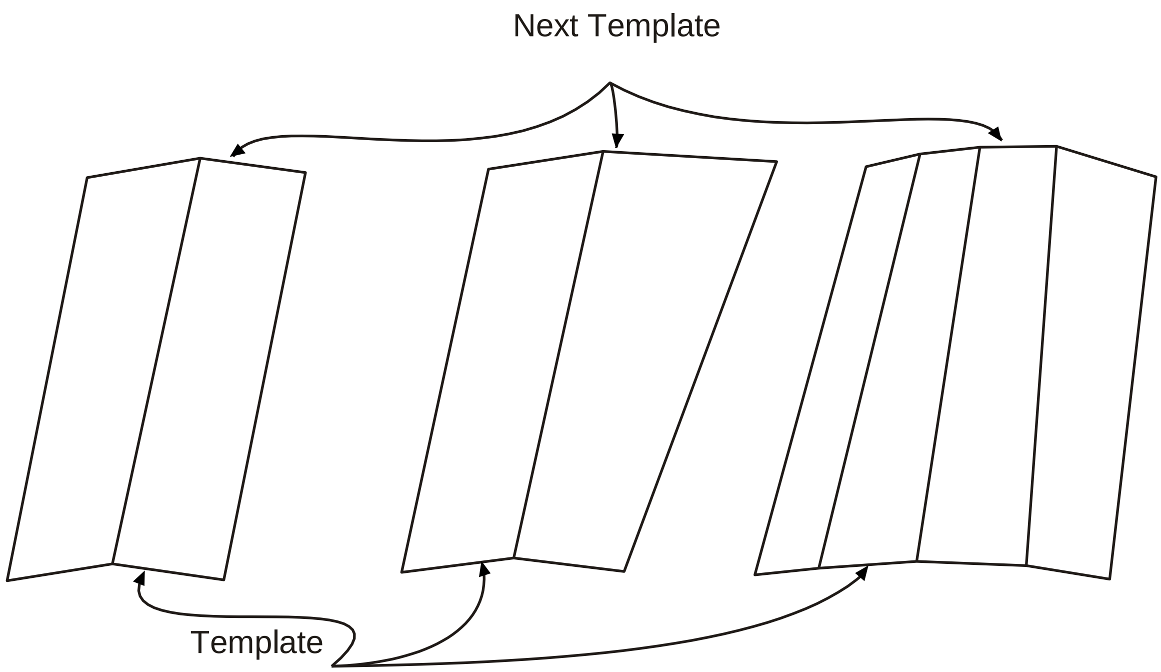


Figure 15 - Slope and Distance Variations

Thus, if the roadway shape is constant from beginning to end, two templates would describe the whole roadway. If there are transitions in shape, additional templates will be needed. TEMPLATES BY THEMSELVES ARE NOT USED TO ACCOMPLISH NORMAL SUPERELEVATION AND WIDENING.

Since every section of roadway must be defined by two templates which have the same number of roadway segments, it is necessary to have a way to change the number of roadway segments being used. This is done as follows: specify a new template at the appropriate station, and then specify a template compatible with the previous template at a station 0.01 ft. or 0.001 meters behind the new template station. The two templates should have the same shape but differ in number of segments. This can be accomplished by locating "dummy" or zero width segments in proper sequence to achieve the desired results.

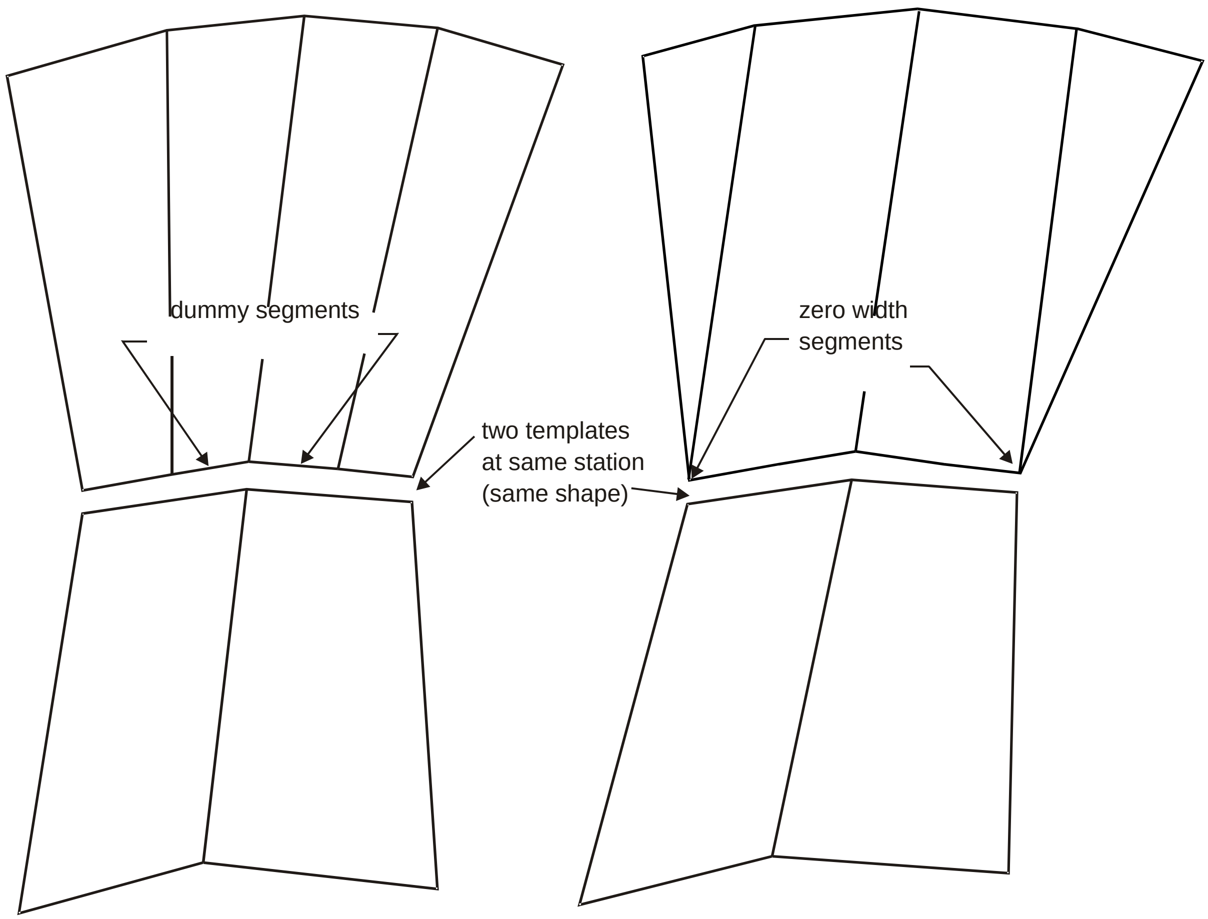


Figure 16 - "Dummy" and Zero Width Segments

Template data is entered on the ***Card 6 - Template* Data Input Card** *(RD30)* which is discussed later in this chapter.

SUPERELEVATION AND WIDENING DATA

Two other types of data can be used to modify the surface thus defined, to introduce superelevations on curves or widenings for extra lanes, or other such purposes. The ***Card 7 - Superelevation* Data Input Card** provides automatic modification of the roadway surface to account for superelevation on curves. The ***Card 8* - Widening Input Card** provides similar capabilities for widening of the roadway.

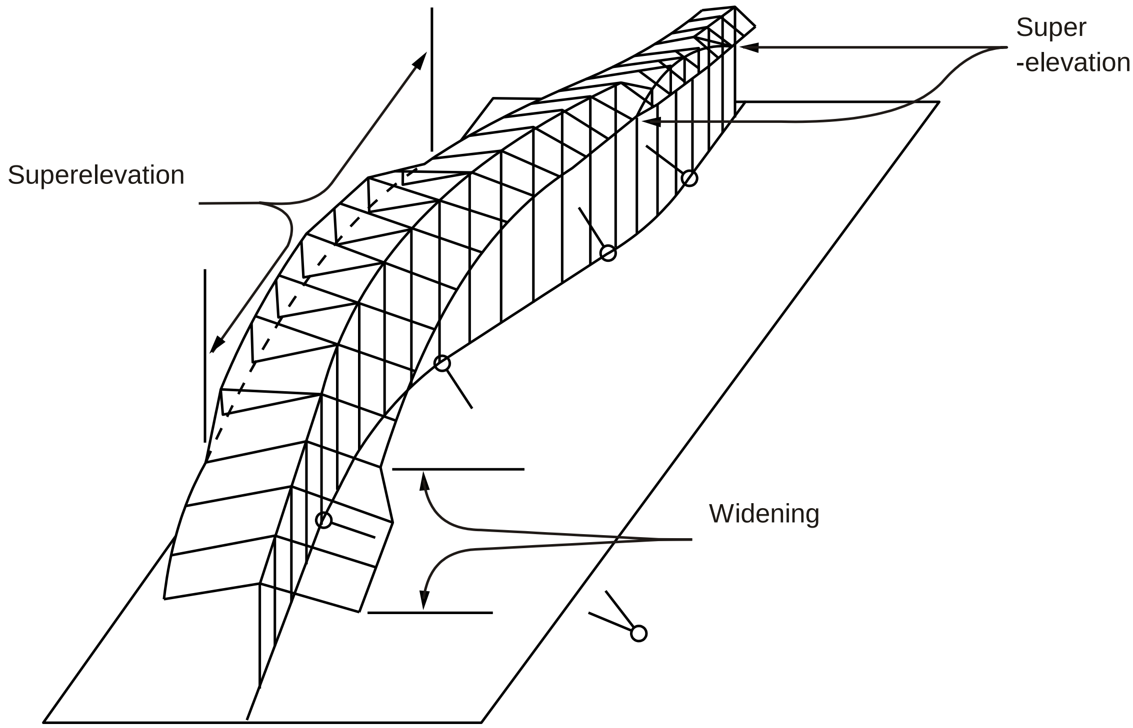


Figure 17 - Superelevation and Widening

Both of these types of data provide for a beginning transition and an ending transition. The full superelevation or widening continues between the beginning and ending transitions. This is illustrated schematically in **Figure 18 - Schematic Examples of Superelevation and Widening**. The data includes indication of whether the transition is a beginning or ending transition, the station at which full superelevation or widening occurs (in either the beginning or ending cases), length of transition and amount of widening or superelevation.

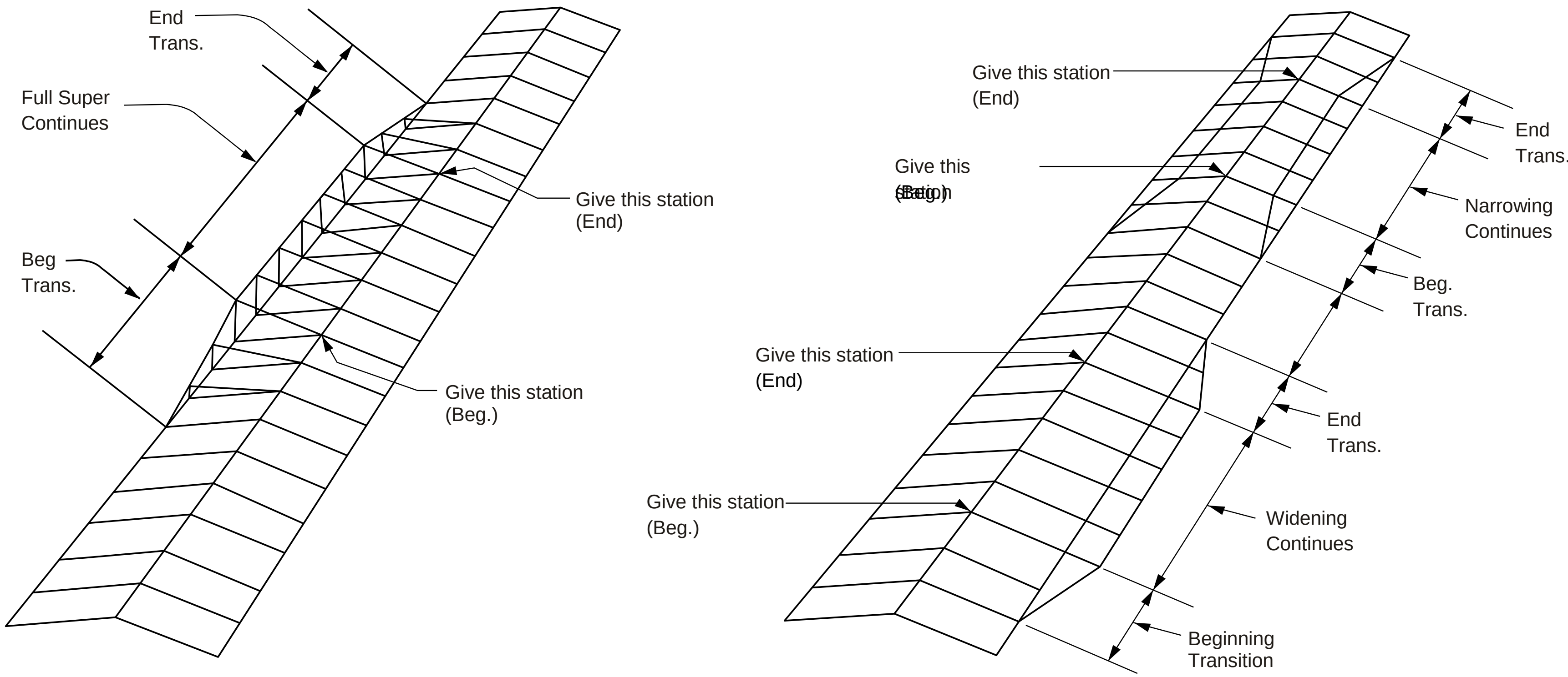


Figure 18 - Schematic Examples of Superelevation and Widening

STATIONING AND EQUATION SCHEME

The Bridge Geometry System uses a stationing scheme in which all overlapping equations are eliminated by modifying the station numbers. Gap equations do not need to be modified.

- Overlapping equations are defined as equations for which the forward station has a smaller number than the back station, such as 10+00BK=7+50FWD.
- Gap equations are defined as equations for which the forward station has a larger number than the back station number, such as 10+00BK=11+00FWD.

The Horizontal Alignment Calculation Process eliminates overlapping equations by adding 10,000 to the station numbers each time an overlapping equation is passed. Nine overlapping equations are allowed in this scheme. The leftmost digit of the adjusted station number indicates the number of overlapping equations. The new stationing is shown on the Horizontal Alignment output and must be used in all subsequent reference to the alignment or data entries.

The gap and overlapping equation numbering schemes are illustrated below. Examples of equations are given in

Figure 20 - Examples of Equations.

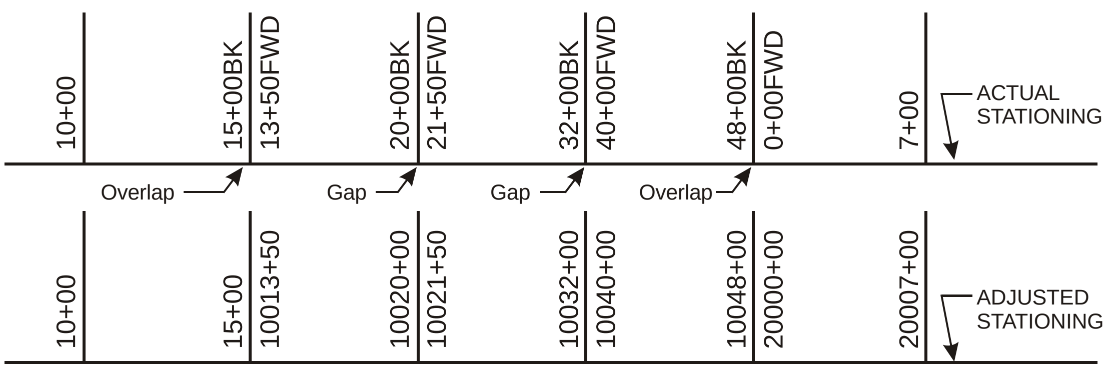
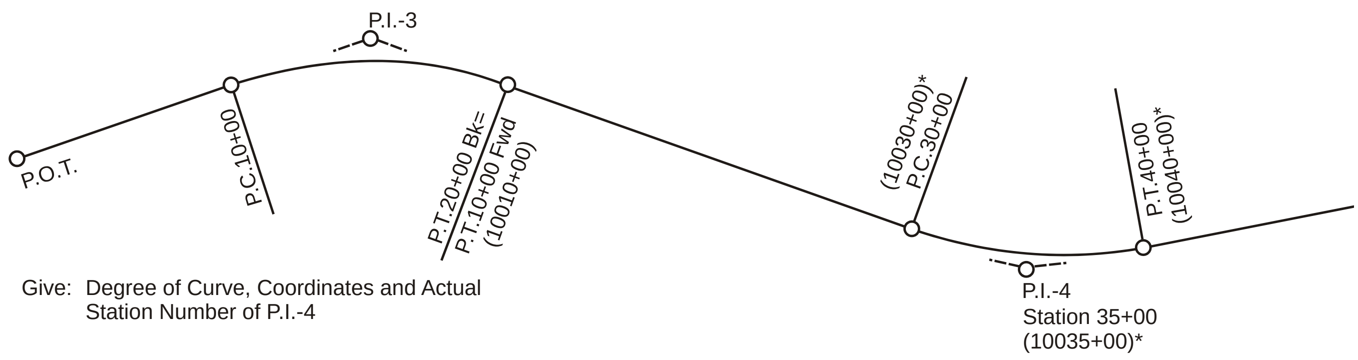


Figure 19 - Gap and Overlapping Equation Numbering

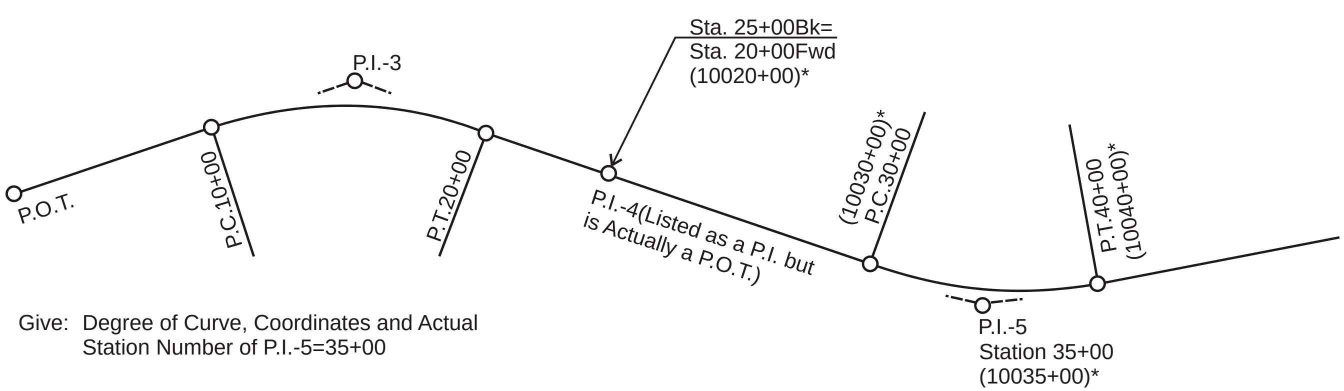
Equation at the P.T. or S.T. of a Curve



Give: Degree of Curve, Coordinates and Actual Station Number of P.I.-4

*NOTE: The Program Automatically Assigns New Station Numbers.

Equation at a P.O.T. Station



Give: Degree of Curve, Coordinates and Actual Station Number of P.I.-5=35+00

Figure 20 - Examples of Equations

INPUTTING ROADWAY DESIGN DATA

ROADWAY DESIGN DATA INPUT CARDS

Each data input card allows the entry of control and section. See **Chapter 3: General Information and Terminology** for discussion of this data.

Each card calls for either a station or range of stations such as beginning and ending stations. In each case, the gap and overlapping equation numbering schemes discussed in this chapter must be observed. Note that in most cases, the station may be on any of the roadways A-Z.

Most of the cards require that the roadway be specified, which is accomplished by entering the appropriate letter A-Z. These letters not only serve to identify the data for a roadway, but also to control the sequence of completion of the design section by the design process. Many of the cards call for the designation left or right. By convention, left and right directions are expressed in terms of the viewpoint of an observer looking in the direction of increasing stations.

The data cards are designed to be as convenient to the user as possible. The cards can be used in any order. In most cases, the cards apply to any of the applicable roadways.

HORIZONTAL ALIGNMENT DATA

INTRODUCTION

Horizontal alignments are required for offset geometry calculations as indicated in **Table 4 - Design Data Card Usage**.

Figure 21 - Horizontal Alignment shows a simple alignment and indicates the limited amount of data that is required to store the alignment. In the process of storing the alignment all of its properties are computed and output. **Figure 22 - Simple Curve Data Output** and **Figure 25 - Spiral Curve Data Output** show the output for simple and spiral curves, respectively.

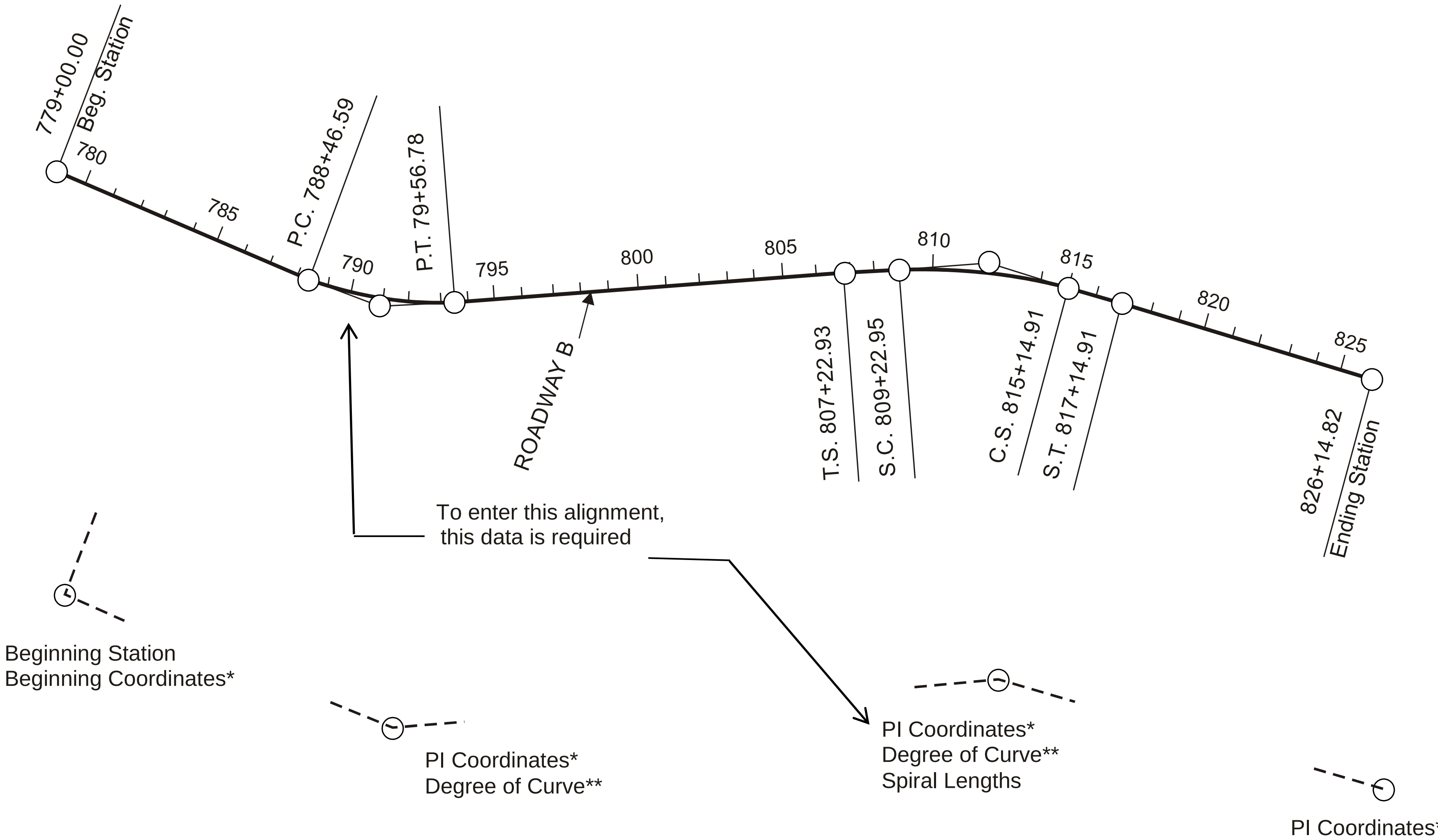
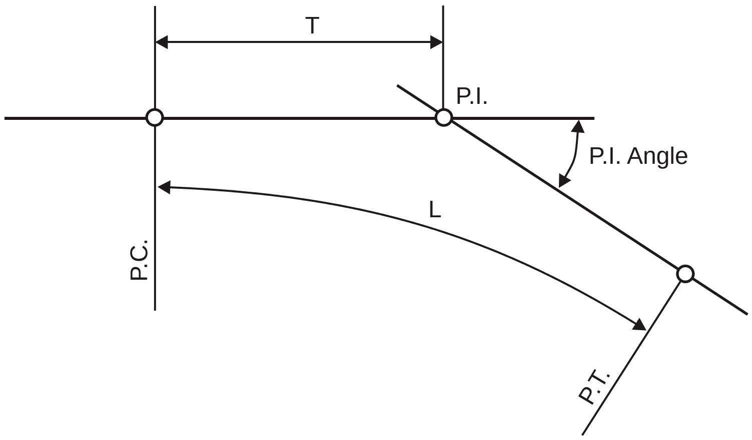


Figure 21 - Horizontal Alignment Example 1



1) P.C. Station
2) P.I. Station
3) P.T. Station
4) Tangent (T)
5) Degree of Curve (D)
6) P.I. Angle (Intersection Angle Between Tangents of Entire Curve)
7) Length of Curve (L)
8) Radius (R)
9) Coordinates of P.C., P.I. and P.T.
10) Bearing of the Tangents

Figure 22 - Simple Curve Data Output

HORIZONTAL ALIGNMENT (RD05) DATA INPUT

FUNCTION

The RD05 command establishes the horizontal alignment of one or more roadways.

USAGE

The ***Card 2 - Horizontal Alignment*** **Data Input Card** *(RD05)* may be used to define any of the roadways A-Z. Data for more than one roadway may be entered, but if any of the roadways A-F are defined and are to have profile grade and template data assigned to them, roadway G must also be defined. Roadway G is a special-purpose alignment, intended to establish the centerline of a highway system consisting of roadway A-F. Because of its special nature, only horizontal alignment data may be defined for roadway G. **It cannot be assigned profile grade or template data.**

A series of two or more horizontal alignment commands/cards are necessary to define each roadway. The first command/card in the series for a given roadway pertains to the beginning point of the alignment. The intermediate and final commands/cards pertain to subsequent PIs. Since each series in the command requires slightly different input data, several of the fields on the basic input card have more than one use.

CONTROL & SECTION (optional)											RDWY
1	2	3	4	5	6	7	8	9	10	11	12
							R	D	0	5	

P.I. NO.		STATION									BEG. STA. I.D.			DEGREE OF CURVE								RADIUS OR FORWARD TANGENT									
														DEG.		MIN.		SEC.													
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44

SPIRAL								P.I. COORDINATES (optional)																						GEOM. POINT. STORE NUMBER				RND BRN OR HOLD (opt.)	
IN				OUT				X											Y																
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 2 - Horizontal Alignment Data Input Card

ARGUMENTS FOR FIRST COMMAND/CARD IN THE SERIES

The first command/card in the series establishes the beginning point of the horizontal alignment.

- *Roadway*: The letter (A–Z) assigned to the roadway alignment. Note that if any of the horizontal alignments A-F are defined and have or will have vertical alignment data, G must also be defined. (It may be identical to one of the alignments A-F, and should be the first alignment defined.)

- *PI Number*: The number, right-justified, assigned to the beginning point of the alignment. The PI numbers for the alignment must be assigned in ascending order but not necessarily in consecutive order. (If, for example, the PIs are numbered by fives, the user may at a later date insert a new PI between two others without changing all the following PI numbers.) *RD05* commands will be sorted by BGS by PI number into ascending order before computations begin.

- *Station*: The station to be assigned to the beginning point of the alignment. This station establishes the stationing for the entire alignment. The alignment must proceed in the direction of increasing stations.

- *Beginning Station ID*: The type of point which begins the alignment: POT for point on tangent, PT for point of tangency, PC for point of curvature, ST for spiral to tangent, TS for tangent to spiral, or PI for point of intersection. If only two characters are entered, they must be right-justified in the three character field.

- *Radius or Forward Tangent*: The Forward Tangent is used when the beginning station does not coincide with the beginning coordinates. The beginning coordinates are on the tangent to the alignment through the beginning station, and at the distance of the forward tangent "behind" the beginning station; that is, in the direction of decreasing stations. See **Figure 23 - Examples of Use of Forward Tangent Data**. Note: Radius is not applicable for this first *RD05* command.

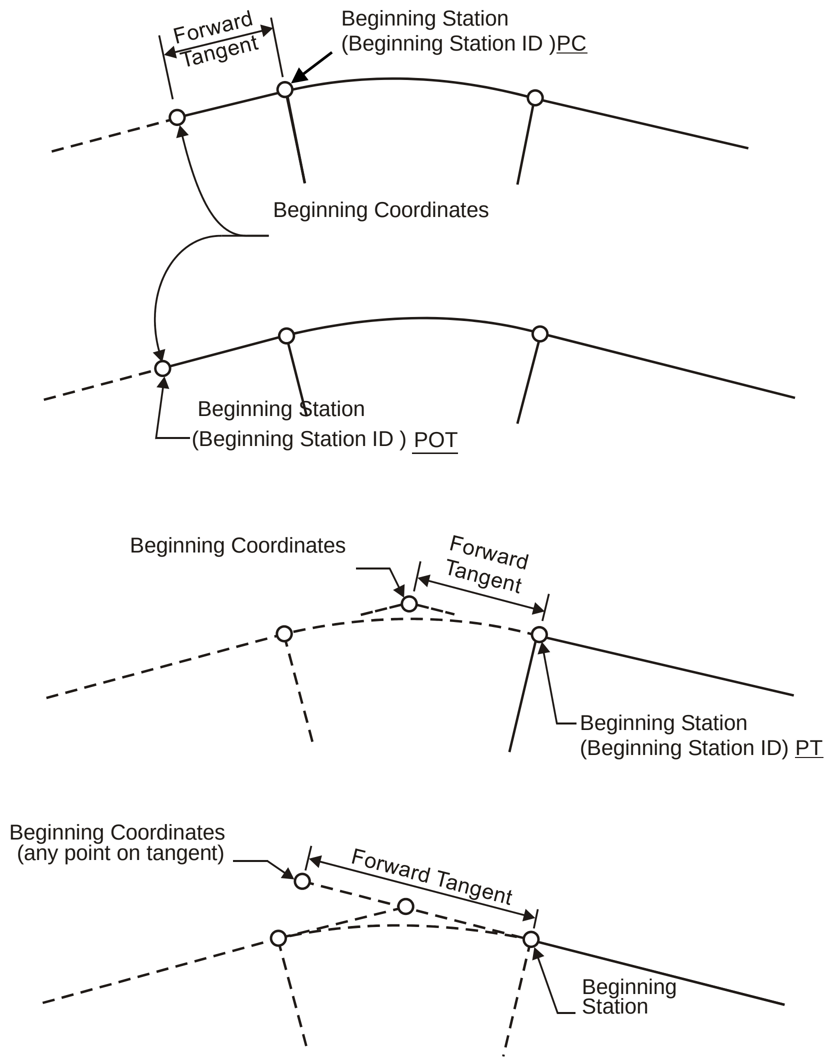


Figure 23 - Examples of Use of Forward Tangent Data

- *PI Coordinates (Optional)*: See Point ID.
- *Point ID (Optional)*: The number of a point previously stored in the Geometry Files and having the coordinates of the PI. If there is no previously stored point with these coordinates, the user must enter X and Y coordinates in the PI Coordinates fields. If both the point ID and the coordinates are entered, the X and Y coordinates will be stored for future use in the Geometry Files under the specified Point ID.
- *Round Bearing or Hold*: If this column is blank, all tangent bearings will be maintained as computed from PI coordinates. If any number from 1-60 is entered in the field, right justified, the tangent bearings will be rounded to the number of seconds specified. The rounded bearing and computed distance will be used to compute a new set of coordinates for the PI. This entry on the first line of an alignment applies throughout the alignment, but the feature can be overridden at selected PIs. This concept will be discussed in further detail in the section describing the data for subsequent PIs.

ARGUMENTS FOR INTERMEDIATE COMMAND(S) IN THE SERIES

Intermediate command(s)/card(s) in the series establish a point of intersection (PI) on the horizontal alignment.

- *Roadway*: The letter (A–Z) assigned to the roadway alignment. Note that if any of the horizontal alignments A-F are defined and have or will have vertical alignment data, G must also be defined. (It may be identical to one of the alignments A-F, and should be the first alignment defined.)
- *PI Number*: The number, right-justified, assigned to the point of intersection of two tangents. The PI numbers for the alignment must be assigned in ascending order but not necessarily in consecutive order. (If, for example, the PIs are numbered by fives, the user may at a later date insert a new PI between two others without changing all the following PI numbers.) *RD05* commands will be sorted by the BGS program by PI number into ascending order before computations begin.
- *Station*: The station to be assigned to the PI, usually left blank. BGS computes PI stations based on the coordinate data entered and on the stations at the previous PIs. This field should be left blank except when an equation occurs between the preceding PI and the current PI. In this case enter the actual station for the current PI.
- *Degree of Curvature*: The degree of curvature at a given PI is equivalent to 100 ft. divided by the radius in feet. (The degree of curvature is not valid for metric data. For metric data, a radius must be used to define a curve.) For English data, the user may enter the degree of curvature instead of the radius, where the PI is not an angle point or a POT.
- *Radius*: The radius of the circular curve at the given PI. If the Degree of Curvature is not specified or the data is metric and the PI is not an angle point (that is, a point not "rounded off" by a circular arc/spiral) or POT, enter the radius of the curve.
- *Spiral (In/Out)*: Length of the beginning spiral of the curve and length of the ending spiral of the curve for In Spiral and Out Spiral, respectively. Unequal spirals may be entered for any curve. The In Spiral will be placed between the first tangent and the beginning of the curve; the Out Spiral will be placed between the end of the curve and the second tangent. Leave these columns blank for simple curves. See **Figure 22 - Simple Curve Data Output** and **Figure 25 - Spiral Curve Data Output**.
- *PI Coordinates (Optional)*: See Point ID.
- *Point ID*: The number of a point previously stored in the Geometry Files and having the coordinates of the PI. These points are usually established using PONT and TRVS commands, but can be established using any command with a point storage option. If there is no previously stored point with these coordinates, the user must enter X and Y coordinates in the PI Coordinate fields. If both the point ID and the coordinates are entered, the X and Y coordinates will be stored for future use in the Geometry Files under the specified Point ID.
- *Round Bearing or Hold*: Entering "H", right justified, in this field holds the coordinates of the PI for this command when the first command in the series specifies rounding of bearings. This feature may be used when tying into an existing alignment. When it is used, the back bearing will not be rounded.

ARGUMENTS FOR FINAL COMMAND IN THE SERIES

The final command/card in the series establishes the ending point of the horizontal alignment.

- *Roadway*: The letter (A–Z) assigned to the roadway alignment. Note that if any of the horizontal alignments A-F are defined and have or will have vertical alignment data, G must also be defined. (It may be identical to one of the alignments A-F, and should be the first alignment defined.)
- *PI Number*: The number, right-justified, assigned to the ending point of the alignment. The PI numbers must be in ascending order but not necessarily in consecutive order. (If, for example, the PIs are numbered by fives, the user may at a later date insert a new PI between two others without changing all the PI numbers that follow the new PI.) *RD05* commands will be sorted by PI number into ascending order before computations begin.
- *Station*: The station to be assigned to the ending point of the alignment, usually left blank. BGS computes PI stations based on the coordinate data entered and on the stations at previous PIs. This field should be left blank except when an equation occurs between the preceding PI and the current PI. In this case enter the actual station for the current PI.
- *PI Coordinates (Optional)*: See Point ID.
- *Point ID*: The number of a point previously stored in the Geometry Files and having the coordinates of the PI. These points may be established using PONT and TRVS commands, but can be established using any command with a point storage option. If there is no previously stored point with these coordinates, the user must enter X and Y coordinates in the PI Coordinate fields. If both the point ID and the coordinates are entered, the coordinates will be stored for future use in the Geometry Files under the specified Point ID.

HORIZONTAL ALIGNMENT OUTPUT

The Horizontal Alignment Calculation Process produces:

1. Output listings of each alignment;
2. Storage of all the elements of each alignment; and
3. Geometry point storage of the specified PIs.

HORIZONTAL ALIGNMENT INPUT/OUTPUT EXAMPLES

Figure 26 - Horizontal Alignment Output for Roadway A and **Figure 27 - Horizontal Alignment Output for Roadway B** are examples of horizontal alignment output listings. These listings reflect the alignment shown in **Figure 21 - Horizontal Alignment Example 1** and the input shown in **Figure 24 - Horizontal Alignment Input Example 1** and.

Note 1: Refer to **Figure 26** - **Horizontal Alignment Output for Roadway A**.

USAGE

Figure 26 - Horizontal Alignment Output for Roadway A displays the calculated alignment data for Roadway A and **Figure 27 - Horizontal Alignment Output for Roadway B** displays the calculated alignment

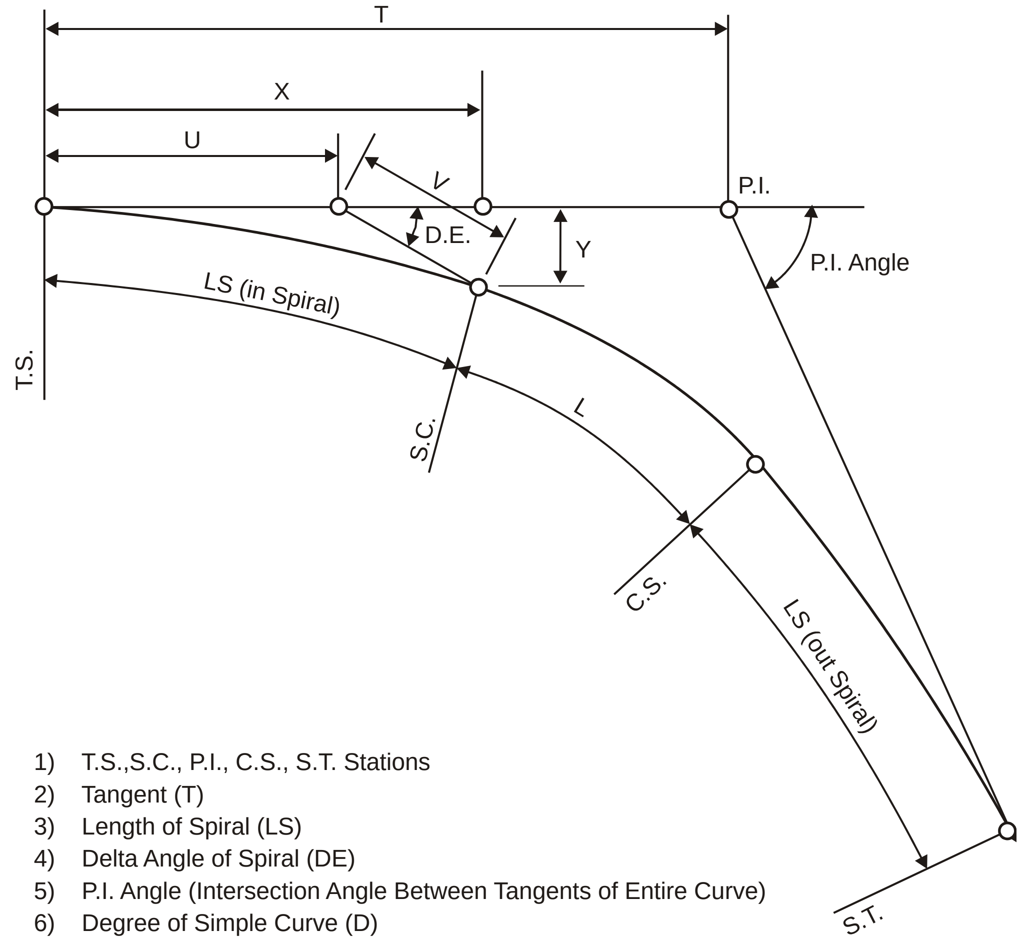
data for Roadway B. Each element of the alignment shown in the output is labeled. Each alignment defined is stored for use by other processes and can be recalled by alignment designation (A-Z). Similarly the points stored in the geometry point file may be recalled by geometry point storage number in later processing. **Figure 28 - Horizontal Alignment Example 2**, **Figure 29 - Horizontal Alignment Input Example 2** and **Figure 30 - Horizontal Alignment Output Example 2** illustrate a second example of horizontal alignment input and output.

CONTROL & SECTION (optional)										
1	2	3	4	5	6	7	8	9	10	11
							R	D	0	5

RDWY	P.I. NO.		STATION									BEG. STA. ID			DEGREE OF CURVE: DEG.		MIN.		SEC.				RADIUS OR FORWARD TANGENT									
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
A		5			7	7	9	0	0	0	0		P	T												4	1	7	6	3	0	5
A	1	0															4	5														
A	1	5														2	3	0														
A	2	0																														
B		2			7	7	9	0	0	0	0	P	O	T																		
B		4																														
B		6														2	3	0								5	0	0	0	0	0	0
B		8																														

SPIRAL IN				SPIRAL OUT				P.I. COORDINATES (optional) X											Y										GEOM. POINT. STOR. NUMBER				RND BRN OR HOLD (opt.)	
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
									1	0	0	0	0	0						1	0	0	0	0	0								1		
									1	0	1	2	0	0	0	0	0	0		1	0	0	0	0	0							1	0		
	1	5	0		1	5	0		1	0	3	0	0	0							9	9	8	0	0							2	0		
									1	0	4	6	0	0						1	0	0	4	0	0							3	0		
									1	0	0	0	0	0						1	0	1	0	0	0									3	0
																															1	0	0		
	2	0	0		3	0	0		1	0	3	2	0	0	0	0	0	0		1	0	1	6	0	0	0	0	0	0		2	0	0		H
																															3	0	0		

Figure 24 - Horizontal Alignment Input Example 1



1) T.S.,S.C., P.I., C.S., S.T. Stations
2) Tangent (T)
3) Length of Spiral (LS)
4) Delta Angle of Spiral (DE)
5) P.I. Angle (Intersection Angle Between Tangents of Entire Curve)
6) Degree of Simple Curve (D)
7) Long Tangent Distance of Spiral Only (U)
8) Short Tangent Distance of Spiral Only (V)
9) Distance From the T.S. or S.T. Along the Main Tangent Line Towards the Main P.I. (X)
10) Perpendicular Distance From the 'X' On the Main Tangent to Establish the .S. or S.C. (Y)
11) Length of the Circular Curve (L)
12) Radius of the circular Curve (R)
13) Coordinates of the T.S., S.C., P.I., C.S. and S.T.
14) Bearing of the Tangents

Figure 25 - Spiral Curve Data Output

The system allows curves to be defined either by degree of curve (for data using English coordinates) or radius (for data using either English or metric coordinates). Previously stored point numbers can be entered in lieu of the PI coordinates. The system can also round the bearings of tangents, accept special cases for the starting point, handle equations and store PI coordinates as geometry points. Alignments may also be updated partially or completely.

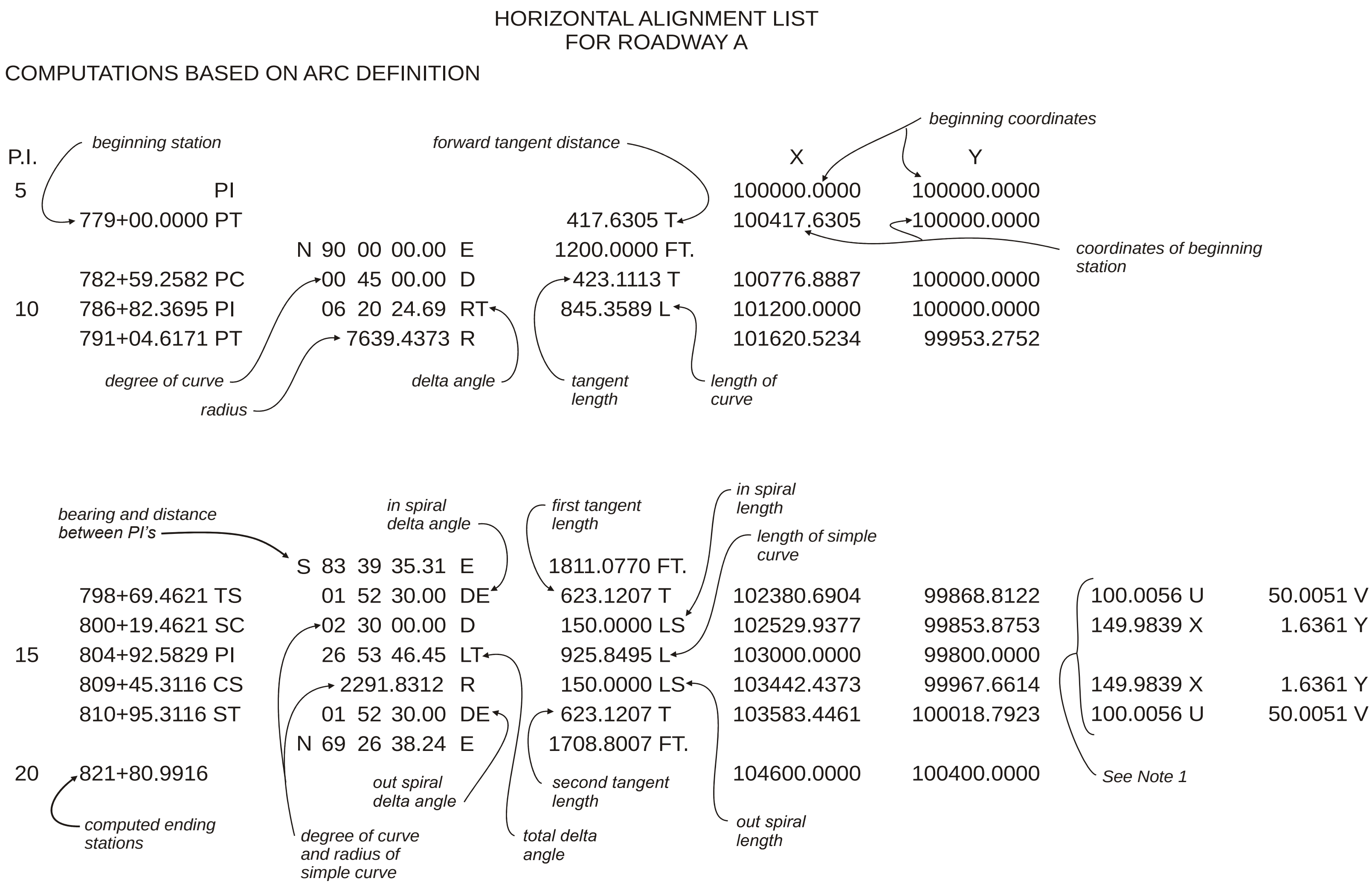


Figure 26 - Horizontal Alignment Output for Roadway A

Note 1: Refer to **Figure 25 - Spiral Curve Data Output** for identification.

```
                              HORIZONTAL ALIGNMENT LIST
                                 FOR ROADWAY B
COMPUTATIONS BASED ON ARC DEFINITION
P.I.                      this bearing rounded to nearest 30 seconds (See Note 1)     X              Y
 2   779+00.0000                                                           100000.0000    101000.0000
                          S 84 17 30.00 E     1205.9851 FT.
     789+92.8189 PC         11 27 32.96 D      113.1662 T                  101087.3997    100891.3033
 4   791+05.9851 PI         25 30 21.79 LT     222.5823 L                  101200.0047    100880.0473
     792+15.4012 PT            500.000  R                                  101306.4822    100918.3768
                          N 70 12  8.21 F     2125.6324 FT.   this bearing held (See Note 2)
     806+40.8171 TS          2 30  0.0  D5     587.0502 T                  102647.6478    101401.1658    133.3466 U     66.6788 V
     808+40.8171 SC          2 30  0.0  D      200.0000 LS                 102836.7760    101466.1564    199.9619 X      2.9085 Y
 6   812+27.8673 PI         23 52 51.79 RT     705.2421 L                  103200.0000    101600.0000
     815+46.0592 CS          2291.8312  R      300.0000 LS                 103531.5551    101569.7711    299.8715 X      6.5430 Y
     818+46.0592 ST          3 45  0.0  DE     632.7375 T                  103831.1313    101554.9445    200.0449 U    100.0408 V
                          S 85 55  0.0  E     1403.5669 FT.
 8   826+16.8886                                                           104600.0040    101500.0558
                          this bearing rounded to nearest 30 seconds
```

Figure 27 - Horizontal Alignment Output for Roadway B

Note 1: Refer to **Figure 23 - Examples of Use of Forward Tangent Data** and **Figure 24 - Horizontal Alignment Input Example 1**.

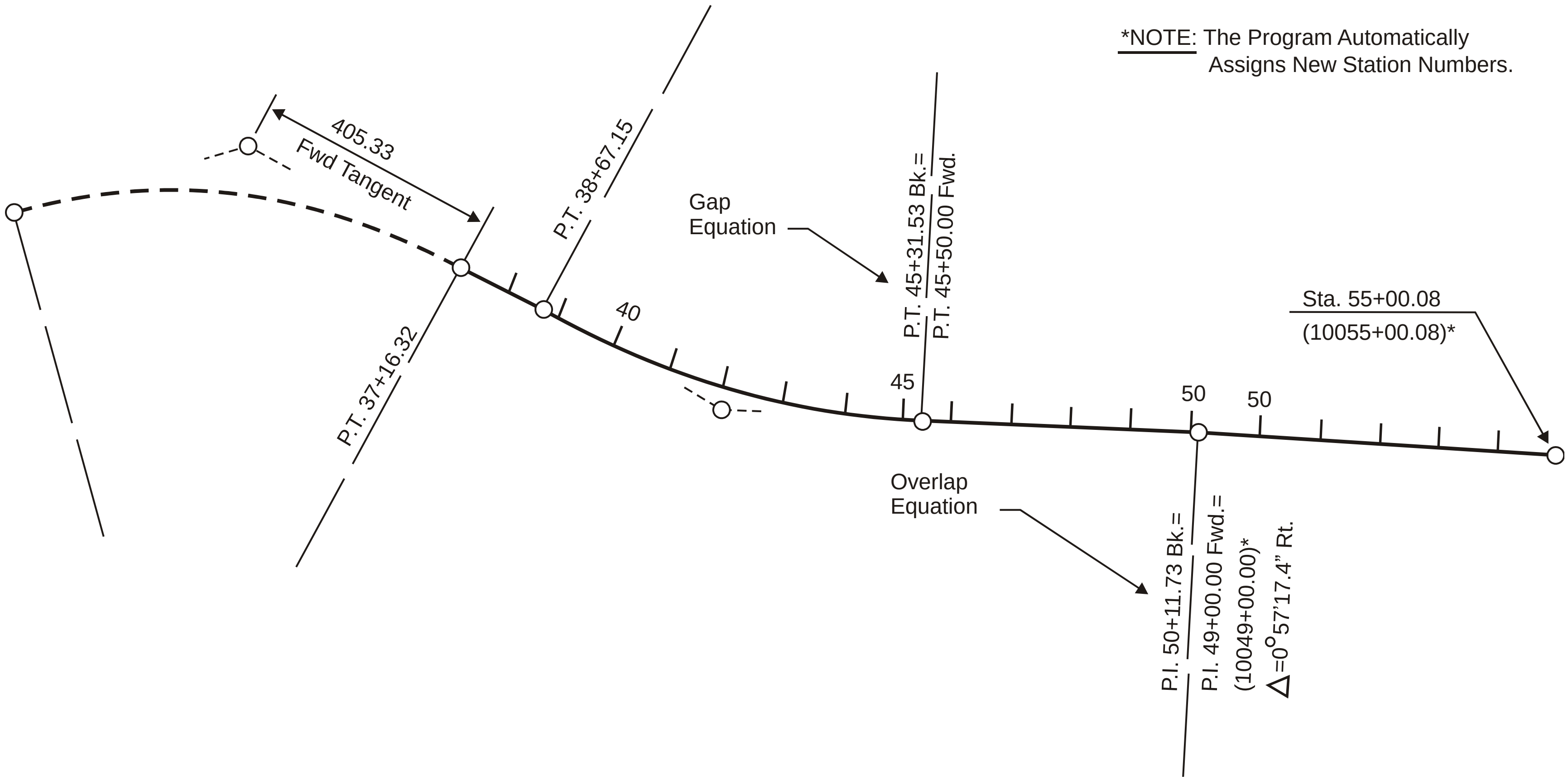


Figure 28 - Horizontal Alignment Example 2

ALTERNATE HORIZONTAL ALIGNMENT (RD06) DATA INPUT

FUNCTION

The ***Card 3 - Alternate Horizontal Alignment* Data Input Card** (*RD06)* establishes the horizontal alignment of one or more roadways with accommodation made for more precise input of a spiral.

USAGE

The *RD06* card is essentially the same as the *RD05* card previously mentioned. The only difference between these input cards is the location of the implied decimal for the spiral in and out lengths. The *RD05* card uses an F4.0 format for the input spiral length (providing for lengths up to 9999.) while the *RD06* card uses an F4.1 format for the input spiral length (providing for lengths to only 999.9).

In other words, with the *RD05* input card and the F4.0 formatted spiral length, the user is allowed to enter up to four decimal digits (e.g. 3422) for either spiral length, or even 34.2, if the decimal point is typed in; but, the user cannot use this card to input the value 342.2 because there would be no room for the decimal point. With the *RD06* input card and the F4.1 formatted spiral length, there is an implicit decimal between columns 47 and 48 and between columns 51 and 52. This way, the user is able to enter the value 3422 in columns 45-48 and/or 48-52, and the number entered is read as 342.2.

CONTROL & SECTION (optional)										
1	2	3	4	5	6	7	8	9	10	11
							R	D	0	6

R D W Y	P.I. NO.		STATION									BEG. STA. ID			DEGREE OF CURVE								RADIUS OR FORWARD TANGENT									
															DEG.		MIN.		SEC.													
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44

SPIRAL								P.I. COORDINATES (optional)																						GEOM. POINT. STOR. NUMBER				RND BRN OR HOLD (opt.)	
IN				OUT				X											Y																
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 3 - Alternate Horizontal Alignment Data Input Card

ARGUMENTS

See **Horizontal Alignment (RD05) Data Input**.

PARALLEL ALIGNMENT (RD16) DATA INPUT

FUNCTION

The *RD16* command establishes an offset alignment parallel to an existing alignment(s).

USAGE

The ***Card 4 - Parallel Alignment* Data Input Card** *(RD16)* may be used to create any number of offset alignments. More than one roadway may be used as a baseline to define the offset roadway. However, any roadways used as a baseline or reference must have been defined and stored prior to establishing a parallel alignment. This may be accomplished in the following ways:

1. Baseline alignments may be entered in a previous run and stored.
2. Horizontal alignment input cards for baseline alignments can be inserted anywhere in the design data of the present run if they precede any parallel alignment input cards and are separated by another process data card(s). This may be accomplished by inserting a *CMNT* card after the horizontal alignment input data.

The parallel alignment creates: (1) PIs and concentric radii for the offset alignment, and (2) an alignment listing which looks like the listing produced from a ***Card 2 - Horizontal Alignment* Data Input Card**. However, it should be noted that spirals cannot be computed from parallel alignments created using the ***Card 4 - Parallel Alignment* Data Input Card**.

CONTROL & SECTION (optional)										
1	2	3	4	5	6	7	8	9	10	11
							R	D	1	6

OFFSET		BASELINE (A - Z)			OFFSET DISTANCE	L OR R
BEGINNING STATION	RDWY	BEGINNING STATION	RDWY	ENDING STATION		
12–20	21	22–30	31	32–40	41–45	46

47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 4 - Parallel Alignment Data Input Card

ARGUMENTS FOR FIRST COMMAND IN THE SERIES

The first card in the series establishes an offset alignment parallel to an existing alignment or alignments. More than one roadway may be used as a baseline to define the offset roadway.

- *Offset Beginning Station*: The beginning station of the parallel alignment. This station will be used to calculate all other stations on the alignment.
- *Offset Roadway*: The letter (A–Z) assigned to the parallel (offset) roadway. Note that if any of the alignments A-F are defined and have or will have vertical horizontal alignments data, G must also be defined although it cannot have vertical alignment data associated with it. G may be defined either with *RD05* commands or with *RD16* commands.
- *Baseline Beginning Station*: The first station on the existing alignment to which the offset roadway will be parallel.
- *Baseline Roadway*: The letter (A–Z) assigned to the existing horizontal alignment to which the offset roadway will be parallel.

- *Baseline Ending Station*: The last station on the existing alignment to which the offset roadway will be parallel.
- *Offset Distance*: The perpendicular distance from the baseline roadway to the offset roadway.
- *L or R*: L if the offset roadway is to the left of the baseline roadway in the direction of increasing stations, and R if it is to the right.

Note: This card may stand alone or be followed by one or more succeeding *RD16* cards for the same parallel roadway. Succeeding cards may refer to the same or other existing alignments. After the parallel alignment is created, it is treated as an ordinary horizontal alignment. The user may define profile grade and templates for the parallel alignment (unless it is alignment G), plot the alignment, and perform other functions as for an ordinary horizontal alignment.

ARGUMENTS FOR OPTIONAL SUCCEEDING COMMAND(S) IN THE SERIES

This (these) card(s) in the series establishes a segment of the parallel alignment succeeding the segment defined on the previous command.

- *Offset Roadway*: The letter (A–Z) assigned to the parallel (offset) roadway in the preceding command. Note that if any of the horizontal alignments A-F are defined and have or will have vertical alignment data, G must also be defined although it cannot have vertical alignment data associated with it. G may be defined either with *RD05* commands or with *RD16* commands.
- *Baseline Beginning Station*: The first station on an existing alignment to which this segment of the offset roadway will be parallel. The existing alignment may or may not be the same as in the preceding command.
- *Baseline Roadway*: The letter (A–Z) assigned to the existing alignment to which this segment of the offset roadway will be parallel.
- *Baseline Ending Station*: The last station on the existing alignment to which this segment of the offset roadway will be parallel.
- *Offset Distance*: The distance from the baseline roadway to this segment of the offset roadway.
- *L or R*: L if the offset roadway is to the left of the baseline roadway in the direction of increasing stations, and R if it is to the right.

PROFILE GRADE (VERTICAL ALIGNMENT) DATA

The Profile Grade and Data Input Card(s) serve(s) to define vertical alignments. Vertical alignments are sometimes required for offset geometry computations as indicated in Table 4 **- Design Data Card Usage**.

CONTROL & SECTION (optional)										
1	2	3	4	5	6	7	8	9	10	11
							R	D	0	5

RDWY	P.I. NO.		STATION									BEG. STA. ID			DEGREE OF CURVE: DEG.		DEGREE OF CURVE: MIN.		DEGREE OF CURVE: SEC.				RADIUS OR FORWARD TANGENT										
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
C		1				3	7	1	6	3	2		P	T												4	0	5	3	3		
C		2																							1	4	3	2	3	4	0	0
C		3				5	0	1	1	7	3																					
C		4				5	5	0	0	0	8																					

SPIRAL: IN				SPIRAL: OUT				P.I. COORDINATES (optional): X											P.I. COORDINATES (optional): Y											GEOM. POINT. STOR. NUMBER				RND BRN OR HOLD (opt.)	
45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
										3	0	0	0	0	0	0	0	0			3	0	0	0	0	0	0	0	0						
										3	0	8	0	0	0	0	0	0			2	9	6	0	0	0	0	0	0						
										3	1	6	0	0	0	0	0	0			2	9	6	0	0	0	0	0	0						
										3	2	2	0	0	0	0	0	0			2	9	5	5	0	0	0	0	0						

Figure 29 - Horizontal Alignment Input Example 2

```
                                        HORIZONTAL ALIGNMENT LIST
                                           FOR ROADWAY C
COMPUTATIONS BASED ON ARC DEFINITION
P.I.                                                               X              Y
 1               PI                                           30000.0000     30000.0000
     37+16.3200 PT                         405.3300 T         30362.5382     29818.7309
                          S  6326  5.82E   894.4272 FT.
     38+67.1459 PC           35954.52D     338.2712 T         30497.4410     29751.2795
 2   42+05.4172 PI          263354.18LT    664.3792 L         30800.0000     29600.0000
     45+31.5251 PT           1432.9400R                       31138.2712     29600.0000
 =   45+50.0012 AHEAD EQUATION
                          N  90 0  0.0E     800.0000 FT.
 3   50+11.7300 PI           44549.11RT                       31600.0000     29600.0000
 =  10048+98.0003 AHEAD EQUATION
                          S  851410.89E     602.0797 FT.
 4  10055+00.0800                                             32200.0000     29550.0000
```

Figure 30 - Horizontal Alignment Output Example 2

FUNCTION

This command establishes the beginning point on a vertical alignment (profile grade).

USAGE

A vertical alignment must be stored for each applicable roadway if elevation computations are to be made. Storage is accomplished by entering elevation data for each PI and vertical curve parameters where applicable. In all cases, the first and last vertical curve length for an alignment must be zero. Sufficient vertical alignment data must be provided to adequately describe the alignment in design areas. A vertical curve may be either symmetrical or asymmetrical as indicated below:

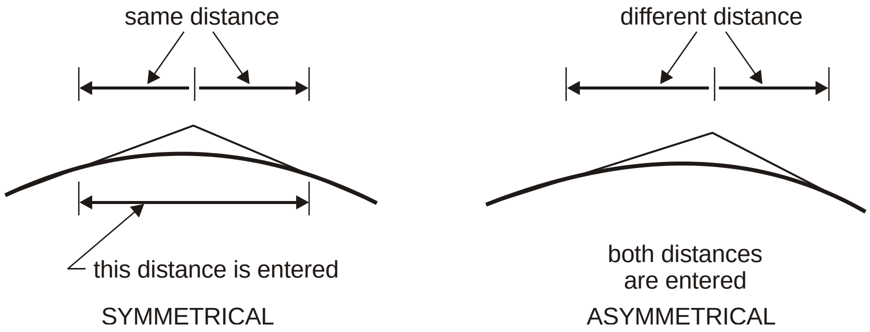


Figure 31 - Vertical Curve Symmetry

Profile grades may be modified by an elevation correction as needed.

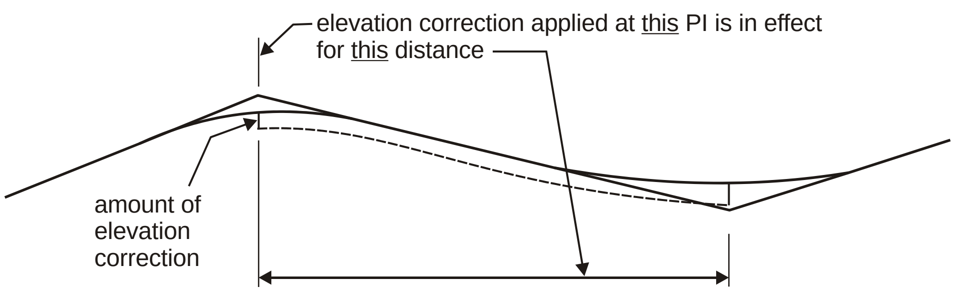
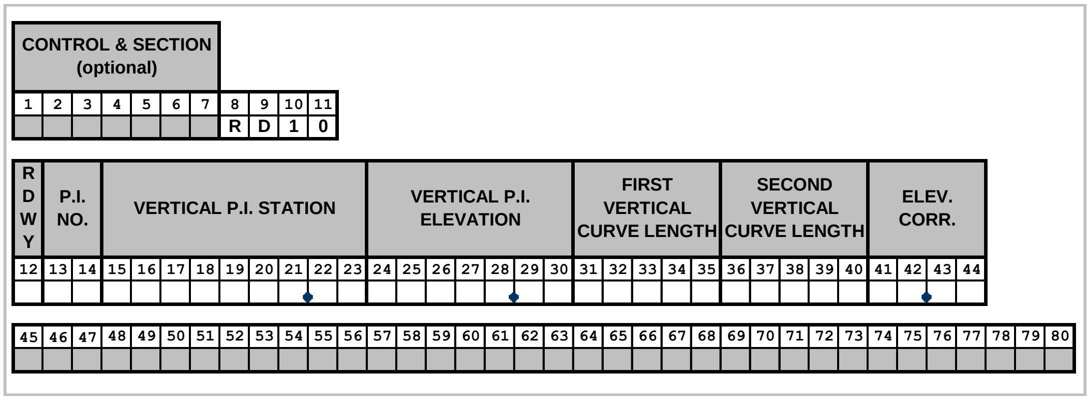


Figure 32 - Elevation Correction

A previously stored vertical alignment for any roadway may be revised either partially or completely. Procedures for revising vertical alignment data are discussed in this chapter under the heading “Updating Design Data.”

The ***Card 5 - Profile Grade* Data Input Card** (*RD10)* is related to the ***Card 6 - Template* Data Input Card** *(RD30)* since it determines the elevation of the template section. The point at which the profile grade is applied to the template section is indicated on the RD30 Card.



Card 5 - Profile Grade Data Input Card

Note: This data may not be entered for roadways A-F unless a horizontal alignment for roadway G has been previously defined.

ARGUMENTS FOR FIRST COMMAND IN THE SERIES

This card establishes the beginning point on a vertical alignment (profile grade).

- *Roadway*: The letter (A–Z, but not G) assigned to the roadway alignment for which the vertical alignment will be defined. Note that if any of the horizontal alignments A-F are defined, G must also be defined although it cannot have vertical alignment data associated with it.
- *Vertical PI Number*: An identification field. Capital letters, numerals, spaces, and special characters may be used. Each Vertical PI for a roadway must have a unique identification.
- *Vertical PI Station*: The station on the roadway alignment where the vertical alignment is to start. *RD10* commands for a roadway are sorted in station order.
- *Vertical PI Elevation*: The elevation at the Vertical PI Station.
- *First and Second Vertical Curve Lengths*: No entries may be made in these fields for this first command in the series.
- *Elevation Correction Factor (optional)*: The positive (up) or negative (down) correction factor for the elevation; if none is needed, leave the field blank.

ARGUMENTS FOR INTERMEDIATE COMMAND(S) IN THE SERIES

This card (these cards) in the series establishes a point of intersection of two grade lines of the vertical alignment (profile grade).

- *Roadway*: The letter (A–Z, but not G) assigned to the roadway alignment for which the vertical alignment will be defined. Note that if any of horizontal alignments A-F are defined, G must also be defined though it cannot have vertical alignment data associated with it.
- *Vertical PI Number*: An identification field. Capital letters, numerals, spaces and special characters may be used. Each Vertical PI for a roadway must have a unique identification.
- *Vertical PI Station*: The station on the roadway alignment where two grade lines intersect. *RD10* commands for a roadway are sorted by PI stations.
- *Elevation*: The elevation at the Vertical PI Station.
- *First and Second Vertical Curve Lengths*: If the vertical curve is symmetric, enter the entire vertical curve length as the First Vertical Curve Length—half of it will be applied before the PI station and half after. The second vertical curve length is omitted. If the vertical curve is asymmetric, the First Vertical Curve Length will be applied before the PI station and the Second Vertical Curve Length will be applied after it.

ARGUMENTS FOR FINAL COMMAND IN THE SERIES

This final card in the series establishes the ending point on the vertical alignment (profile grade).

- *Roadway*: The letter (A–Z, but not G) assigned to the roadway alignment for which the vertical alignment will be defined. Vertical alignment data cannot be defined for roadway G.
- *Vertical PI Number*: An identification field. Capital letters, numerals, spaces, and special characters may be used. Each Vertical PI for a roadway must have a unique identification.
- *Vertical PI Station*: The station on the roadway alignment where the defined vertical alignment is to end. *RD10* commands for a roadway are sorted by PI stations.
- *Vertical PI Elevation*: The elevation at the Vertical PI Station.
- *First and Second Vertical Curve Lengths*: No entries may be made in these fields for this last command in the series.
- *Elevation Correction Factor (optional)*: The positive (up) or negative (down) correction factor for the elevation; if none is needed, leave the field blank.

TEMPLATE DATA

FUNCTION

This command defines a roadway template for a single station on a roadway.

USAGE

Makes use of the Store/Recall feature. If the desired shape is already stored, the number for the shape is all that is needed. If the desired shape has not been stored, defining it on the card will cause it to be stored by the number indicated.

Template shapes are made up of a series of road segments with ridge points at each end of each road segment.

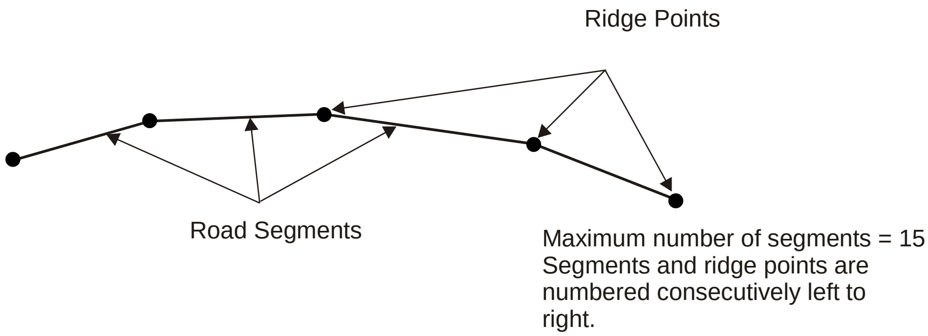
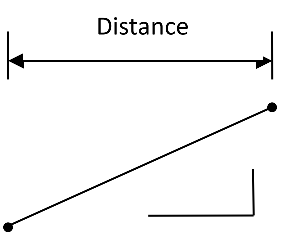
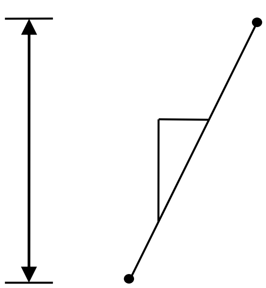


Figure 33 - Template Shape Definition

A road segment may be defined in one of two methods:

Table 5 - Roadway Segment Definition

Method 1 	*Give: Horizontal distance in feet; slope in feet per foot.* *This method may be one of two options:* *(1) Blank – normal superelevation is applied to the segment* *(2) H – superelevation is not applied to the segment*
Method 2 	*Give: Vertical distance in feet; slope in feet per foot.* *This method must be option V. No super-elevation is applied to the segment.* NOTE: Slopes extending upward to the right are positive.

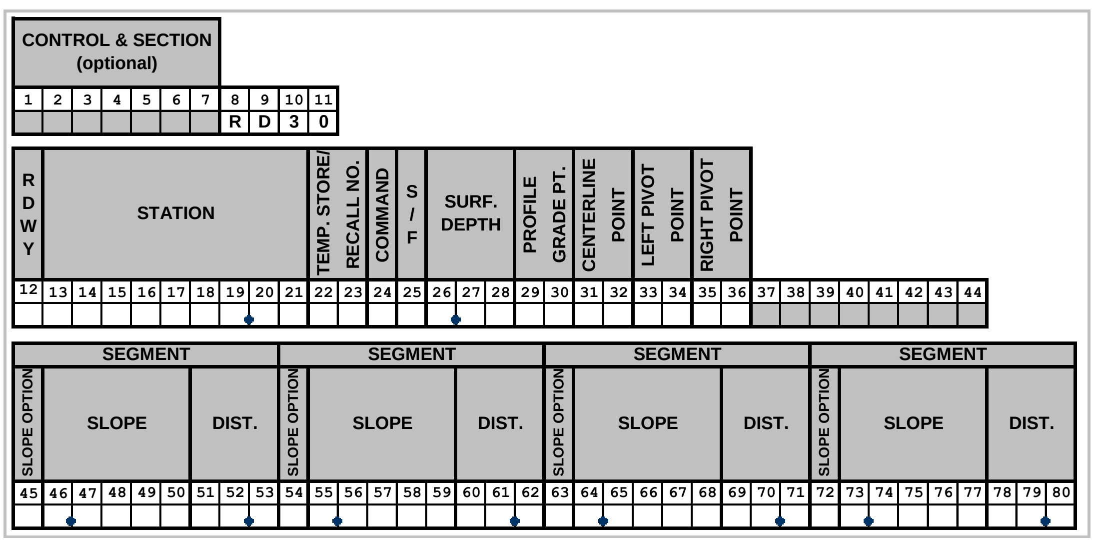
A series of *RD30* commands establishes the entire roadway surface. Each RD30 command consists of a roadway letter, a station number, a storage/recall number, and a template shape (optional). A template shape is made up of a series of road segments. Each end of each road segment is a ridge point. Generally, a given template shape is defined on the ***Card 6 - Template*** **Data Input Card** *(RD30)* for the first station to which that template applies. The storage/recall number is then used to store the shape for use by succeeding stations. If a shape is not included on an *RD30* card, it is retrieved with the storage/recall number.

A template must have a ridge point at the principal points:

1. Centerline of roadway (centerline point).
2. Point where the profile grade applies (profile grade point).
3. Point about which curves to the left are superelevated (left pivot point).
4. Point about which curves to the right are superelevated (right pivot point).

These points are referred to by their numbers. The ***Card 6 - Template*** **Data Input Card** *(RD30)* is related to other data in the following ways (the user should have a good understanding of these relationships):

Horizontal Alignment or Offset Data	*- Centerline point provides tie*
Vertical Alignment	*- Profile grade point provides tie*
Superelevation	*- Left and right pivot points provide tie. Segment options control application of superelevation*
Widening	*- Number of segments to be widened is indicated on the Widening Input Card*



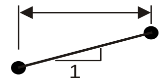
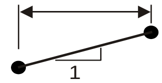
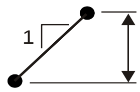
Card 6 - Template Data Input Card

ARGUMENTS

- *Roadway*: The letter (A–Z, but not G) assigned to the alignment to which the template will be applied. Note that if any of horizontal alignments A-F are defined, G must also be defined although it cannot have vertical alignment data associated with it.

- *Station*: The station on the alignment where the template will be applied. Let templates be defined at the stations at either end of a section of the alignment. Then, at any given station between these stations, the system interpolates a template from the defined templates. For this interpolation to be successful, the two templates must have the same number of points and the same principal points: profile grade, centerline, and left and right pivot points. To change to a template with a different number of points or with different principal points, specify a template compatible with the previous template at a station 0.01 ft. or 0.001 meters behind the new template station.
- *Storage/Recall Number*: The number used to store the template shape if entries are made in the subsequent fields of the command. If no entries are made in the subsequent fields, the storage/recall number is the number used to retrieve the template shape.
- *Line Number (Command)*: The number of a line used to enter the segments which define the shape for the template. For each template, as many as four lines may be used to enter from 1 to 15 segments. These segments must be entered consecutively from left to right, facing in the direction of increasing stations.
- *S/F*: Enter S to indicate that a subgrade template is being defined and F to indicate a finished grade template.
- *Surface Depth*: If a finished grade template is being defined, enter the finished to subgrade depth here.
- *Profile Grade Point*: The number of the ridge point, counting from left to right along the template, which will be used as the profile grade point. Note that this and one or more of the other principal points may share the same ridge point.
- *Centerline Point*: The number of the ridge point that will be used as the centerline point. Note that this and one or more of the other principal points may share the same ridge point.
- *Left Pivot Point*: The number of the ridge point that will be used as the left superelevation pivot point. Note that this and one or more of the other principal points may share the same ridge point.
- *Right Pivot Point*: The number of the ridge point that will be used as the right superelevation pivot point. Note that this and one or more of the other principal points may share the same ridge point.
- *Segment*: The following defines one of the segments of the template:
  - Slope Option: If this is blank, the distance is the horizontal distance of the segment and superelevation is applied to the segment. If this is H, the distance is the horizontal distance and superelevation is not applied. If this is V, the distance is the vertical distance and superelevation is not applied.

Table 6 - Slope Options

OPTION	FT/FT*	FT		SUPER-ELEVATED
blank	Vert. Per Ft Hor.	Hor.		Yes
H	Vert. Per Ft Hor.	Hor.		No
V	Hor. Per Ft Hor.	Vert.		No
F	Vert. Per Ft Hor.	Hor.	Special option used with finished grade template.	Yes

*Negative when slope is downward to the right.

- Slope: If the slope option is blank or H, the slope is rise over run. If the slope option is V, the slope is run over rise. Up and to the right is positive and down and to the left is negative.
- Distance: This is the distance from the left ridge point to the right measured either horizontally or vertically as indicated by the slope option.

SUPERELEVATION AND WIDENING DATA

SUPERELEVATION DATA INPUT CARD

FUNCTION

This ***Card 7 - Superelevation*** **Data Input Card** (RD20) defines a superelevation transition.

USAGE

Provides an automatic capability for modifying the roadway surface to introduce superelevation on curves. Both beginning and ending transitions may be entered on this card. The distinction between the two is illustrated in **Figure 34 - Beginning Transition and Ending Transition**.

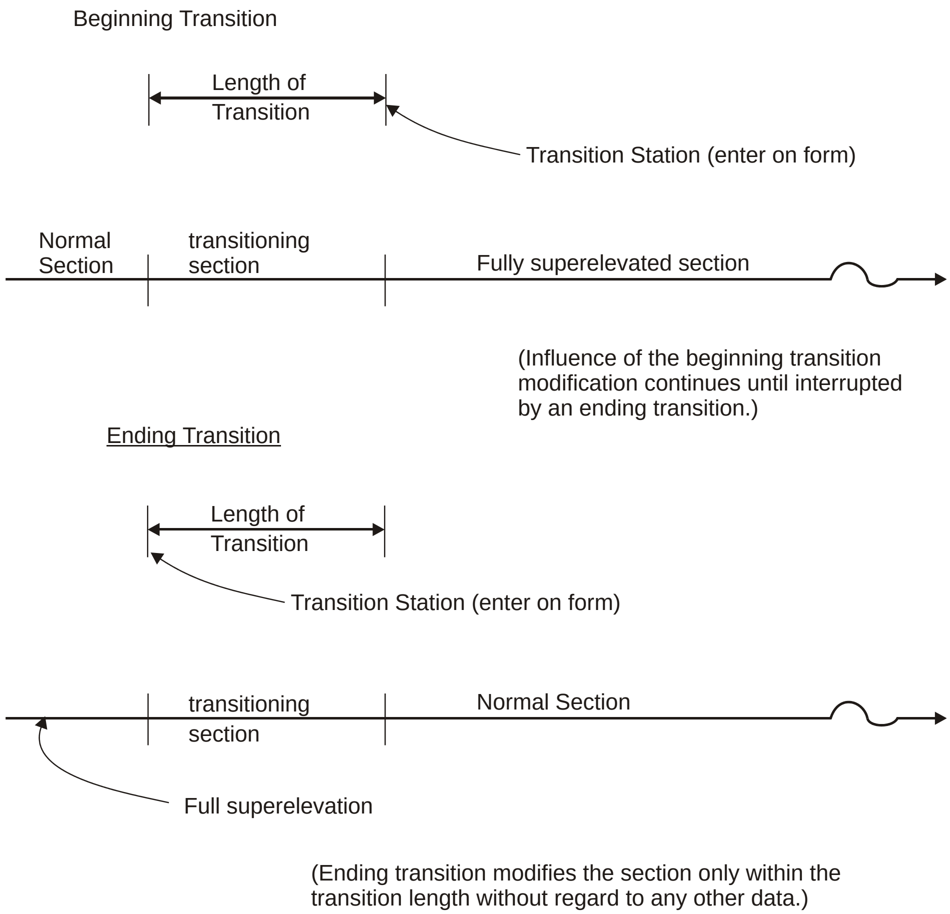


Figure 34 - Beginning Transition and Ending Transition

Transition of all segments of the roadway template occurs simultaneously around designated pivot points to provide the desired transitions. Three options are available for controlling slope transitions. Type 1 option gives a straight line transition. Type 2 and Type 3 options may vary the slope as the square of the distance to produce a reversed parabolic slope transition. Type 3 option is recommended for a smoother transition. For Type 2 transitions the following fields apply:

- *First Vertical Curve Length*: Defines the length of the first parabolic curve. (For a beginning transition, the roadway proceeds from the normal section to the first parabolic transition, to a linear transition, to the second parabolic transition, and finally to full superelevation. For an ending transition, the roadway proceeds from full superelevation to the first parabolic transition, to a linear transition, to the second parabolic transition, and finally to the normal section.) The default First Vertical Curve Length is 50 ft.

- *Second Vertical Curve Length:* Defines the length of the second parabolic curve. The default Second Vertical Curve Length is 50 ft.

The effect of these options on outside crowns is shown schematically in .

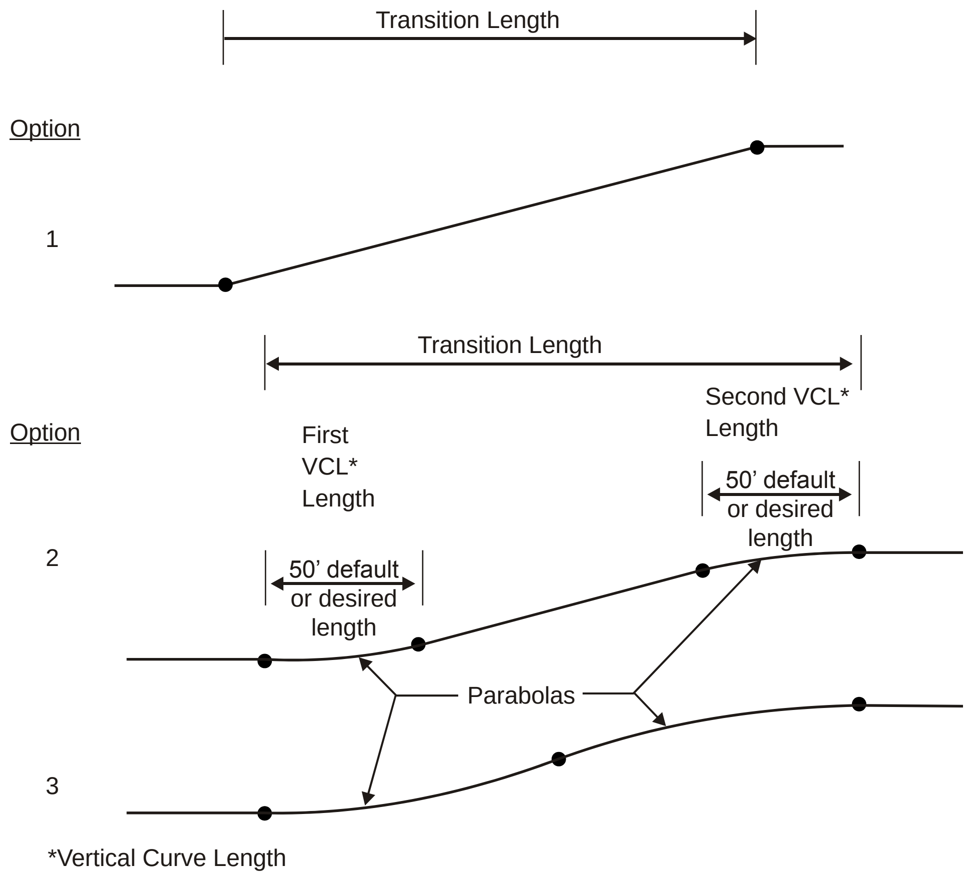
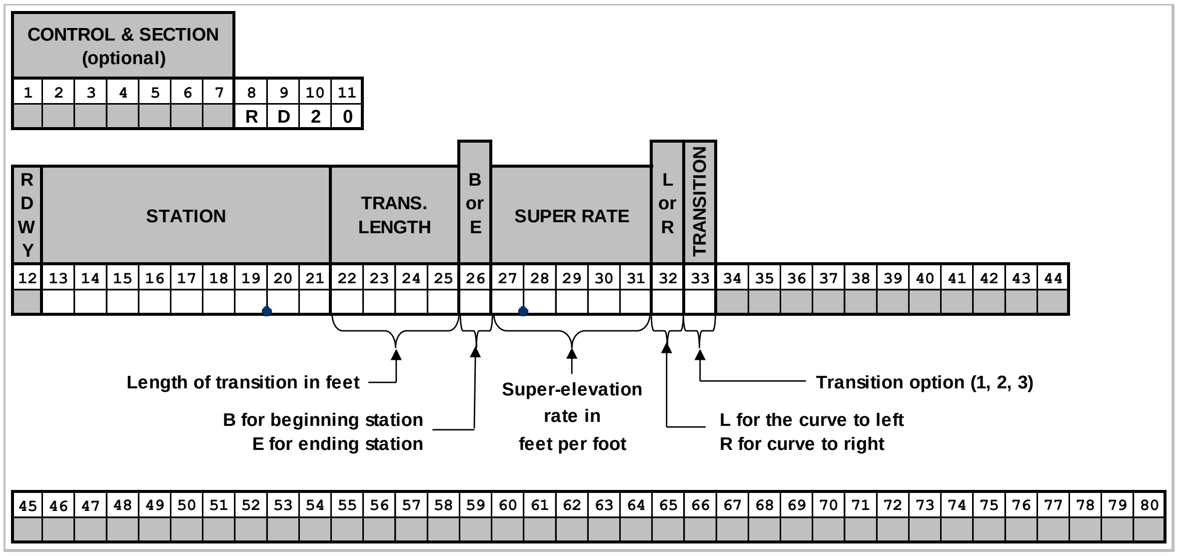


Figure 35 - Slope Transition Control Options

The ***Card 6 - Template* Data Input Card** *(RD30)* supplements the data given on the superelevation card. It includes data that pertains to the template section as follows:

- Left and Right pivot points
- Designation of segments which are not to be superelevated.

Failure to correlate the data on these two cards WILL result in errors. Only template segment distances can be changed within the transition.



Card 7 - Superelevation Data Input Card

ARGUMENTS

- *Roadway*: The letter (A–Z, but not G) assigned to the roadway alignment to which the superelevation will be applied. Note that if any of horizontal alignments A-F are defined, G must also be defined though it cannot have superelevation data associated with it.
- *Station*: If a beginning transition is being defined, this must be the beginning station of the fully superelevated section; it remains in effect until an ending transition is encountered. If an ending transition is being defined, this must be the ending station of the fully superelevated section.
- *Transition Length*: Length of the transition (see Transition Option).
- *Transition Type*: Type of the transition, specified by B for beginning or E for ending.
- *Superelevation Rate*: The superelevation rate in feet per foot or meters per meter.
- *Curve Direction*: The direction of the curve, specified by L for left or R for right. The template is superelevated to the left or right around the left or right pivot point, as specified by the Curve Direction. (See the ***Card 6 - Template* Data Input Card** *(RD30)* command for the definitions of the pivot points, and the method of designating segments which are not to be superelevated.)
- *Transition Option*: Defines the type of transition that will be applied. Must be 1 (linear), 2 (partially parabolic), or 3 (fully parabolic).

WIDENING INPUT CARD

FUNCTION

This command alters the width of the roadway segments defined by the template (*RD30*) command, with linear transitions. Widening occurs in beginning/ending pairs with the same width on each member of the pair.

USAGE

Serves to define modifications to roadway surface shapes by altering the width of the road segments defined on the ***Card 6 - Template*** **Data Input Card** *(RD30)*.

The *Widening Input Card* provides for either widening or narrowing (negative widening) of a road segment and for transition to and from the widened shape. Widening always takes place on the edge of the road segment which is farthest from the profile grade line. The distinction between beginning and ending transitions is illustrated in **Figure 36 - Positive Widening** and **Figure 37 - Negative Widening**.

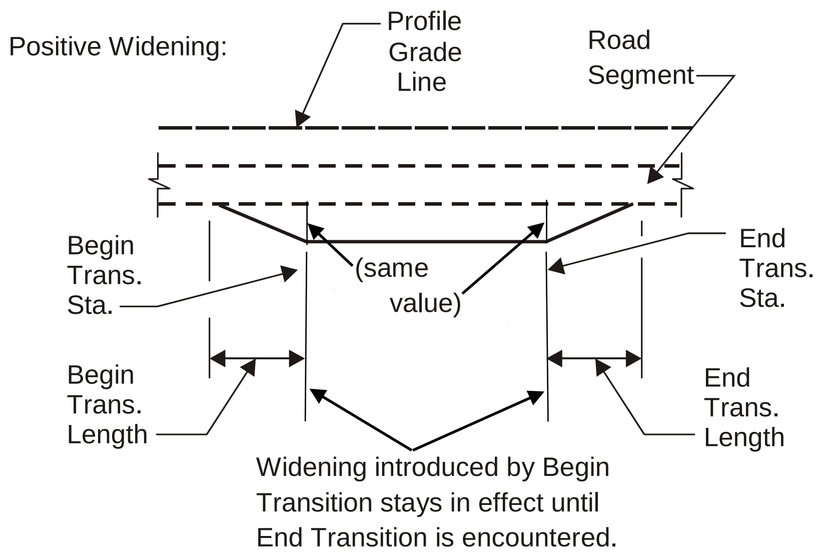


Figure 36 - Positive Widening

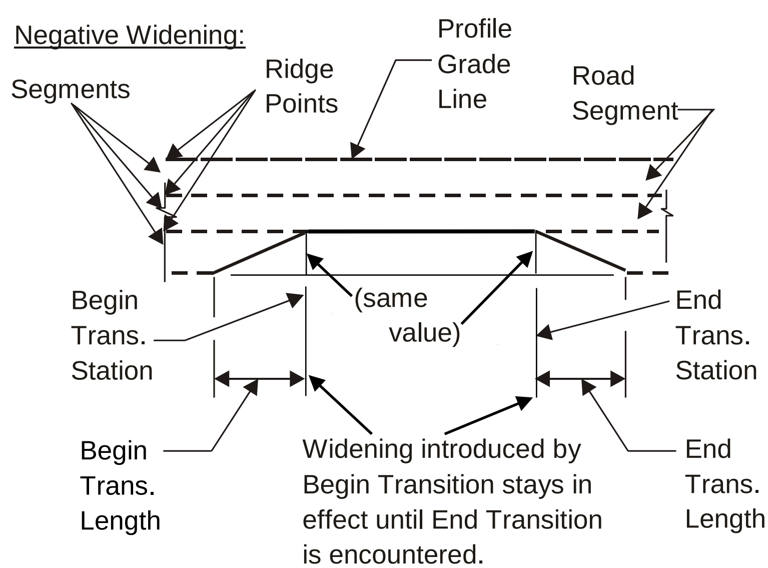
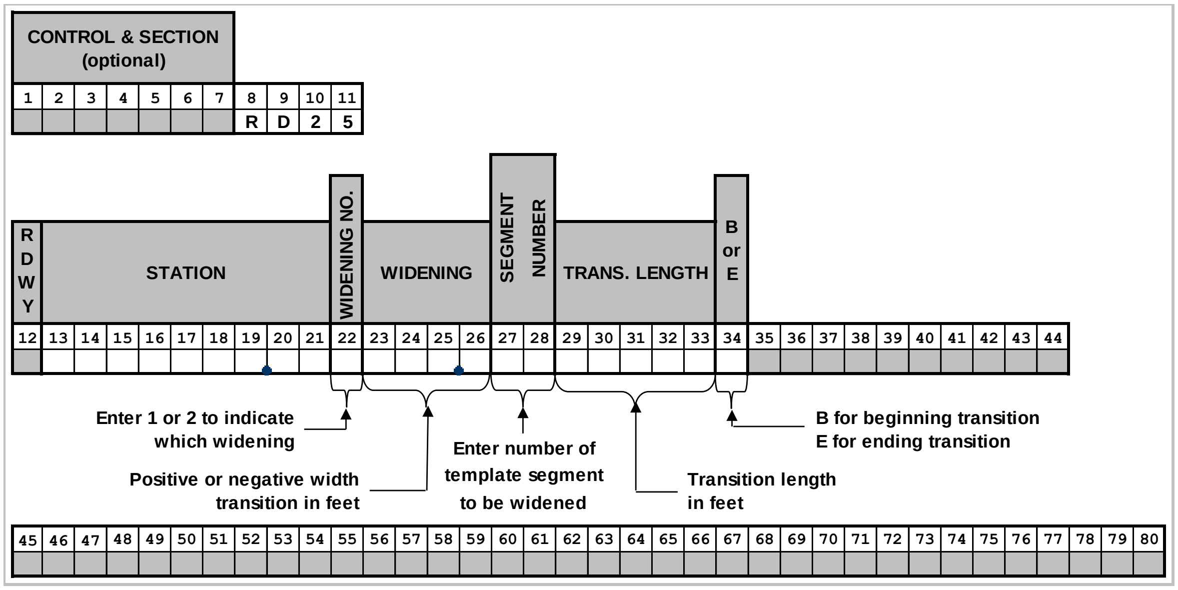


Figure 37 - Negative Widening

Note that widening specified by the beginning transition stays in effect until an ending transition is encountered, while widening specified by the ending transition applies only over the transition length. Beginning and ending widenings MUST be the same value.

The user should have the template data available when completing this card. The user can specify two widenings (two data entries designated 1 or 2) at any point on a roadway and must specify the roadway template segment to be widened in each case. Particular attention must be given to cases where the number of template segments changes within a widening.



Card 8 - Widening Input Card

ARGUMENTS

- *Roadway Alignment*: The letter (A–Z, but not G) assigned to the alignment to which the widening will be applied. Note that if any of the alignments A-F are defined and have or will have vertical alignment data, G must also be defined.
- *Station*: If a beginning transition is being defined, this must be the beginning station of the fully widened section; it remains in effect until an ending transition is encountered. If an ending transition is being defined, this is the ending station of the fully widened section; it applies only over the transition length.
- *Widening Number*: Must be 1 or 2. Two widenings may be specified at any template station.
- *Widening (Narrowing)*: Positive or negative width to be added to the widened segment. Beginning and ending widenings **must** be the same value.
- *Segment Number*: Number of template segment to be widened or narrowed. Widening always occurs on the edge of the segment farthest from the profile grade point.
- *Transition Length*: Length of the transition.

- *Transition Type*: Type of transition, specified by B for beginning or E for ending.

UPDATING DESIGN DATA

Facility is provided in the Bridge Geometry System for revising, correcting or adding new design data when the SAVE and RECALL function of the SYSTEM Card is used.

DELETING ALL DESIGN DATA FOR THE PROJECT

The user may delete all design data for the project by initializing the design data files on the *System Card* and entering completely new data.

REVISING DESIGN DATA FOR A SINGLE ROADWAY (RD00)

FUNCTION

This command facilitates revising, correcting or adding new design data when the data is to be revised for only one (or a few) roadway(s).

USAGE

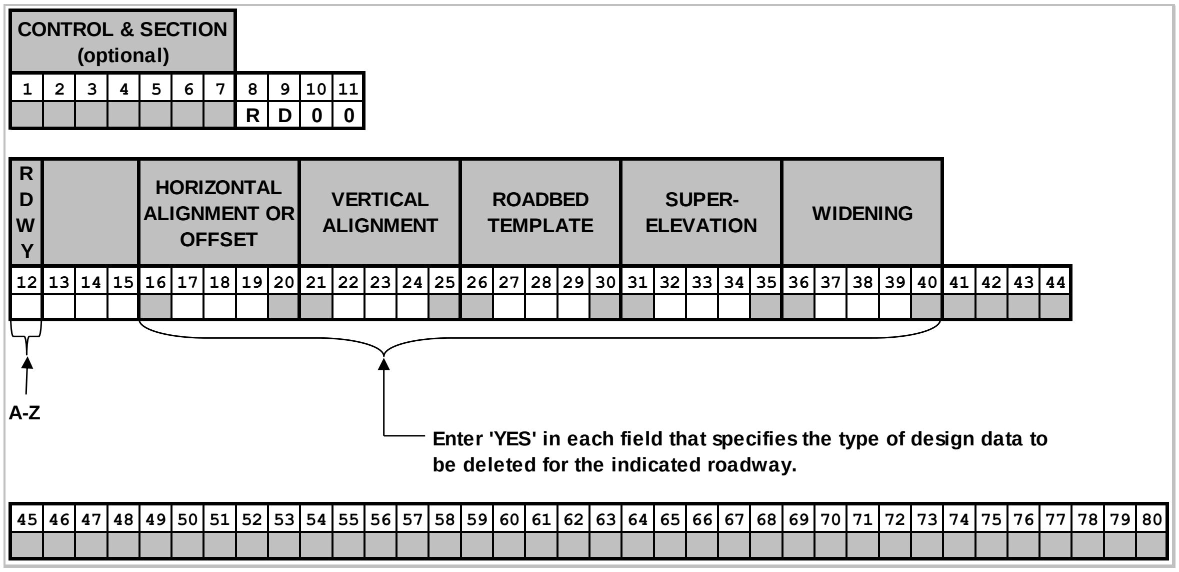
The user may use **Card 9 - Design Data Delete Input Card** to specify the following operations:

DELETING ALL DESIGN DATA FOR A SINGLE ROADWAY

This input card may be used to delete all design data for a single roadway. New design data may then be entered for the roadway by using the RD05, RD10, etc., cards.

DELETING SPECIFIC DESIGN DATA FOR A SINGLE ROADWAY

This input card may be used to delete specific design data for a single roadway. For example, all superelevation and widening data for a single roadway could be deleted without affecting other types of data for that roadway. New superelevation and widening data may then be entered for the roadway by using the RD20 and RD25 cards.



Card 9 - Design Data Delete Input Card

UPDATING HORIZONTAL AND VERTICAL ALIGNMENT DATA

A previously stored horizontal or vertical alignment for any roadway may be revised either partially or completely. If an alignment is to be completely revised, it should be deleted using design data delete prior to entering the new alignment. If an alignment is to be partially revised, no data deletion is required and only the revised or added PI's need to be entered. Data entry in either case is accomplished using normal alignment data entry.

The PI numbering scheme facilitates partial revisions to previously stored alignments. In this case, new data is interpreted as follows:

- If the PI number corresponds to that of an existing PI, the data will be treated as a revision and will replace the existing data. It must be remembered that PI numbers for vertical alignments are alphanumeric identifications and not numeric sequence numbers as in horizontal alignments. A vertical PI number of 03 cannot be revised by a PI number entered as a right justified 3 since the blank space preceding the 3 is a legal character in the PI identification. When a vertical PI is revised, the existing PI will be deleted and the new PI will be inserted in proper station order. A revised horizontal PI will be inserted in the same position as was the existing PI.

- If the PI number does not correspond to that of an existing PI, the data will be treated as an addition. In the case of horizontal alignments, the added PI will be inserted in proper numerical sequence of the PI number. In the case of vertical alignments, the added PI will be inserted in proper station order.

Figure 38 - Examples of Alignment Update shows three examples of the alignment update procedure. The first is a typical case showing revisions and additions to a horizontal alignment. The second is an update to a horizontal alignment illustrating how a PI can be deleted even though there is no direct deletion facility. The third is a typical case showing revisions and additions to a vertical alignment.

PI Numbers

_ _ _ _ _ _ _ _ _ _ Previously stored alignment
______________ Updated alignment
(Assume curve data remains constant unless PI is revised.)

Prev. Stored Align.	Update Data	Updated Align.	
10	12	10	
15	22	12	new
20	25	15	
25	32	20	
30		22	new
		25	rev.
		30	
		32	new
10	35	10	
15	40	15	
20		20	
25		25	
30		30	
35		35	rev.
40		40	rev.
1	3	1	
2	4A	2	
3	4B	3	rev.
4		4	
5		4A	new
		4B	new
		5	

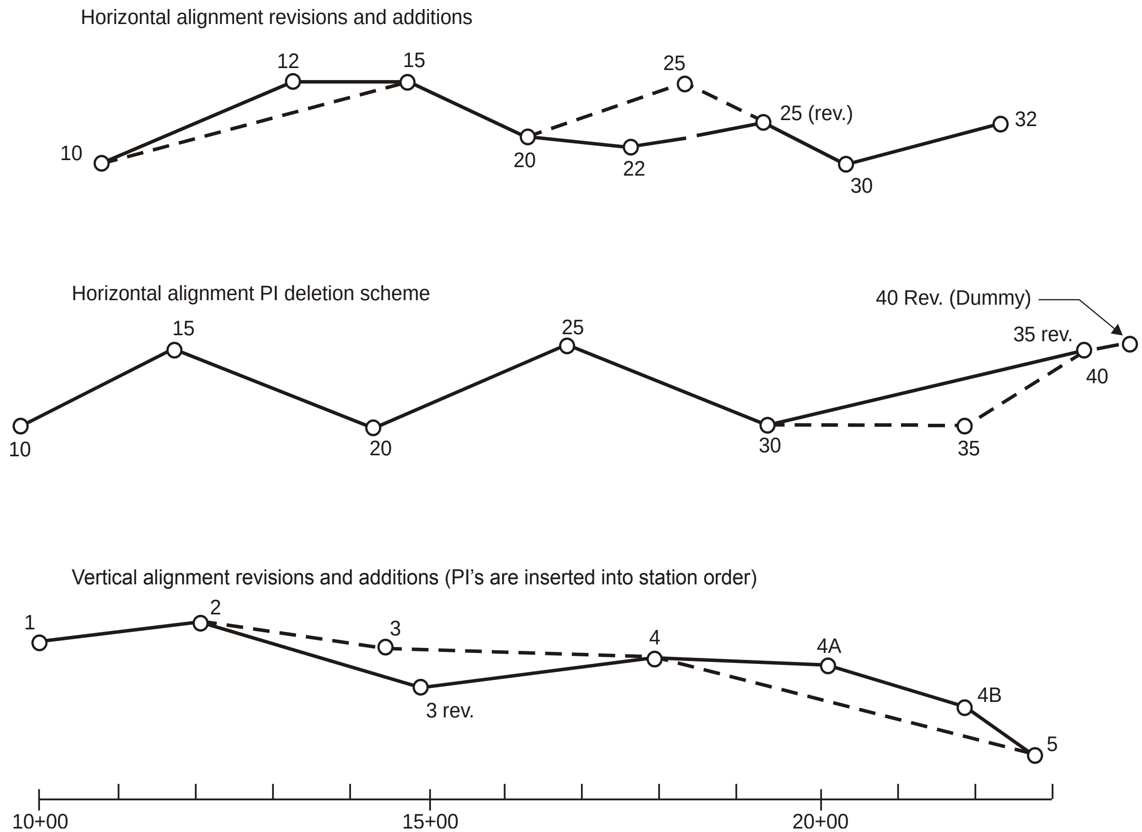


Figure 38 - Examples of Alignment Update

CREATING (PUNCHING) AND LISTING DESIGN DATA

CREATING/LISTING DESIGN DATA (RD02)

FUNCTION

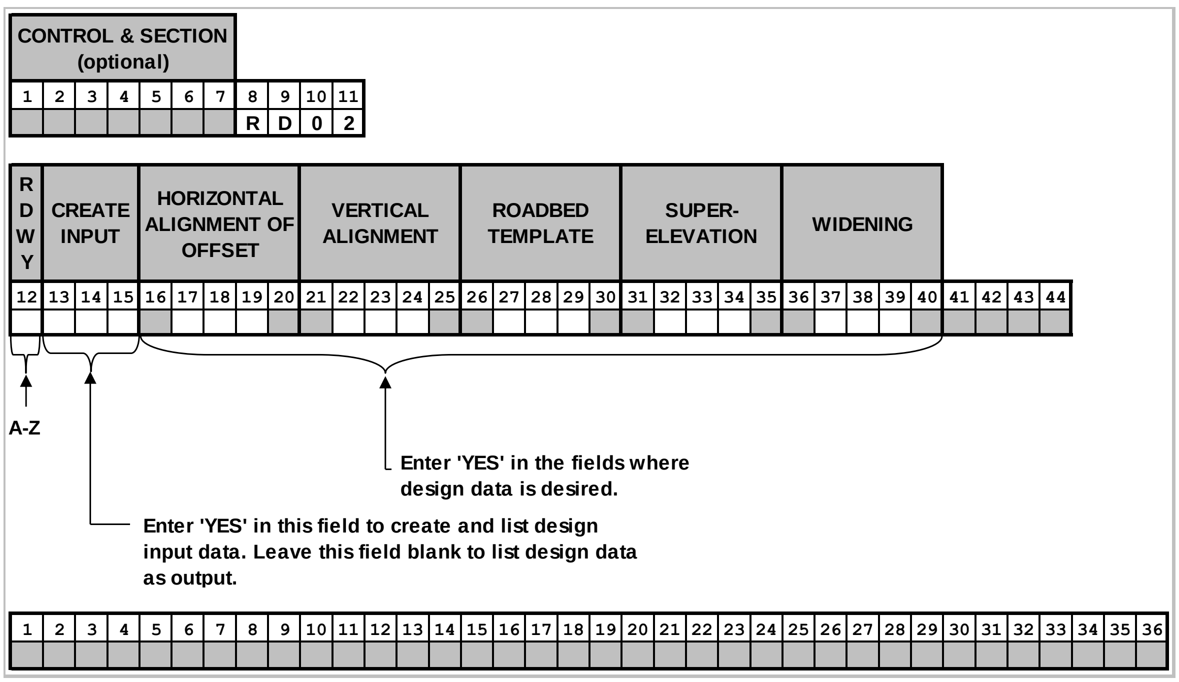
This command produces two different design data listings.

USAGE

Card 10 - Design Data Create/List Input Card allows the user to produce one of the following two design data listings for roadways A-Z:

1. A data input listing of any designated design data which will present the data in the original format as entered on the input cards.
2. A standard design data list of any designated design.

When using the *Create/List Card*, any data requested must have been previously stored or entered prior to this card. Also, in any run, the card(s) must be preceded by one *CMNT* card.



Card 10 - Design Data Create/List Input Card

ARGUMENTS

- *Roadway*: The letter (A–Z) assigned to the roadway.
- *Create Input*: Designates the type of design listing desired. Enter “YES” to obtain a listing of design data input. “YES” must also be entered in the desired design data field(s) (Columns 17-19, 22-24,

27-29, 32-34 and/or 37-39). This will create design data input in the format as originally entered on the various cards. Leave blank and enter "YES" in any of the desired design data fields to obtain a standard design data list.

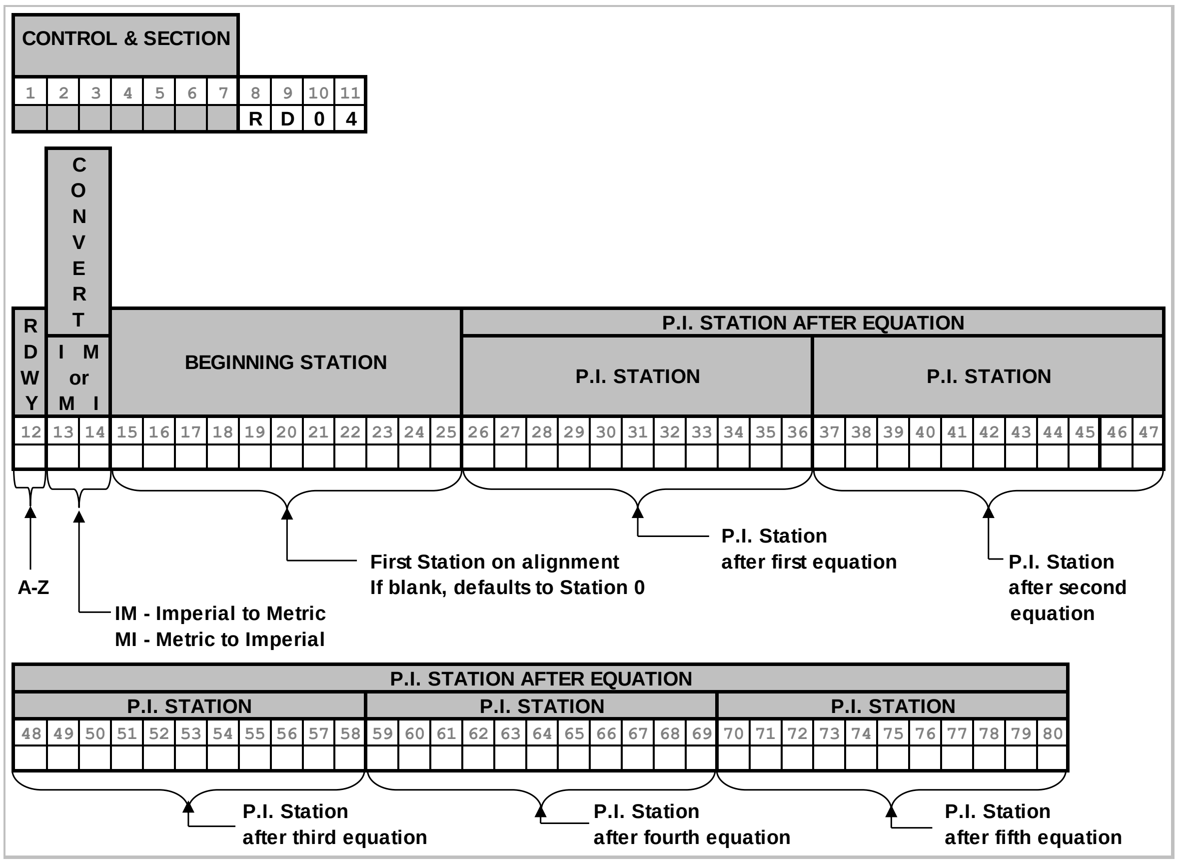
CREATING DESIGN DATA WITH UNIT TRANSFORMATION (RD04)

FUNCTION

This command converts a design data file from English/Imperial (feet) to metric (meter) or from metric to English/Imperial.

USAGE

***Card 11 - Design Data* Conversion Input Card** will only convert design data.



Card 11 - Design Data Conversion Input Card

ARGUMENTS

- *Roadway*: The letter (A-Z) assigned to the roadway alignment being converted.
- *Convert IM or MI*: Enter 'IM' to convert design data from English/Imperial to metric. Enter 'MI' to convert design data from metric to English/Imperial.

- *Beginning Station*: Assigns the station to be the beginning station on the converted horizontal alignment. The user MUST soft-convert the original beginning station to the units of measurement required and enter the value in this field. If left blank, the stationing will begin at 0.

- *P.I. Station After Equation*: There are five (5) P.I. Station after Equation Fields. Entries are made in the order of the equations on the alignment. Use these fields only if there is an equation for the alignment that is indicated in Column 12. Enter the P.I. station following the first equation in columns 26-36, the P.I. station following the second equation in columns 37-47, the P.I. station following the third equation in columns 48-58, the P.I. station following the fourth equation in columns 59-69 and the P.I. station following the fifth equation in columns 70-8.

Table 7 - Maximum Amount of Design Data Permitted

DESIGN DATA TYPE		***ALIGNMENTS A-G***		***ALIGNMENTS H-Z***	***STORE / RECALL AND OTHER TABULAR DATA***
		PER ROADWAY	***PER PROJECT***	***PER ROADWAY***	
Horizontal Alignment	*RD05*	*100 PI's*	*NA*	*25 PI's*	*NA*
Profile Grade	*RD10*	*	*250 PI's*	*25 PI's*	*NA*
Template	*RD30*	*	*500 entries*	*15 entries*	*70 descriptions***
Superelevation	*RD20*	*	*500 entries*	*50 entries*	*NA*
Widening	*RD25*	*	*250 entries*	*10 entries*	*NA*

* As many entries as desired may be referenced from any roadway (A-G) as long as the total number of entries does not exceed the maximum per project.

** Tabular data is available to all roadways.

NA – Not applicable

CHAPTER 6: COMMAND STRUCTURED INPUT – GENERAL GEOMETRY

INTRODUCTION

Many functions in BGS are invoked by user specified non-sequential commands. These commands are not directly dependent upon each other or design data which precede or follow them in the input listing. The only requirement in terms of sequencing of these commands is that sufficient data be accessible for command execution. These commands make use of point, line, circle, and roadway template data tables for execution. In many cases these data tables are modified upon execution of the command. The tables must contain all the data required by the command arguments invoked.

A brief explanation of BGS command structured input is given below. More detailed explanation of each individual commands is found under appropriate headings.

COMMAND STRUCTURED INPUT CARDS

BGS currently has sixty-five (65) commands available in the system. More commands may be developed and added in future releases. Most commands have multiple options, making the total number of possible input schemes quite numerous. Fortunately, the input schemes of all commands except RWTR (Right of Way Traverse) conform to the generic format shown below.

1	2	3	4	5	6	7	8	9	10	11	12
							R	G			

COMMAND	VARIABLE A	VARIABLE B	VARIABLE C	VARIABLE D	VAR. E	VAR. F	X COORDINATE OR CORRECTION
13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28	29 30 31 32	33 34	35 36	37 38 39 40 41 42 43 44 45 46 47

Y COORDINATE OR STATION	RADIUS, OFFSET, DISTANCE, ETC.	BEAR, AZ, OR SKEW				
		N or S	DEGREES	MIN.	SECONDS	E or W
48 49 50 51 52 53 54 55 56 57 58	59 60 61 62 63 64 65 66 67 68 69	70	71 72 73	74 75	76 77 78 79	80

Card 12 - Command Input Scheme

LEGACY FIELDS (COLUMNS 1-7 AND 10-12)

These fields of the command structured input cards were originally intended for card identification purposes. When coding the input for the mainframe version of RDS using punch cards, columns 1-7 were used for input of the control and section number and columns 10-12 were used for entering a card number. This identification system ensured that punch cards could be restored to their original sequence should the cards be dropped or otherwise placed out of order. Both of these purposes are now obsolete since “virtual cards” (i.e. lines of text) are now used rather than physical cards. Cards no longer need a unique control, section and card number, though users may still input identifiers if they so choose. Since these fields serve no technical purpose in BGS they are grayed out in the generic format shown above.

Since these “legacy fields” are the same for all command structured input, they have been excluded from card images of the various commands discussed in this user guide.

COMMAND (COLUMNS 13-16)

Four letter abbreviations of commands are entered in columns 13-16. A detailed description of each command is given in this chapter. Examples of commands include ISCT, which is used when two lines are to be intersected; TRVS, which is used when traversing a specified distance from a point in a specified direction; and CMNT which is used to enter comments to be output by the program.

VARIABLE FIELDS A, B, C, AND D (COLUMNS 17-32)

Use Fields A, B, C, and D to enter point and curve numbers in calculations. These numbers must be positive integers, right justified in their respective four (4) column fields. Usage of these fields is command dependent but the fields always contain point and curve numbers as shown below:

VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D			
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
			1				6							4	0
	2	7	3			2	2								
		6	1			5	3		1	1	6				2
1	5	1	3												

Figure 39 - Variable Fields A-D

Point numbers must be right justified integers between 1 and 2100. Curve numbers must be right justified integers between 1 and 1400.

VARIABLE FIELDS E (COLUMNS 33-34)

Use this field to call out the alignment upon which the invoked command will operate or otherwise base its calculation. The alignment designator is a letter between “A” and “Z”, inclusive, and is entered into column 34 of this field. Specified alignments must have been previously stored. See **Chapter 5: Roadway Design Data** for discussion of the alignment designations. When elevation calculations are requested for an alignment, all of the data pertaining to the surface of the roadway (profile grade data and template data) must be available.

VARIABLE FIELDS F (COLUMNS 35-36)

Use this field to enter various options and other parameters that are required by the command and option selected. The input may be in the form of numbers or letters, depending on the command and option chosen.

OTHER FIELDS (COLUMNS 37-80)

The remaining fields containing columns 37 through 80 are labeled according to their usage except as noted in the command-specific input scheme narrative. With exception of the BEAR, AZ, OR SKEW field, numbers may be entered in these columns in any desired decimal form that is consistent with the field width allocations.

Explicit decimal points, when used for real type data, occupy one column of the data field. Thus, they reduce by one (1) the maximum number of digits that could be entered in the field. If no decimal is input for real type data, one is implied in the location shown on the command input form for the specific command considered. Most fields have implied decimals that provide for 4 digits to the right of the decimal. However, as is shown in the command structured input generic format given below, the decimal point for seconds in the BEAR, AZ, OR SKEW field is implied between columns 77 and 78 which provides for just two digits to the right of the decimal.

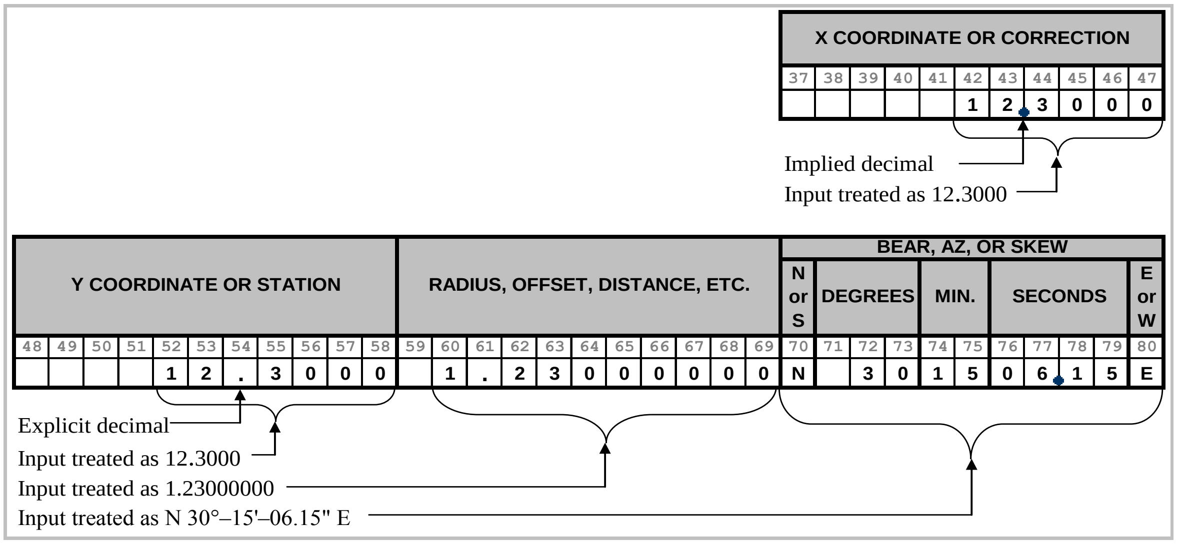


Figure 40 - Other Fields

When entering a station in the Y-COORDINATE OR STATION field, the decimal is still assumed to be just before the rightmost four columns. For example, the station 1015+13.62 is entered as shown below.

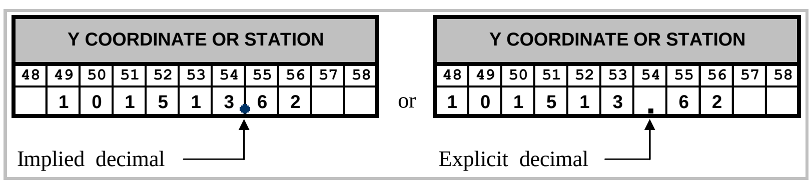


Figure 41 - Y-Coordinate or Station Field

When placing numeric data utilizing an implied decimal, discard all trailing zeros to the right of the implied decimal. When placing partial width numeric data within fields using explicit decimals, left justify the data. These practices will improve the readability of the input file.

The BEAR, AZ, OR SKEW field is for input of bearings, azimuths, or skew angles. Bearings and skews require that directions be specified, whereas azimuths require no such directions. Examples of each are shown below.

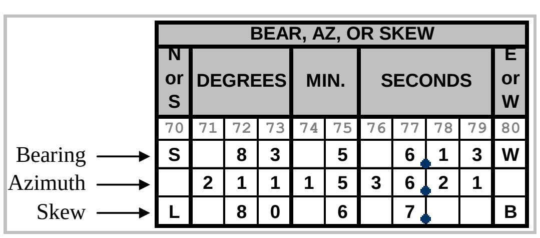


Figure 42 - Bear, AZ, or Skew Field

Bearings or azimuths may be used interchangeably when either is called for. Azimuths are expressed as angles measured clockwise from the south (S) direction.

MODIFYING REPORT OUTPUT

The following three commands allow limited customization of BGS program output.

CMNT (COMMENT)

Use this command to instruct BGS to print specified characters (alphanumeric data) entered in columns 37 thru 80 in the program output. This command may be used to insert helpful comments in the output. Characters allowed for input include upper and lower case letters, numbers, blank spaces, and the following special characters: /, +, -, ., (,), $, *, and =.

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
C	M	N	T																															

These characters will be printed on the output

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

These characters will be printed on the output

Card 13 - CMNT Argument Input Scheme Card

SKIP

Use this command to skip a specified number of lines in the output or, said differently, to insert a specified number of blank lines in the output.

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
S	K	I	P																															

Number of lines to be skiped (If blank, one line will be skipped).

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 14 - SKIP Argument Input Scheme Card

EJCT (EJECT)

Use this command to cause the subsequent output to begin at the top of a new page.

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
E	J	C	T																															

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 15 - EJCT Argument Input Scheme Card

GENERAL GEOMETRY

General geometry includes the BGS capabilities of storing, creating, and plotting points, curves, and lines, intersection curves and lines, obtaining information about points and curves, and other general geometry functions.

GENERAL GEOMETRY COMMANDS

Following is a listing of available BGS general geometry commands. Each command and option heading contains the option or command name, a description of the operation performed, and general instructions for preparing and inputting data.

CURV (CURVE)

FUNCTION

This command defines either a straight line or a circle and assigns it a Curve ID for storage.

USAGE

Use this command to store data for defining either straight lines or curves. This command is for input only, meaning that it does not perform computations but rather stores curve data for use by other program operations. Seven argument input schemes are available for this command.

CURV ARGUMENT INPUT SCHEME A – STRAIGHT LINE

This input scheme defines a straight line at a specified bearing or azimuth passing through a specified point.

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
C	U	R	V																															

Number assigned to the curve defined. (Variable A)

X -coordinate (columns 37–47)

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Y-coordinate (columns 48–58)

Bearing (columns 70–80)

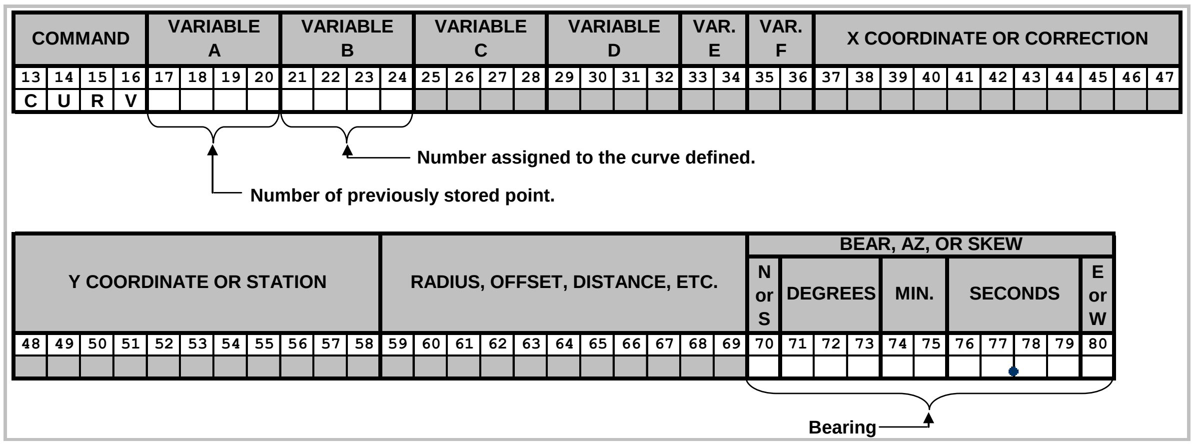
Card 16 - CURV Argument Input Scheme A Card

This argument input scheme requires the following data:

- Curve ID (VAR. A): The number assigned for storage of the defined line.
- X Coordinate: The X coordinate of the point on the line.
- Y Coordinate: The Y coordinate of the point on the line.
- Bearing: The bearing or azimuth of the line.

CURV ARGUMENT INPUT SCHEME B – STRAIGHT LINE

This input scheme defines a straight line at a specified bearing or azimuth passing through a previously stored point.



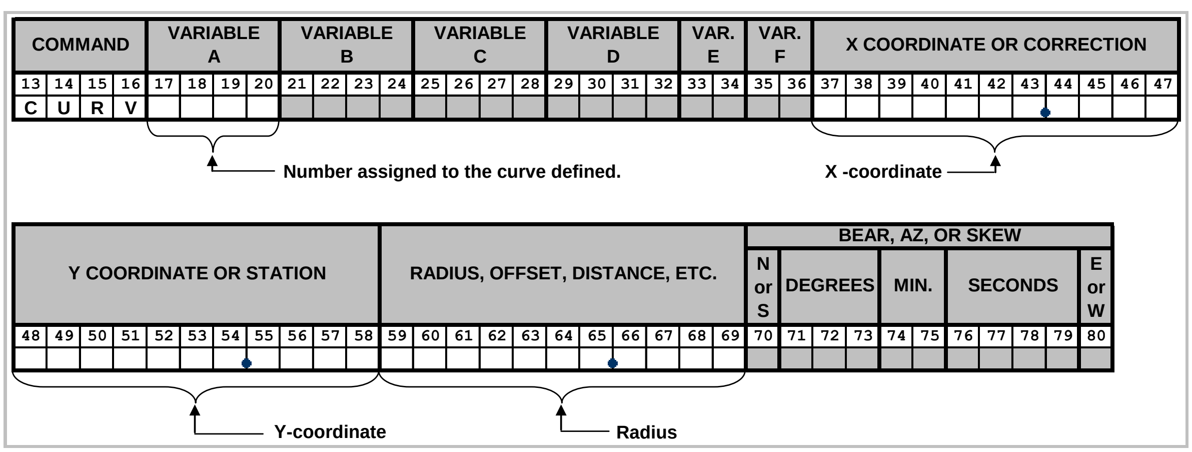
Card 17 - CURV Argument Input Scheme B Card

This argument input scheme requires the following data:

- Point ID (VAR. A): The number of the previously stored point on the line.
- Curve ID (VAR. B): The number assigned for storage of the defined line.
- Bearing: The bearing or azimuth of the line.

CURV ARGUMENT INPUT SCHEME C – CIRCLE

This input scheme defines a circle using a center point and a radius.



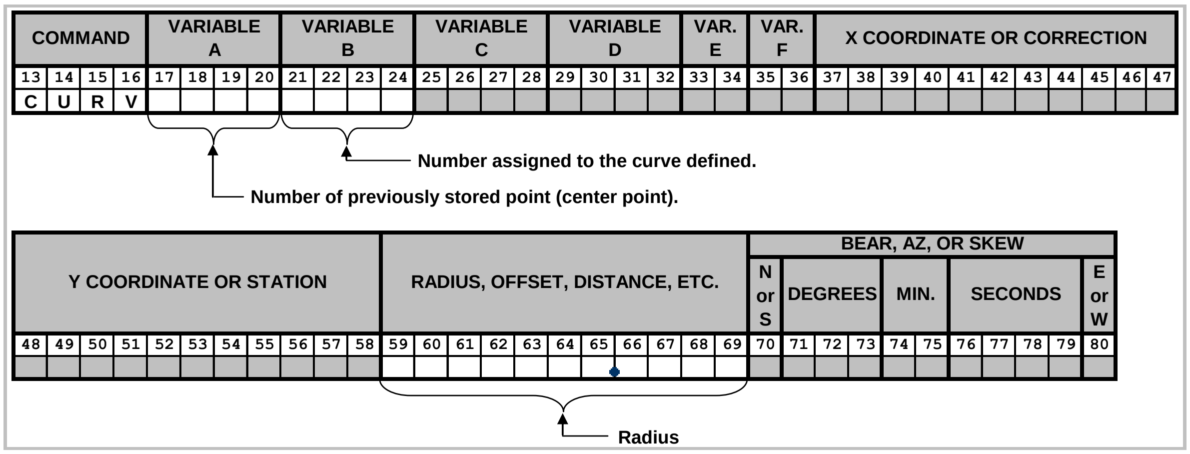
Card 18 - CURV Argument Input Scheme C Card

This argument input scheme requires the following data:

- Curve ID (VAR. A): The number assigned for storage of the defined circle.
- X Coordinate: The X coordinate of the center of the circle.
- Y Coordinate: The Y coordinate of the center of the circle.
- Radius: The radius of the circle.

CURV ARGUMENT INPUT SCHEME D – CIRCLE

This input scheme defines a circle using a previously stored center point and a radius.



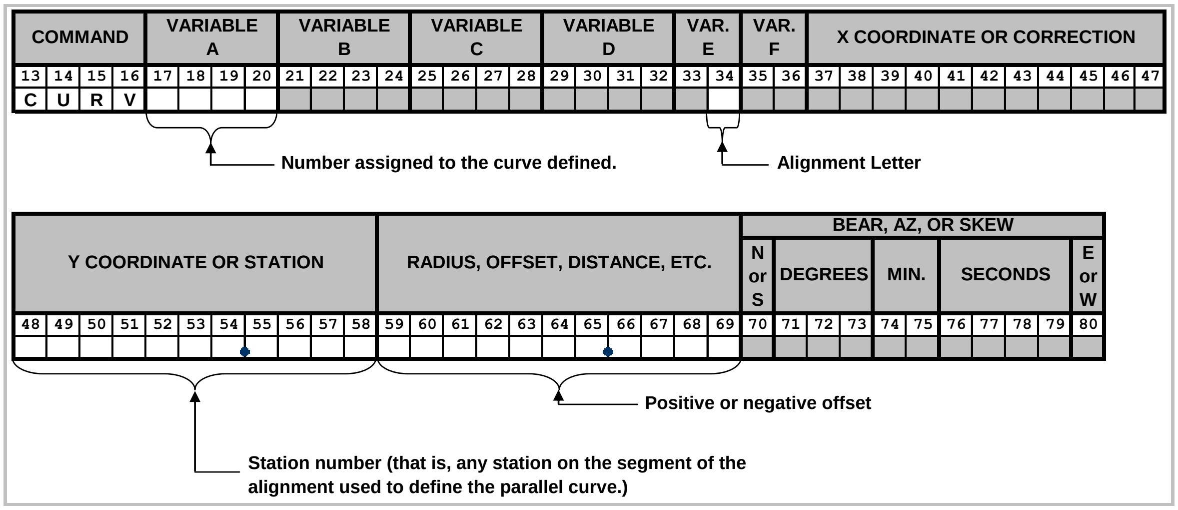
Card 19 - CURV Argument Input Scheme D Card

This argument input scheme requires the following data:

- Point ID (VAR. A): The number of the previously stored center point of the circle.
- Curve ID (VAR. B): The number assigned for storage to the defined circle.
- Radius: The radius of the circle.

CURV ARGUMENT INPUT SCHEME E – CIRCLE OR LINE

This input scheme defines a curve parallel to a specified segment of an alignment and at a given offset.



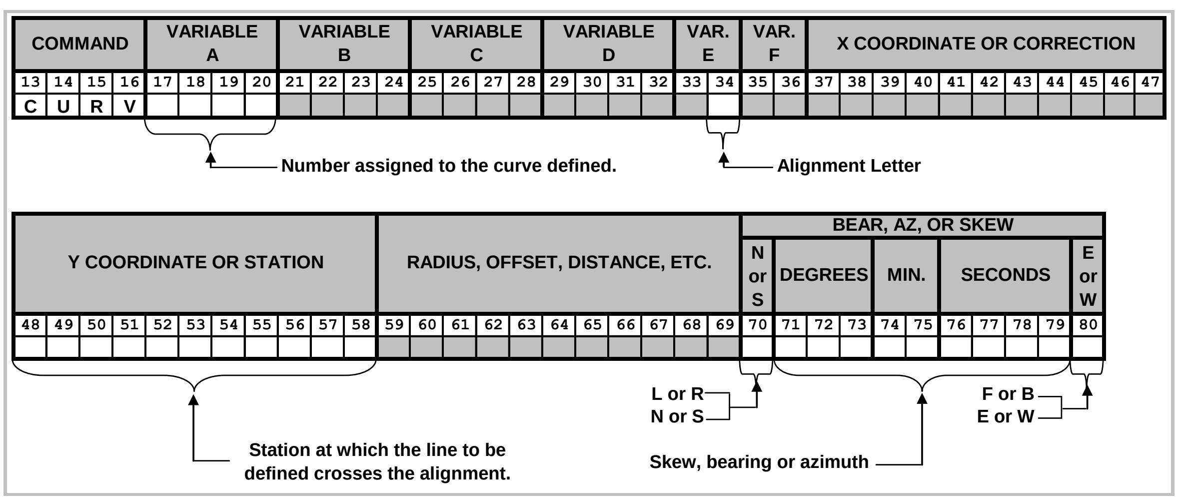
Card 20 - CURV Argument Input Scheme E Card

This argument input scheme requires the following data:

- *Curve ID (VAR. A)*: The number assigned for storage of the defined curve.
- *Roadway Alignment (VAR. E)*: The letter of the alignment which the curve is to parallel.
- *Station*: Any station on the segment of the alignment which the curve is to parallel.
- *Offset*: The offset of the line from the alignment. The offset is positive if the line is to the right of the segment and negative if the line is to the left of the segment, looking in the direction of increasing stations.

CURV ARGUMENT INPUT SCHEME F – LINE

This input scheme defines a line which intersects an alignment at a specified station.



Card 21 - CURV Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Curve ID (VAR. A)*: The number assigned for storage of the defined line.
- *Roadway Alignment (VAR. E)*: The letter of the alignment the line is to intersect.
- *Station*: The station on the alignment at the point where the line is to intersect the alignment.
- *Bearing*: The bearing, azimuth or skew of the line at the point of intersection. See the Note and diagram below.

NOTES ON CURV COMMAND

If the skew option is used, the skew must be given in the columns headed BEAR, AZ, or SKEW in one of the four following forms:

1. R, DEG, MIN, SEC, F = right forward skew.
2. L, DEG, MIN, SEC, F = left forward skew.
3. R, DEG, MIN, SEC, B = right backward skew.
4. L, DEG, MIN, SEC, B = left backward skew.

All skew angles are measured from a line perpendicular to the station line at the given station. Forward indicates that the skew is to be measured in the direction of increasing stations; backward indicates decreasing stations. Right and left is determined by looking in the direction of increasing stations.

Since the new line must be stored with a direction, it is necessary to designate whether it extends to the left (L) or right (R) from the station line and whether it is forward (F) or backward (B) from the perpendicular or radial line as shown in the sketch below.

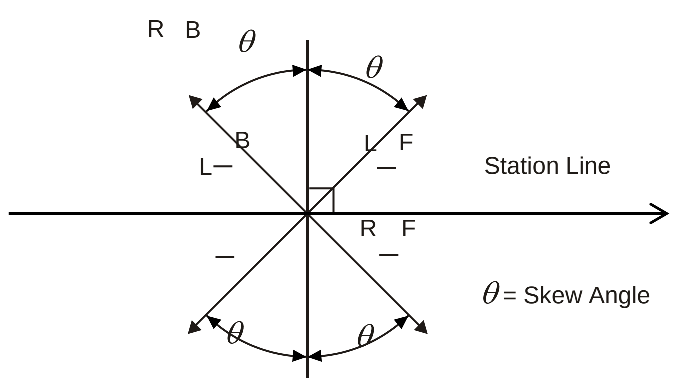
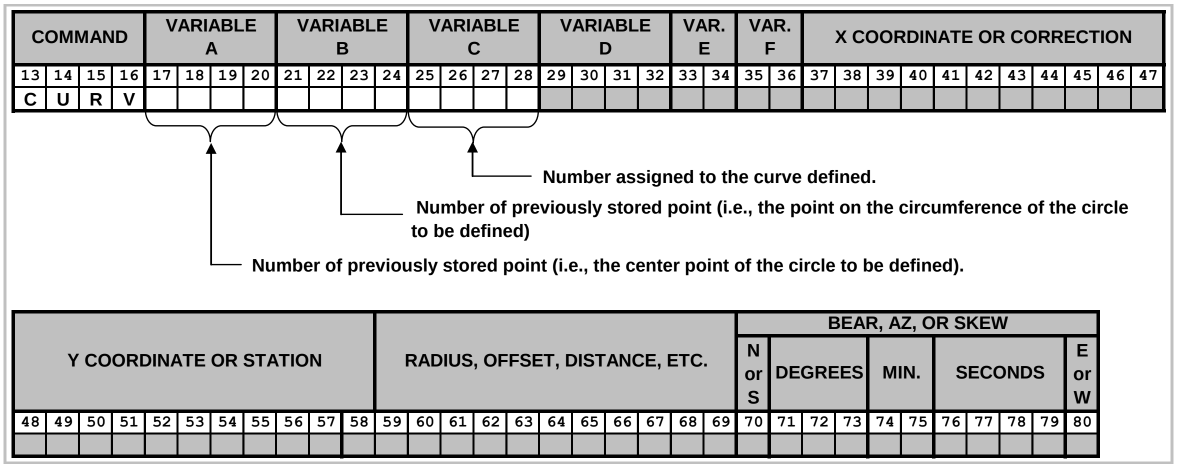


Figure 43 - Skew Angles

CURV ARGUMENT INPUT SCHEME G – CIRCLE

This input scheme defines a circle using a previously stored center point and a previously stored point on the circumference.



Card 22 - CURV Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number of the previously stored center point of the circle.
- *Point ID (VAR. B)*: The number of a previously stored point on the circumference of the circle.
- *Curve ID (VAR. C)*: The number assigned for storage to the defined circle.

PONT (POINT)

FUNCTION

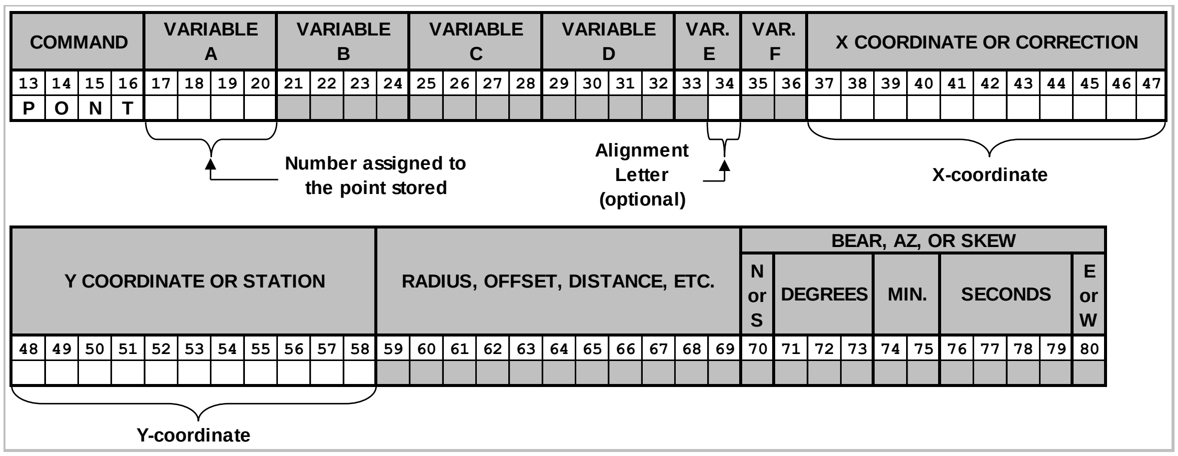
This command defines a point and stores it for later reference.

USAGE

Use this command to store the X and Y coordinates of a point of interest. PONT is used primarily for input but can also be used for querying the system for calculated point-related information.

PONT ARGUMENT INPUT SCHEME A

This input scheme defines the point using X and Y coordinates.



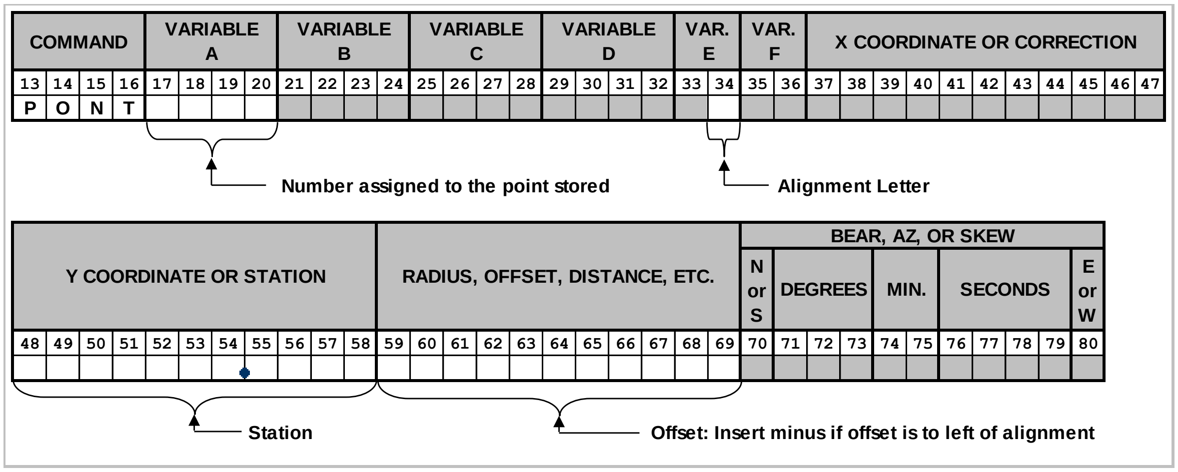
Card 23 - PONT Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number assigned for storage of the point.
- *Roadway Alignment (VAR. E)*: If provided, the system computes the station and offset of the point from the given alignment measured along the line through the point perpendicular to the alignment.
- *X Coordinate*: The X coordinate of the point to be stored.
- *Y Coordinate*: The Y coordinate of the point to be stored.

PONT ARGUMENT INPUT SCHEME B

This scheme defines a point at a given offset from a given station on a given alignment. The output provides computed coordinates for the point. Note: ZPNT accomplishes the same task and, in addition, computes the elevation of the stored point.



Card 24 - PONT Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number assigned for storage of the point.
- *Roadway Alignment (VAR. E)*: The alignment relative to which the point is defined.
- *Station*: The station on the given alignment nearest the point to be defined.
- *Offset*: The offset of the point from the given station on the given alignment. Use a negative offset for a point to the left of the alignment, looking in the direction of increasing stations.

BRDS (BEARING AND DISTANCE)

FUNCTION

Calculates the bearing and distance between two specified points. A Curve ID may be assigned to the line between the two points. If the Curve ID is given, the line is stored for later reference.

USAGE

Use this command to cause the bearing and distance between two given points to be calculated and output and, if desired, to establish and store a line bearing from the first to the second point for reference.

BRDS ARGUMENT INPUT SCHEME

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
B	R	D	S																															

1st Point

2nd Point

Curve (optional)

Use any two previously stored points. The resulting curve will be stored as the curve number entered, if any.

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 25 - BRDS Argument Input Scheme Card

The argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number of a previously stored point (the first point).
- *Point ID (VAR. B)*: The number of a previously stored point (the second point).
- *Curve ID (VAR. C)*: The number assigned for storage to the line connecting the two points.

YPNT

FUNCTION

This command calculates the coordinates and station number of the point on an alignment nearest a previously stored point, and the offset of the previously stored point from the alignment.

USAGE

Use this command to cause the coordinates, station and offset of a previously stored point to be printed out. The alignment letter must be given. As an option, the coordinates of the calculated nearest point on the alignment (the centerline point) can also be stored.

YPNT ARGUMENT INPUT SCHEME

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
Y	P	N	T																															

Number of previously stored point

Alignment 2

Alignment Letter

Number assigned to computed centerline point (optional)

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 26 - YPNT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number of the previously stored point.
- *Point ID (VAR. B)*: The number assigned for storage of the centerline point; that is, the point on the roadway alignment (VAR. E) nearest the previously stored point.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the coordinates, station number and offset are computed.
- *Roadway Alignment 2*: If an alignment letter is entered in column 36, VAR. F, the coordinates and station number of the point on this second alignment (alignment 2) nearest the previously stored point, and the offset of the previously stored point from alignment 2 are computed.

ZPNT

FUNCTION

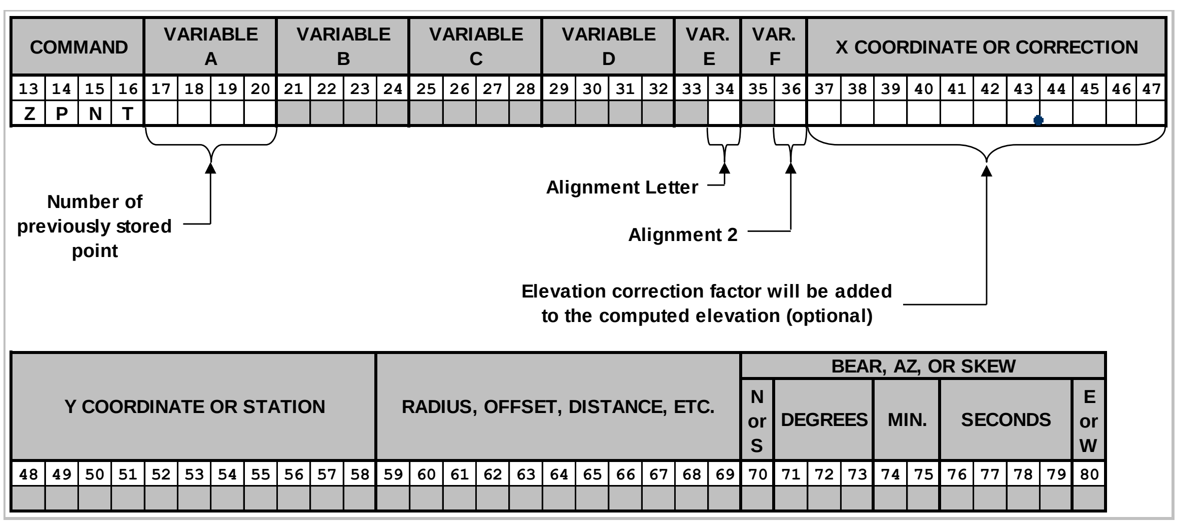
This command calculates the coordinates, station, offset and elevation of a point with respect to a given alignment.

USAGE

Use this command to cause the coordinates, station, offset, and elevation of a point to be printed out. This elevation may be corrected by a designated amount. If no correction factor is designated, the elevation will not be corrected. Two input options are available for ZPNT, as given below.

ZPNT ARGUMENT INPUT SCHEME A

This input scheme calculates the data for the point on the given alignment nearest a previously stored point.



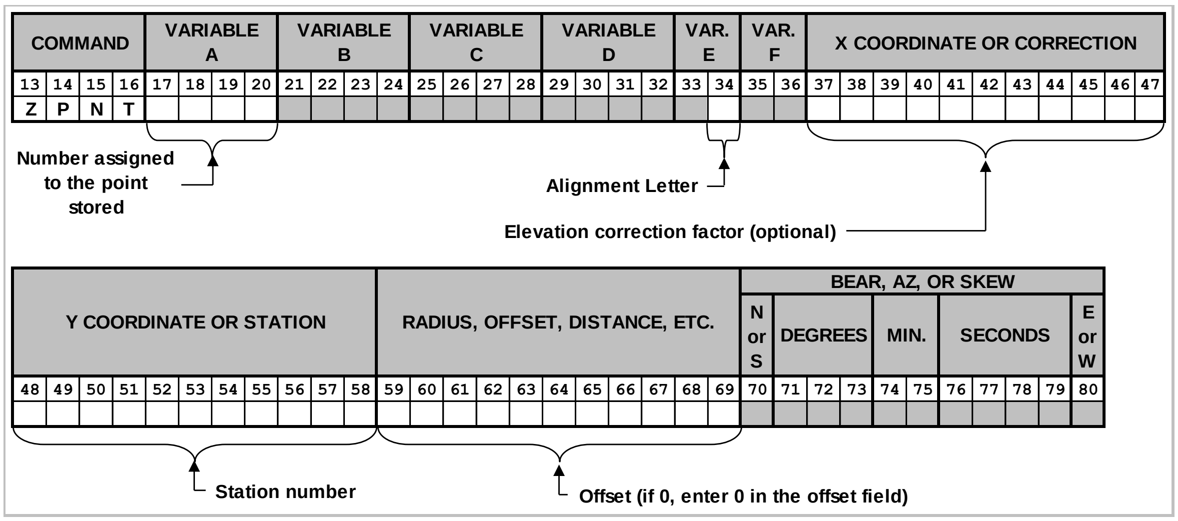
Card 27 - ZPNT Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of a previously stored point.
- *Roadway Alignment (VAR. E):* The letter of the alignment from which the coordinates, station number and offset of the point are computed; if profile and template data have been entered for the alignment, the elevation of the point is also computed.
- *Roadway Alignment 2:* If a second alignment letter is entered in column 36, VAR. F, the coordinates and station number of the point on alignment 2 nearest the previously stored point, and the offset of the previously stored point from alignment 2 are computed.
- *Elevation Correction Factor:* The correction factor for the elevation (optional).

ZPNT ARGUMENT INPUT SCHEME B

This input scheme defines a point at a given offset from a given station on a given alignment.



Card 28 - ZPNT Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number assigned for storage to the point.
- *Roadway Alignment (VAR. E):* The letter of the alignment for which the station number and offset are specified and from which the coordinates for the point are computed; if profile and template data have been entered for the alignment the elevation of the point is also computed.
- *Elevation Correction Factor:* The correction factor for the elevation (optional).
- *Station:* The station on the specified alignment nearest the desired point.
- *Offset:* The offset at which the desired point lies from the specified station on the specified alignment. Use a negative value for offsets left of the alignment when facing in the direction of increasing stations.

ISCT (INTERSECTION)

FUNCTION

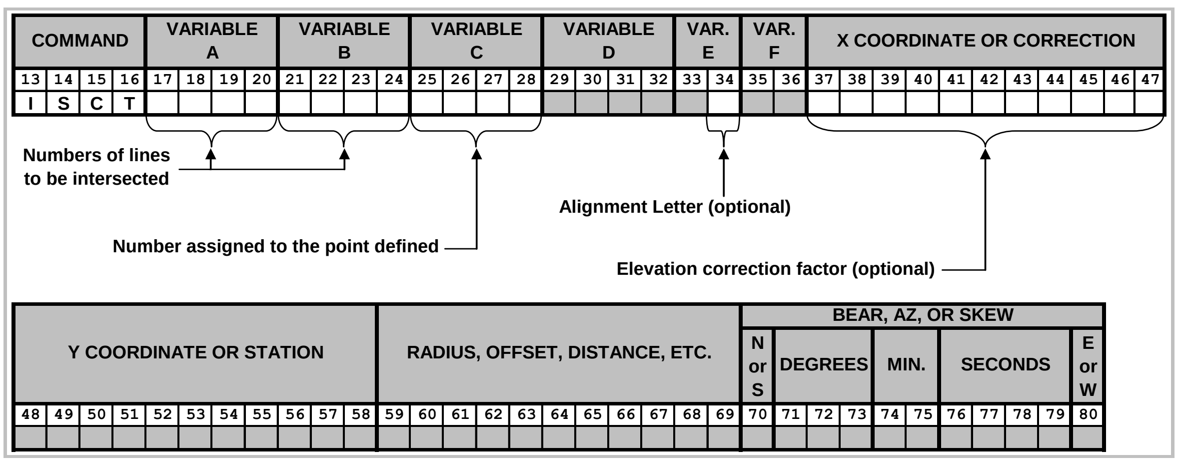
This command calculates and stores the intersection(s) of two previously stored curves. If an alignment is given, the command will calculate the nearest station on the alignment and the offset of the intersection from the alignment. The elevation of the intersection point will be computed if profile and template data have been entered for the alignment. At the user's option, the computed elevation may be adjusted by a specified correction factor.

USAGE

Use this command to calculate the station, offset, and, if data is available, elevation, of the intersections of two specified curves. This command is for calculation and storage, meaning that it both performs computations and stores resulting data for use by other program operations. The ISCT command has two argument input schemes.

ISCT ARGUMENT INPUT SCHEME A – INTERSECT LINES

This input scheme stores the intersection of two previously stored lines. Note: If the lines are parallel, no intersection or station and elevation can be computed.



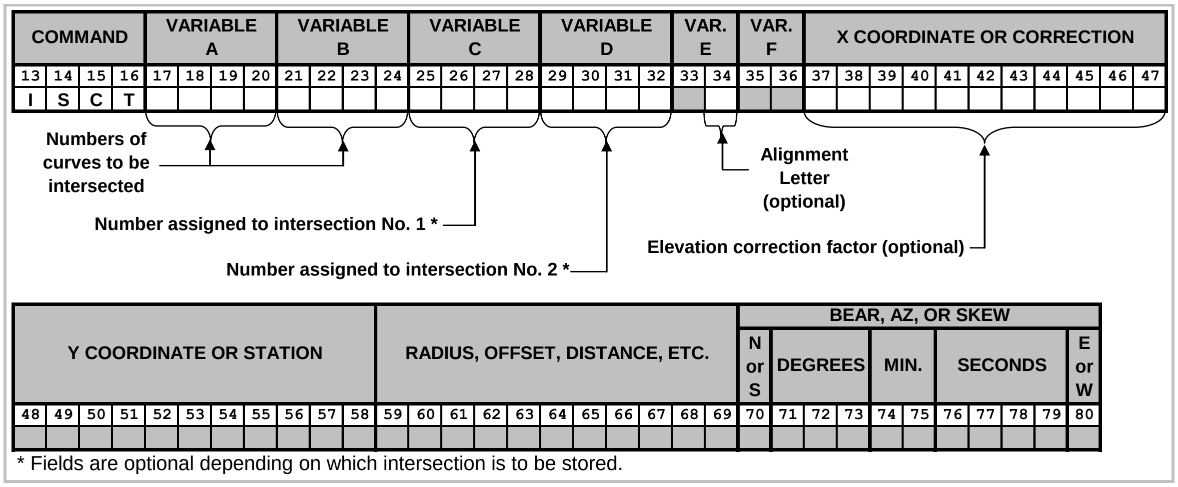
Card 29 - ISCT Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Curve ID (VAR. A):* The number of the first previously stored line.
- *Curve ID (VAR. B):* The number of the second previously stored line.
- *Point ID (VAR. C):* The number assigned for storage of the point of intersection of the two lines.
- *Roadway Alignment (VAR. E):* The letter of the alignment from which the station, offset, and elevation of the intersection are computed (optional).
- *Elevation Correction Factor:* The correction factor for the computed elevation (optional).

ISCT ARGUMENT INPUT SCHEME B – INTERSECT TWO CIRCLES OR CIRCLE AND A LINE

This input scheme stores the intersections of two circles or a line and a circle.



Card 30 - ISCT Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Curve ID (VAR. A)*: The number of the first previously defined line or circle.
- *Curve ID (VAR. B)*: The number of the second previously defined line or circle.
- *Point ID (VAR. C)*: The number assigned for storage of the first point of intersection of Curves 1 and 2. This field does not need to be filled out if only the second point of intersection is to be stored. See the Notes and diagrams below for additional information.
- *Point ID (VAR. D)*: The number assigned for storage of the second point of intersection of Curves 1 and 2. Complete this field only if the second intersection point is to be stored for later reference. See the Notes and diagrams below.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the station, offset, and elevation of the intersections are computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation (optional).

NOTES ON ISCT COMMAND

- For the intersection of two circles, intersection one is the leftmost intersection looking from the center of the first circle to the center of the second circle. The first circle in the input will be designated Circle 1; the second circle will be designated Circle 2. If the circles do not intersect, a point midway between the two circles will be given for one or both points. If the two circles are tangent, the point of tangency will be stored for both intersections.

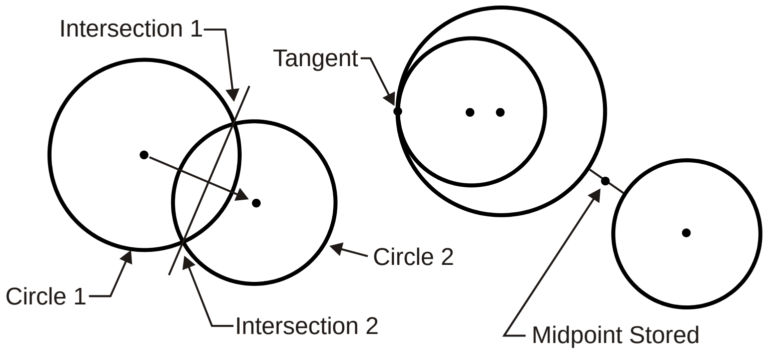


Figure 44 - Intersection of Two Circles

- For the intersection of a circle and line, intersection one is the first intersection with the circle moving in the direction of the bearing of the line. If the line and circle do not intersect, a point midway between the line and the circle will be given for one or both points. If the line is tangent to the circle, the point of tangency will be stored and both points will have the same value.

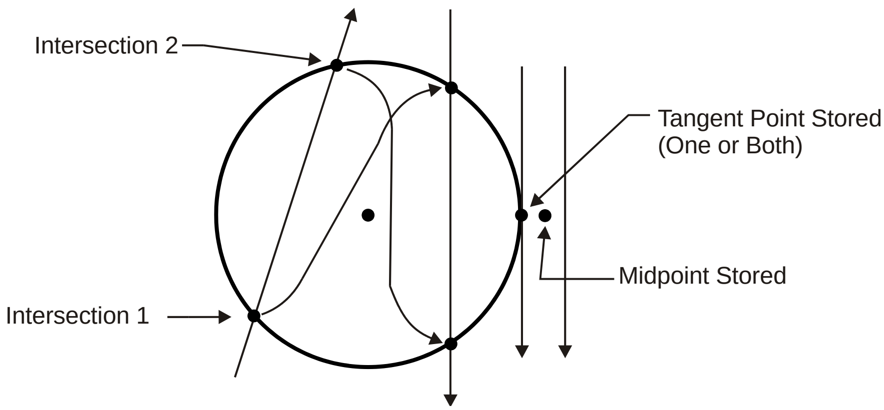


Figure 45 - Intersection of a Circle and a Line

- Either one or both of the Point ID fields may be filled, depending on which intersections need to be stored.
- In RDS the approximate station number could be entered at the user's option. This option is not included in this BGS User Guide.

OSCT (INTERSECTION)

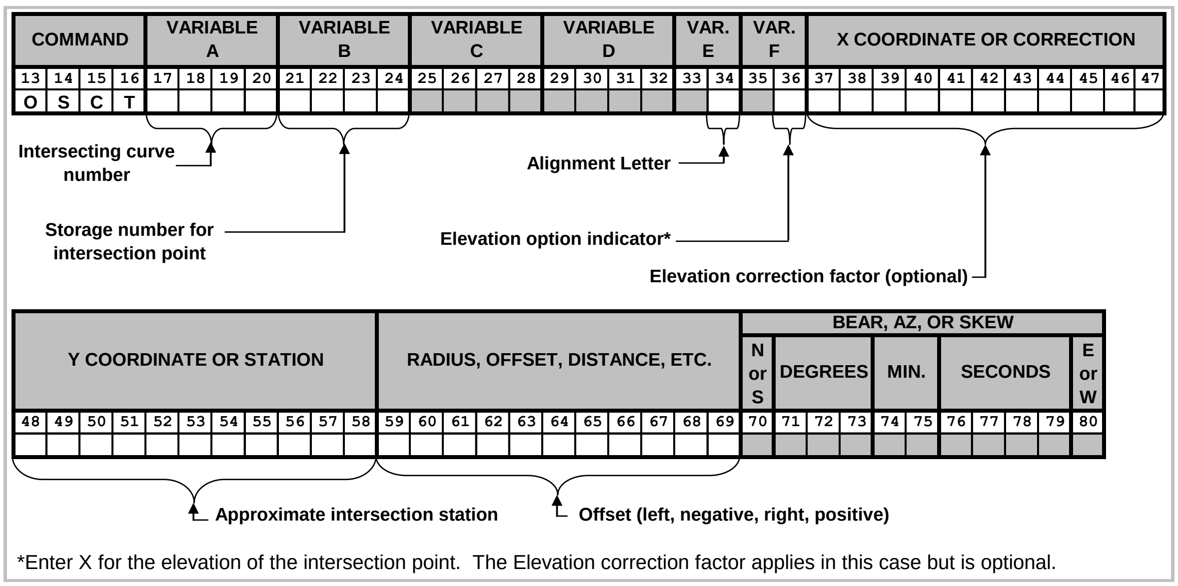
FUNCTION

This command calculates and stores the intersection of a previously stored curve and the offset to a previously stored alignment. The intersection is calculated based on an offset distance and a user-specified approximate station where the stored curve crosses the alignment. See the **Figure 46 - Offset Alignment** for an illustration of this command. If no intersection is found on the alignment section specified by the approximate station, an intersection is attempted using the adjacent alignment segments. If more than one intersection is found on the alignment segment, the closest intersection to the specified station will be printed and stored. At the user's option, the elevation of the intersection point will be computed if profile and template data have been entered for the alignment. The computed elevation may be adjusted by a specified correction factor.

USAGE

Use this command to compute the intersection of the offset to a previously stored alignment with a previously defined curve (line or circle). The command output includes the station number of the point on the alignment nearest the intersection point, the X- and Y-coordinates of the intersection point, and the elevation of the intersection point if requested by the user.

OSCT ARGUMENT INPUT SCHEME



Card 31- OSCT Argument Input Scheme Card

The following input data are required for the OSCT command:

- *Curve ID (VAR. A)*: The number of the previously stored curve (line or circle).
- *Point ID (VAR. B)*: The number assigned for storage to the intersection point.
- *Roadway Alignment (VAR. E)*: The letter of the previously defined alignment.
- *Elevation Option (VAR. F)*: Enter X if the elevation of the intersection point is to be computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation if Elevation Option is selected (optional).
- *Approximate Intersection Station*: The approximate station on the previously defined alignment nearest the offset intersection point.
- *Offset*: The perpendicular distance of the intersection point from the previously defined alignment.

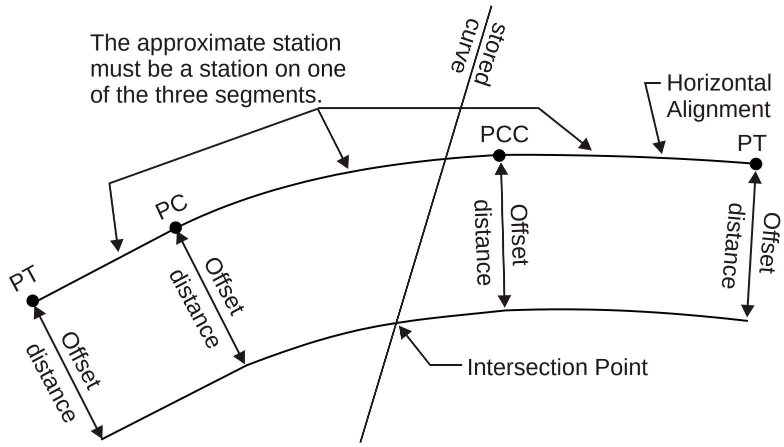


Figure 46 - Offset Alignment

ANGL (ANGLE)

FUNCTION

This command calculates and outputs the acute angle formed by two lines or three points.

USAGE

Use this command to compute the angle formed by two previously stored lines or three previously stored points. If a radius is entered in the RADIUS, OFFSET, ETC. columns, the angle, arc length, tangent length and radius will be printed. The ANGL command has two argument input schemes.

ANGL ARGUMENT INPUT SCHEME A

This input scheme calculates the acute angle between two lines.

COMMAND	VARIABLE A	VARIABLE B	VARIABLE C	VARIABLE D	VAR. E	VAR. F	X COORDINATE OR CORRECTION
13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28	29 30 31 32	33 34	35 36	37 38 39 40 41 42 43 44 45 46 47
A N G L							

Variables A and B: Numbers of previously stored lines.

Y COORDINATE OR STATION	RADIUS, OFFSET, DISTANCE, ETC.	BEAR, AZ, OR SKEW: N or S	DEGREES	MIN.	SECONDS	E or W
48 49 50 51 52 53 54 55 56 57 58	59 60 61 62 63 64 65 66 67 68 69	70	71 72 73	74 75	76 77 78 79	80
	Radius (optional)*					

*If a radius is given in the RAD., OFFSET, ETC. columns, the angle, arc length, tangent length, and radius will be printed.

Card 32 - ANGL Argument Input Scheme A Card

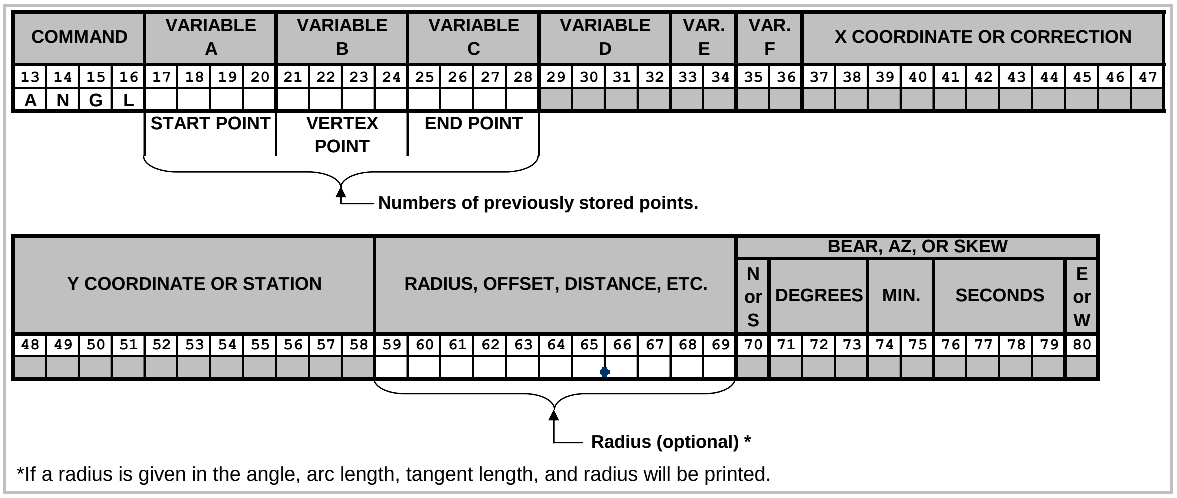
The following input data are required for this argument input scheme:

- *Curve ID (VAR. A)*: The number of the first previously stored line.

- *Curve ID (VAR. B)*: The number of the second previously stored line.
- *Radius*: The radius to be used to compute the arc length and the tangent length (optional).

ANGL ARGUMENT INPUT SCHEME B

This input scheme calculates the angle formed by three points. The second of the three points is the vertex of the angle. One line is defined from the vertex through the first point; a second line from the vertex through the third point.



Card 33 - ANGL Argument Input Scheme B Card

The following input data are required for this argument input scheme.

- *Point ID (VAR. A)*: The number of the first previously stored point.
- *Point ID (VAR. B)*: The number of the second previously stored point; the vertex.
- *Point ID (VAR. C)*: The number of the third previously stored point.
- *Radius*: The radius to be used to compute the arc length and tangent length (optional).

TRVS

FUNCTION

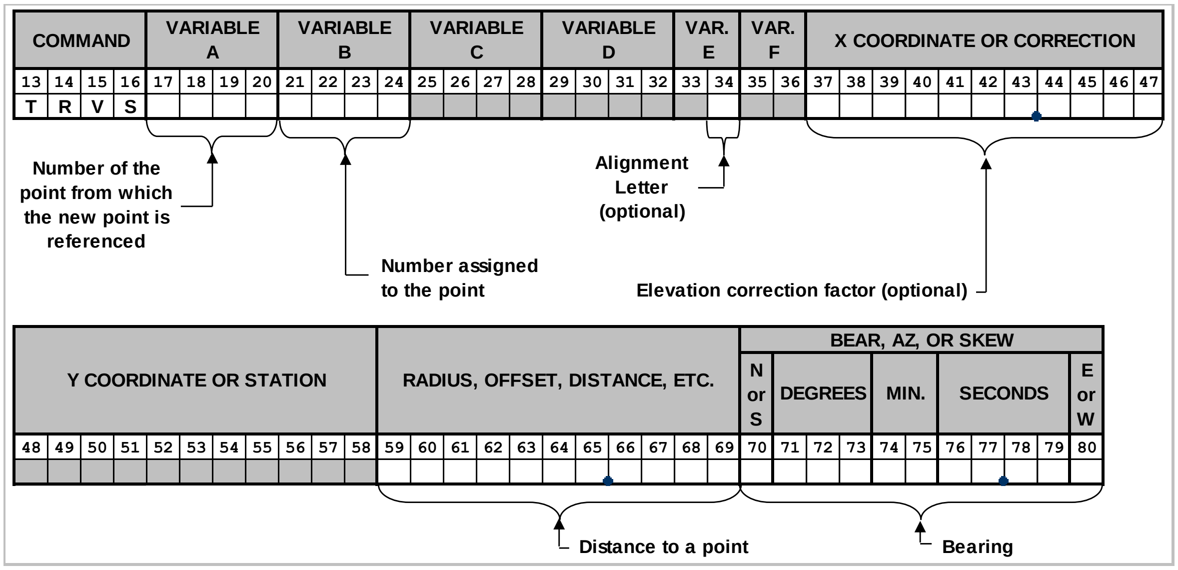
This command stores a point at a specified distance measured along a previously stored curve or in a specified direction from a previously stored point.

USAGE

Use this command to cause a point to be computed and stored. TRVS will also compute the station number and offset if an alignment number is entered. The elevation of the point will be computed if profile and template data have been defined; the elevation may be adjusted according to a designated correction factor. If no such factor is given, there will be no adjustment to the elevation. The TRVS command has four argument input schemes for defining the new point.

TRVS ARGUMENT INPUT SCHEME A

This input scheme defines the point at a given distance and at a given bearing from a previously stored point. Azimuth may be used in lieu of bearing.



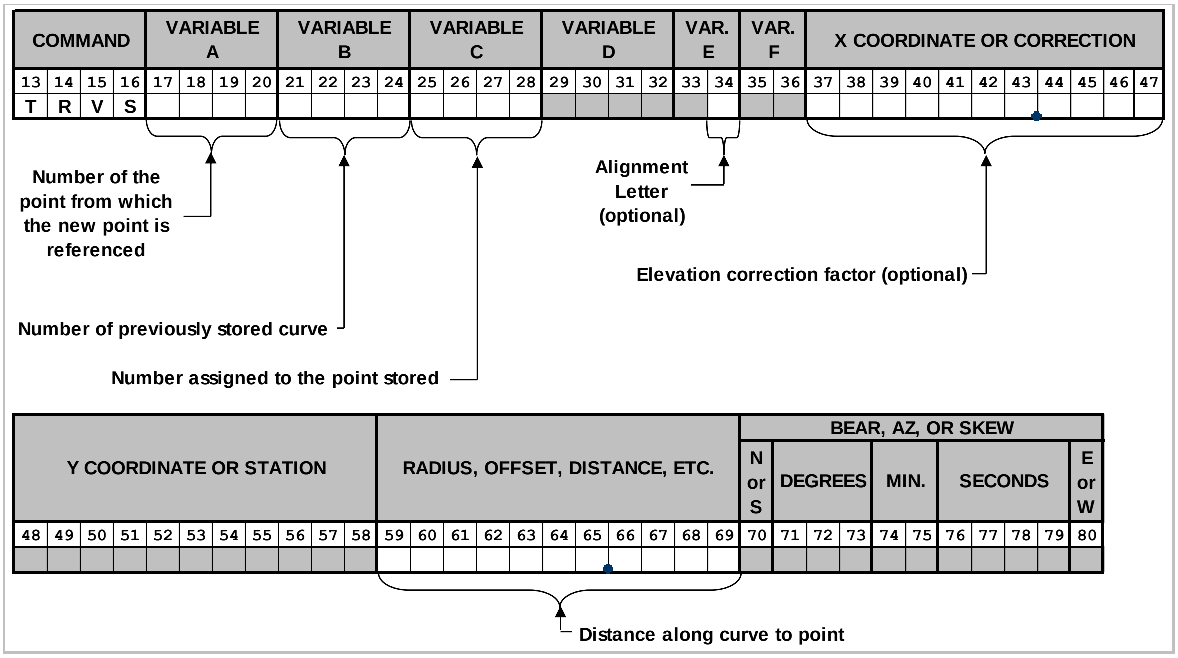
Card 34 - TRVS Argument Input Scheme A Card

This argument input scheme requires the following input:

- *Point ID (VAR. A)*: The letter of the previously stored point from which the new point is defined.
- *Point ID (VAR. B)*: The number assigned for storage of the new point.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the station number, offset, and elevation are computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation (optional).
- *Distance*: The distance from the previously stored point to the new point.
- *Bearing*: The bearing or azimuth of the line from the old point to the new point.

TRVS ARGUMENT INPUT SCHEME B

This input scheme defines the point at a given distance from a previously stored point measured along a previously stored curve.



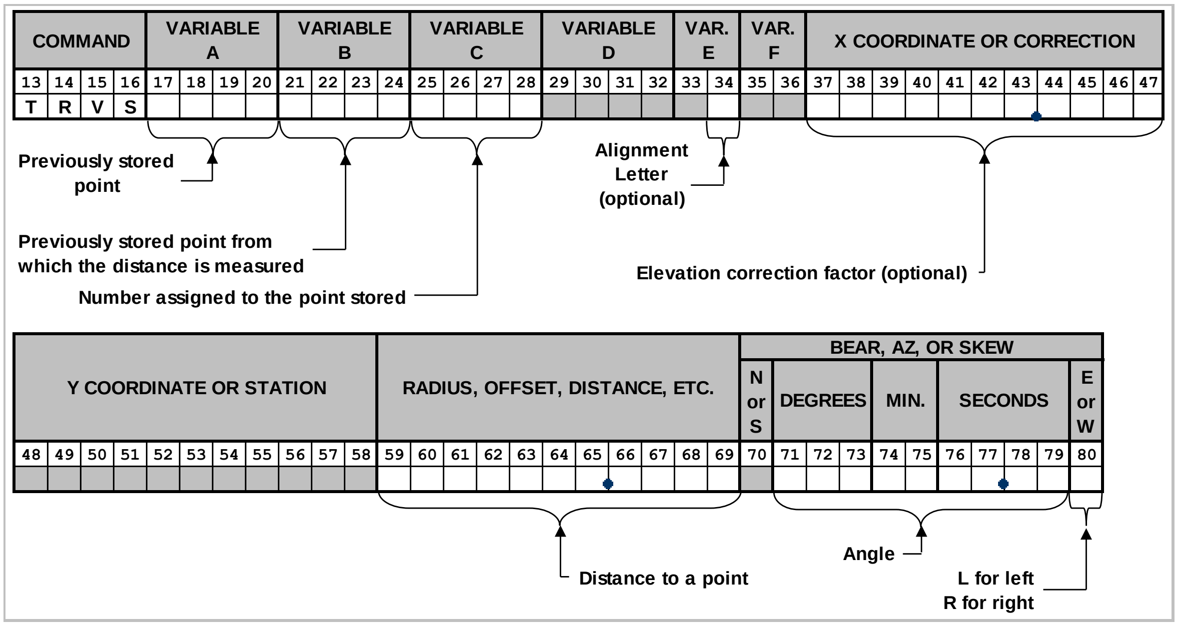
Card 35 - TRVS Argument Input Scheme B Card

The following input data are required for this argument input scheme:

- *Point ID (VAR. A)*: The number of the point from which the new point is defined.
- *Curve ID (VAR. B)*: The number of the previously stored curve.
- *Point ID (VAR. C)*: The number assigned for storage of the new point.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the station number, offset, and elevation are computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation (optional).
- *Distance*: The distance along the previously stored curve from the previously stored point to the new point. When the previously stored curve is a line, the distance will be measured along that line in the direction of its bearing if the distance is positive. If negative, the distance will be measured in the opposite direction. When the previously stored curve is a circle, the distance will be measured along its circumference in a clockwise direction if the distance is positive. If negative, the distance will be measured in a counterclockwise direction. All measurements in both cases will begin at the previously stored point and will be made along a parallel line or circle concentric to the stored circle if the point is not on the curve.

TRVS ARGUMENT INPUT SCHEME C

This input scheme defines the point using two previously stored points, a distance and an angle right (clockwise) or left (counterclockwise). The line from the first previously stored point through the second forms one side of an angle. The line from the second previously stored point at the given angle from the first line forms the second side of the angle. Then the newly defined point is at the given distance from the vertex (the second point) along the second side of the angle. The output distance will be the distance from the vertex to the newly defined point. See **Figure 47 - Distance and Angle Examples**.



Card 36 - TRVS Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The previously stored number of the first point on the first side of the angle.
- *Point ID (VAR. B)*: The previously stored number of the second point on the first side of the angle forming the vertex of the angle. The distance to the new point will be measured from this point.
- *Point ID (VAR. C)*: The number assigned for storage of the new point.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the station number, offset, and elevation are computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation (optional).
- *Distance*: The distance from the second point to the newly defined point.
- *Angle*: The angle between the line defined by the second and first points and the line defined by the second point and the new point.
- *Direction*: The direction in which the angle is measured. Enter L for counterclockwise or R for clockwise.

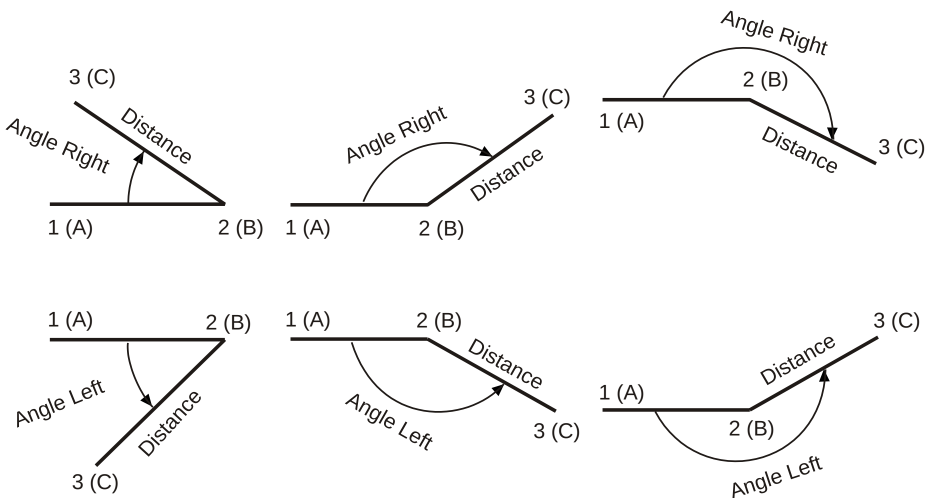
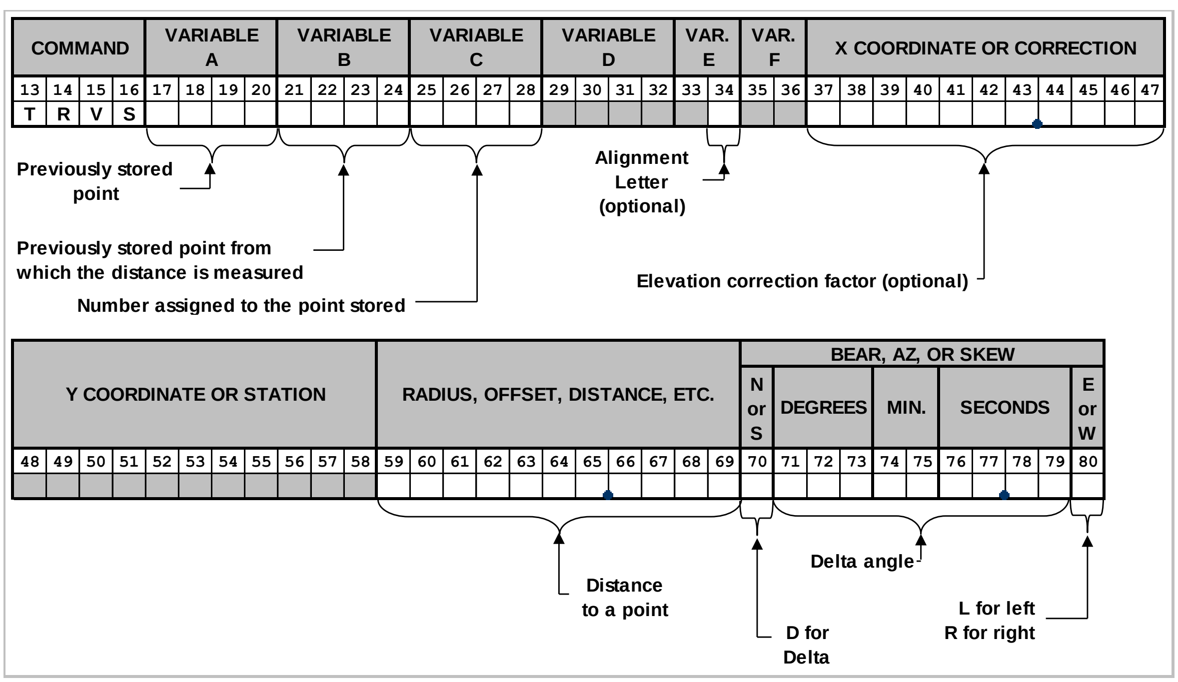


Figure 47 - Distance and Angle Examples

For all examples above, points 1 and 2 are previously stored points and point 3 is the point to be stored. The distance given will be the distance between points 2 and 3.

TRVS ARGUMENT INPUT SCHEME D

This input scheme defines the point using two previously stored points, a distance and a delta angle to the right (clockwise) or left (counterclockwise). Construct a line from the first previously stored point through the second. The point to be stored is formed by following a line from the first previously stored point to the second previously stored point, rotating the specified delta angle and moving the specified distance from the second point along the angle. If L is specified, the newly defined point is to the left of the extension of the first line (counterclockwise); if R is specified, the newly defined point is to the right of the extension (clockwise). The sum of the delta angle plus the angle formed by the line between Points 1 and 2 and the line between Points 2 and 3 is 180 degrees. See **Figure 48 - Delta Angle Examples**.



Card 37 - TRVS Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Point ID (VAR. A)*: The number of the first point on the first line
- *Point ID (VAR. B)*: The number of the second point on the first line. This point forms the vertex of the angle. The distance to the new point will be measured from this point.
- *Point ID (VAR. C)*: The number assigned for storage to the new point.
- *Roadway Alignment (VAR. E)*: The letter of the alignment from which the station number, offset, and elevation are computed (optional).
- *Elevation Correction Factor*: The correction factor for the elevation (optional).
- *Distance*: The distance from the second point to the new point.
- *Delta Flag*: Enter D in this field to indicate the delta angle measurement.
- *Delta Angle*: The angle between the extended line from the first point through the second point and the line from the second point through the new point.
- *Direction*: The direction in which the angle is measured. Enter L for counterclockwise or R for clockwise.

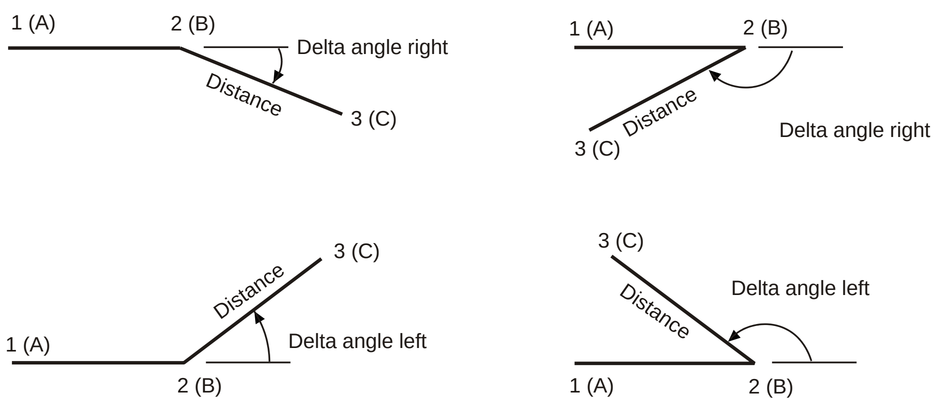


Figure 48 - Delta Angle Examples

For all examples above, points 1 and 2 are previously stored points and point 3 is the point to be stored. The distance given will be the distance between points 2 and 3.

PARL (PARALLEL)

FUNCTION

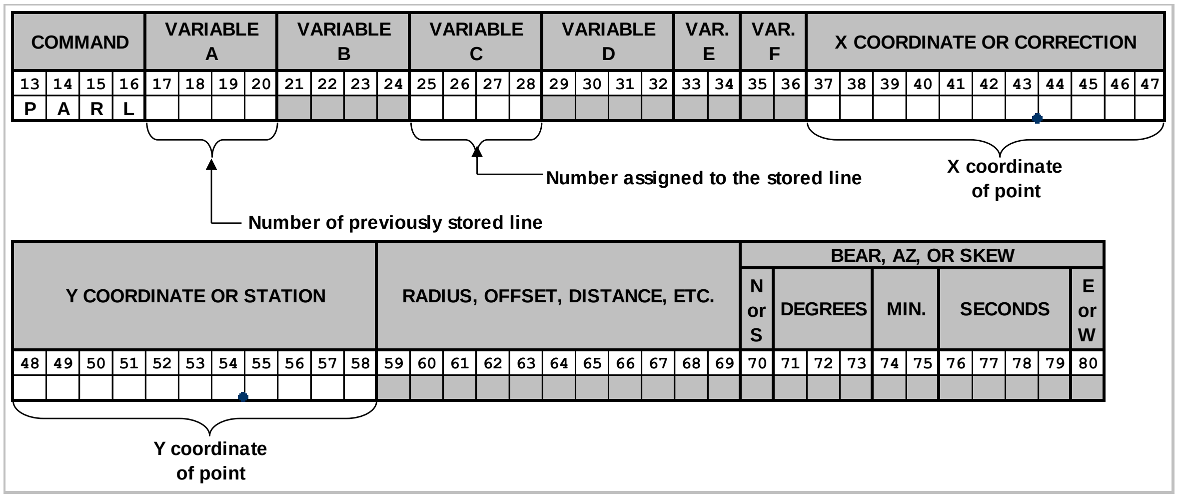
This command stores a line parallel to a previously stored line.

USAGE

Use this command to construct and store a line which is parallel to a given line. The PARL command has three argument input schemes.

PARL ARGUMENT INPUT SCHEME A

This input scheme stores a line through a given point parallel to a previously stored line. The new line will have the same bearing as the previously stored line and will pass through the user-specified point.



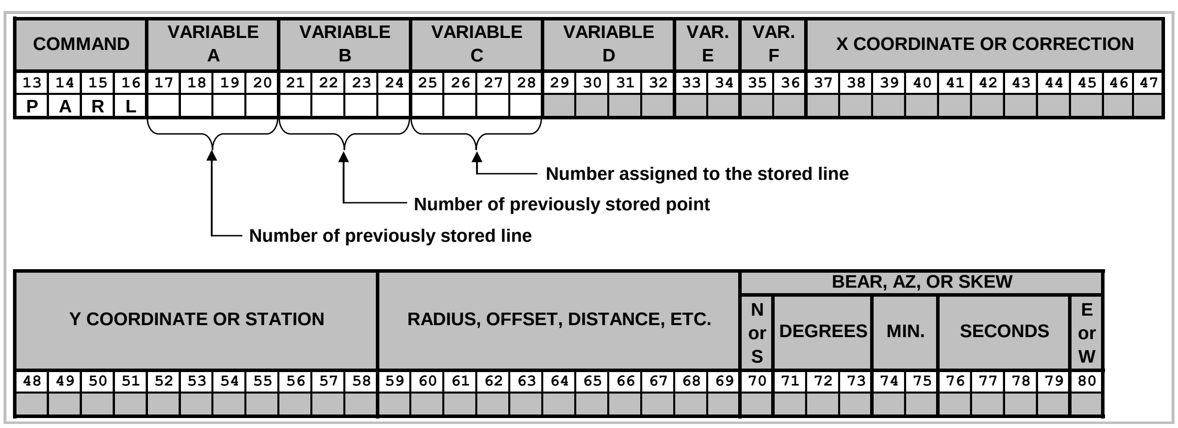
Card 38 - PARL Argument Input Scheme A Card

The following input data are required for this argument input scheme:

- *Curve ID (VAR. A)*: The number of a previously stored line. The stored line will be parallel to this line.
- *Curve ID (VAR. C)*: The number assigned for storage of the parallel line.
- *X Coordinate*: The X coordinate of the point through which the new line will pass.
- *Y Coordinate*: The Y coordinate of the point through which the new line will pass.

PARL ARGUMENT INPUT SCHEME B

This input scheme stores a line through a previously stored point parallel to a previously stored line. The new line will have the same bearing as the previously stored line and will pass through the previously stored point.



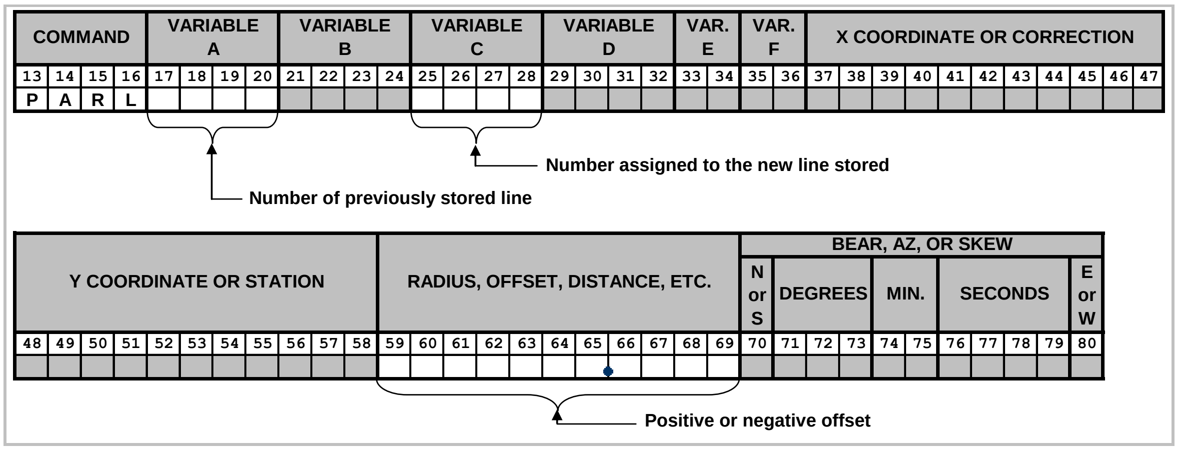
Card 39 - PARL Argument Input Scheme B Card

The following input data are required for this argument input scheme:

- *Curve ID (VAR. A)*: The number of a previously stored line. The stored line will be parallel to this line.
- *Point ID (VAR. B)*: The number of the previously stored point.
- *Curve ID (VAR. C)*: The number assigned for storage of the parallel line.

PARL ARGUMENT INPUT SCHEME C

This input scheme stores a line parallel to a previously stored line and at a specified positive or negative offset.



Card 40 - PARL Argument Input Scheme C Card

The following input data are required for this argument input scheme:

- *Curve ID (VAR. A)*: The number of a previously stored line. The stored line will be parallel to this line.
- *Curve ID (VAR. C)*: The number assigned for storage of the parallel line.
- *Offset*: The offset of the parallel line from the previously stored line. A positive offset places the line to the right of the previously stored line and a negative offset to the left when facing in the direction of bearing.

PERL

FUNCTION

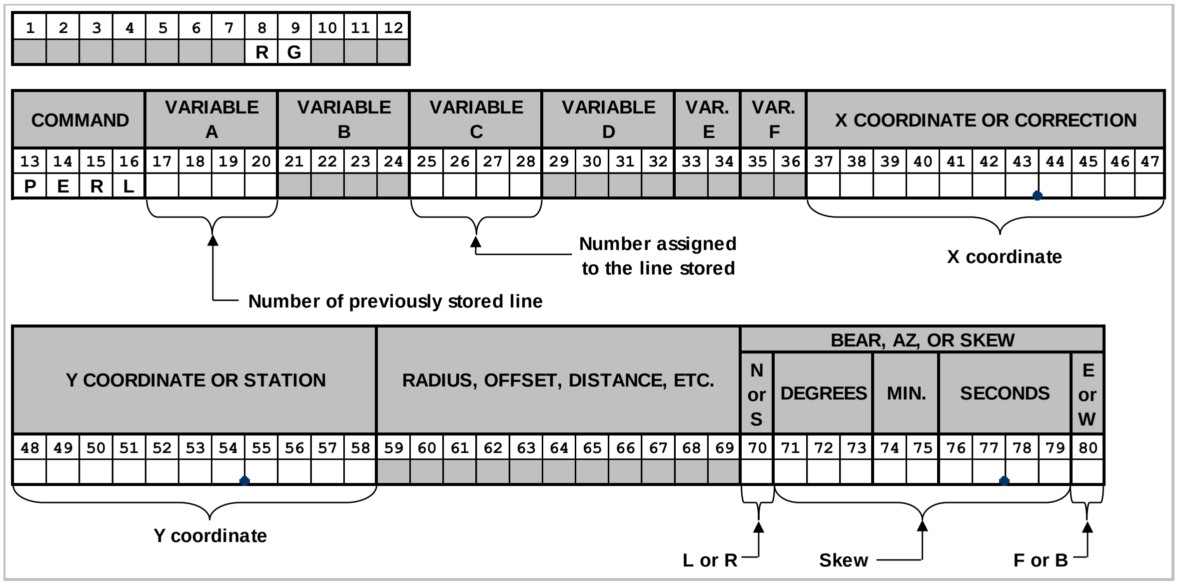
This command defines a line at a specified skew to a previously stored curve and through a specified point.

USAGE

Use this command to construct and store a line at a certain skew to a specified line or circle and passing through a specified point. The PERL command has two argument input schemes.

PERL ARGUMENT INPUT SCHEME A

This input scheme constructs and stores a line at a specified skew to a previously stored curve passing through the X- and Y- coordinate specified by the user. See notes below for additional information.



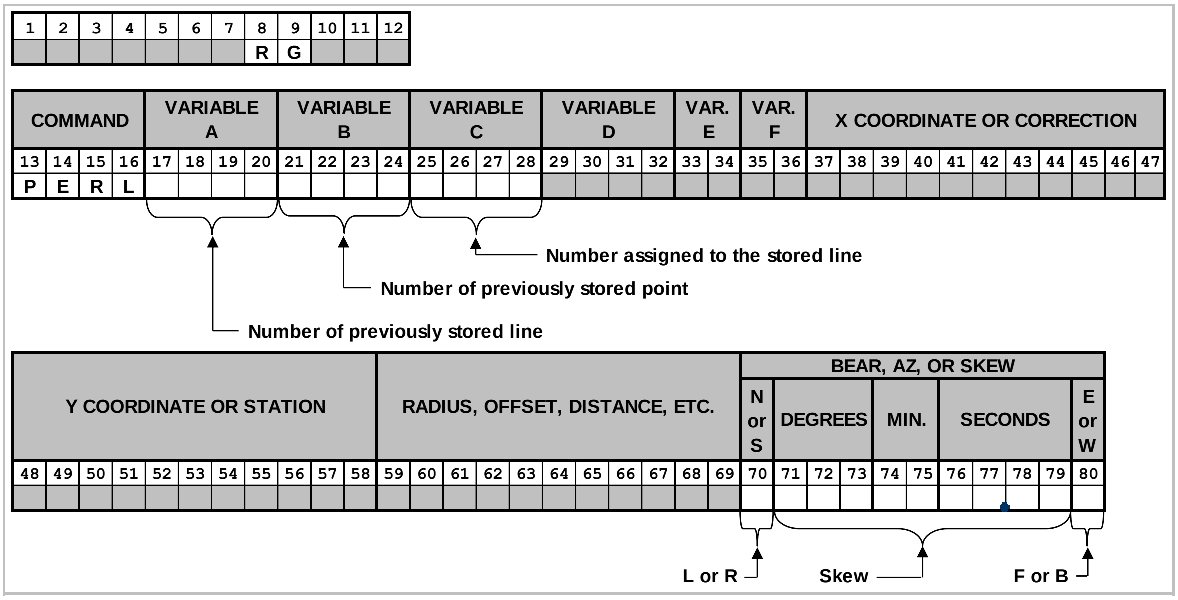
Card 41 - PERL Argument Input Scheme A Card

This argument input scheme requires the following input:

- *Curve ID (VAR. A)*: The number of a previously stored curve.
- *Curve ID (VAR. C)*: The number assigned for storage of the newly defined line.
- *X Coordinate*: The X coordinate of the point through which the new line will pass.
- *Y Coordinate*: The Y coordinate of the point through which the new line will pass.
- *Skew*: The skew of the newly defined line relative to the previously stored curve. Enter L for left or R for right, F for forward or B for back.

PERL ARGUMENT INPUT SCHEME B

This input scheme constructs and stores a line at a specified skew to a previously stored curve passing through a previously stored point. See notes below for additional information.



Card 42 - PERL Argument Input Scheme B Card

This argument input scheme requires the following input:

- *Curve ID (VAR. A)*: The number of a previously stored curve.
- *Point ID (VAR. B)*: The number of a previously stored point.
- *Curve ID (VAR. C)*: The number assigned for storage of the newly defined line.
- *Skew*: The skew of the newly defined line relative to the previously stored curve. Enter L for left or R for right, F for forward or B for back.

NOTES ON PERL COMMAND

- If no skew is specified, the new line will be defined to be perpendicular to the previously stored curve. In cases where the previously stored curve is a line, the bearing of the new line will be to the right of the old line. When the previously stored curve is a circle, then the bearing of the new line is toward the center of the circle.
- The forward direction is in the direction of bearing in the case where the previously stored curve is a line, or in a clockwise direction when the previously stored curve is a circle; the backward direction is opposite. Right and left are determined by looking in the direction of the bearing of the stored curve.
- The distance along the new line from the previously stored point to the intersection with the previously stored line is printed in the RADIUS, OFFSET, ETC column.

TANG (TANGENT)

FUNCTION

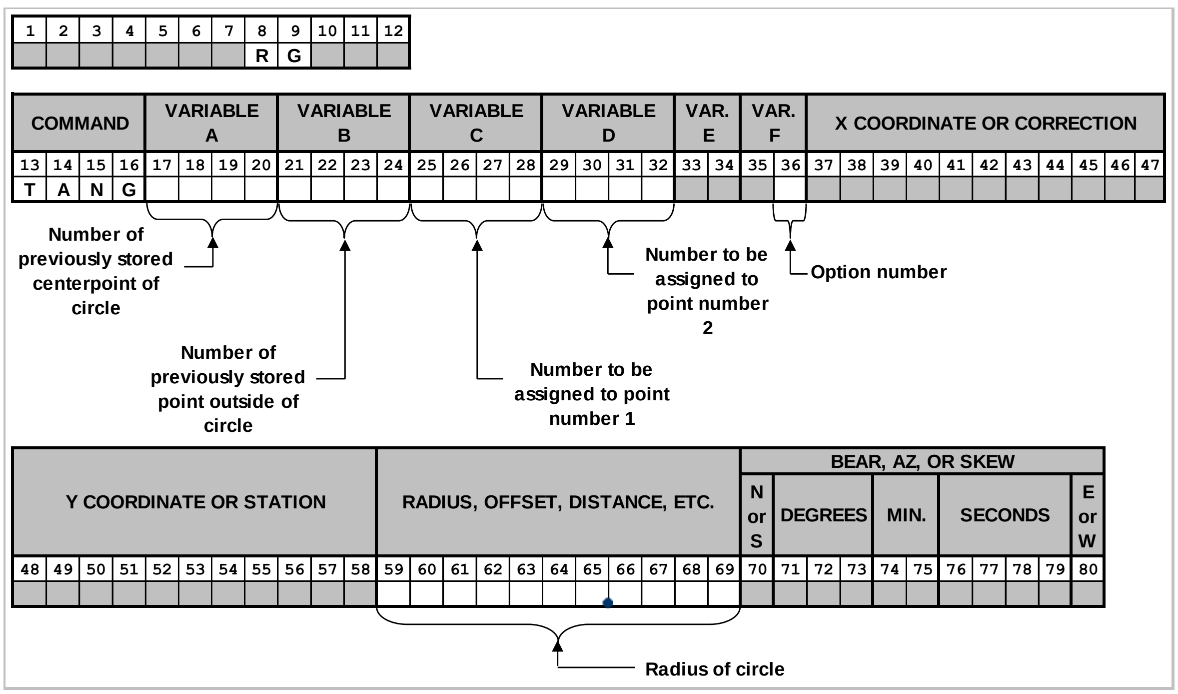
This command computes and stores tangent points to a circle or circles.

USAGE

Use this command to compute and store tangent points to a circle or circles. The TANG command has three argument input schemes.

TANG ARGUMENT INPUT SCHEME A

Given a circle and a point outside the circle, this argument input scheme computes and stores the coordinates of Points 1 and 2. Points 1 and 2 are the points of tangency resulting from two lines that pass through a user-specified point outside the circle (Point B).



Card 43 - Tang Argument Input Scheme A Card

This argument input scheme requires the following input:

- *Point ID (VAR. A)*: The number of the previously stored center point of the circle.
- *Point ID (VAR. B)*: The number of the previously stored point outside the circle.
- Point ID (VAR. C): The number assigned for storage of the left point of tangency (the point to the left of the line from the circle center to the outside point).
- Point ID (VAR. D): The number assigned for storage to the right point of tangency.

- *Option Number (VAR. F)*: A zero (0) must be entered in this field.
- *Radius*: The radius of the circle.

Note: If storage of only one point is desired, either one of the Point IDs (VAR. C or VAR. D) may be left blank.

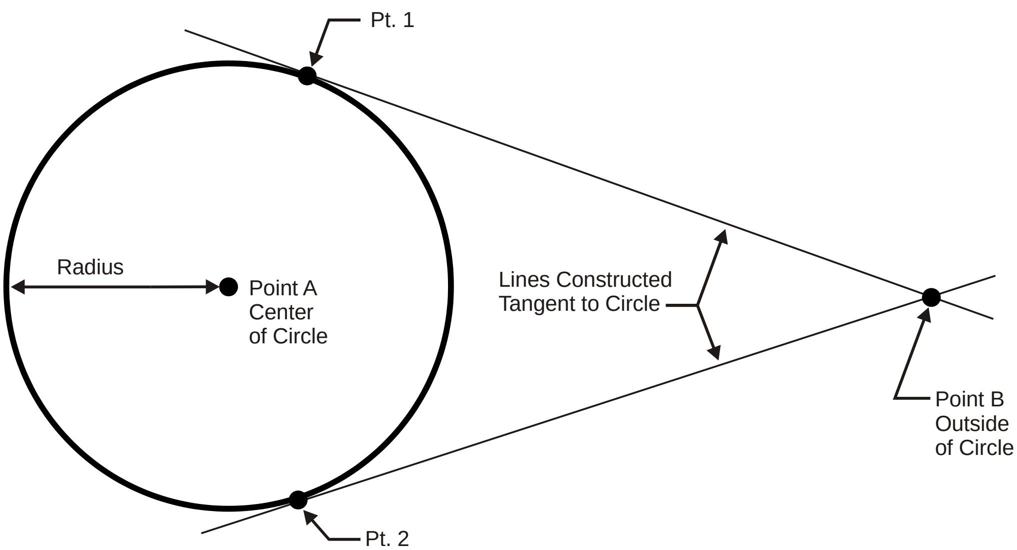
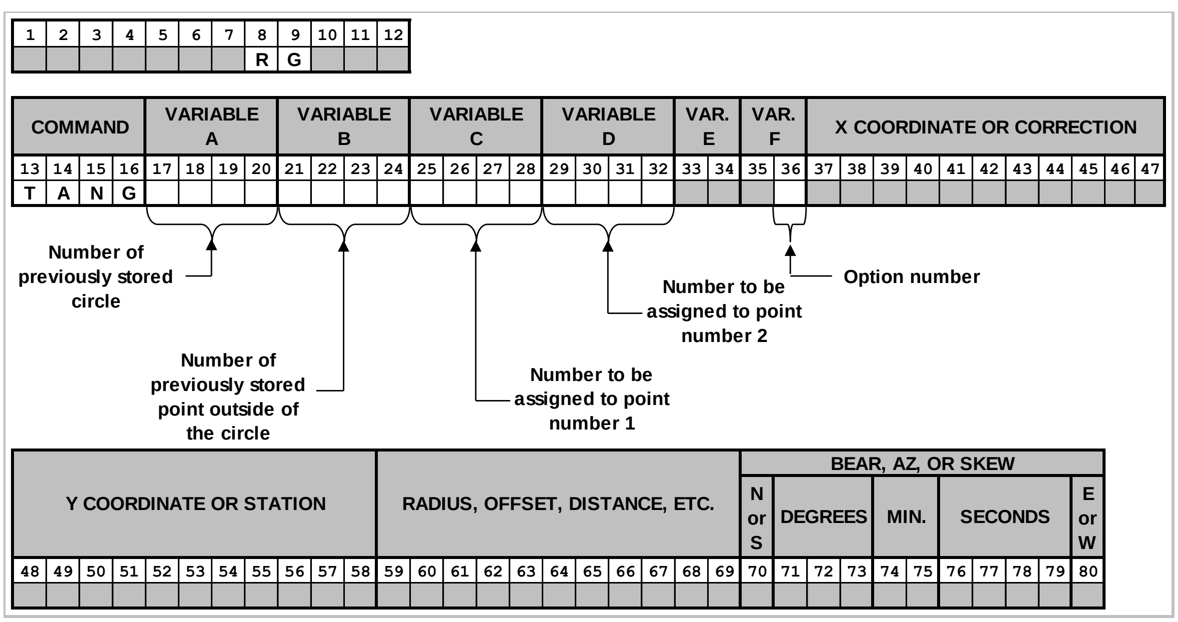


Figure 49 - Tangent Computation (Option 0)

TANG ARGUMENT INPUT SCHEME B

Given a circle and a point outside the circle, this argument input scheme computes and stores the coordinates of Points 1 and 2. Points 1 and 2 are the points of tangency resulting from two lines that pass through a user-specified point outside the circle (Point B). See diagram for TANG Scheme A.



Card 44 - TANG Argument Input Scheme B Card

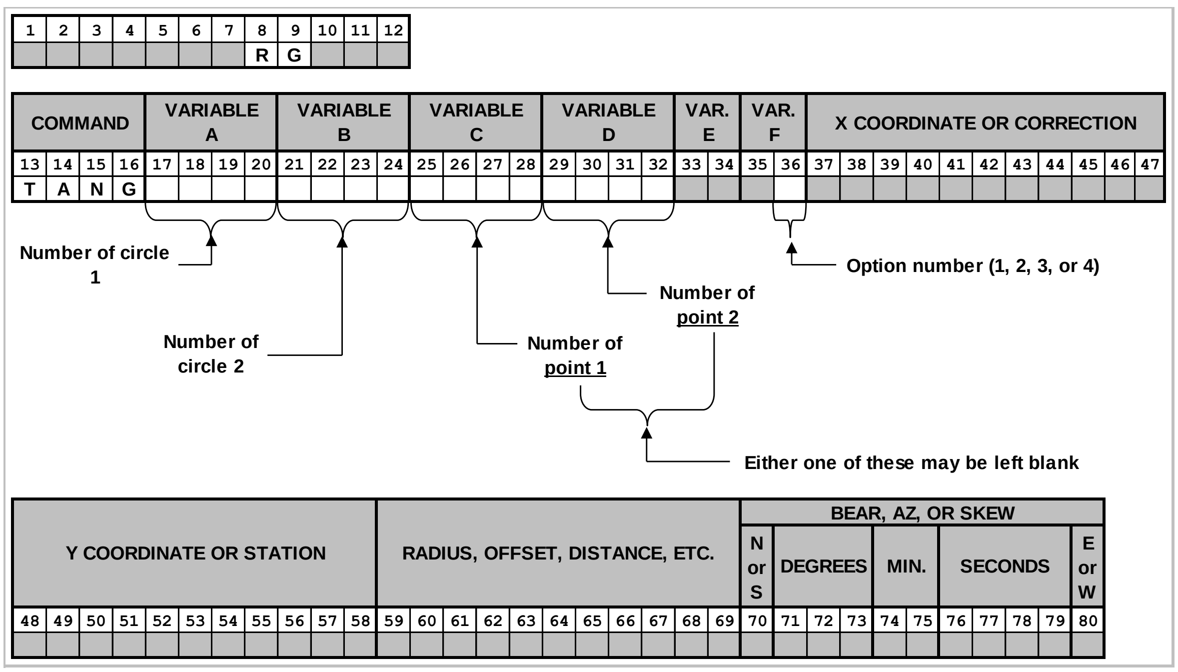
This argument input scheme requires the following input:

- *Curve ID (VAR. A)*: The number of the previously stored circle.
- *Point ID (VAR. B)*: The number of the previously stored point outside the circle.
- *Point ID (VAR. C)*: The number assigned for storage of the left point of tangency (the point to the left of the line from the circle center to the outside point).
- *Point ID (VAR. D)*: The number assigned for storage of the right point of tangency.
- *Option Number (VAR. F)*: A zero (0) must be entered in this field.

Note: If storage of only one point is desired, either one of the point IDs (VAR. C or VAR. D) may be left blank.

TANG ARGUMENT INPUT SCHEME C

Given two previously stored circles, this argument input scheme computes and stores the coordinates of Points 1 and 2. Points 1 and 2 are the points of tangency resulting from a line that is tangent to both circles. Four options are available for this argument input scheme. The option number determines the location of the tangent line relative to the two circles. See the Option Number input description for more information.



Card 45 - TANG Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR. A)*: The number of a previously stored circle. This is circle 1.
- *Curve ID (VAR. B)*: The number of a previously stored circle. This is circle 2.
- *Point ID (VAR. C)*: The number assigned for storage to point of tangency 1.
- *Point ID (VAR. D)*: The number assigned for storage to point of tangency 2.

- *Option Number (VAR. F)*: Reference the following diagram. This field specifies which two of the four computed points of tangency are to be stored. In the following discussion, “left” and “right” are defined by the line from the center of circle 1 to the center of circle 2. Available option numbers and descriptions are as follows:

  Option 1: The points stored are those to the left of both circles. The first point is to the left of circle 1 and the second to the left of circle 2.

  Option 2: The points stored are those to the right of both circles. The first point is to the left of circle 1 and the second to the left of circle 2.

  Option 3: The first point stored is to the left of circle 1. The second point stored is to the right of circle 2.

  Option 4: The first point stored is to the right of circle 1. The second point stored is to the left of circle 2.

Note: A point on the circumference of circle 1 will be stored by the number entered as VAR. C. If no number appears in this field, the point will not be stored. A point on the circumference of circle two will be stored by the number entered as VAR. D. If no number appears in this field, the point will not be stored. Either or both points may be stored.

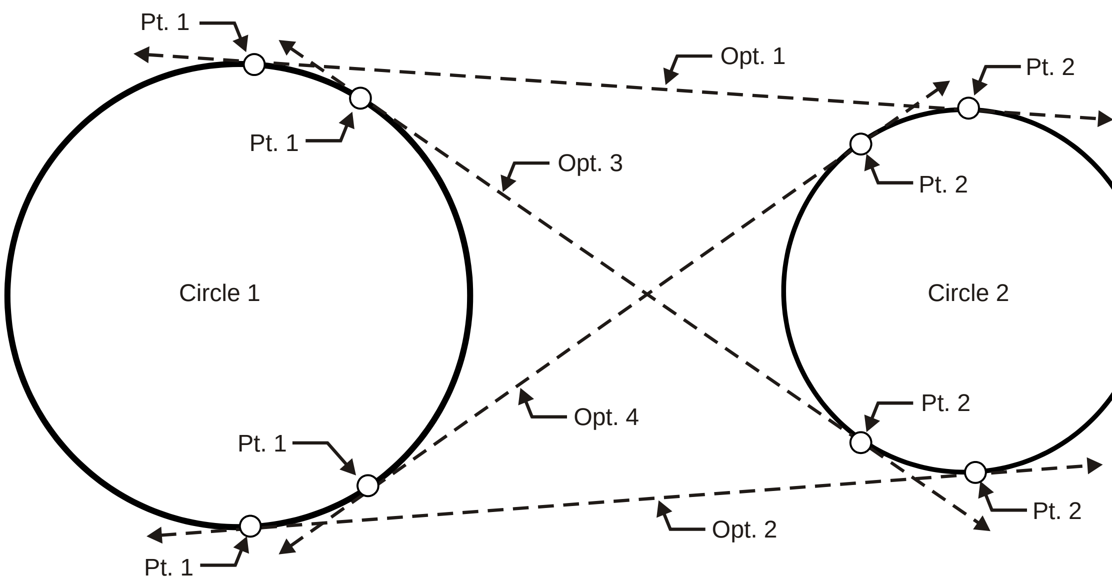


Figure 50 - Tangent Computation (Options 1-4)

AREA

FUNCTION

This command computes the area of a closed shape formed by a set of stored points and associated radii, indicating the curved portions of the shape.

USAGE

Use this command to compute the area of a closed shape formed by a set of stored points and associated radii, indicating the curved portions of the shape. The bearing and length of each side are computed. For a curved side the chord bearing, chord length, arc length, tangent bearings, radial bearings and central angle are computed. A plot of the shape is optional.

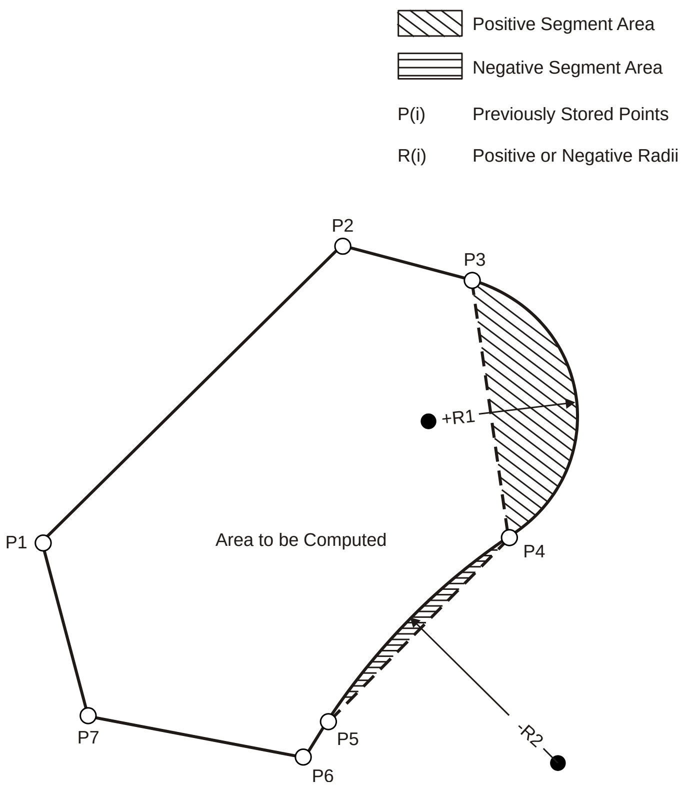
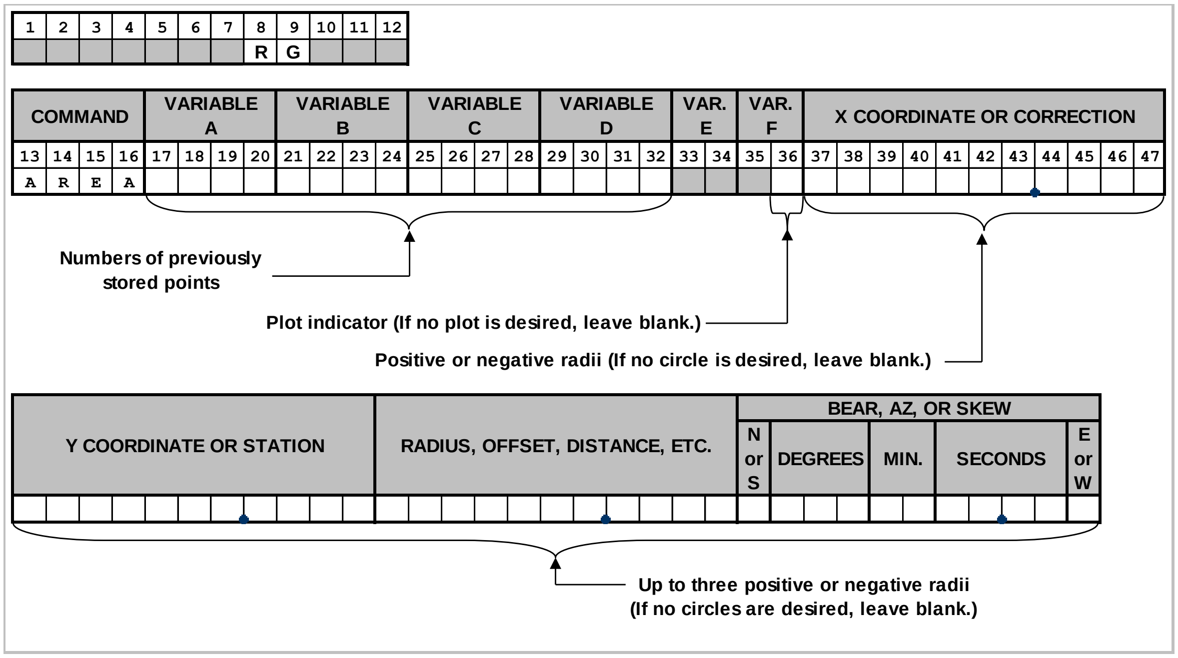


Figure 51 - Area Computation

AREA ARGUMENT INPUT SCHEME



Card 46 - AREA Argument Input Scheme Card

The AREA argument input scheme requires the following data:

- Point ID (VAR A): The number of a previously stored point. The point numbers must be entered in the order in which they would appear when tracing about the shape in a clockwise direction. As many as 99 distinct points may be used, four points to an AREA command. Enter as many AREA commands as are needed to describe the desired shape. The last point must have the same point number as the first.
- Point ID (VAR B): The number of a previously stored point. See Point ID (VAR A), above.
- Point ID (VAR C): The number of a previously stored point. See Point ID (VAR A), above.
- Point ID (VAR D): The number of a previously stored point. See Point ID (VAR A), above.
- Plot indicator (VAR F): If no plot is desired, leave blank. If a plot is desired, enter a '1' in this field, right justified. If a plot axis has been defined previously with an APLT or AXIS command, the AREA plot will use that axis. If no plot axis has been defined previously, the system will compute an axis for the AREA plot.
- Radius A (X-COORDINATE OR CORRECTION): If this field is not blank, it defines the radius of a circular arc bounded by points D (on the previous command) and A (on the current command). If this is the first command in the series, or if there is no circular arc bounded by points D and A, the field must be left blank. This field is used exclusively for the plot scale factor on the first line of input. A negative radius creates a concave arc, viewing the shape from outside, and the segment of the circle defined is subtracted from the total area of the shape. A positive radius creates a convex arc, viewing the shape from outside, and the segment of the circle defined is added to the total area of the shape.

- Radius B (Y-COORDINATE OR STATION): If this field is not blank, it defines the radius of a circular arc bounded by points A and B on this command. If there is no circular arc bounded by points A and B, the field must be left blank. See the description of Radius A for the effects of negative or positive radii.
- Radius C (RADIUS, OFFSET, ETC.): If this field is not blank, it defines the radius of a circular arc bounded by B and C on this command. If there is no circular arc bounded by points B and C, the field must be left blank. See the description of Radius A for the effects of negative or positive radii.
- Radius D (BEAR, AZ, OR SKEW): If this field is not blank, it defines the radius of a circular arc bounded by C and D on this command. If there is no circular arc bounded by points C and D, the field must be left blank. See the description of Radius A for the effects of negative or positive radii.

NOTE ON AREA COMMAND

Insert comments at the top of an AREA report by preceding the AREA instruction with a CMNT command or commands. If the instruction preceding the CMNT command(s) is not another AREA instruction the CMNT command(s) must be preceded by an EJCT command.

A general example of an AREAS calculation which plots and uses “n” number of points is shown below.

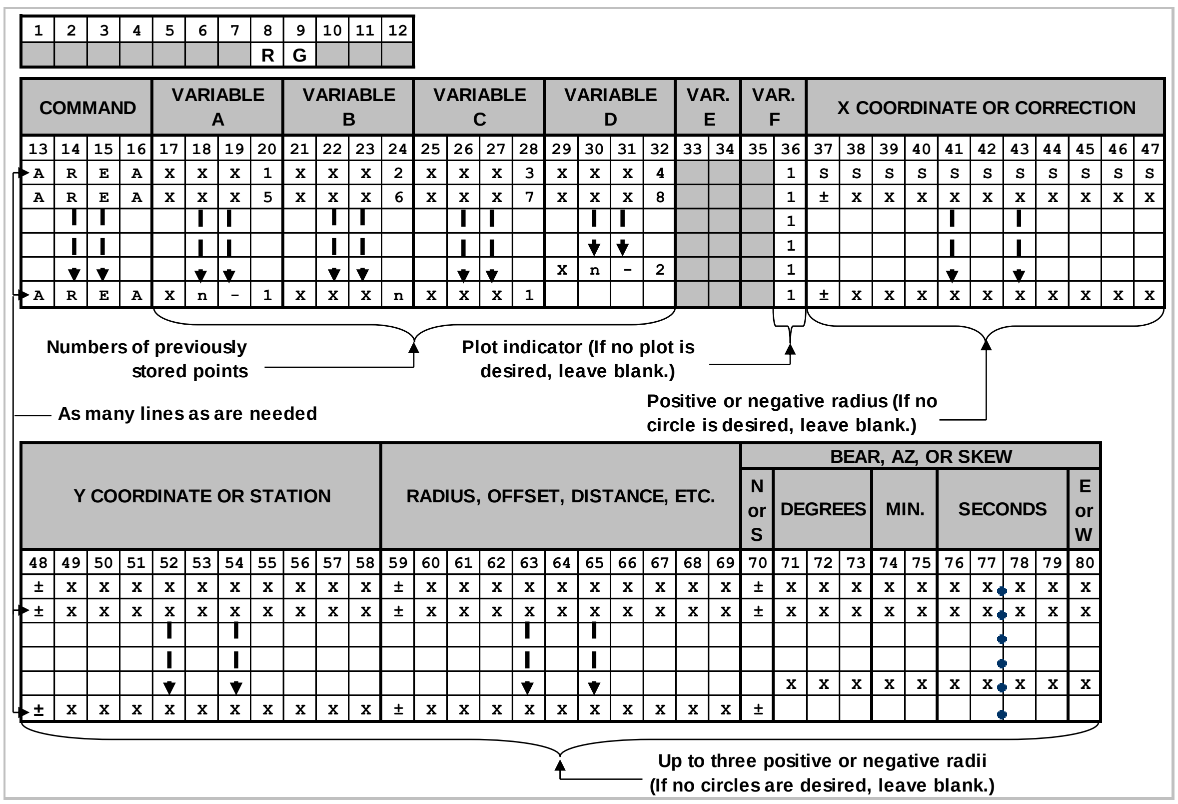


Figure 52 - Illustration of Use of the AREA Command

ROADWAY ELEVATIONS

RDWY – ROADWAY ELEVATIONS

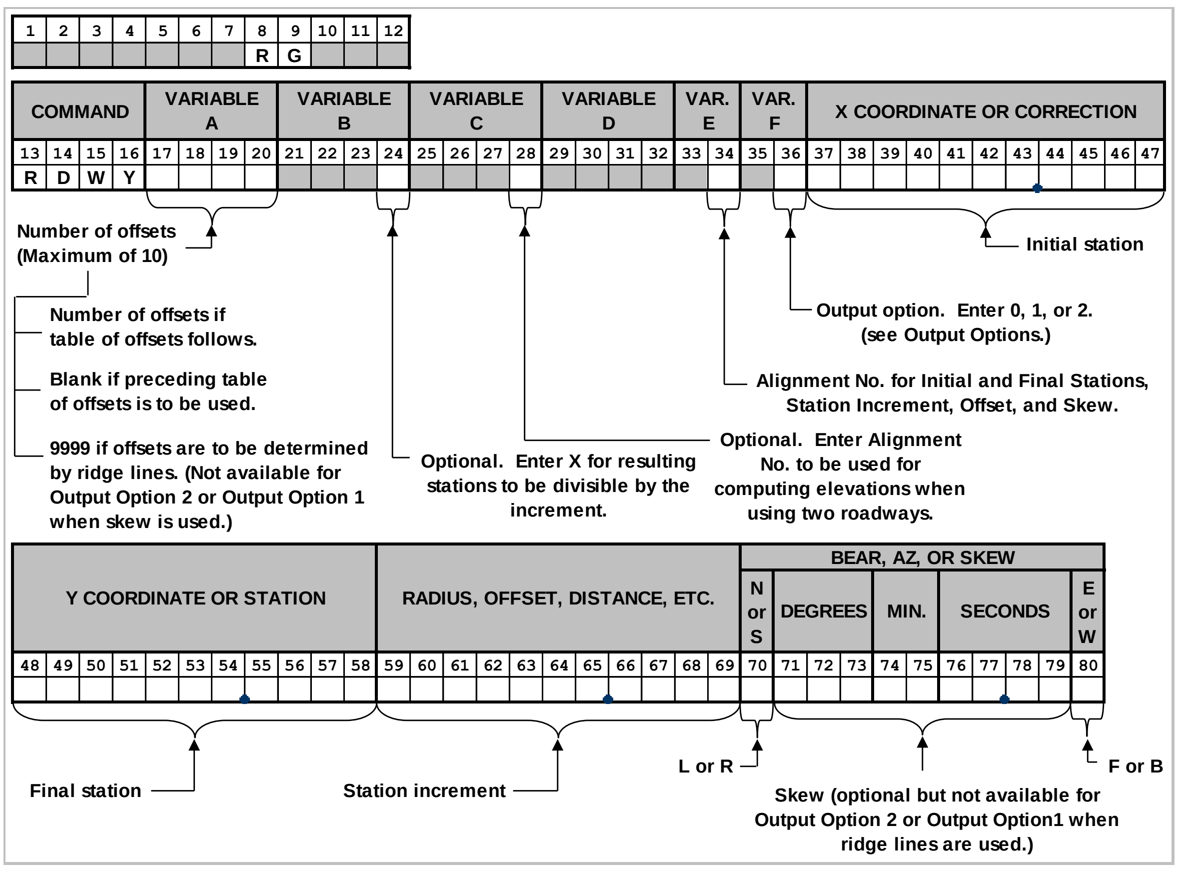
FUNCTION

This command calculates and outputs stations, elevations, and offset distances on a roadway (alignment) along an incremented range of stations.

USAGE

Use this command to produce a tabulation of stations, elevations, and offset distances along an incremented range of stations. Optionally it may include the cross-slope between offsets and the approximate percent grade between station increments. Three different tabulations are available based on the output option and roadway(s) specified. Note that ridge lines are lines between corresponding ridge points on templates at adjacent stations.

RDWY ARGUMENT FOR FIRST COMMAND IN SERIES

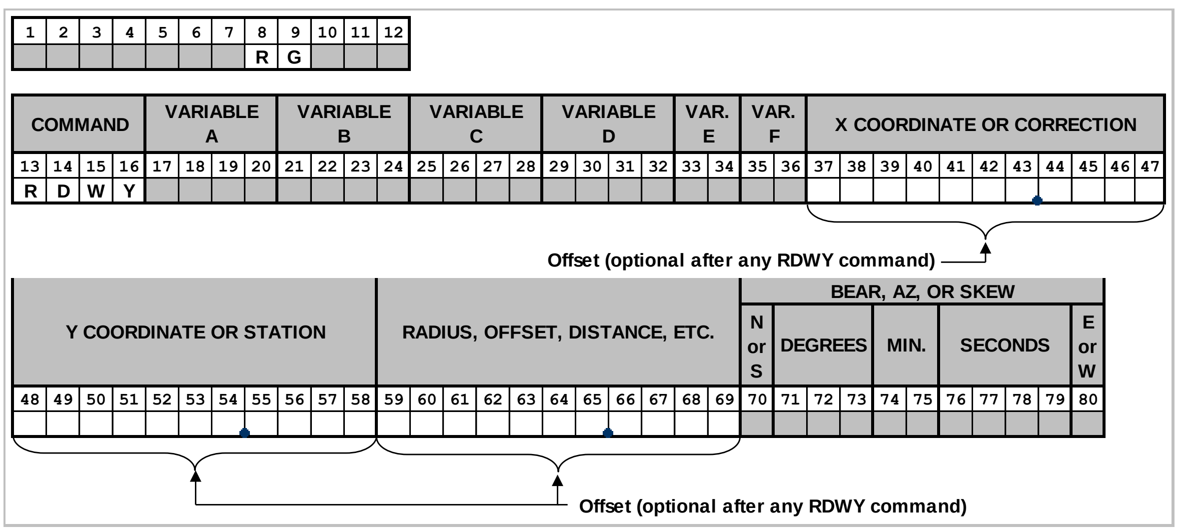


Card 47 - RDWY Argument for First Command in Series Card

This argument input scheme requires the following data:

- *Number of Offsets (VAR A):* If this command is followed by succeeding RDWY commands containing offset data, enter in this field the total number of offsets (a maximum of 18, three on each command). If instead the preceding offset table is to be used, leave this field blank. If offsets will be determined using ridge lines, enter 9999 in this field. Ridge lines may not be used with Output Option 2 or Output Option 1 (see Notes) when a skew is used.
- *Divisibility Option (VAR B) (optional):* If X is entered, the resulting stations will be evenly divisible by the increment.
- *First Roadway Alignment (only for Option 2) (VAR C) (optional):* This alignment will be used for computing elevations when two roadways are used.
- *Second Roadway Alignment (for all options) (VAR E):* The stations, offsets and skews are referenced to this roadway.
- *Output Option (VAR F):* Enter 0, 1, or 2. See Notes.
- *Initial Station (X-COORDINATE OR CORRECTION):* Station where the computations start.
- *Final Station (Y-COORDINATE OR STATION):* Station where the computations end. If no Final Station and no Station Increment are given, computations are performed only at the Initial Station.
- *Station Increment (RADIUS, OFFSET, ETC):* The distance between stations where computations are to be performed. If no increment is entered, computations will be performed for the Initial Station only.
- *Skew (BEAR, AZ, OR SKEW) (optional):* The skew of transverse lines. Elevations will be computed where these lines intersect either ridge lines (see RD30 command) or offset lines. Not available for Output Option 2, or for Output Option 1 when ridge lines are used. Perpendicular transverse lines are used for these cases.

RDWY ARGUMENT FOR SUBSEQUENT COMMANDS IN SERIES (TABLE OF OFFSETS OPTIONAL)



Card 48 - RDWY Argument for Subsequent Commands in Series Card

This argument input scheme requires the following data:

- *Offset:* The distance at which an offset line parallel to the roadway alignment is to be placed. Use negative and positive values for left and right respectively when facing in the direction of increasing stations.
- *Offset (optional):* The distance for an additional offset line.
- *Offset (optional):* The distance for an additional offset line.

NOTES ON RDWY COMMAND

- Output Option 0 produces a tabulation of stations, elevations and offset distances along an incremented range of stations for a previously defined roadway. It may only be used with one roadway.
- Output Option 1 outputs the same tabulation as Option 0, but also includes the cross slope between offsets and the approximate percent grade between stations.
- For Options 0 and 1, elevations may be computed either on ridge lines (when 9999 is entered in the number of offsets field) or on specified offset lines. If on specified offset lines, the field for the number of offsets must remain blank if the table of offsets has been given for a previous RDWY command. If the table of offsets has not been previously given, the number of offsets (maximum 18) must be entered in the number of offsets field, and the table of offsets must be given as succeeding RDWY commands.
- Output Option 2 requires that two roadways be specified, and it computes elevations using the horizontal alignment, vertical alignment, and roadway template from the first roadway alignment, and the station increments and offsets from the second roadway alignment. It outputs the same tabulation as Option 1, but includes the station and offset for both roadways. This tabulation is useful for computing cross slopes and profile grades for merging roadways.
- <u>*Offsets*</u>*:* Two options are available for specifying the offsets at which elevations will be computed:
    1. Elevations may be computed on specified offset lines. (See Case A and Case B in Figure 53 - **Illustration for Cases A, B & C**.)
    2. Elevations may be computed on the ridge lines when only one roadway is specified. Ridge lines are defined by the Design Data template pattern ridge points which are discussed in Chapter 5. (See Case C in Figure 53 - **Illustration for Cases A, B & C**.)
- <u>*Station*</u>*:* The tabulation of elevations will include points at the intersection of all offset lines or ridge lines with transverse lines. Ridge lines cannot be used when two roadways are specified. The transverse lines will start with the perpendicular or skewed line which crosses the station line at the INITIAL STATION and be incremented by the STATION INCREMENT until the FINAL STATION is reached. (See Cases A, B, and C in **Figure 53 - Illustration for Cases A, B & C**.) An option is also available so that all resulting stations will be divisible by the increment regardless of the beginning station or equations. If the tabulation is desired at a single station, STATION INCREMENT or FINAL STATION may be omitted.
- <u>*Skew*</u>*:* A skew may be specified for the lines crossing the station line; otherwise these lines will be perpendicular or radial to the station line. The skew feature should only be used when one

roadway is specified and then only on tangents and when offsets are specified. (See Case A in **Figure 53 - Illustration for Cases A, B & C**.)

- *Table of Offsets:* The first RDWY command of a problem must either include a set of offsets or indicate use of computed offsets of the ridge lines. Subsequent RDWY instructions may omit giving a table of offsets; in this case, the last table of offsets in effect will be used. For example, if the immediately preceding RDWY instruction were Case A or B, its table of offsets would be used for the current instruction. If it were Case C, then the set of ridge line offsets used at the FINAL STATION of the last RDWY instruction would be used for the current instruction.

- *Elevation Correction:* A positive or negative elevation correction may be specified if desired. The correction entered will be added algebraically to the computed surface elevation. A separate command (CORR) is used to specify elevation correction. It affects the Roadway Elevation command immediately preceding the CORR command.

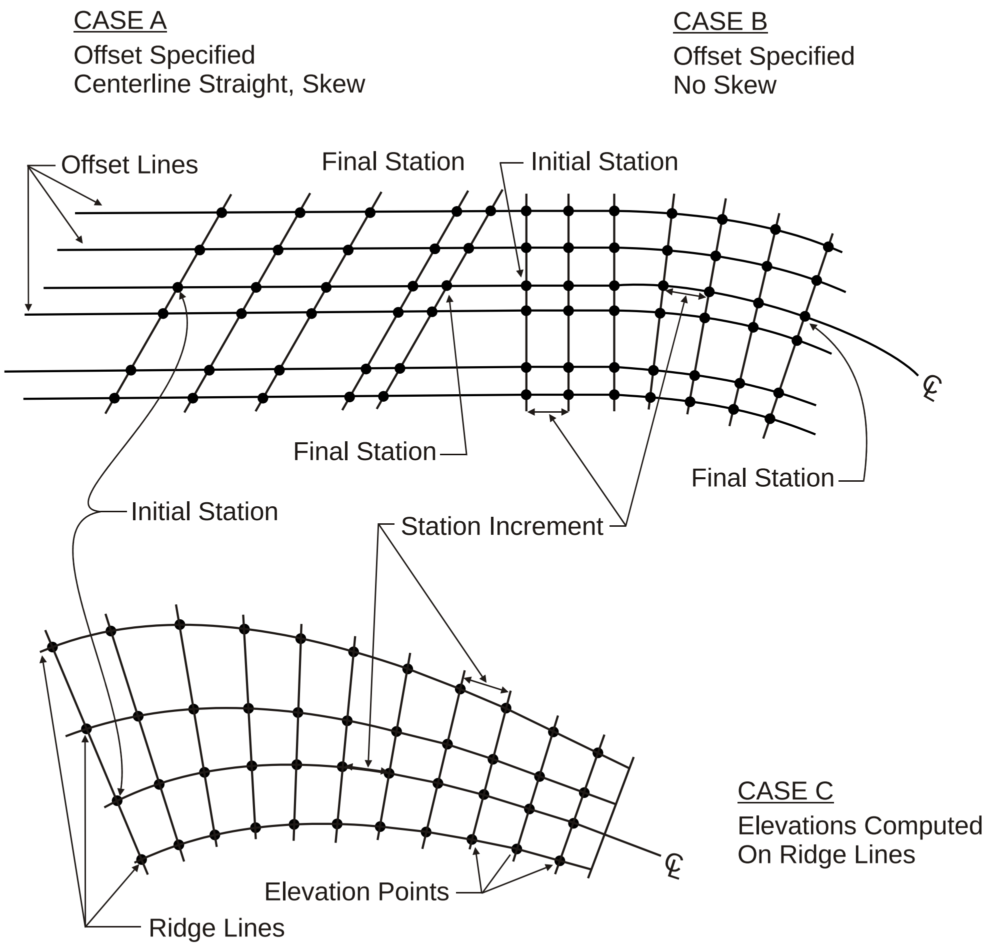


Figure 53 - Illustration for Cases A, B & C

CORR – ELEVATION CORRECTION FACTOR

FUNCTION

This command specifies a positive or negative correction for the elevations computed by the RDWY command.

USAGE

Use this command to specify a positive or negative correction for the elevations computed by the RDWY command. If used, it immediately follows the RDWY command to which it applies, preceding any offset RDWY commands.

CORR ARGUMENT INPUT SCHEME

1	2	3	4	5	6	7	8	9	10	11	12
							R	G			

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
C	O	R	R																															

Elevation correction factor (columns 37–47)

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW: N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 49 - CORR Argument Input Scheme Card

This argument input scheme requires the following data:

- *Elevation Correction Factor:* The correction factor for the elevations. This quantity will be added algebraically to the computed surface elevations.

ALIGNMENT RELATIONSHIP

AREL

FUNCTION

Calculates and outputs the points, stations, skew angles, and offset distances between two alignments over a range of stations defined by the user.

USAGE

Use this command to produce a tabulation of points, stations, skew angles, and offset distances which define the relationship of two alignments at specified stations. The tabulation will cover a range of stations that is defined by the user, at a station increment defined by the user.

Alignment relationship computations allow the user to designate any of the alignments A-Z as the baseline and any other alignment A-Z as the offset alignment. Two options are available for specifying how the alignments should be related.

1. With this option, the range of stations given is assumed to be on the designed baseline and the intersections of transverse lines (perpendicular to the baseline at each of the baseline stations in the range) with the designated offset line define the calculated station range on the offset line. (See Case A in **Figure 54 - Illustration of AREL Cases A & B**)

2. With this option, the range of stations given is assumed to be on the designated offset line, and the intersections of transverse lines (perpendicular to the baseline at each of the offset line stations in the range) with the baseline define the calculated station range on the designated baseline. (See Case B in **Figure 54 - Illustration of AREL Cases A & B**)

Regardless of which option is used, the transverse lines are always perpendicular to the designated baseline and only coincidentally perpendicular to the offset line in the case of parallel alignments.

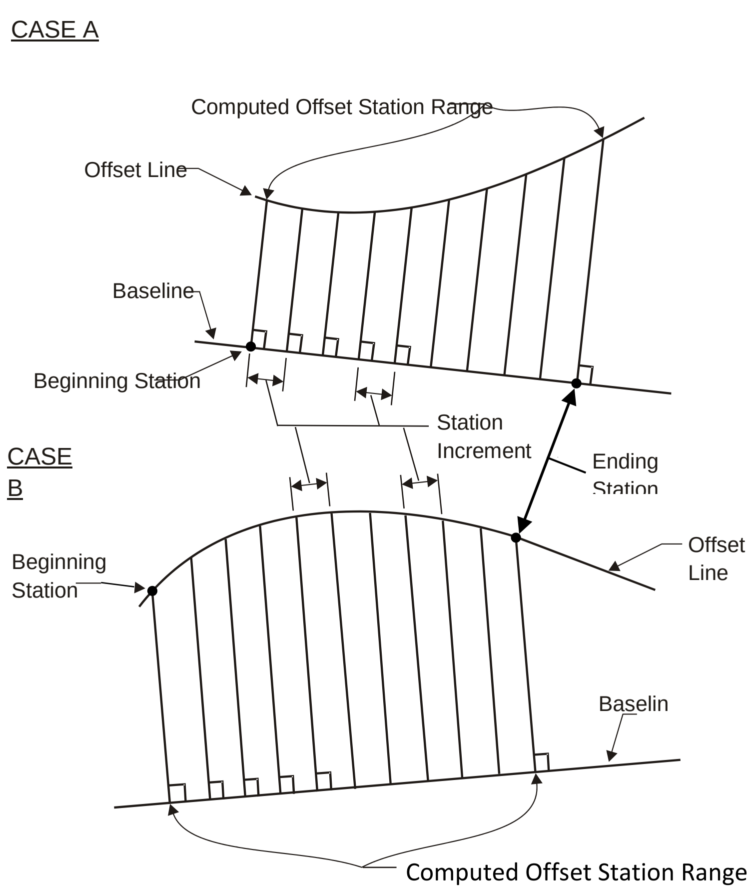
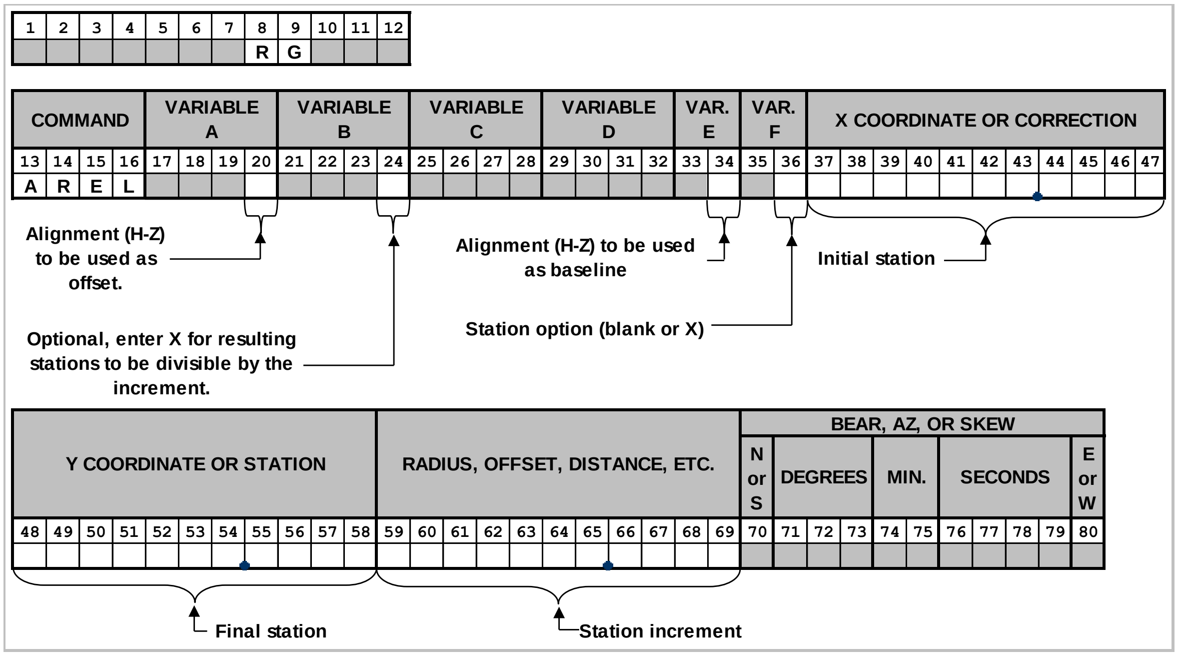


Figure 54 - Illustration of AREL Cases A & B

AREL ARGUMENT INPUT SCHEME



Card 50 - AREL Argument Input Scheme Card

This argument input scheme requires the following data:

- *Offset Alignment (VAR A):* The alignment to be used as the offset line. If the baseline and the offset alignments are the same, a station and coordinate list will be generated along the designated alignment.
- *Divisibility Option (VAR B) (optional):* If X is entered, the resulting stations will be evenly divisible by the increment.
- *Baseline Alignment (VAR E):* The alignment to be used as the baseline. Transverse lines used to define the relation between the two alignments are perpendicular to the baseline.
- *Station Option (VAR F):* If left blank, the station range indicated in the Initial Station and Final Station fields is assumed to be on the baseline. (See Case A in the **Figure 54 - Illustration of AREL Cases A & B**.) If X is entered, the station range indicated in the Initial Station and Final Station fields is assumed to be on the offset alignment. (See Case B in **Figure 54 - Illustration of AREL Cases A & B**.)
- *Initial Station (X-COORDINATE OR CORRECTION):* Station where the computations start.
- *Final Station (Y-COORDINATE OR STATION):* Station where the computations end. If no Final Station and no Station Increment are given, an alignment relation is performed only at the Initial Station.
- *Station Increment (RADIUS, OFFSET, ETC) (optional):* The distance between the stations where computations are to be performed. If no increment is entered, an increment of 100 is used.

NOTES ON AREL COMMAND

- Insert comments at the top of an AREL report by preceding the AREL instruction with a CMNT command or commands. If the instruction preceding the CMNT command(s) is not another AREL command (or other special report such as RDWY or AREA), the CMNT command(s) must be preceded by an EJCT command.
- *Roadway Designations:* Two roadway designations must be specified by the user. The designations are alphabetic characters A through Z. Column 20 is used to designate which one of the roadways the user wishes to be utilized as the offset line. Column 34 is used to designate which one of the roadways the user wishes to be utilized as the baseline. If the baseline and the offset roadway designation are the same, a station and coordinate list will be generated along the designated roadway.
- *Station Option:* Option 1, where the given station range is on the baseline, is assumed if no entry is made in column 36. Option 2, where the given station range is on the offset line, is in effect if an "X" is entered in this column.
- *Stations:* A beginning station and an ending station must be specified by the user in order to define a station range. The beginning station is entered in columns 37 through 47 and the ending station is entered in columns 48 through 58. A station increment may or may not be entered in columns 59-69. If an increment is entered, the routine will perform an alignment relation at the initial station and increment down the range by the given station increment until the ending station is reached. An option is also available so that the resulting stations will be divisible by the increment regardless of the beginning station or equations. If a single station is needed then the ending station and increment may be omitted.

CREATING (PUNCHING) AND LISTING STORED GEOMETRY DATA

PLST – CREATE (PUNCH)/LIST STORED POINTS

FUNCTION

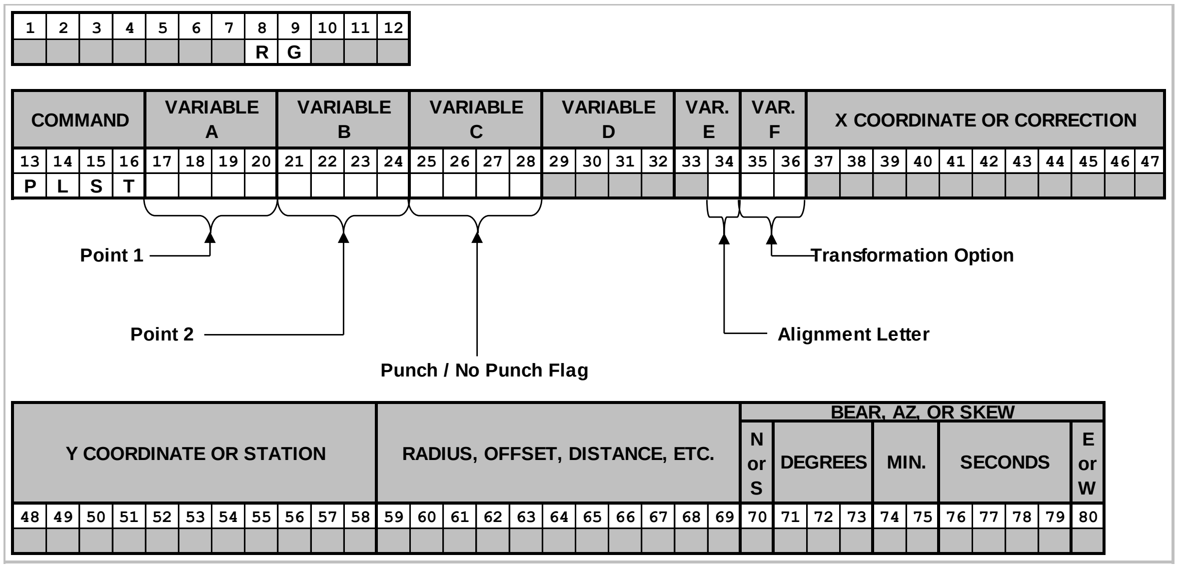
This command prints a list of the points that have been entered or computed. Optionally, it also creates ("punches") card images of the points, and, also optionally, transforms the coordinates of the points from English to metric or vice versa. The card images of the points can then be entered into a BGS data file.

USAGE

Use this command to print a list of the points that have been entered or computed for this job, and/or entered or computed for previous jobs, stored on working files, and entered as input for this job (On SYSTEM card: JOB TYPE = OLD; OMIT POINT/CURVE FILES -- NO.) If the user specifies a roadway alignment on the command, the system computes and prints the distance of each point from the roadway. In addition, the coordinates of the points may be transformed from English to metric or vice versa. The transformed points are then 'punched' (written to a .pch file).

This command should be placed at the end of a BGS data set. (If it is not at the end, and a subsequent geometry instruction is issued which stores a point, that point will not be printed/punched.)

PLST ARGUMENT INPUT SCHEME



Card 51 - PLST Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point1:* Number of first point to be processed. (If no point has been defined for this number, the routine will go on to the next number.) If Point1 = 1 and Point2 = 2100, all defined points will be printed and/or transformed and punched.
- *Point2:* Number of last point to be processed. If Point1 = 1 and Point2 = 2100, all defined points will be printed and/or transformed and punched.
- *Punch / No Punch Flag :* If a 0 (zero) is entered in column 28 or columns 25 – 28 are blank, no points are 'punched.' If column 28 contains a 1 (or if columns 25 - 28 contain any integer(s)), all defined points will be 'punched.'
- *Alignment Letter:* If this (the letter A-Z) is given, the distance from the point to the given alignment is computed and printed.
- *Transformation Option:* If IM (Imperial/English to metric) is entered in columns 35 - 36, the coordinates of the point will be transformed from English to metric; if MI (metric to imperial/English) is entered, the coordinates will be transformed from metric to English. Note that these transformed coordinates are virtual coordinates, not State Plane coordinates. All points so transformed will have the proper relation to each other that they would in State Plane coordinates, but the user will have to translate the coordinates (bias them appropriately) to get them into the State Plane system. (The user may choose to leave them as virtual coordinates.)

CLST – CREATE (PUNCH)/LIST STORED CURVES

FUNCTION

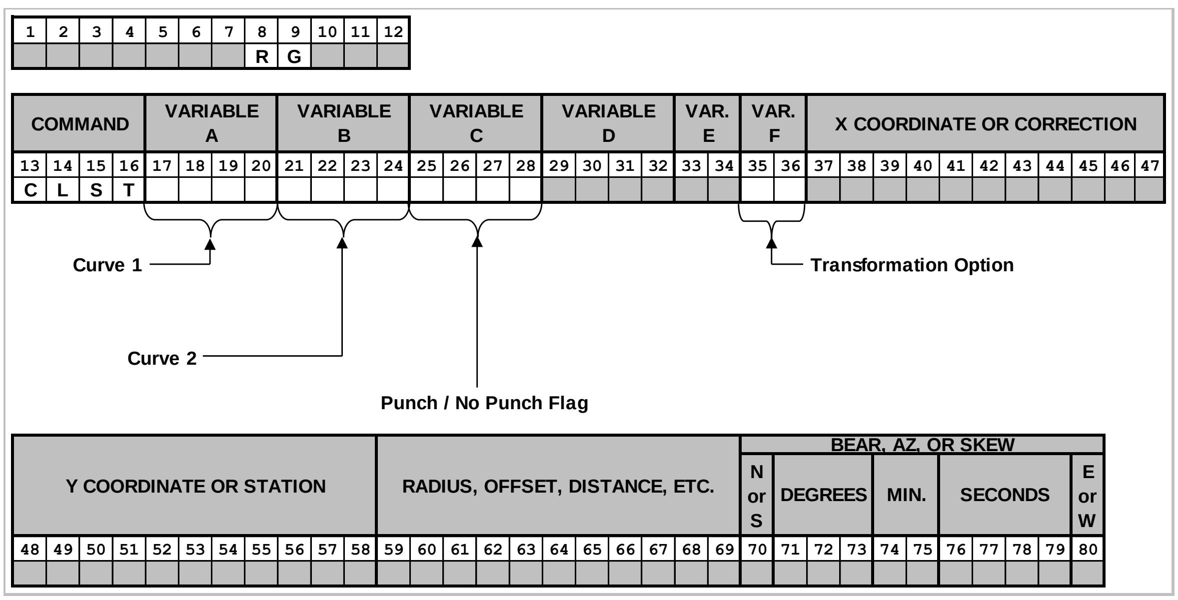
This command prints a list of the curves that have been entered or computed. Optionally, it also creates ("punches") card images of the curves, and, also optionally, transforms the coordinates of the curves from English to metric or vice versa. The card images of the curves can then be entered into a BGS data file.

USAGE

Use this command to print a list of the curves that have been entered or computed for this job, and/or entered or computed for previous jobs, stored on working files, and entered as input for this job (On SYSTEM card: JOB TYPE = OLD; OMIT POINT/CURVE FILES -- NO.) In addition, the coordinates and, for circular arcs, radii of the curves may be transformed from English to metric or vice versa. The transformed curves are then 'punched' (written to a .pch file).

This command should be placed at the end of a BGS data set. (If it is not at the end, and a subsequent geometry instruction is issued which stores a curve, that curve will not be printed/punched.)

CLST ARGUMENT INPUT SCHEME



Card 52 - CLST Argument Input Scheme Card

This argument input scheme requires the following data:

- *Curve1:* Number of first curve to be processed. (If no curve has been defined for this number, the routine will go on to the next number.) If Curve1 = 1 and Curve2 = 1400, all defined curves will be printed and/or transformed and punched. *Curve2:* Number of last curve to be processed. If Curve1 = 1 and Curve2 = 1400, all defined curves will be printed and/or transformed and punched.

- *Punch / No Punch Flag:* If a 0 (zero) is entered in column 28 or columns 25 – 28 are blank, no curves are 'punched.' If column 28 contains a 1 (or if columns 25 – 28 contain any integer(s)), all defined curves will be 'punched.'

- *Transformation Option:* If IM (imperial/English to metric) is entered in columns 35 - 36, the coordinates of the feature and the radius (if the feature is a circular arc) will be transformed from English to metric; if MI (metric to imperial/English) is entered, the coordinates and the radius will be transformed from metric to English. Note that these transformed coordinates are virtual coordinates, not State Plane coordinates. All features so transformed will have the proper relation to each other that they would in State Plane coordinates, but the user will have to translate the coordinates (bias them appropriately) to get them into the State Plane system. (The user may choose to leave them as virtual coordinates.)

BGPN – TRANSFORM COMMAND UNITS AND PUNCH

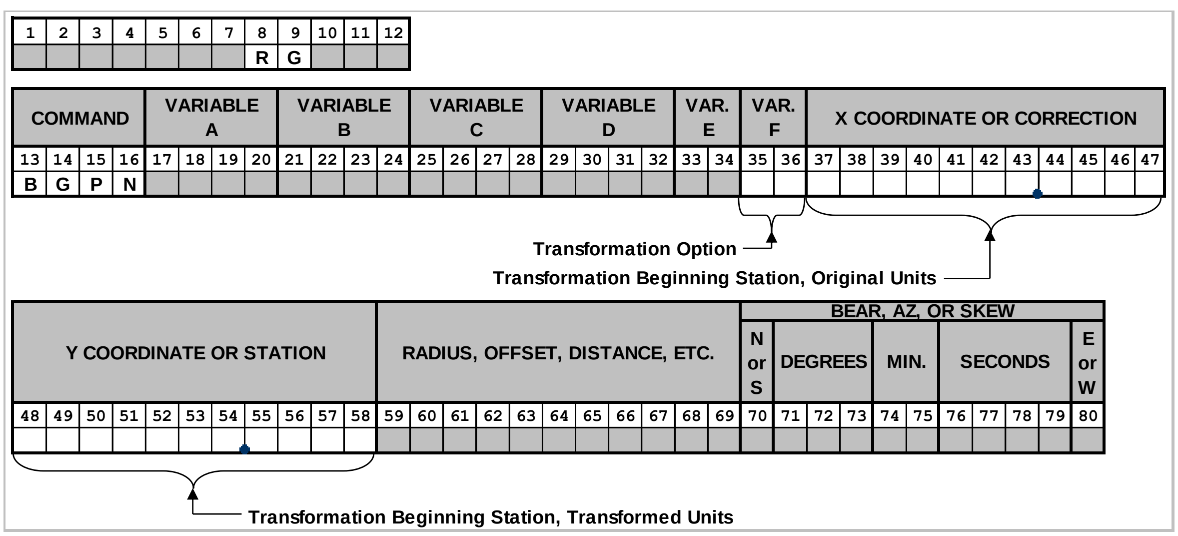
FUNCTION

This command duplicates geometry and bridge geometry commands, with the coordinates, station numbers, offsets, etc., transformed from English to metric or vice versa. These commands are then "punched" as card images, which can then be entered into a BGS data file.

USAGE

Use this command to duplicate geometry and bridge geometry commands, with the coordinates, station numbers, offsets, etc., transformed from English to metric or vice versa. The commands are then 'punched' (written to a .pch file). The BGPN command asks for a station both in original units and in transformed units. This permits the user to control the stationing in the transformed output. This command must be placed in the BGS data set JUST BEFORE the data that is to be transformed.

BGPN ARGUMENT INPUT SCHEME



Card 53 - BGPN Argument Input Scheme Card

This argument input scheme requires the following data:

- *Transformation Option:* If IM (imperial/English to metric) is entered in columns 35 - 36, all distances in the command (coordinates, station numbers, offsets, etc.) will be transformed from English to metric; if MI (metric to imperial/English) is entered, all distances will be transformed from metric to English. Note that these transformed coordinates are virtual coordinates, not State Plane. All coordinates so transformed will have the proper relation to each other that they would in State Plane coordinates, but the user will have to translate the coordinates (bias them appropriately) to get them into the State Plane system. (The user may choose to leave them as virtual coordinates.)
- *Transformation Beginning Station, Original Units:* For an English-to-metric transformation, this is the beginning station in feet. For a metric-to-English transformation, this is the beginning station in meters. The field has four assumed decimal places, as elsewhere in BGS.
- *Transformation Beginning Station, Transformed Units:* For an English-to-metric transformation, this is the beginning station in meters. For a metric-to-English transformation, this is the beginning station in feet. The field has four assumed decimal places, as elsewhere in BGS.

CHAPTER 7: COMMAND STRUCTURED INPUT – BRIDGE GEOMETRY

BRIDGE GEOMETRY COMMANDS

INTRODUCTION

Bridge geometry commands empower the user to:

- Define the plan view elements of structures.
- Compute the dimensional aspects of the bridge frame and slab.
- Compute the vertical and horizontal blocking data for continuous beams.
- Plot the plan view of the structure.
- Compute bridge construction grades.
- Compute vertical clearance between structures and lower roadways or between the top of a roadway's beams and its own bottom of slab.

These operations are performed by using the bridge commands in sequence. A typical sequence is listed below with an annotated explanation of the function of each command.

NAME (name) – establishes a file for storing each structure's data. The Bridge alignment and stationing are identified along with the size, type and loading.

PSLB (parallel slab line) – defines lines that are the outside edges of the slab and slab break lines.

TSLB (transverse slab line) – defines straight lines which are used to locate the ends of the slab.

SLAB (slab) – intersects two PSLB lines with two TSLB or Bent Lines to define the boundaries of the slab and plots the slab (optional). It also defines the interior and overhang slab depths.

SLEL (slab elevations) – produces a tabulation of surface elevations and bottom of slab elevations along the boundaries of the slab.

BENT (bent line) – defines straight lines which represent the centerline of bents or other supporting members for the structure.

BRNG (bearing seat) – locates the bearing seats and beam ends relative to the Bent Lines.

DIAF (diaphragm line) – defines straight lines which indicate the location of diaphragm members between beams.

SPLC (splice line) – defines straight lines which indicate the location of beam splices in continuous units.

BEAM (beam line) – defines Beam Lines which are used in various ways to locate actual beams in the structure.

BGRP (beam line group) – defines groups of parallel or concentric Beam Lines.

FOPT (frame option) – requests computation of the bridge frame layout. This command intersects Bent and Splice Lines with Beam Lines to define the actual location of the beams. Bearing seat locations and diaphragm intersections are computer on chords between successive bents and splices. An option is available for curved continuous beams. Various reports are generated along with an optional plan view plot.

BMGD (beam grade) – produces a tabulation of surface elevations, bottom of slab elevations, and bottom of slab elevations plus deflection along the centerline of each beam.

VCLR (vertical clearance) – computes vertical clearances between the structure and a lower roadway and may be used to determine required haunch between the beams and slab of its own roadway.

The sequence given above is not rigid since the commands are independent of one another. The commands can be used in any order but all of the data required by a command must be previously defined. The following is a list of data sequence requirements for using the bridge commands.

- All roadway surface design data (horizontal alignment, profile grade, template, superelevation (optional), and widening (optional) must be defined before entering the NAME command.
- All points and curves referenced by bridge commands must be previously defined. It is good practice to enter all general geometry commands before the NAME command, although bridge and general geometry commands may be mixed.
- The name command must be the first bridge command for each structure.
- The TSLB, BENT, and PSLB commands must precede the SLAB command for which they apply.
- The SLEL command must directly follow the SLAB command or another SLEL command.
- The BENT, BRNG, DIAF, SPLC, BEAM and BGRP commands must precede the FOPT command for which they apply.
- If the slab and/or frame are to be plotted, an AXIS or an automatic orientation APLT command must precede the SLAB and FOPT commands.
- The BMGD and VCLR commands must be preceded by the FOPT for which they apply.

A maximum of 17 NAME commands each defining or referencing a separate structure file may be used. Separate sets of independent bridge commands are defined for each NAME command. According to the **RDS User Manual** there are fixed limits on some of these commands as indicated below.

- Each of the following commands is assigned a storage number.

Command		Storage Number Limits [1][2]
BENT		1-75
SPLC		1-20
TSLB		1-10
PSLB		1-99
BEAM, BGRP	Beam Lines	1-99
DIAF		No storage # but maximum of 60 entries per NAME card

[1] These storage limits apply to each NAME command.

[2] Notwithstanding these limits, it seems that any combination of TSLB, SPLC, DIAF and BEAM cards can be used as long as the total does not exceed 219.

- The BRNG command allows back, forward, or both conditions for each Bent Line entered.

FUNCTION, USAGE AND INPUT SCHEMES FOR BRIDGE GEOMETRY COMMANDS

NAME

FUNCTION

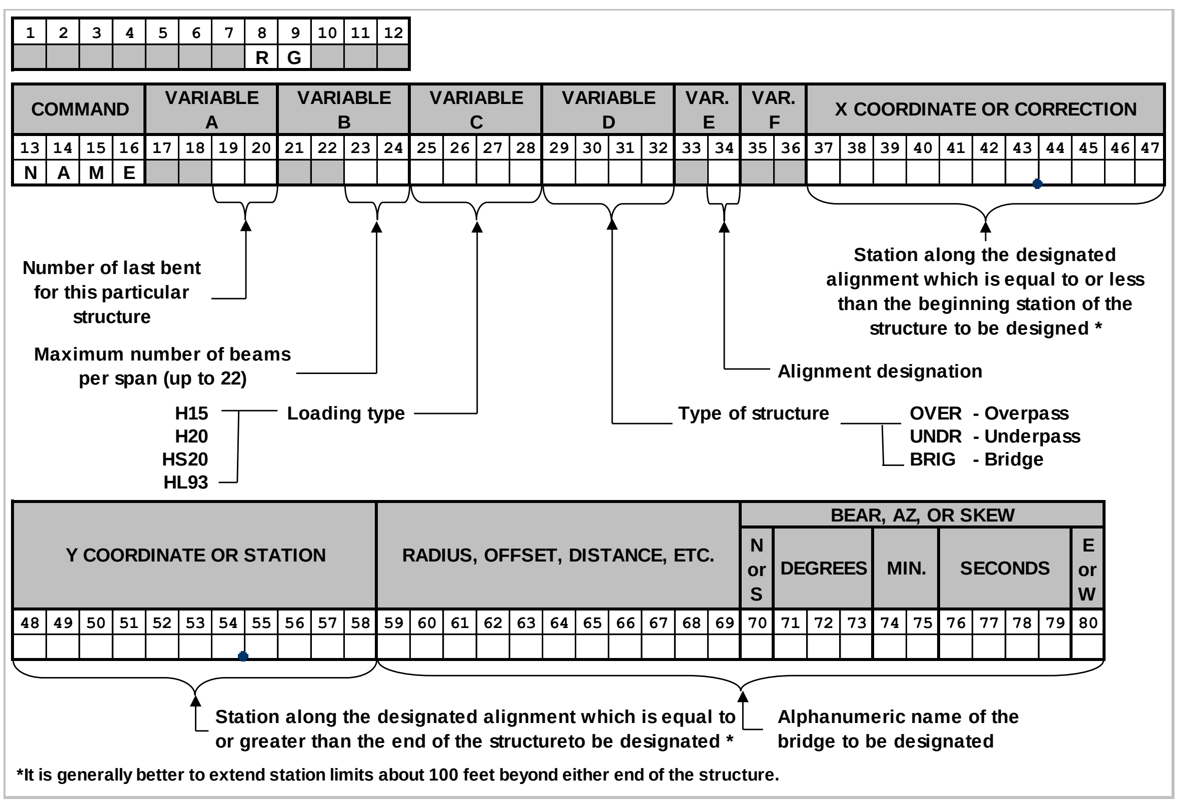
This command establishes a bridge file (a temporary file) for storing bridge data. A structure number is automatically assigned to the bridge using this command. The bridge alignment and stationing are identified along with the size, type, and loading. Maximum beam and bent numbers are established using this command for memory allocation purposes. Once established, these values cannot be exceeded. Increase the maximum number of bents and beams (usually by two) from the preliminary number to avoid changing the NAME card input in the event a subsequent revision in the number of beams and/or bents is needed**.**

USAGE

Use this command to dimension a bridge's data file or to access a previously stored bridge (structure) file.

NAME ARGUMENT INPUT SCHEME A

The number of bents, maximum number of beams per span, loading type, type of structure, station limits, and bridge name are entered using this option.



Card 54 - NAME Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Bent Number (VAR A):* Enter the number of the last bent for the structure. The user may add additional bents to the total to account for possible changes.
- *Beam Number (VAR B):* Enter the maximum number of beams in the span. The user may add additional beams to the total to account for possible changes.
- *Loading (VAR C):* Enter the loading type for the structure.
- *Structure Type (VAR D):* Identify the type of structure.
- *Alignment: (VAR E):* Enter the primary alignment for the structure.
- *Begin Station (X-COORDINATE OR CORRECTION):* Enter the station along the designated alignment that is equal to or less than the begin station for the structure.
- *End Station (Y-COORDINATE OR STATION):* Enter the station along the designated alignment that is equal to or greater than the end station for the structure.
- *Name (RADIUS, OFFSET, ETC. and BEAR, AZ, OR SKEW):* Enter the name of the structure to be designed.

NAME ARGUMENT INPUT SCHEME B

This input scheme accesses a previously stored bridge file. Such a file allows the bridge data to be accessed on subsequent runs. By entering a previously assigned structure number, additional bridge commands may be executed to update the bridge file or generate new reports. The maximum beam and bent numbers entered on the original name card still apply and cannot be exceeded.

1	2	3	4	5	6	7	8	9	10	11	12
							R	G			

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
N	A	M	E																															

Structure Number
Identifies the bridge file that is to be accessed

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 55 - NAME Argument Input Scheme B Card

This argument input scheme requires only one input, as follows:

- *Structure Number (VAR F):* Enter the previously assigned structure number (see Input Scheme A) for the bridge file to be accessed.

PSLB (PARALLEL SLAB LINE)

FUNCTION

This command establishes a longitudinal line used to define slab edge boundaries and slab break lines.

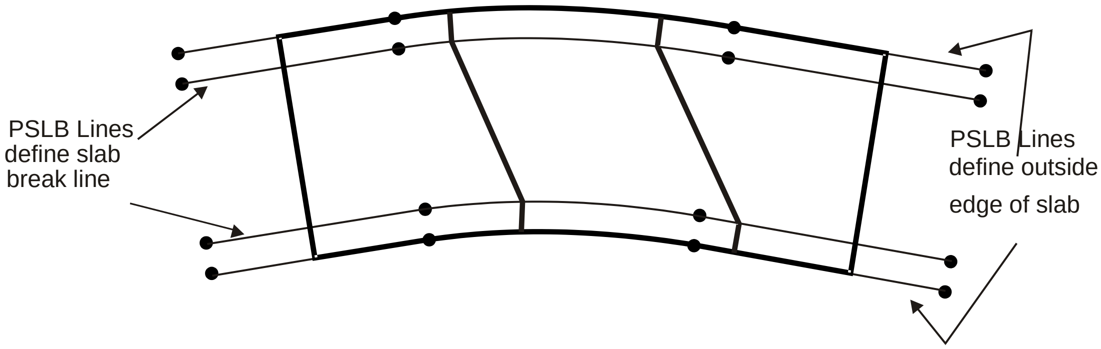


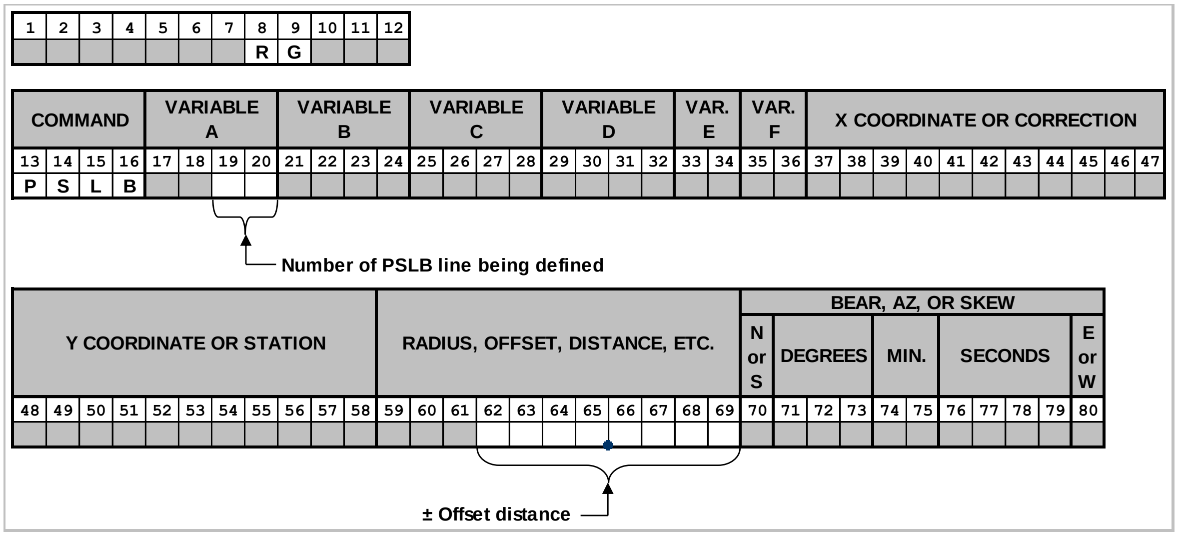
Figure 55 - PSLB Lines

USAGE

Use this command to define longitudinal lines that represent the outside edges of the slab and slab break lines. PSLB lines may consist of from one to thirty-four (34) straight line and/or circular elements. They are limited in extent since their end points must be defined. PSLB lines are given a storage number between 1 and 99 for each structure. These numbers are used for reference by other commands. The user should be aware of the direction of the PSLB line. See the argument input schemes for information regarding direction of the PSLB lines. Lines may be defined by giving their offset from another PSLB line or from any stored alignment. The direction of the PSLB line will be the same as the direction of the referenced PSLB line or alignment.

PSLB ARGUMENT INPUT SCHEME A

This input scheme defines a PSLB line parallel to the bridge alignment. The centerline of the bridge between the station limits specified using the NAME command is automatically stored. The PSLB line will have the same direction as the referenced bridge alignment.



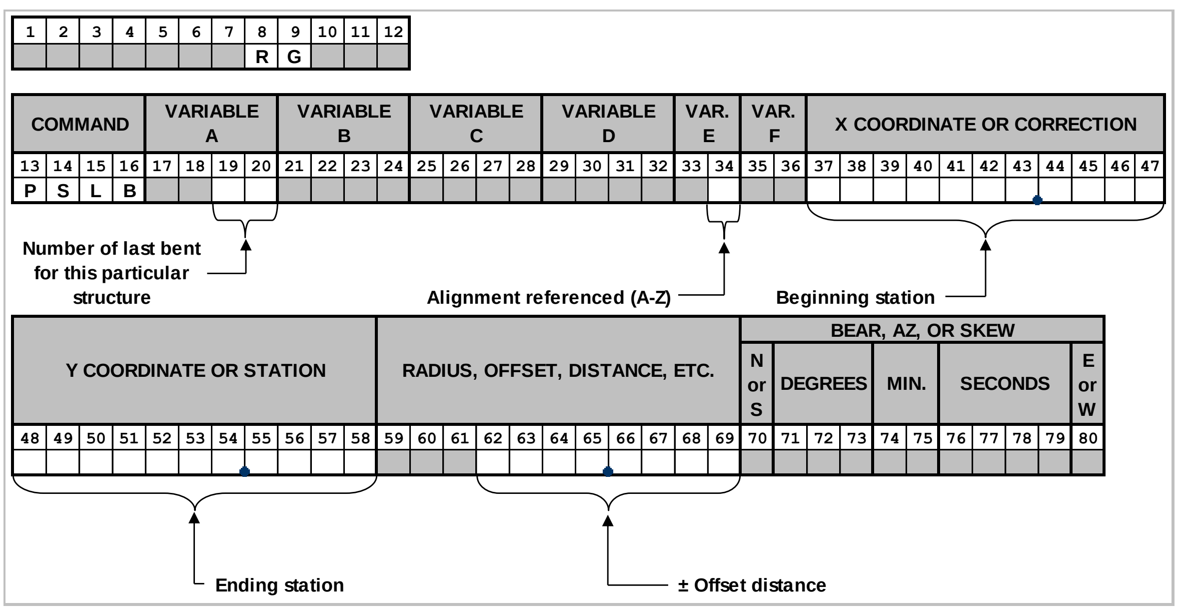
Card 56 - PSLB Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Parallel Slab Line (VAR. A):* The number assigned to the PSLB line.
- *Offset:* The offset from the bridge alignment. Use a negative value for offsets to the left of the alignment.

PSLB ARGUMENT INPUT SCHEME B

This input scheme defines a PSLB line parallel to a given alignment other than the bridge alignment.



Card 57 - PSLB Argument Input Scheme B Card

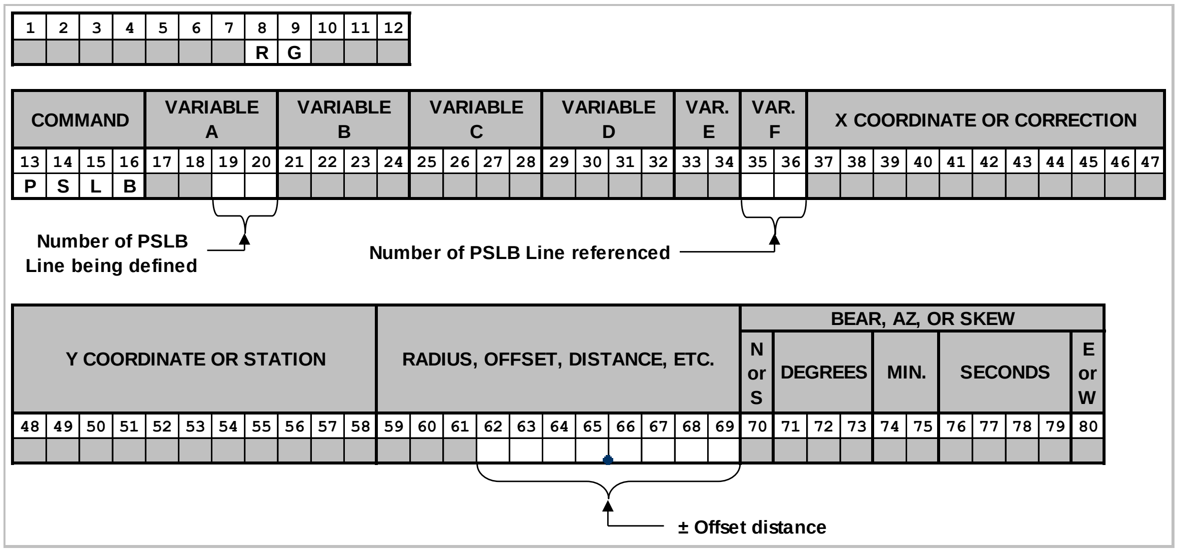
This argument input scheme requires the following data:

- *Parallel Slab Line (VAR. A):* The number assigned to the PSLB line.

- *Alignment (VAR. E):* The alignment from which the PSLB line is offset.
- *Beginning Station (X-COORDINATE OR CORRECTION):* The station on the given alignment where the PSLB line starts.
- *Ending Station (Y-COORDINATE OR STATION):* The station on the given alignment where the PSLB line ends.
- *Offset (RADIUS, OFFSET, ETC):* The offset of the PSLB line from the specified alignment. Use a negative value for offsets to the left of the alignment.

PSLB ARGUMENT INPUT SCHEME C

This input scheme defines a PSLB line parallel to another PSLB line at the specified offset. The PSLB line will have the same limits as the referenced PSLB line.



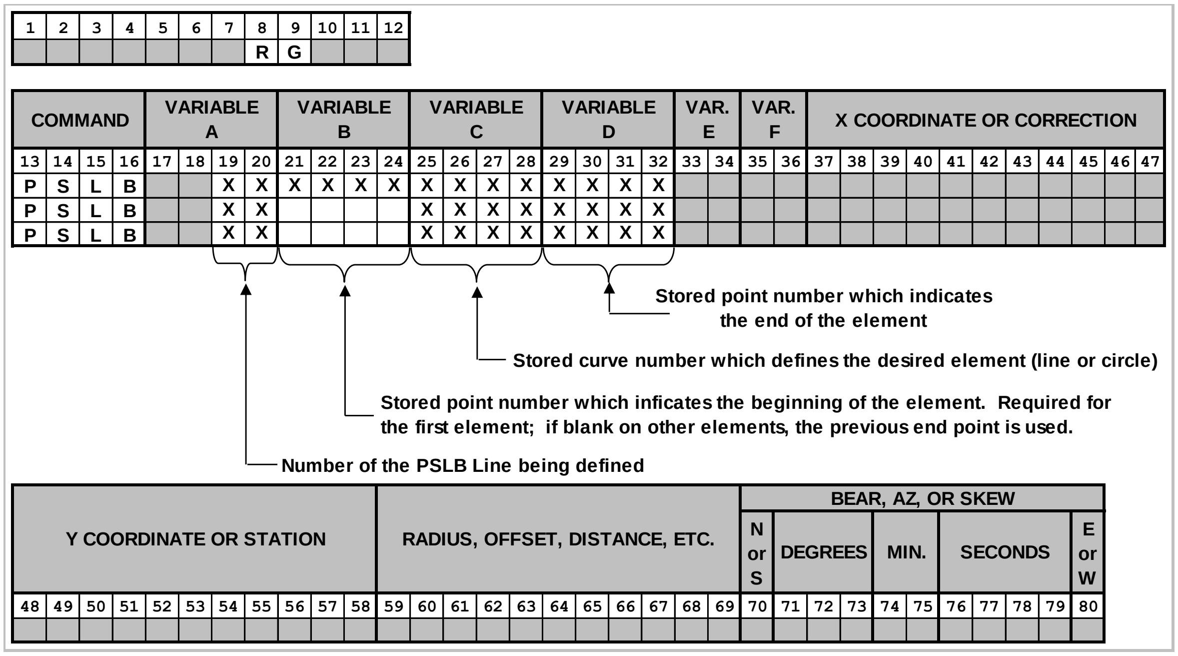
Card 58 - PSLB Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Defined Parallel Slab Line (VAR. A):* The number assigned to the PSLB line being defined.
- *Referenced Parallel Slab Line (VAR. F):* The number of the previously defined PSLB line being referenced.
- *Offset (RADIUS, OFFSET, ETC):* The offset from the referenced PSLB line. Use a negative value for offsets to the left of the referenced PSLB line.

PSLB ARGUMENT INPUT SCHEME D

This input scheme defines a parallel slab line using previously stored curves and points. A series of PSLB commands may be required for this option, with a maximum of two points and one curve per command entered in the order that indicates the direction of the PLSB line. One PSLB command must be entered for each element of the PSLB line.



Card 59 - PSLB Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Parallel Slab Line (VAR. A):* The number assigned to the PSLB line.
- *Point ID (VAR. B):* The number of the previously stored beginning point for the element. If blank on successive commands, the ending point of the previous command will be used.
- *Curve ID (VAR. C):* The number of a previously stored curve defining the desired element. The curve may be a line or a circle.
- *Point ID (VAR. D):* The number of the previously stored ending point for the line segment.

NOTE ON PSLB COMMAND

The beginning and ending points for a segment typically lie on the curve. If not, the beginning or ending point is defined by the intersection of the referenced curve and a line perpendicular to the referenced curve, which passes through the point specified. In this manner the same point can be used in defining multiple parallel slab lines. See the **Figure 56 - Defined Multiple Parallel Slab Lines** below for an illustration of this concept.

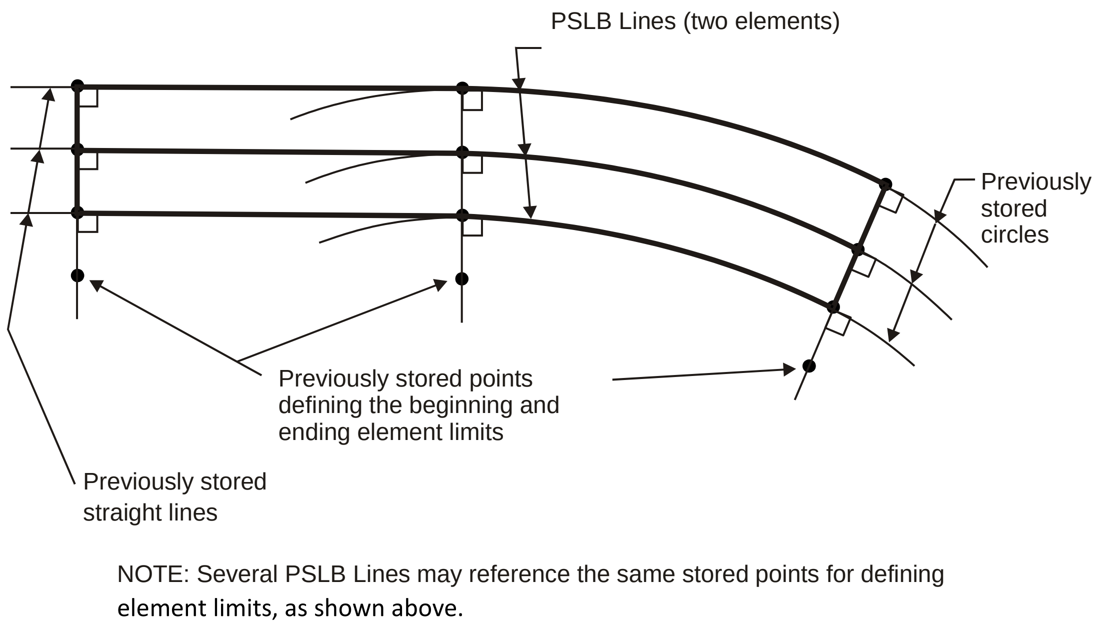


Figure 56 - Defined Multiple Parallel Slab Lines

TSLB (TRANSVERSE SLAB LINE)

FUNCTION

This input scheme defines a transverse slab line, used to locate the slab end when it does not coincide with the centerline of the bent.

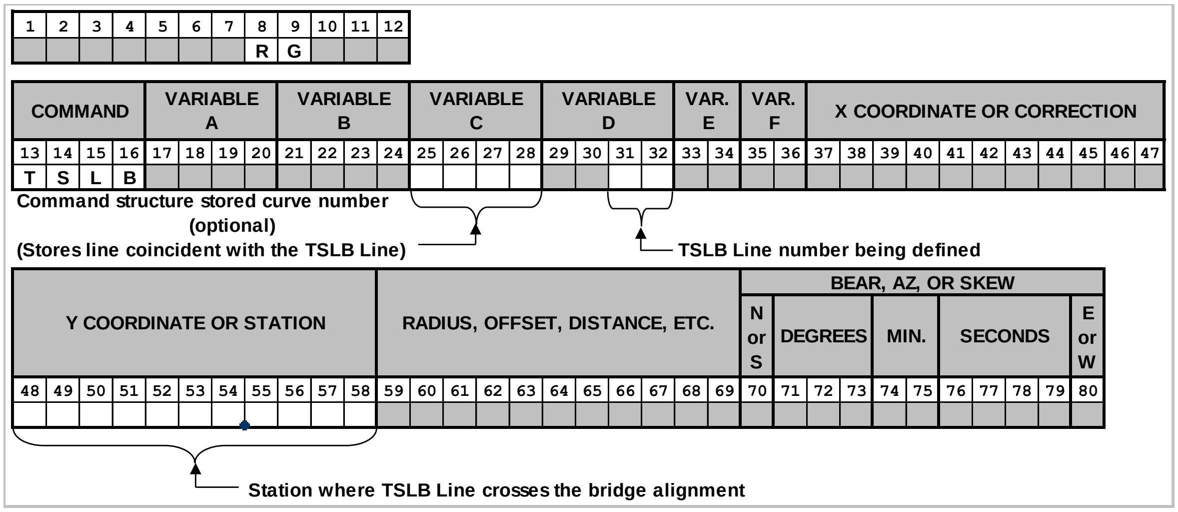
USAGE

Use this function to define transverse slab lines to locate the ends of slabs. A TSLB Line should only be defined when the slab end does not coincide with the centerline of the bent. TSLB lines must be assigned a storage number between one and ten for each structure.

Note: The limits stated in the **RDS User Manual** and any that may be stated in this *BGS User Guide* on the number of TSLBs, SPLCs, DIAFs, and BEAMs are not strict maximums. The user may specify as many of each as needed, as long as their summation does not exceed 219.

TSLB ARGUMENT INPUT SCHEME A

This input scheme defines a TSLB line perpendicular or radial to the specified bridge alignment at the station indicated.



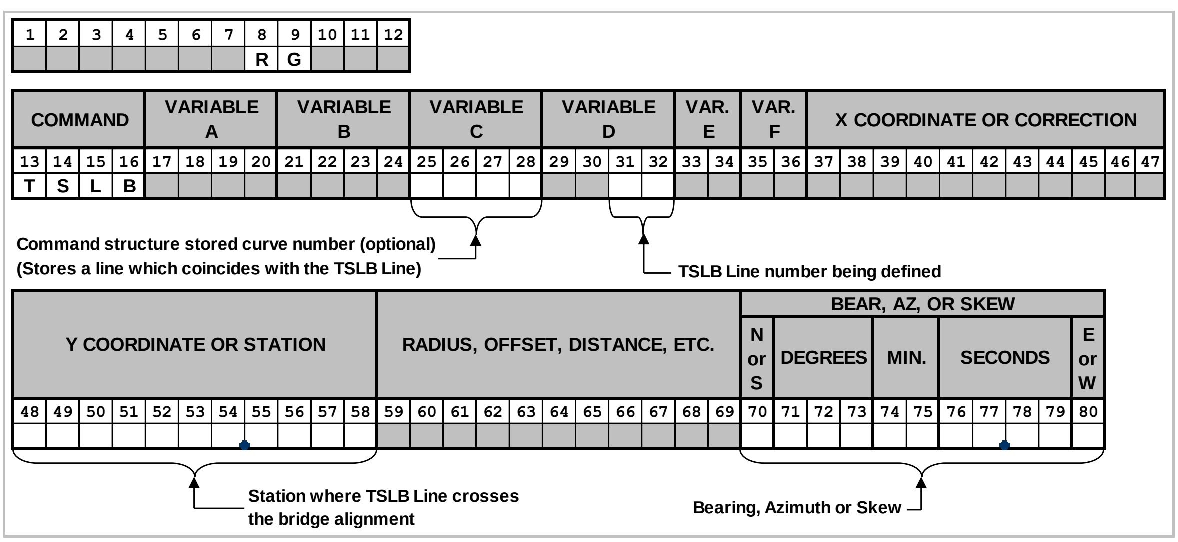
Card 60 - TSLB Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Curve Number (VAR A) (optional):* The number assigned to the line which coincides with the TSLB line.
- *Transverse Slab Line Number (VAR D):* The number assigned to the TSLB line being defined.
- *Station (Y-COORDINATE OR STATION):* Station where the TSLB line intersects the bridge alignment.

TSLB ARGUMENT INPUT SCHEME B

This input scheme defines a TSLB line crossing the bridge alignment at a given station and at a given bearing, azimuth, or skew.



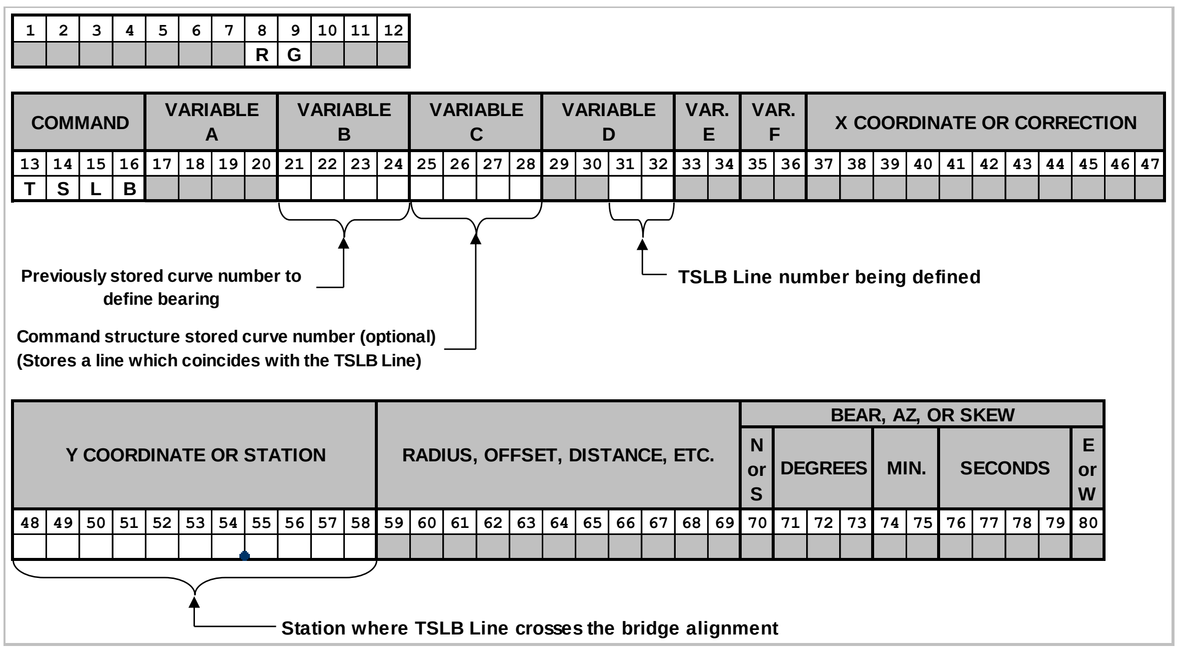
Card 61 - TSLB Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Curve ID (VAR. C) (optional):* The number assigned to the line which coincides with the TSLB line.
- *Transverse Slab Line Number (VAR D)*: The number assigned to the TSLB line being defined.
- *Station (Y-COORDINATE OR STATION):* Station where the TSLB line intersects the bridge alignment.
- *Bearing, Azimuth, or Skew (BEAR, AZ, OR SKEW):* The bearing, azimuth, or skew of the TSLB line. If blank, the line will be perpendicular to the alignment through the given station on the alignment.

TSLB ARGUMENT INPUT SCHEME C

This input scheme defines a TSLB line that crosses the bridge alignment at a given station with the bearing of a given curve.



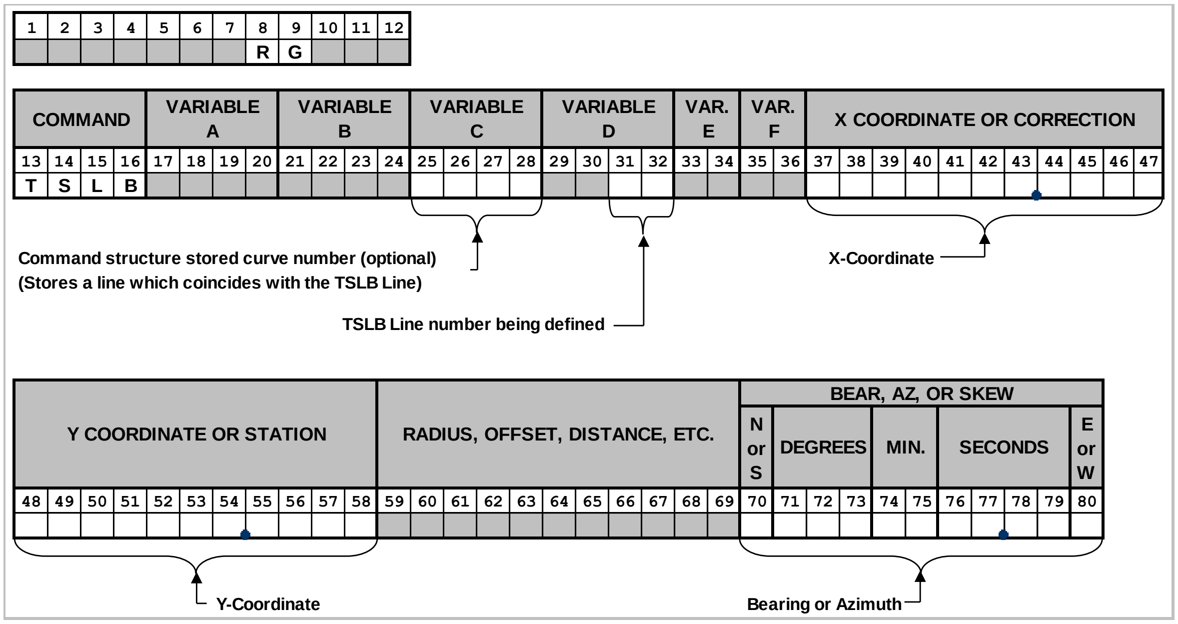
Card 62 - TSLB Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR. B):* The number of a previously stored curve used to define the bearing of the TSLB line.
- *Curve ID (VAR. C) (optional):* The number assigned to the line which coincides with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.
- *Station (Y-COORDINATE OR STATION):* The station where the transverse slab line crosses the bridge alignment.

TSLB ARGUMENT INPUT SCHEME D

This input scheme defines a TSLB line that passes through a given point at a given bearing or azimuth.



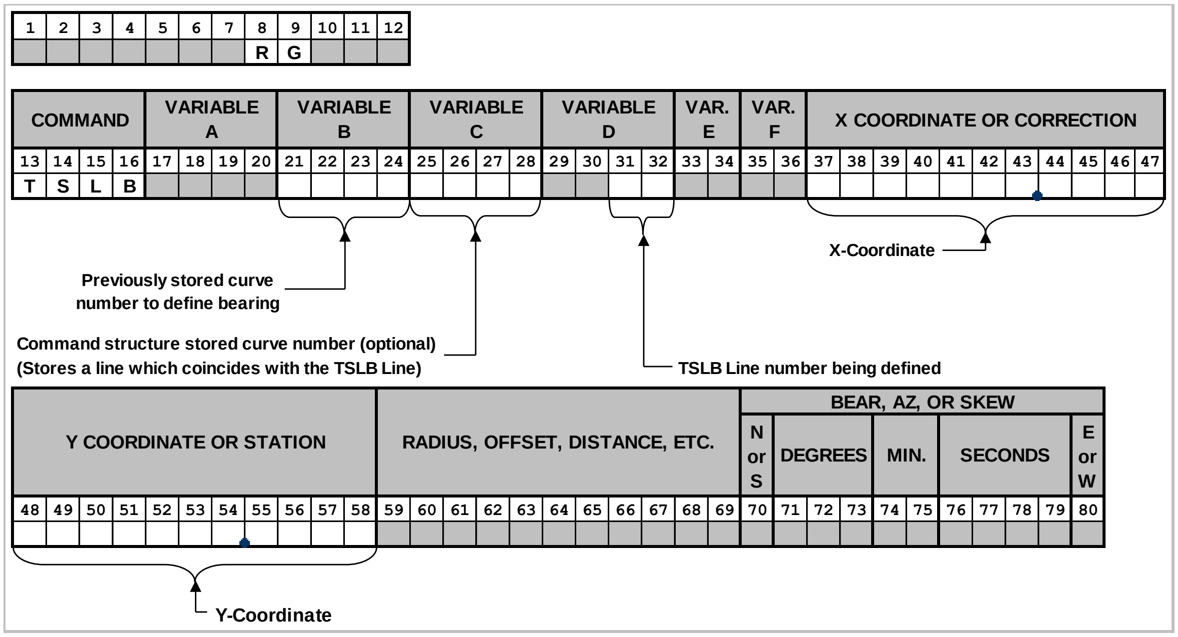
Card 63 - TSLB Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Curve ID (VAR. C)*: The number assigned to store a curve coincident with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.
- *X Coordinate (X-COORDINATE OR CORRECTION*): The X-coordinate of the point through which the TSLB line is to pass.
- *Y Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the point through which the TSLB line is to pass.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the TSLB line.

TSLB ARGUMENT INPUT SCHEME E

This input scheme defines a TSLB line that passes through a given point with the bearing of a given curve.



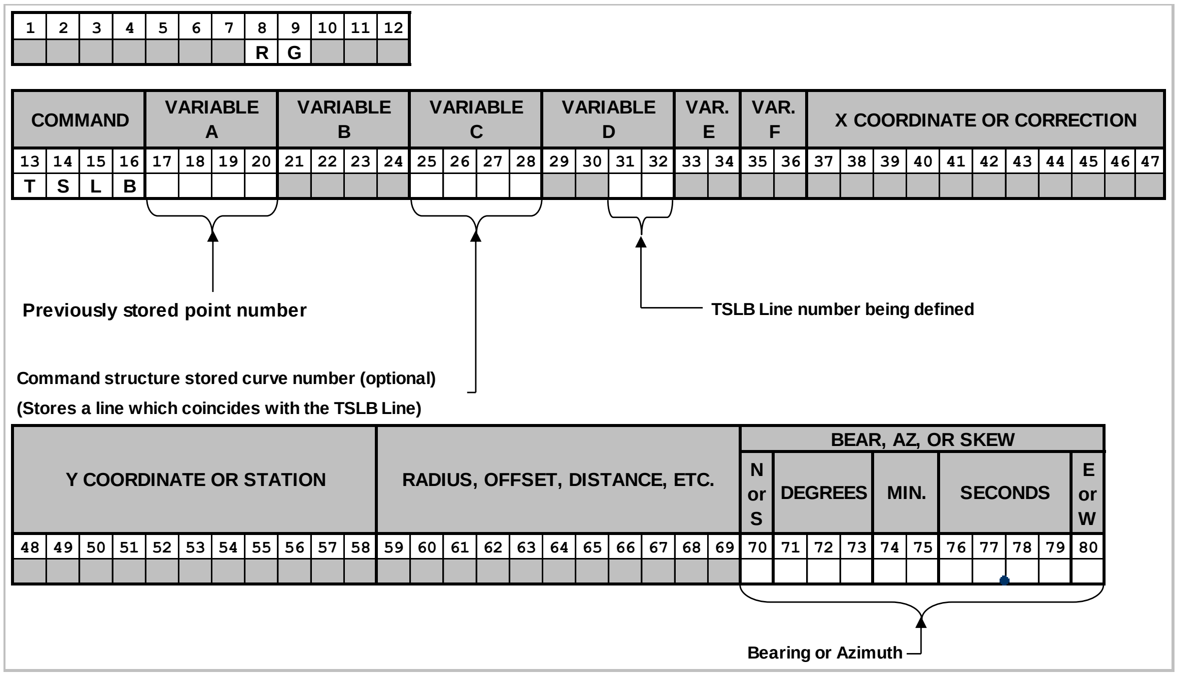
Card 64 - TSLB Argument Input Scheme E Card

This argument input scheme requires the following data:

- *Curve ID (VAR. B):* The number of a previously stored curve used to define the bearing of the TSLB line.
- *Curve ID (VAR. C):* The number assigned to store a curve coincident with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.
- *X-Coordinate (X-COORDINATE OR CORRECTION*): The X-coordinate of the point through which the TSLB line is to pass.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the point through which the TSLB line is to pass.

TSLB ARGUMENT INPUT SCHEME F

This input scheme defines a TSLB line that passes through a given point with a given bearing or azimuth.



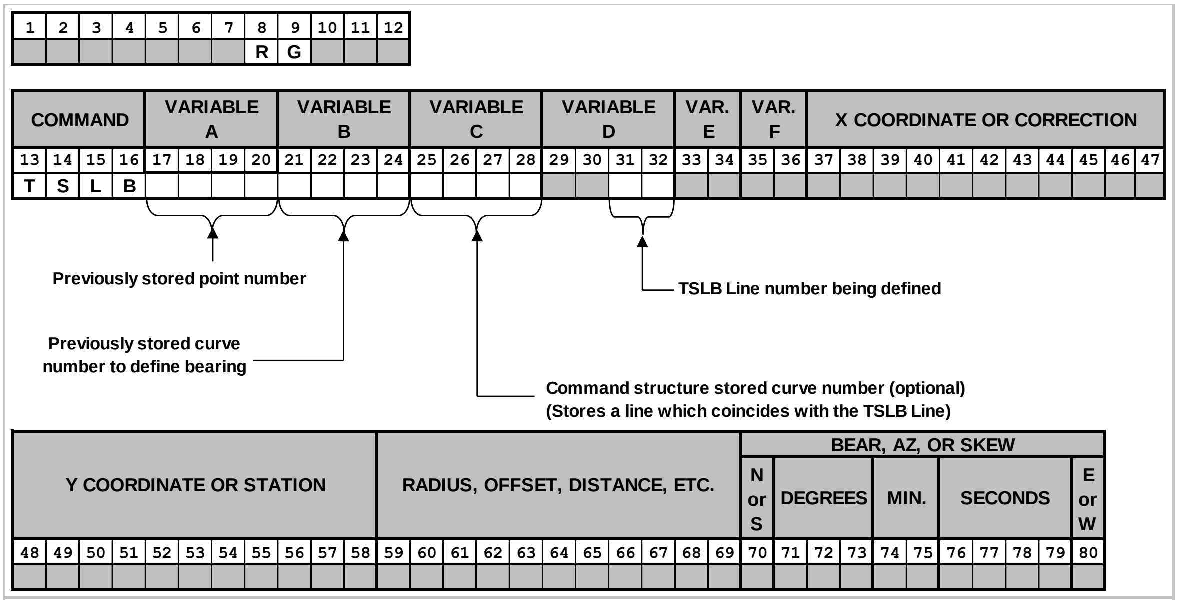
Card 65 - TSLB Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of the previously stored point through which the TSLB line is to pass.
- *Curve ID (VAR. C):* The number assigned to store a curve coincident with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the TSLB line.

TSLB ARGUMENT INPUT SCHEME G

This input scheme defines a transverse slab line that passes through a given point with the bearing of a given curve.



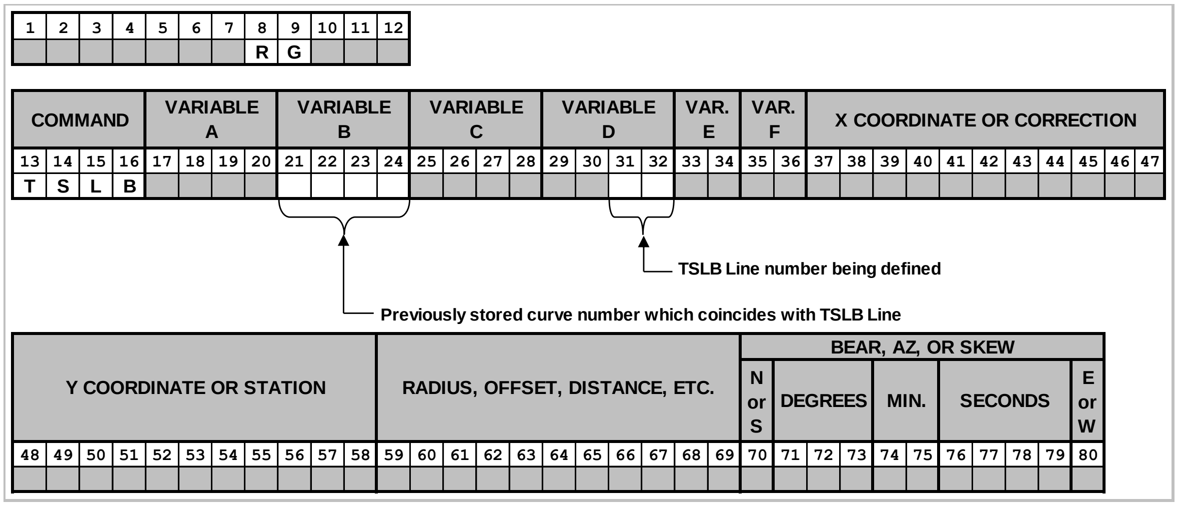
Card 66 - TSLB Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of the previously stored point through which the TSLB line is to pass.
- *Curve ID (VAR. B):* The number of a previously stored curve used to define the bearing of the TSLB line.
- *Curve ID (VAR. C):* The number assigned to store a curve coincident with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.

TSLB ARGUMENT INPUT SCHEME H

This input scheme defines a transverse slab line coincident with a previously stored curve.



Card 67 - TSLB Argument Input Scheme H Card

This argument input scheme requires the following data:

- *Curve ID (VAR. B):* The number of a previously stored curve that coincides with the TSLB line.
- *Transverse Slab Line Number (VAR. D):* The number assigned to the TSLB line being defined.

SLAB

FUNCTION

This command defines the edges of a bridge slab and the interior and overhang depths, expressing the edges in terms of previously defined transverse (BENT or TSLB) lines and longitudinal (PSLB) lines.

USAGE

Use this command to define and enter into temporary storage the boundaries of a bridge slab and the interior and overhang depths. The boundaries are expressed in terms of previously defined transverse lines (Bent or TSLB Lines) and longitudinal lines (PSLB Lines). The transverse edges (back and forward) may be either straight lines or broken lines. One or both edges of the slab may be broken. Broken lines (break lines) are longitudinal lines defined by entering one or two additional PSLB lines. The transverse lines intersect the additional PSLB lines and then extend perpendicularly or radially to intersect the longitudinal edges. **Figure 61 - Example Slab Diagram** illustrates how two additional PSLB lines may be used to define a break back slab. The resulting longitudinal edges are limited to ten elements on each side.

The output will include slab dimensions and the slab area. Plan and profile plots of the slab may be generated if a plot field has been established by either a previous AXIS command or an automatic orientation APLT command. See the Plot Option section of the argument input scheme data for this command.

Table 8 - Example Slab Report

SLAB REPORT
SPAN 2

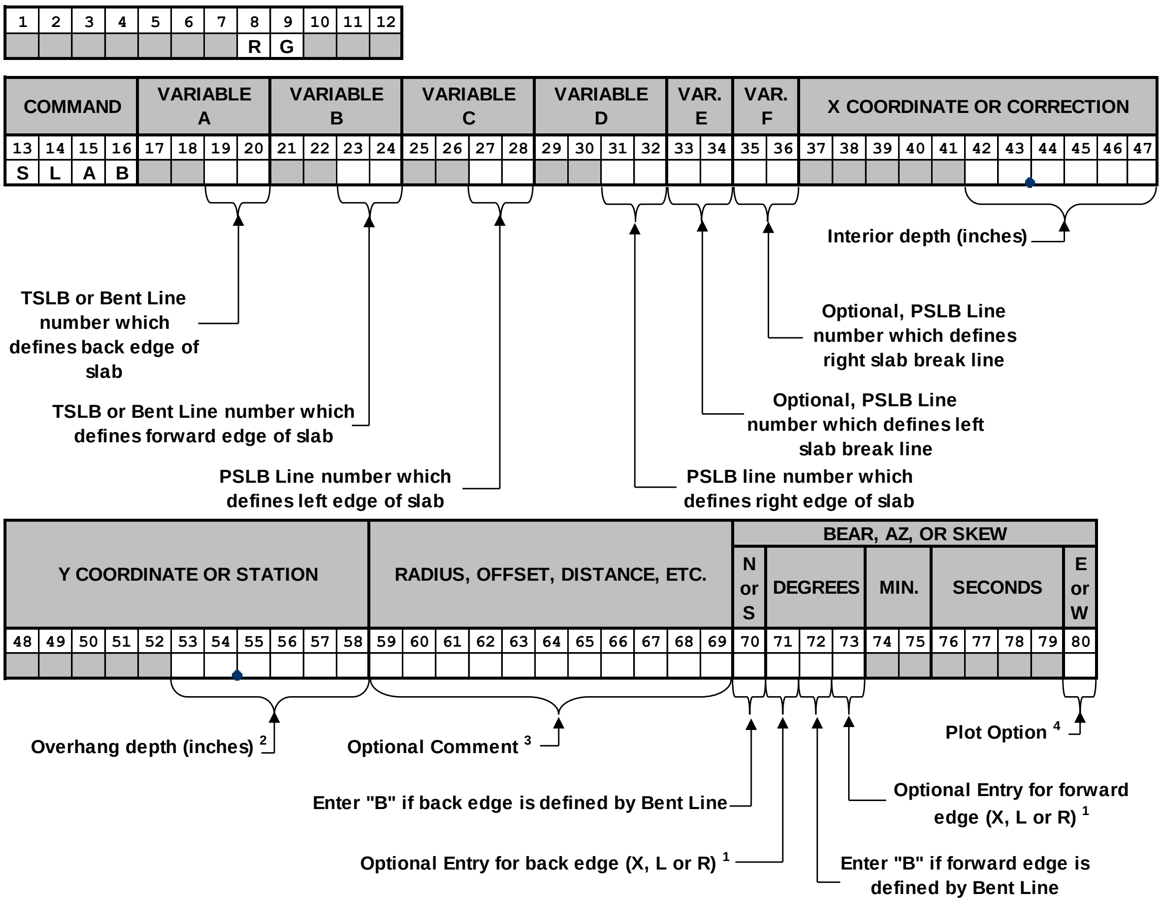
		SEG. NO.	***SEGMENT LENGTH***	***SEGMENT OR CHORD BEARING***	***CHORD LENGTH***	***RADIUS***	***ACCUMULATED SEGMENT LENGTHS***	***DISTANCE TO RADIAL INTERSECT***
LEFT EDGE	*(PSLB 1)*	*1*	*13.5314*	*N 72 20 49.96 E*	*13.5314*	*0.0000*	*13.5314*	
		2	*66.2786*	*N 73 39 19.15 E*	*66.2729*	*-1451.5195*	*79.8100*	*18.7854*
RIGHT EDGE	*(PSLB 2)*	*1*	*80.2104*	*N 74 10 49.88 E*	*80.1997*	*-1413.2695*	*80.2104*	*59.4165*

		SEG. NO.	***SEGMENT LENGTH***	***SEGMENT BEARING***	***SKEW ANGLE***	***DISTANCE TO STATION LINE***	***RADIAL DISTANCE***
BACK EDGE	*(BENT 2)*	*1*	*2.0000*	*N 17 39 10.04 W*			
		2	*39.0087*	*N 46 13 15.82 W*	*28 34 5.79*	*19.4990*	*36.2500*
		3	*2.0000*	*N 17 26 43.43 W*			
FORWARD EDGE	*(BENT 3)*	*1*	*2.0000*	*N 15 2 11.86 W*			
		2	*40.2139*	*N 46 13 15.82 W*	*31 36 0.00*	*20.0615*	*36.2500*
		3	*2.0000*	*N 14 11 36.82 W*			

SLAB DEPTH = 8.0000 IN. , OVERHANG DEPTH = 7.0000 IN.
SLAB AREA = 3060.3195 SQ. FT. = 340.0355 SQ. YDS.

SLAB ARGUMENT INPUT SCHEME

This input scheme defines the edges of a bridge slab and the interior and overhang depths.



[1] These columns are used to selectively break the back edge (Column 71) and forward edge (Column 73) of a slab. Enter an "X" if neither the left nor the right side are broken; enter an "L" if the left side is broken; enter an "R" if the right side is broken. If these columns are blank the corners will be broken. (These fields do not apply if no PSLB break lines are entered.)

[2] If the overhang depth is not entered, it will be assumed to be the same as the interior depth.

[3] If blank, the Span number printed on the output will be determined by the number entered in Columns 19 and 20 which defines the back edge of the slab. The user may change this by entering the desired description. EX: SPAN NO. 2L.

[4] Plot Option
- 0 or blank for plan plot only
- 1 for both plan and profile plots
- 2 omit both plan and profile plots
- 3 omit plan plot, plot profile plot

Card 68 - SLAB Argument Input Scheme Card

This argument input scheme requires the following data:

- *Back and Forward Slab Edges (VAR A and VAR B*): The numbers of the BENT or TSLB lines that form the back and forward slab edges.
- *Left and Right Slab Edges (VAR C and VAR D):* The numbers of the PSLB lines that form the left and right slab edges.
- *Left and Right Break Lines (VAR E and VAR F) (optional):* The numbers of the PSLB lines that form the left and right break lines. Both of these numbers may be given, either one may be given, or both may be omitted.
- *Interior and Overhang Depth (X-COORDINATE OR CORRECTION and Y-COORDINATEOR STATION):* The depth of the interior and overhang portions of the slab.
- *Title (RADIUS, OFFSET, ETC) (optional):* The title for the slab elevations report.
- *Back/Forward Edge Flag (BEAR, AZ, OR SKEW):* If the back or forward edge is defined by a BENT command, enter B here. Otherwise, leave blank.
- *Slab Break Options (BEAR, AZ, OR SKEW):* Used to selectively break back the back and forward edges of the slab. Enter X if neither the left nor right side is broken. Enter L if only the left side is broken. Enter R if only the right side is broken. If these fields are left blank the corners will be broken. These fields do not apply if no PSLB break lines are entered.
- *Plot Option (BEAR, AZ, OR SKEW):* Enter “0” to produce a plan plot and omit a profile plot, “1” to produce a plan plot and a profile plot, “2” to omit both a plan plot and a profile plot, or “3” to omit a plan plot and produce a profile plot.

NOTES ON SLAB COMMAND

SCALES

- Horizontal scale = 1:1; that is, one foot to one foot, or one meter to one meter. Thus, there is no scale factor.
- Vertical Scale = profile scale on SLEL
    - The vertical scale factor may be entered on any SLEL card immediately following a SLAB card. If the vertical scale factor is changing for each SLEL card, the profile plots will be broken into individual plots.
    - If no vertical scale is entered, the default scale is 1” = 20 feet per foot, or 1 meter = 20 meters.

ANNOTATION (SEE ***FIGURE 57 - EXAMPLE SLAB LINE ELEVATION PLOT****)*

- Title as in Name card with “SURFACE ELEVATION LEFT SLAB LINE” or “SURFACE ELEVATION RIGHT SLAB LINE.”
- Profiles – line connected elevations at slab edge points with “0” mark for each end of slab line.
- Axis – elevations at every inch on vertical axis, mark “+” and distance in feet at end slab lines on horizontal axis.

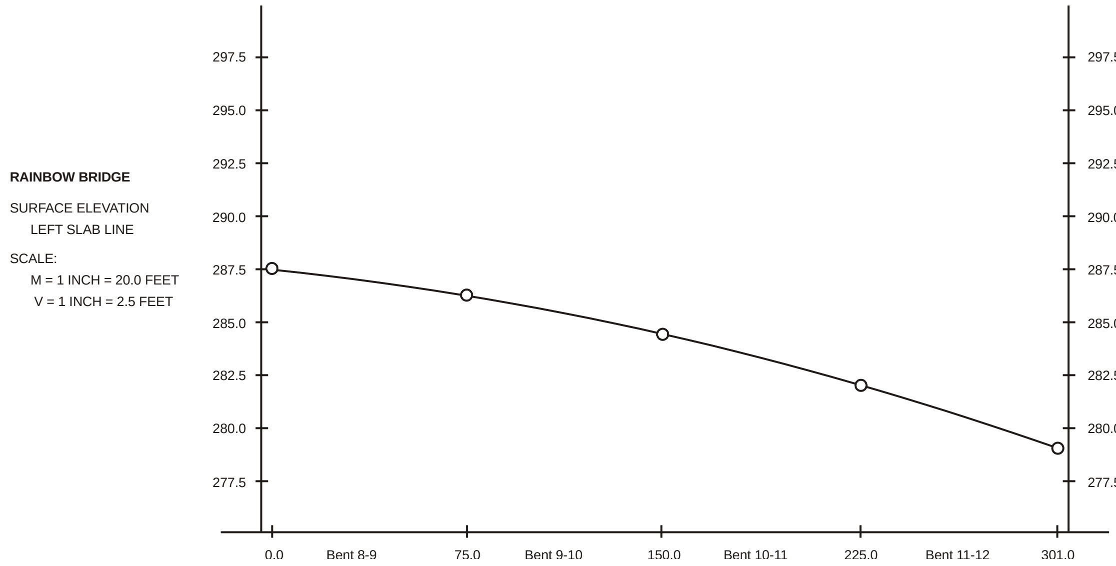


Figure 57 - Example Slab Line Elevation Plot

DATA PLOTTED

- Surface elevations versus true slab distances

LOCATION OF PLOTS

- After slab plan plot, on two axes –
    - top axis for left slab line
    - bottom axis for right slab line

Note that if a profile plot is desired at a scale other than 20 ft/in or 20 m/m, the scale must be entered on a SLEL card.

SLEL (SLAB ELEVATIONS)

FUNCTION

This command calculates and outputs a tabulation of distances, surface elevations, bottom-of-slab elevations, and bottom-of-slab elevations plus deflection along the edges of the slab. This command must be immediately preceded by a SLAB or another SLEL command. Note the following:

- Elevations are tabulated at either an incremented or at equal divisions along the transverse and longitudinal edges of the slab.

- If a slab has a broken transverse edge, the increments or divisions will start at the break line rather than the outside edge. However, the tabulation will include the outside points and any increments that fall between the outside edge and the break.

- For transverse edges, bottom-of-slab elevations use the interior slab depth. For longitudinal edges, bottom-of-slab elevations use the overhang slab depth.

- For curved longitudinal edges, chord and offset distances are tabulated as well. See **Figure 58 - Plan View Showing Location of Slab Elevations**.

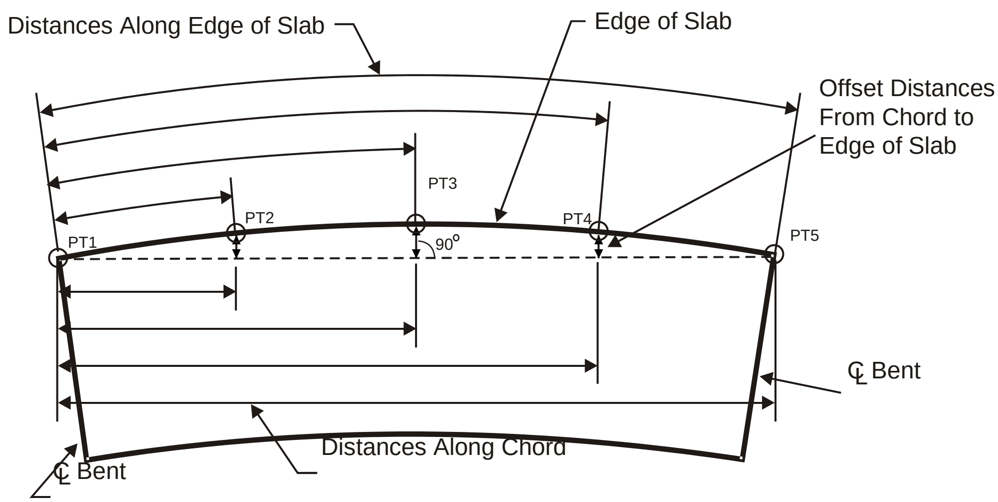


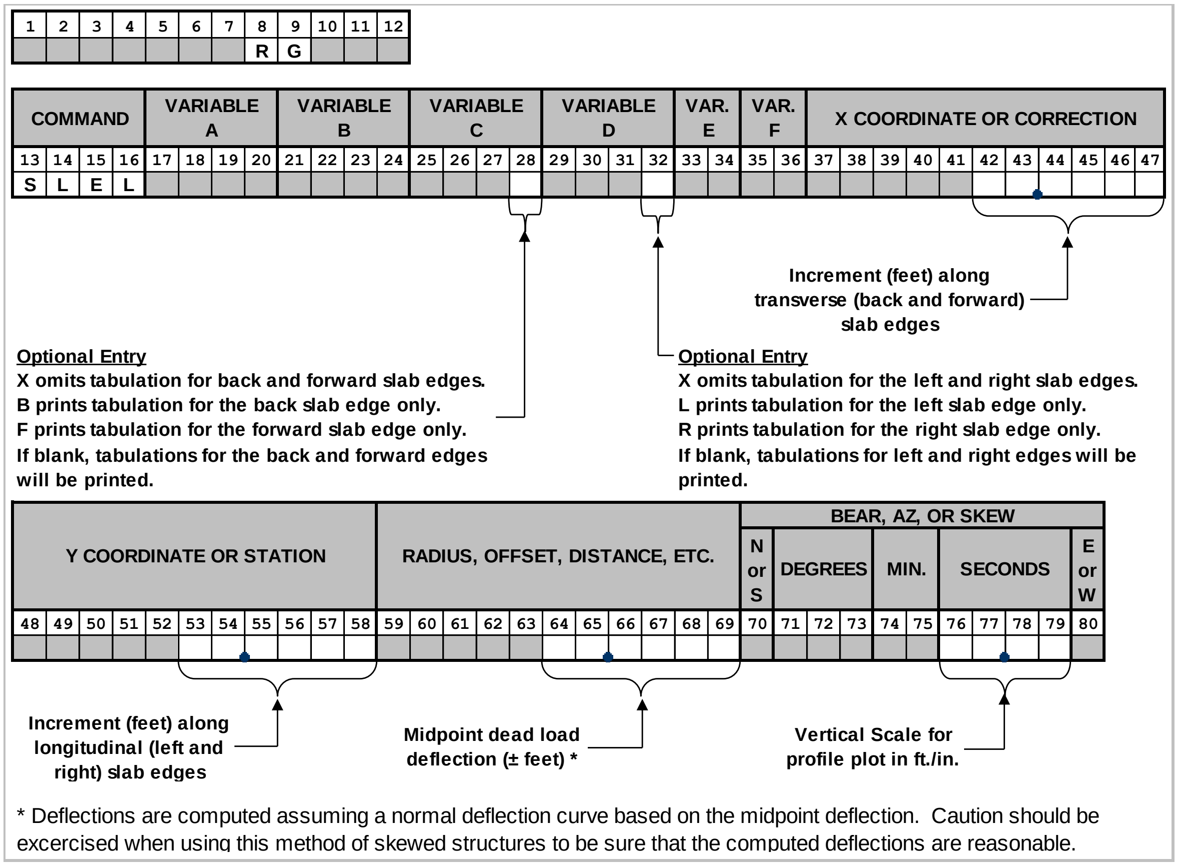
Figure 58 - Plan View Showing Location of Slab Elevations

USAGE

Use this command to produce a tabulation of distances, surface elevations, bottom of slab elevations, and bottom of slab elevations plus deflection along the boundaries of the slab.

SLEL ARGUMENT INPUT SCHEME A

Calculates and outputs elevations at an incremented distance along the transverse and longitudinal edges of the slab.



Card 69 - SLEL Argument Input Scheme A Card

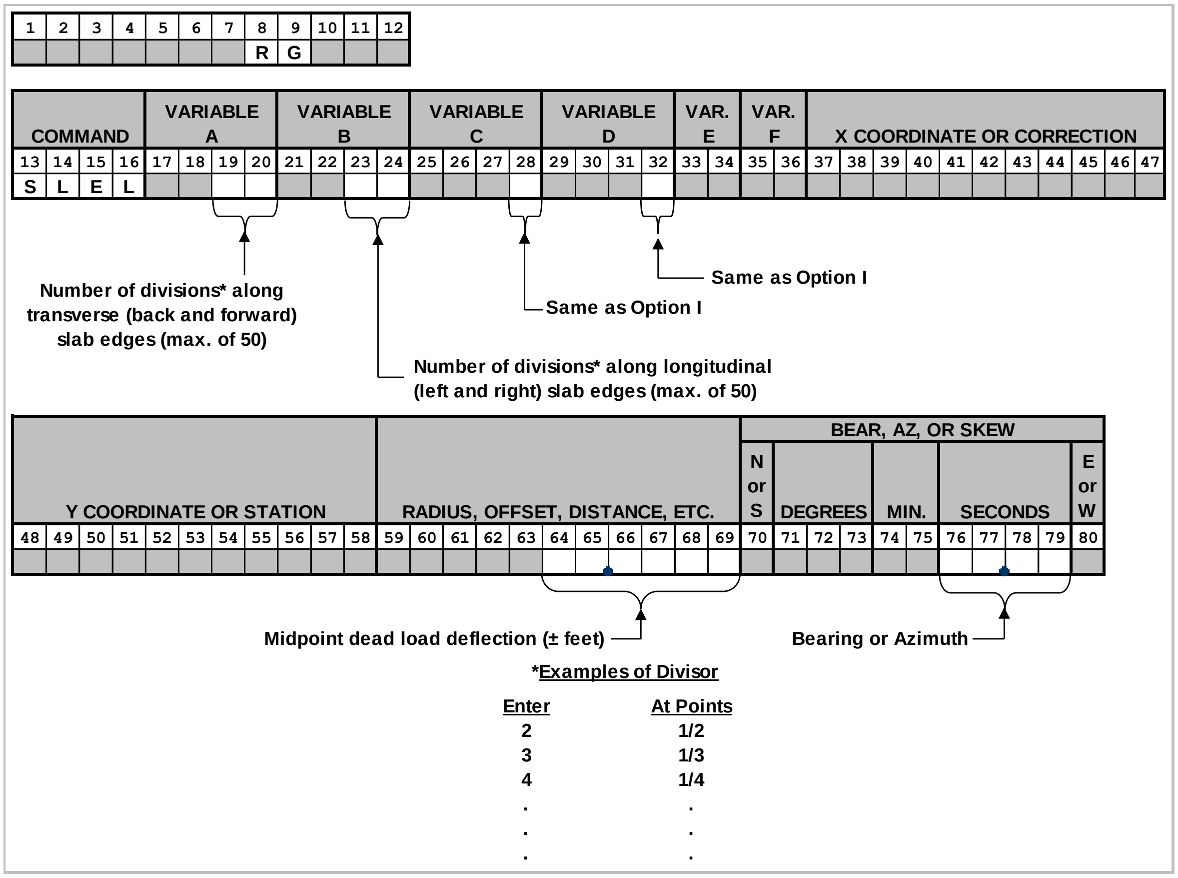
This argument input scheme requires the following data:

- *Forward/Backward Tabulation Option (VAR C) (optional):* Input X to omit the back and forward slab edges from calculations, B to output the back slab edge but not the forward, F to output the forward slab edge but not the back, and blank to output both back and forward edges.
- *Left/Right Tabulation Option (VAR D) (optional):* Input X to omit the left and right slab edges from calculations, L to output the left slab edge but not the right, R to output the right slab edge but not the left, and blank to output both left and right edges.
- *Increment (X-COORDINATE OR CORRECTION):* The increment to be used along the back and forward slab edges. Must divide the edge into no more than 50 segments. If the increment yields more than 50 segments, the slab edge is divided into 50 equal segments.
- *Increment (Y-COORDINATE OR STATION):* The increment to be used along the left and right slab edges. Must divide the edge into no more than 50 segments. If the increment yields more than 50 segments, the slab edge is divided into 50 equal segments.
- *Deflection (RADIUS, OFFSET, ETC):* The midpoint dead load deflection. Calculated deflections are based on a normal deflection curve derived from the midpoint deflection. Use caution for skewed structures.

- *Scale (BEAR, AZ, OR SKEW):* The vertical scale for the profile plot in feet/inch or meters/meter. Note that although the scale for the profile plot is entered here, the plot is requested by the SLAB command, by specifying a plot option of 1 or 3.

SLEL ARGUMENT INPUT SCHEME B

Calculates and outputs the data at equally spaced points along the slab edges.



Card 70 - SLEL Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Divisions (VAR A):* The number of divisions along back and forward slab edges, for a maximum of 50.
- *Divisions (VAR B):* The number of divisions along left and right slab edges, for a maximum of 50.
- *Forward/Backward Tabulation Option (VAR C):* Input X to omit the back and forward slab edges from calculations, B to output the back slab edge but not the forward, F to output the forward slab edge but not the back, and blank to output both back and forward edges.
- *Left/Right Tabulation Option (VAR D):* Input X to omit the left and right slab edges from calculations, L to output the left slab edge but not the right, R to output the right slab edge but not the left, and blank to output both the left and right edges.
- *Deflection (RADIUS, OFFSET, ETC):* The midpoint dead load deflection. Deflections are based on a normal deflection curve derived from the midpoint deflection. Use caution for skewed structures.

- *Scale (BEAR, AZ, OR SKEW):* The vertical scale for the profile plot in feet/inch. Note that although the scale for the profile plot is entered here, the plot is requested by the SLAB command, by specifying a plot option of 1 or 3.

BENT (BENT LINE)

FUNCTION

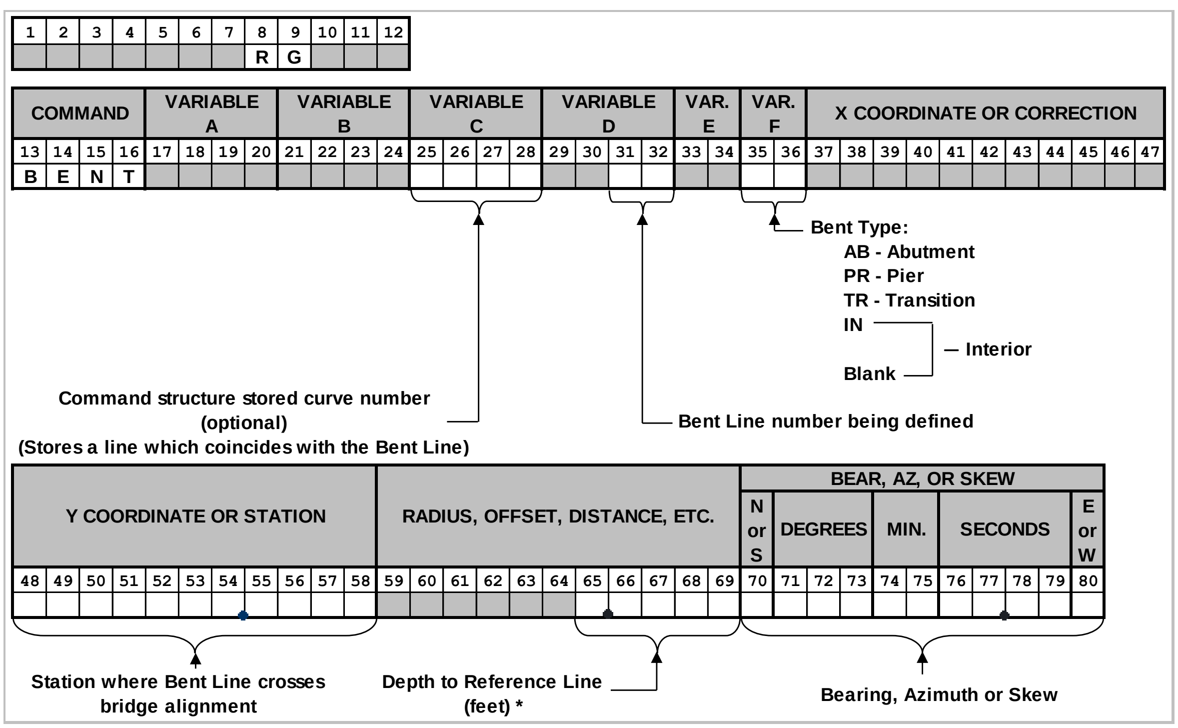
This command defines a bent line, which is a straight line representing the centerline of a bent or another supporting member of the structure.

USAGE

Use this command to define straight lines which represent the centerline of bents or other supporting members for structures. These bent lines may be for either simple or continuous units. The BENT command accomplishes the storage of bent lines. Designating a line as a bent line tells the system how it is to be treated in connection with intersections, framing layouts and other computations. Bent lines must be numbered consecutively from the beginning of the bridge to the end of the bridge; as many as 75 bents may be defined for a given structure. Bent line numbers are structure-dependent—that is, they may be repeated but must be redefined for a different structure under a different NAME command. Bent Lines may be defined by eight transverse line options similar to those used for defining TSLB Lines.

BENT ARGUMENT INPUT SCHEME A

This input scheme defines a bent line which crosses the bridge alignment at a given station. A bearing, azimuth, or skew may be entered at the user's option.



Card 71 - BENT Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *Station (Y-COORDINATE OR STATION):* The station where the bent line crosses the bridge alignment.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See below for a discussion of the reference line.
- *Bearing (BEAR, AZ, OR SKEW) (optional):* The bearing, azimuth, or skew of the bent line. If blank, the bent will be perpendicular to the alignment.

NOTES ON BENT COMMAND

REFERENCE LINE

The reference line is a line through space that gives the user facility for placement of the beam with reference to the roadway surface. It also serves to establish bearing seat elevations. Horizontally, the reference line always follows the actual position of the beam, but its vertical position is established by input depths from the roadway surface. The user might choose to have the reference line represent the top of the rolled section or the top of the web for plate girders, or let the reference line follow the top of the beam. Whatever the case might be, the user must enter a depth to the reference line on the BENT command or a depth below the reference line on the BRNG command to obtain depths other than zero. Reference line input information is provided below for simple and continuous spans.

SIMPLE SPAN

The depth to the reference line is input on the BENT command and the depth below the reference line is input on the BRNG command. If both are left blank for a simple span, then a zero depth will be used. See **Figure 59 - Simple Span**.

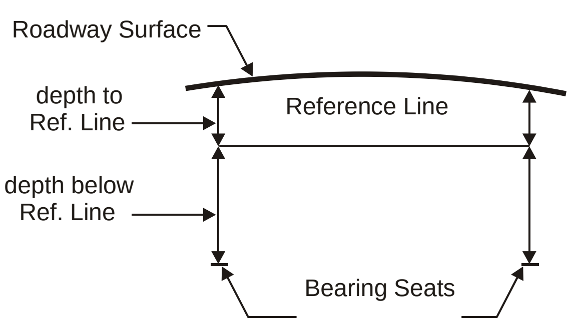


Figure 59 - Simple Span

CONTINUOUS UNIT

The depth to the reference line is input on the end bents (BENT) of the unit and at splice points (SPLC). The depth below the reference line is input on the BRNG command. Continuous frame options (FOPT command) chord the reference line through successive end bents and splice points. See **Figure 64 - Continuous Unit**.

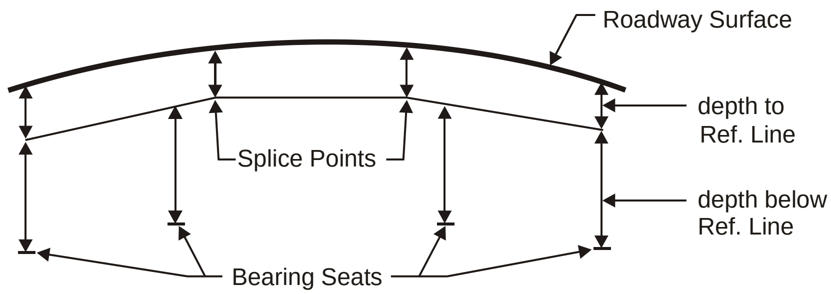


Figure 60 - Continuous Unit

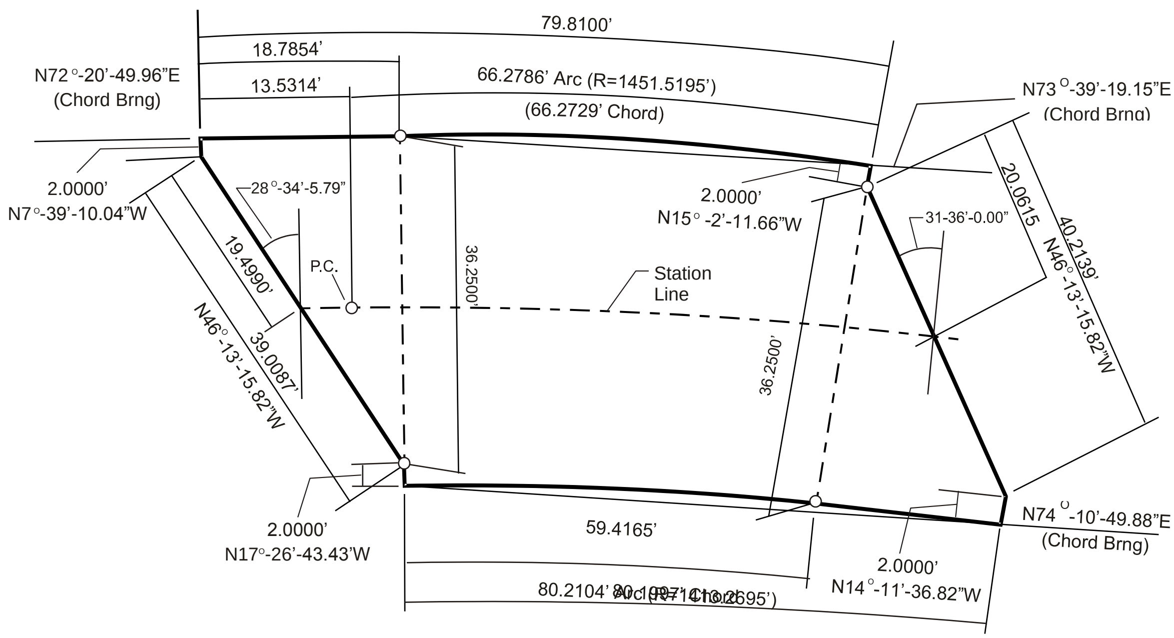
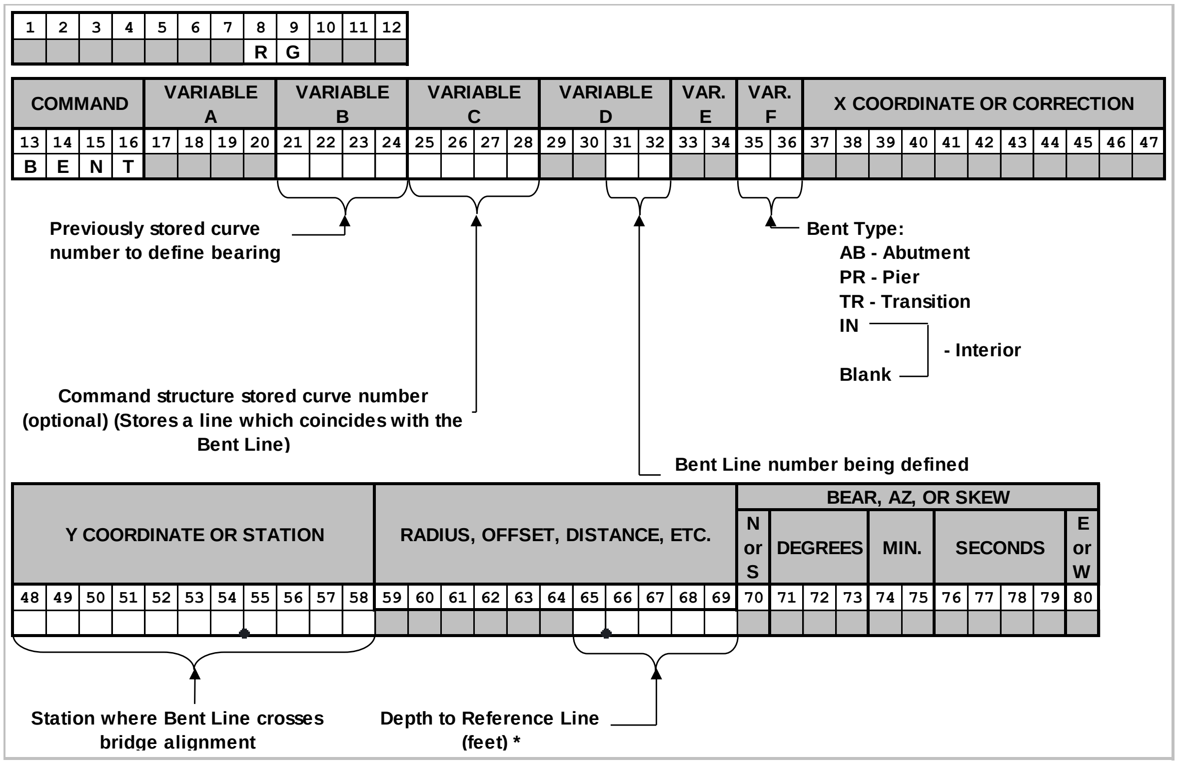


Figure 61 - Example Slab Diagram

BENT ARGUMENT INPUT SCHEME B

This input scheme defines a bent line which crosses the bridge alignment at a given station with the bearing of a stored curve.



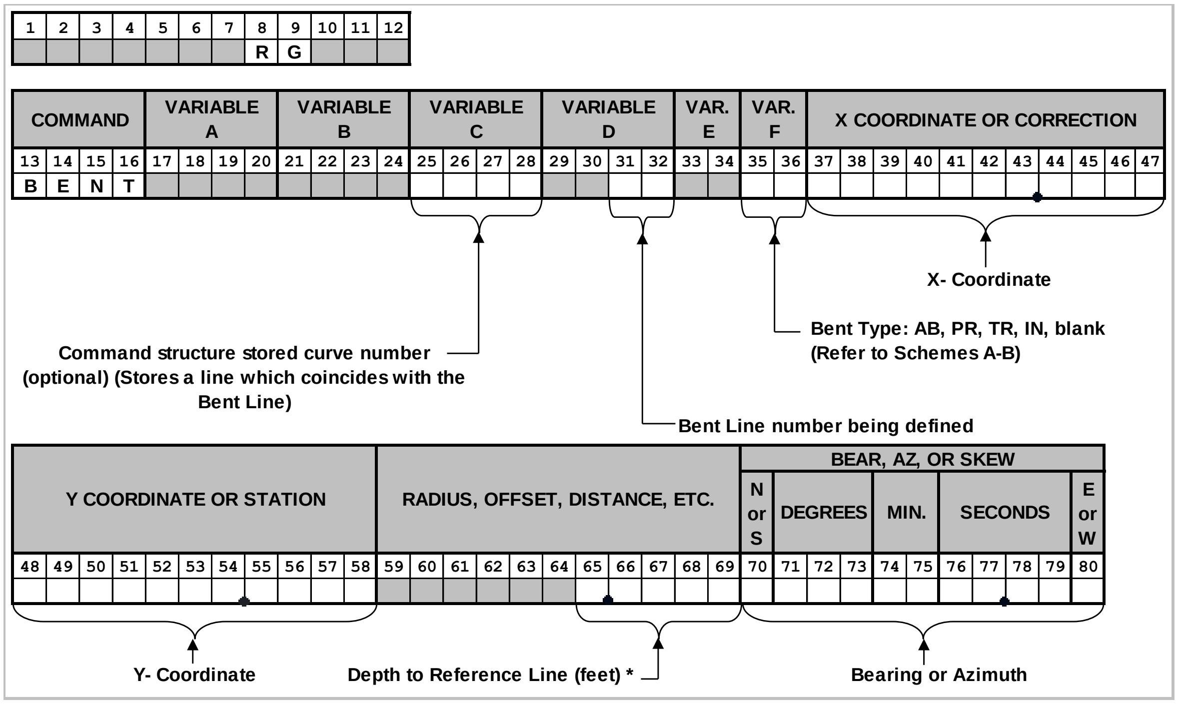
Card 72 - BENT Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve which defines the bearing of the bent line.
- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *Station (Y-COORDINATE OR STATION):* The station where the bent line crosses the bridge alignment.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.

BENT ARGUMENT INPUT SCHEME C

This input scheme defines a bent line through a given point and at a given bearing.



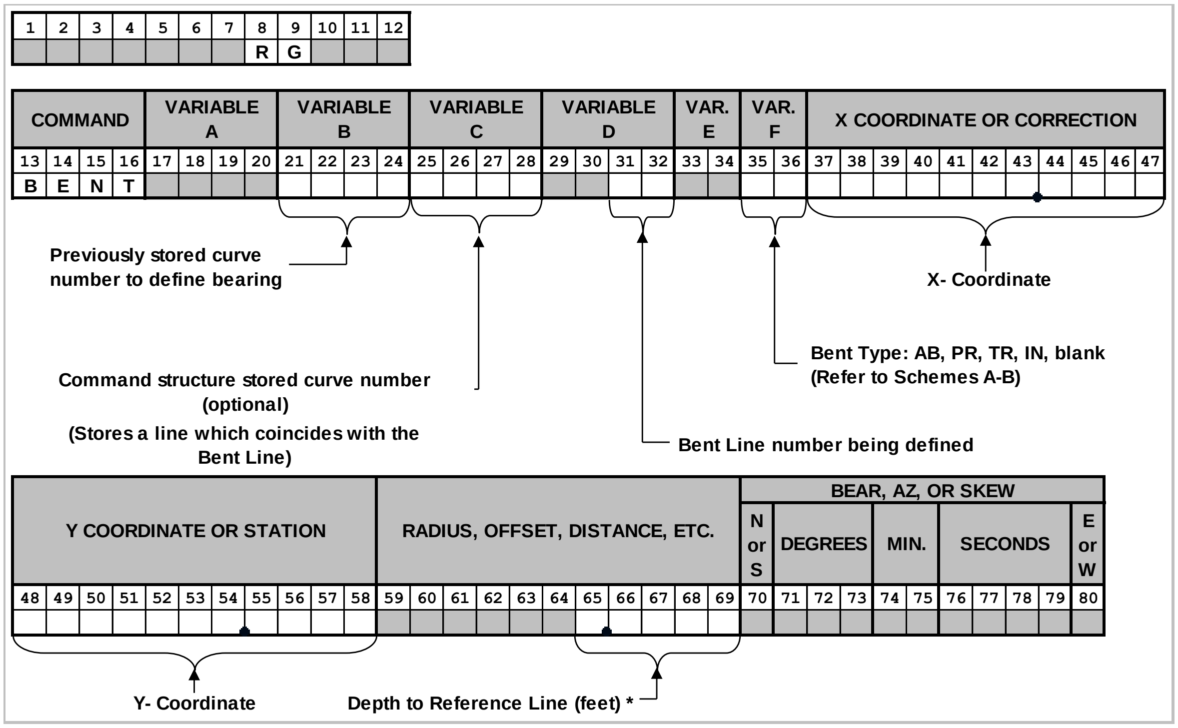
Card 73 - BENT Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the given point.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the given point.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.
- *Bearing or azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the bent line.

BENT ARGUMENT INPUT SCHEME D

This input scheme defines a bent line through a given point and at the bearing of a previously stored curve.



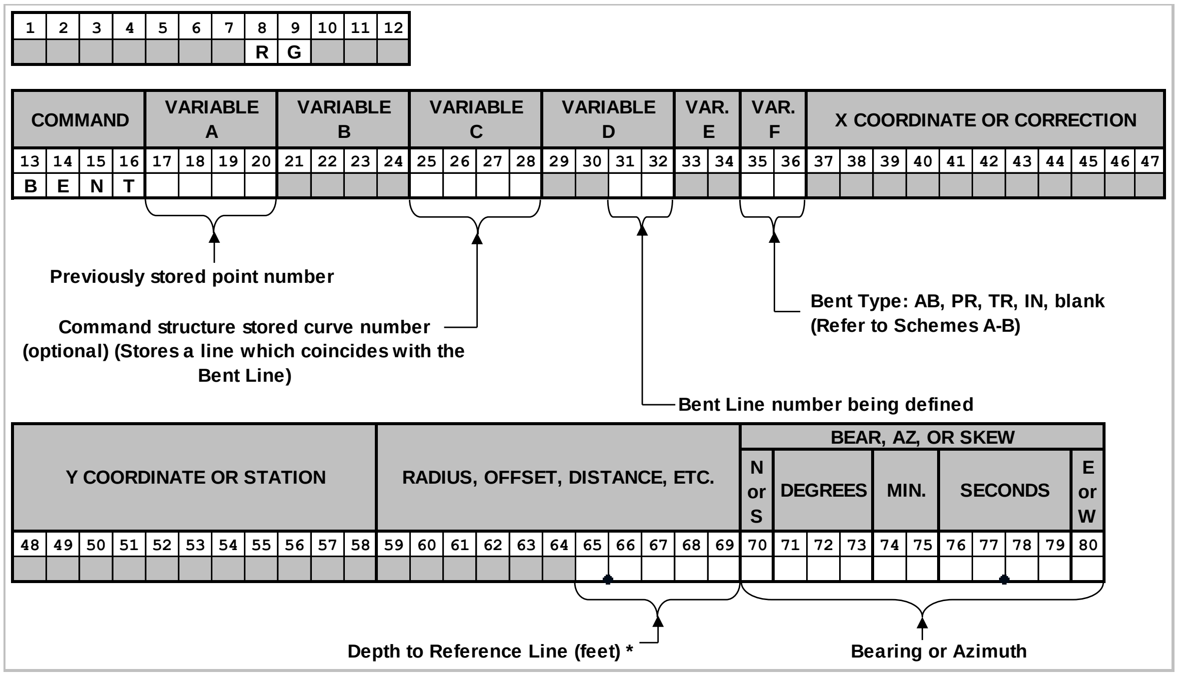
Card 74 - BENT Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Curve Number (VAR B):* The number of a previously stored curve to define the bearing of the bent line.
- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *X-Coordinate (X-COORDINATE OR CORRECTION)*: The X-coordinate of the given point.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the given point.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.

BENT ARGUMENT INPUT SCHEME E

This input scheme defines a bent line through a previously stored point and at a given bearing.



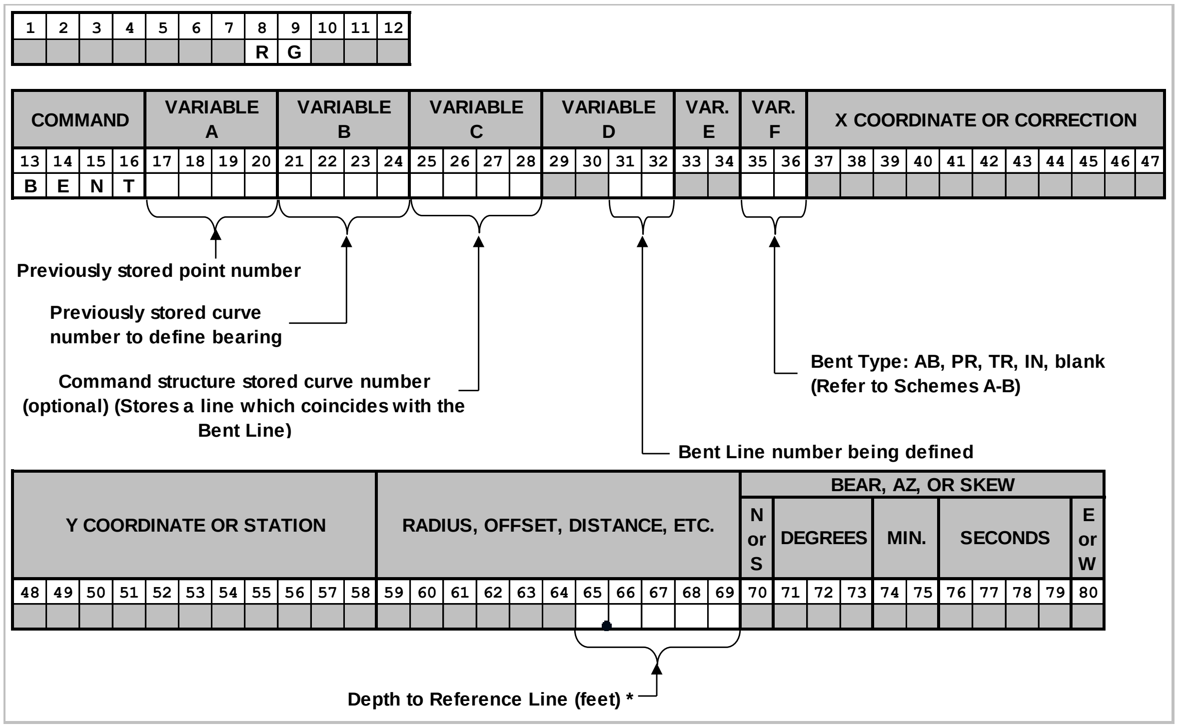
Card 75 - BENT Argument Input Scheme E Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of the previously stored point through which the bent line will pass.
- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the bent line.

BENT ARGUMENT INPUT SCHEME F

This input scheme defines a bent line through a previously stored point and at the bearing of a previously stored curve.



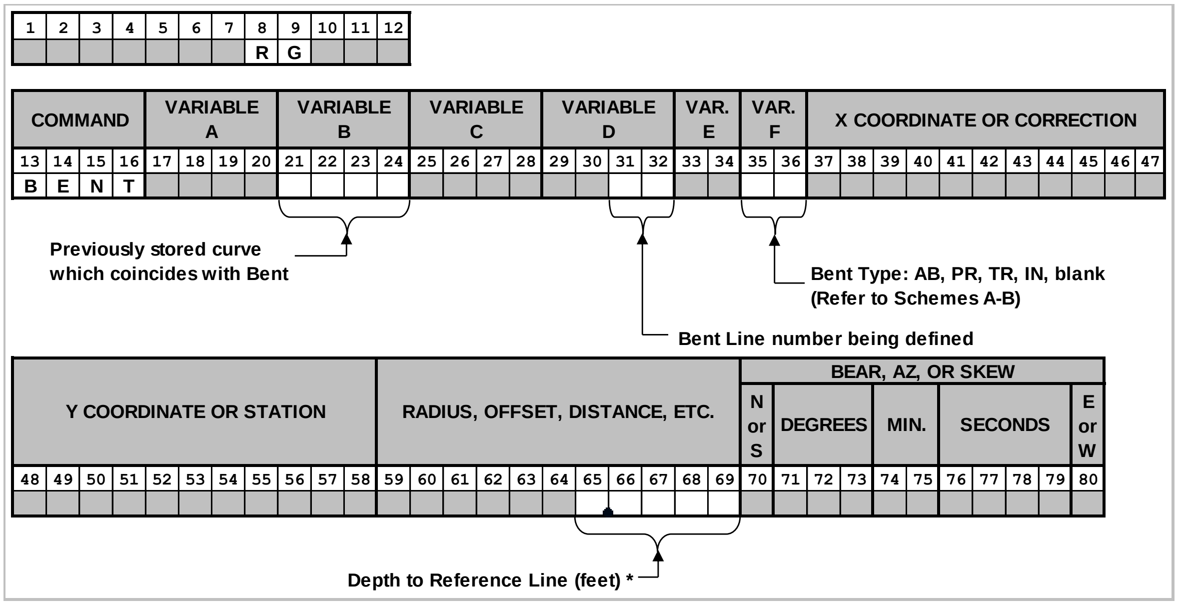
Card 76 - BENT Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of the previously stored point through which the bent line will pass.
- *Curve ID (VAR B):* The number of a previously stored curve to define the bearing of the bent line.
- *Curve ID (VAR C) (optional):* The number assigned to store a line coincident with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.

BENT ARGUMENT INPUT SCHEME G

This input scheme defines a bent line coincident with a previously stored curve.



Card 77 - BENT Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve coinciding with the bent line.
- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Bent Type (VAR F):* Either AB, PR, TR, or IN for abutment, pier, transition, or interior, respectively. If this field is left blank, the bent type defaults to interior.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Scheme A for a discussion of the reference line.

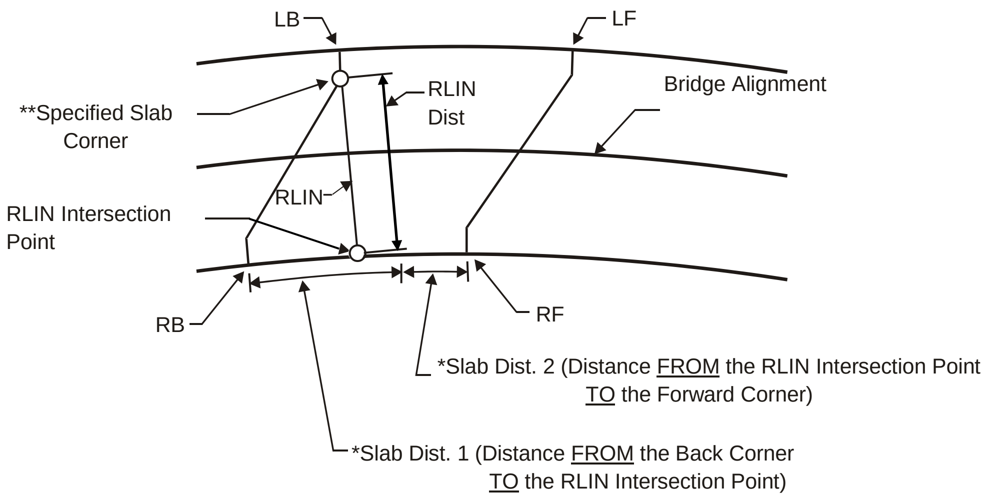
RLIN (RADIAL LINE)

FUNCTION

This command constructs, for the last SLAB command which precedes it, a radial line which passes through a specified slab corner and intersects the opposite side of the slab. The command computes the distance from the corner to the opposite side of the slab, and the distances from the opposite slab corners to the intersection point.

USAGE

Use this command to construct a line which passes through a specified slab corner and intersects the opposite side of the slab. It then computes distances that are useful in the layout of reinforcement bars. The output includes all of the input information, the X and Y coordinates of the specified slab corner and the RLIN intersection point (if the store option is used). The RLIN distance, slab distance 1, slab distance 2, and the bearing of the RLIN are also output in the X-coordinate, Y-coordinate, distance, and bearing fields, respectively. This command must be immediately preceded by a SLAB, SLEL, or another RLIN command. **Figure 62 - Computed Distances** illustrates the computed distances.



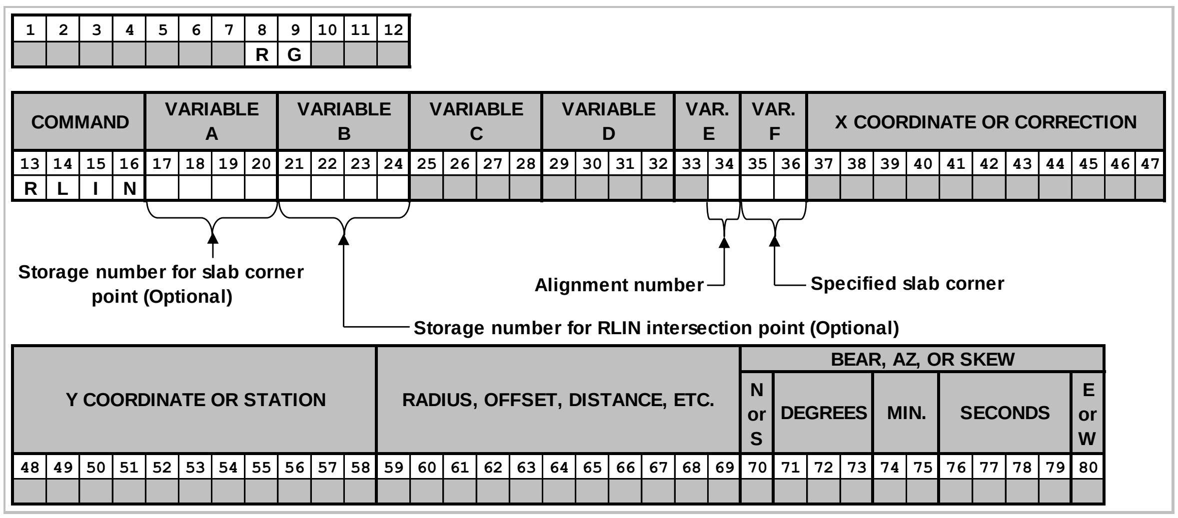
* These distances will be negative (-) when they are measured in the direction of decreasing stations.

** Here, the RLIN passes through the break-back point of the transverse slab line. However, when the transverse edge of the slab is broken, as shown here, The RLIN normally passes through the outside corner of the slab.

Figure 62 - Computed Distances

RLIN ARGUMENT INPUT SCHEME A

This input scheme defines the radial line through the slab corner perpendicular to the given alignment.



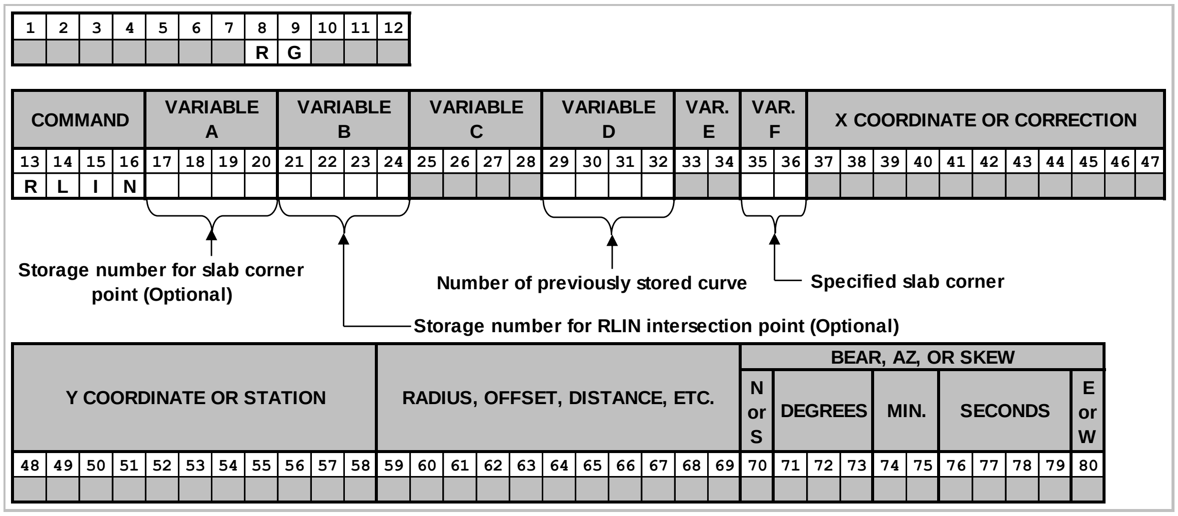
Card 78 - RLIN Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Point ID (optional):* The number to be assigned to the slab corner point, if it is to be stored.
- *Point ID (optional):* The number to be assigned to the point at which the RLIN line intersects the slab edge, if it is to be stored.
- *Roadway Alignment:* The letter assigned to the alignment perpendicular to which the RLIN will be constructed.
- *Slab Corner:* LB, RB, LF, and RF for left back, right back, left forward, and right forward corners, respectively. *Note*: For broken-back slab edges, the slab corner specified will be the break-back point, rather than the exterior slab corner.

RLIN ARGUMENT INPUT SCHEME B

This input scheme defines the radial line through the slab corner and perpendicular to the given curve.



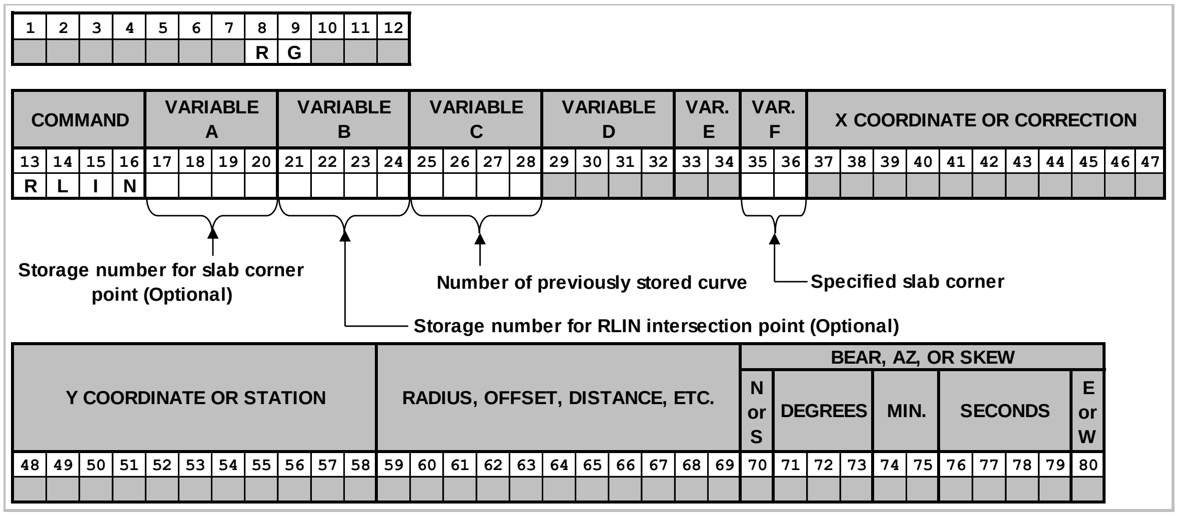
Card 79 - RLIN Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Point ID (optional):* The number to be assigned to the slab corner point, if it is to be stored.
- *Point ID (optional):* The number to be assigned to the point at which the RLIN line intersects the slab edge, if it is to be stored.
- *Curve ID:* The number of a previously stored curve perpendicular to which the RLIN line will be constructed.
- *Slab Corner*: LB, RB, LF, and RF for left back, right back, left forward, and right forward corners, respectively. Note: For broken-back slab edges, the slab corner specified will be the break-back point, rather than the exterior slab corner.

RLIN ARGUMENT INPUT SCHEME C

This input scheme defines the radial line through the slab corner and parallel to the given curve.



Card 80 - RLIN Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Point ID (optional):* The number to be assigned to the slab corner point, if it is to be stored.
- *Point ID (optional):* The number to be assigned to the point at which the RLIN line intersects the slab edge, if it is to be stored.
- *Curve ID:* The number of previously stored curve parallel to which the RLIN line will be constructed.
- *Slab Corner:* LB, RB, LF, and RF for left back, right back, left forward, and right forward corners, respectively.

Note: For broken-back slab edges, the slab corner specified will be the break-back point, rather than the exterior slab corner.

BRNG (BEARING SEAT)

FUNCTION

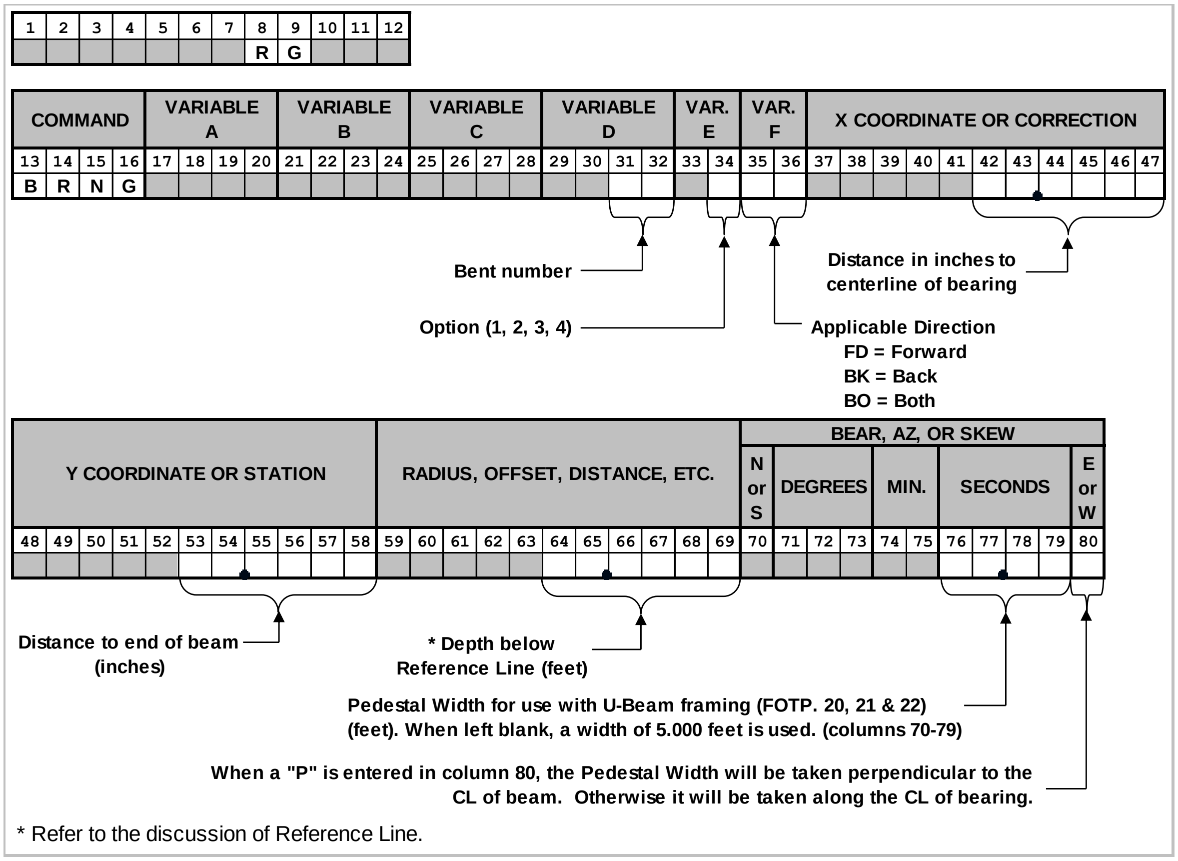
This command establishes a bearing seat centerline relative to the bent lines and to the reference line, if defined. See Command BENT, Scheme A, for a discussion of the reference line.

USAGE

Use this command to locate the centerline of bearing seats relative to the bent lines and Reference Line. Three options are available for defining the centerline of the bearing seat. Refer to bridge standards for beam end distances and distances to centerline of bearing. The option chosen must be compatible with the measurement scheme and distance values shown on the standards.

BRNG ARGUMENT INPUT SCHEME

This input scheme defines the centerline of bearing seats using different distance options.



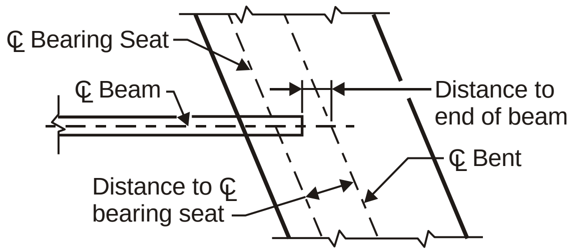
Card 81 - BRNG Argument Input Scheme Card

This argument input scheme requires the following data:

- *Bent Line Number (VAR D):* The number assigned to the bent line.
- *Distance Option (VAR E):* A number 1–4 that specifies the measurement option as depicted in **Figure 63 - Measurement Options**.
- *Applicable Direction (VAR F):* The location of the bearing line offset with respect to the centerline of bent, looking in the direction of increasing station. Enter “FD” (forward) for bearing seats on the forward side of the bent line, “BK” (back) for bearing seats on the back side of the bent line, or “BO” (both) if the bearing deduct and other measurements apply in both directions.
- *Distance to Centerline of Bearing (X-COORDINATE OR CORRECTION):* Measured in inches. See Distance Options 1-4 above for orientation of measurement and applicable beam standards for distance values.
- *Distance to End of Beam (Y-COORDINATE OR STATION):* Measured in inches. See Distance Options 1-4 above for orientation of measurement and applicable beam standards for distance values.
- *Depth Below Reference Line (RADIUS, OFFSET, ETC):* The vertical distance from the reference line to the bearing seat at the centerline of the bearing seat. This value is also known as the bearing deduct. See Command BENT, Scheme A, for a discussion of the reference line.

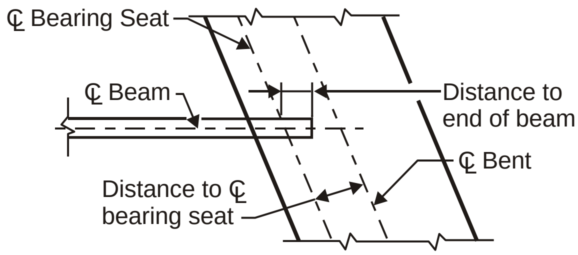
- *Pedestal Width (BEAR, AZ, OR SKEW):* The width of the U-beam pedestal. Use only for U-beams.
- *Pedestal Width Option (BEAR, AZ, OR SKEW):* P or blank as depicted above. Use only for U-beams.

Distance Option 1



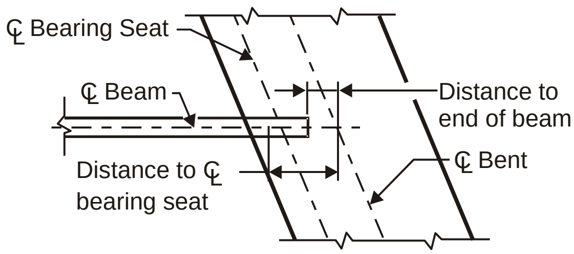
(a)

Distance Option 2



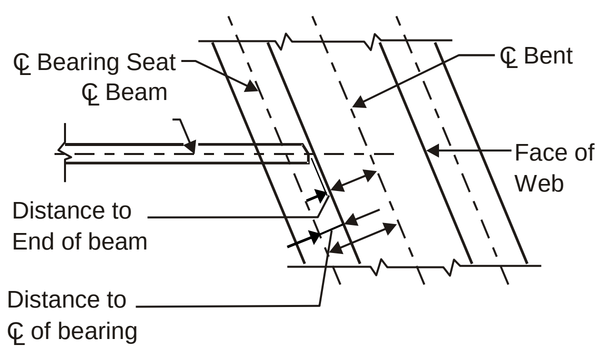
(b)

Distance Option 3



(c)

Distance Option 4



(d)

Figure 63 - Measurement Options

NOTE ON USAGE OF OPTION 4

For steel units with bearing offsets perpendicular to the bent use Option 4.

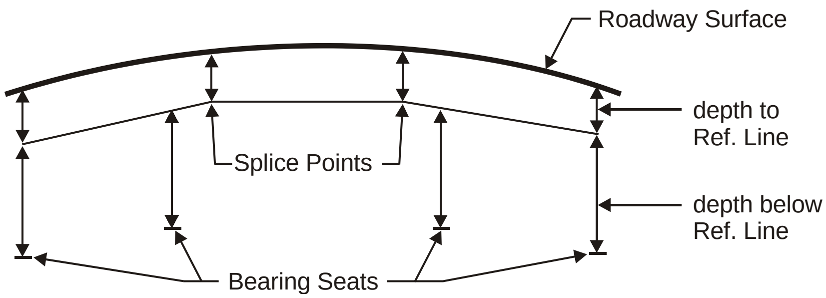


Figure 64 - Continuous Unit

DIAF (DIAPHRAGM LINE)

FUNCTION

Defines diaphragm lines, which are straight lines indicating the locations of diaphragm members between beams.

USAGE

Use this command to define straight lines which indicate the locations of diaphragm members between beams. Diaphragm locations may be specified by defining a straight line by one of the transverse (BENT or TSLB) line methods, or an automatic option may be exercised to specify the location of diaphragm lines at the mid-point, quarter points, third points, etc., of the simple or continuous span. Diaphragms must be entered in order of increasing stations. A typical application of both approaches is shown in **Figure 65 - Diaphragm Locations**.

Note: The limits stated in the **RDS User Manual** and any that may be stated in this *BGS User Guide* on the number of TSLBs, SPLCs, DIAFs, and BEAMs are not strict maximums. The user may specify as many of each as needed, as long as their summation does not exceed 219.

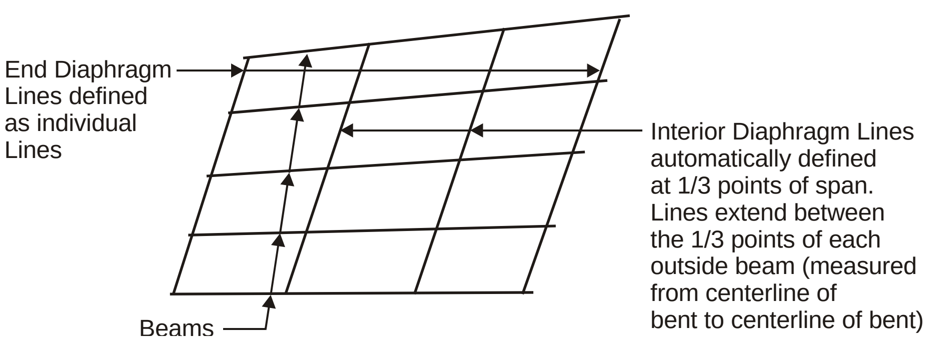


Figure 65 - Diaphragm Locations

Diaphragm members may be located along the lines defined by either method or they may be specified to be located in a staggered pattern as illustrated in **Figure 66 - Staggered Diaphragms.**

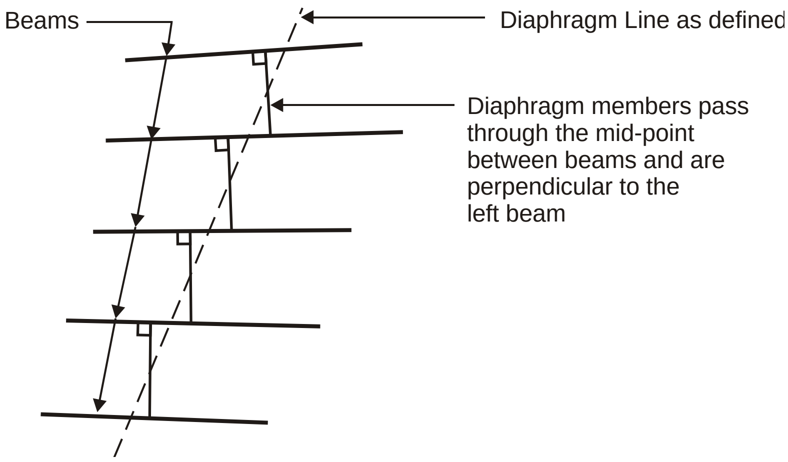


Figure 66 - Staggered Diaphragms

The user may specify limits for diaphragms which are defined as single lines by giving the beam numbers between which the diaphragm line applies. This feature is optional. If no beam numbers are given, the diaphragm will be assumed to apply to all beams. When specifying the limits of diaphragm lines, the actual beam numbers for the applicable unit must be used, <u>not beam line numbers.</u> Regardless of beam line numbers which apply to a unit, <u>the system treats the leftmost beam as number one</u>; therefore, the third beam from the left would be number three. The option to limit the extent of diaphragm lines is illustrated in **Figure 67** - **Diaphragm Limits**.

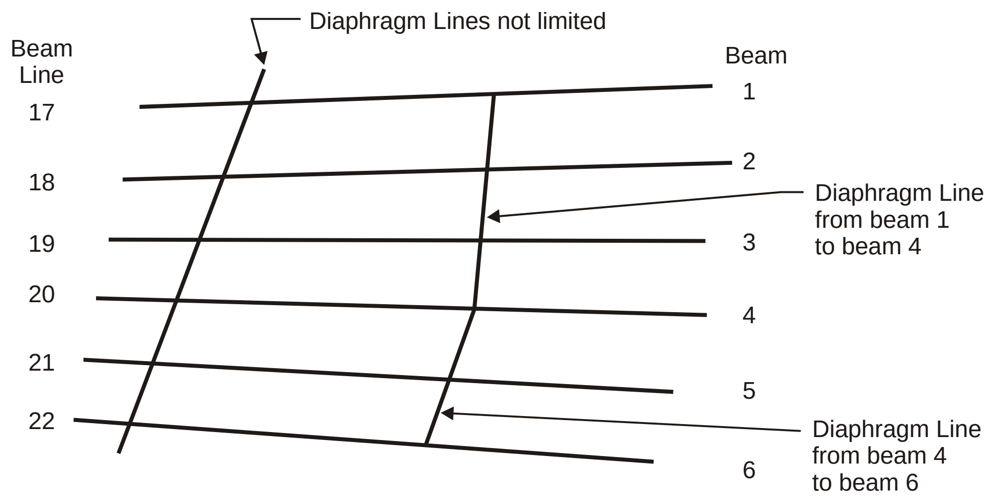
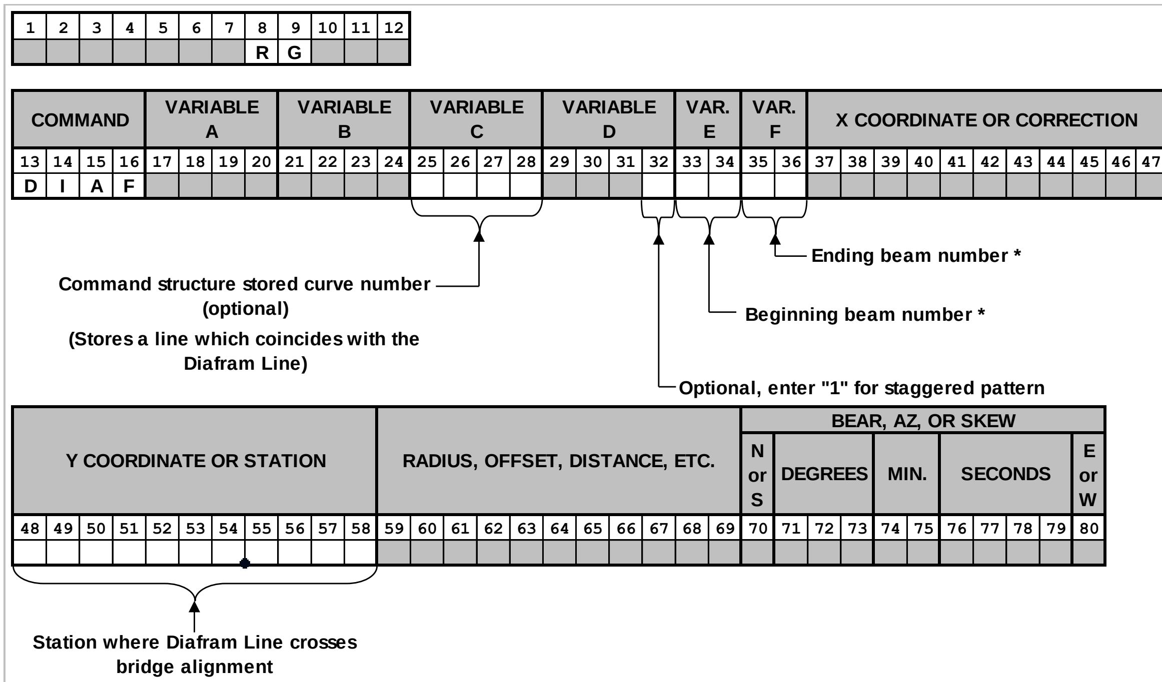


Figure 67 - Diaphragm Limits

- Diaphragm lines are not assigned numbers; they are applied automatically to the appropriate units.

DIAF ARGUMENT INPUT SCHEME A

This input scheme defines a diaphragm line perpendicular or radial to the bridge alignment at a given station.



* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

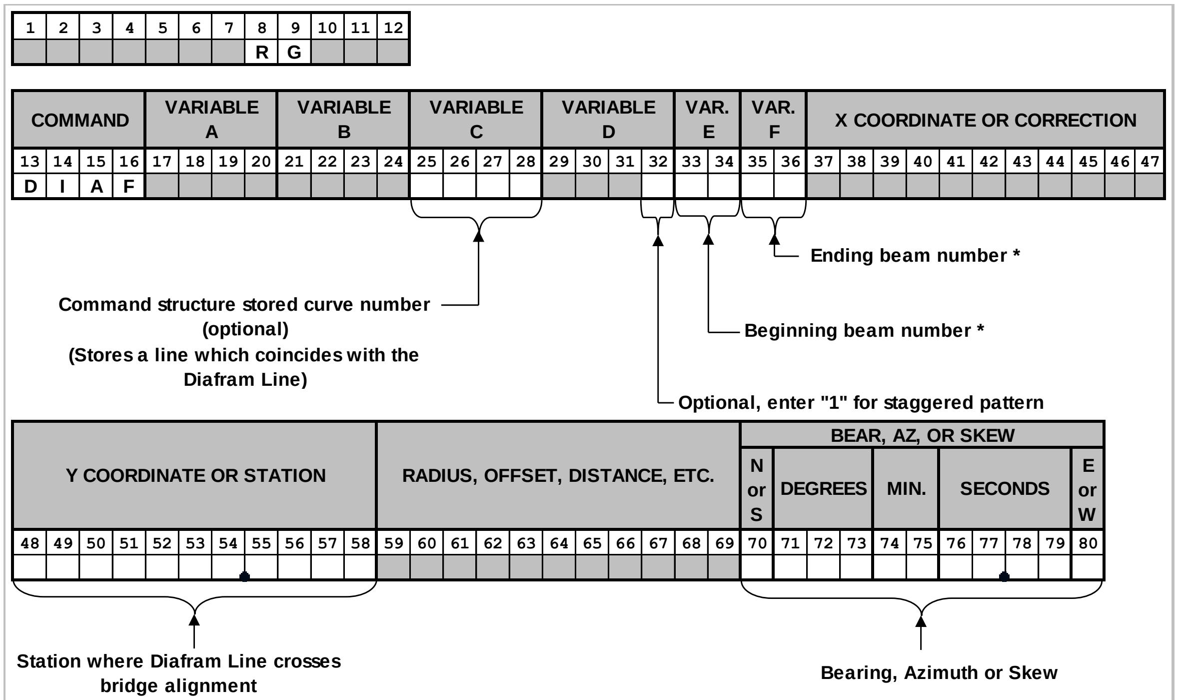
Card 82 - DIAF Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *Station (Y-COORDINATE OR STATION):* The station where the diaphragm line crosses the bridge alignment.

DIAF ARGUMENT INPUT SCHEME B

This input scheme defines a diaphragm line that crosses the bridge line at a given station and given bearing, azimuth, or skew.



* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

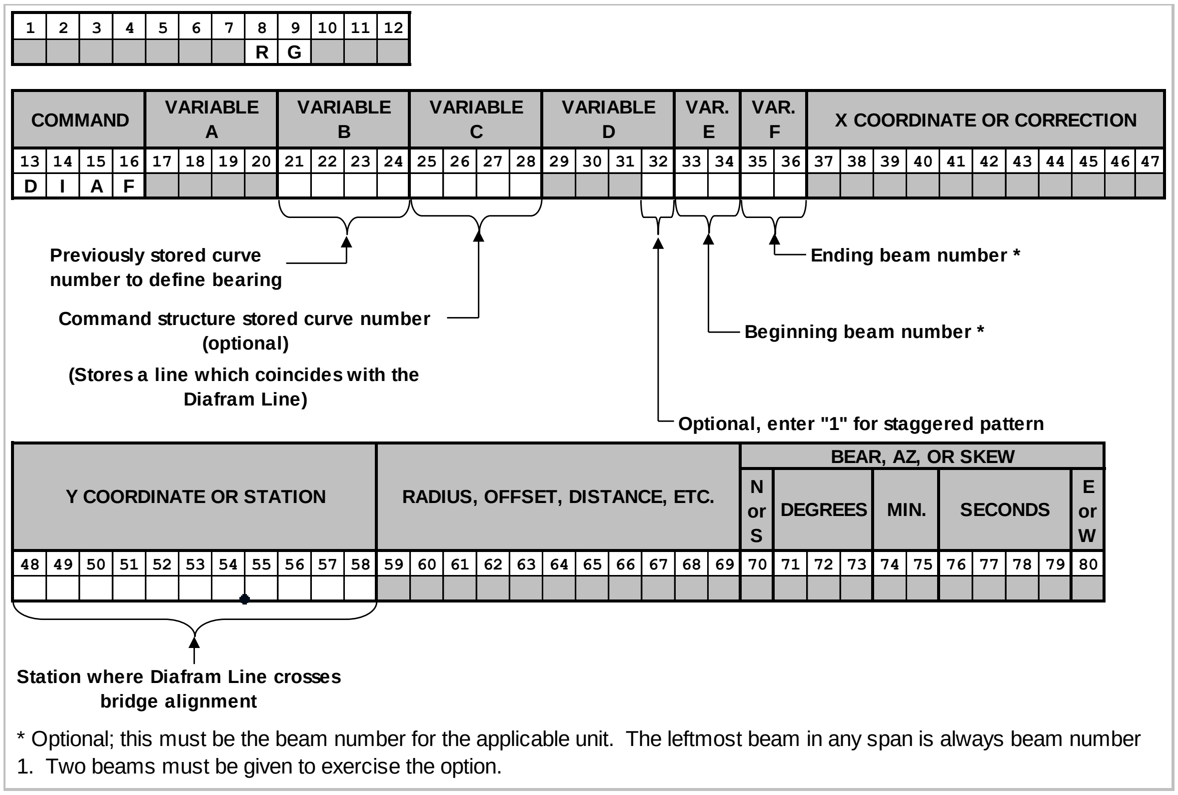
Card 83 - DIAF Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *Station (Y-COORDINATE OR STATION):* The station where the diaphragm line crosses the bridge alignment.
- *Bearing, Azimuth, or Skew (BEAR, AZ, OR SKEW):* The bearing or azimuth of the diaphragm line or its skew relative to the bridge alignment.

DIAF ARGUMENT INPUT SCHEME C

This input scheme defines a diaphragm line that crosses the bridge alignment at a given station and at the bearing of a stored curve.



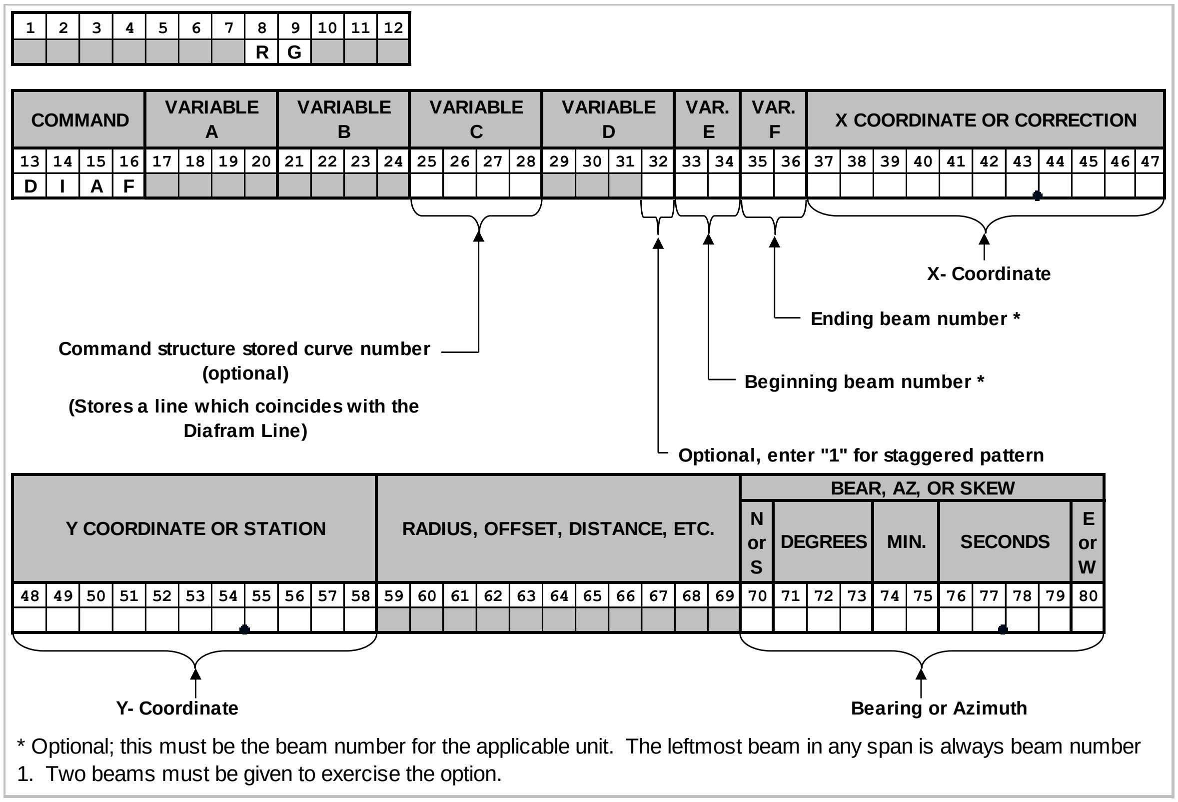
Card 84 - DIAF Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve. The bearing of this curve will be used as the bearing of the diaphragm line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *Station (Y-COORDINATE OR STATION):* The station where the diaphragm line crosses the bridge alignment.

DIAF ARGUMENT INPUT SCHEME D

This input scheme defines a diaphragm line which passes through a given point at a given bearing or azimuth.



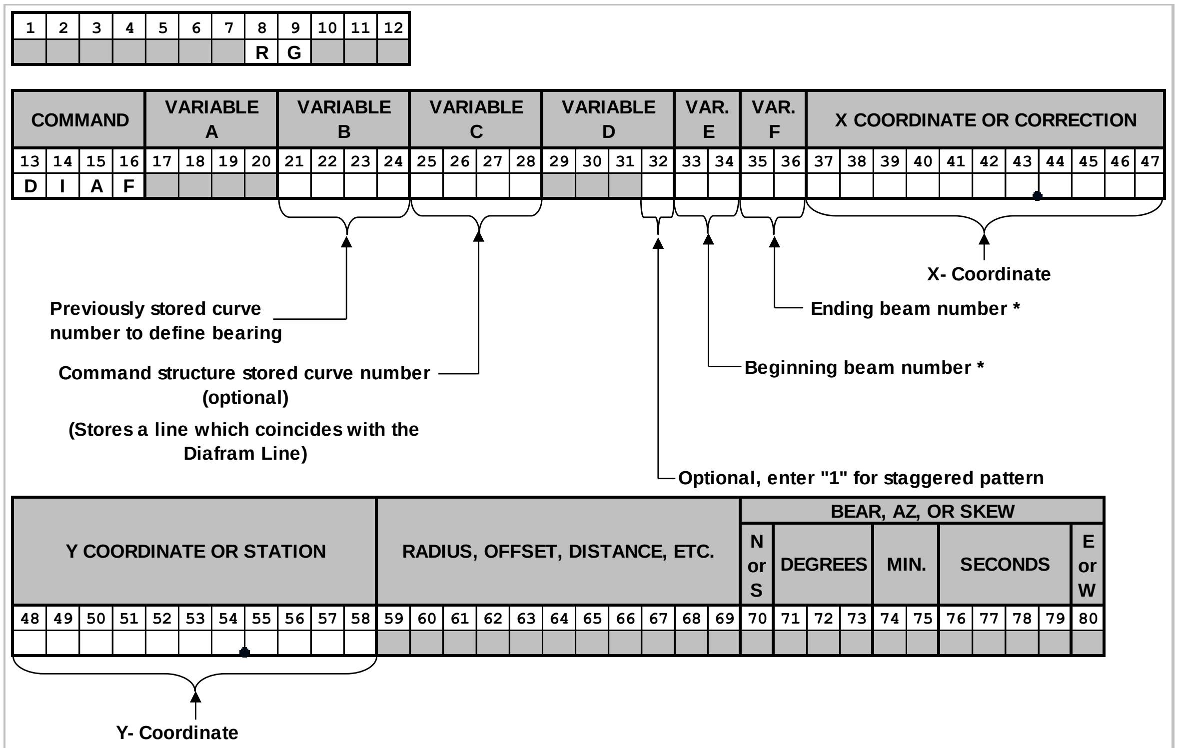
Card 85 - DIAF Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Curve ID (VAR B) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the given point that the diaphragm line will intersect.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the given point that the diaphragm line will intersect.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the diaphragm line.

DIAF ARGUMENT INPUT SCHEME E

This input scheme defines a diaphragm line through a given point at the bearing of a stored curve.



* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

Card 86 - DIAF Argument Input Scheme E Card

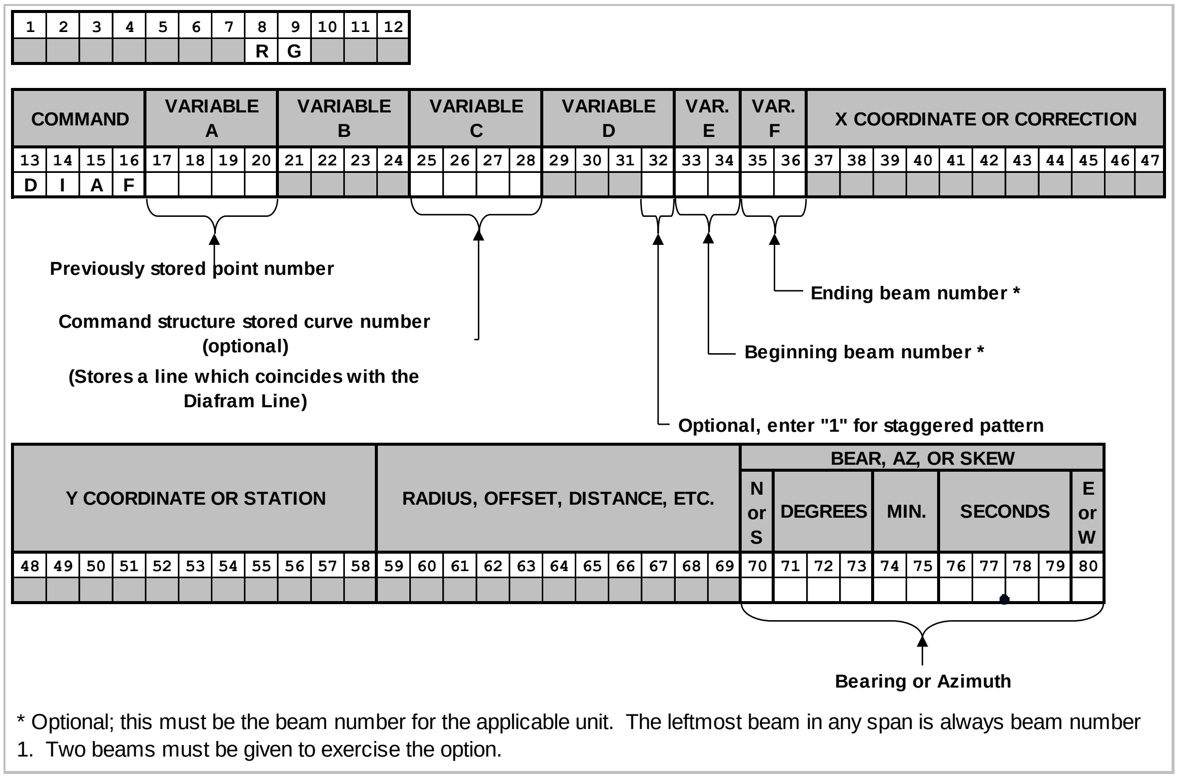
This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve. The bearing of this curve will be used as the bearing of the diaphragm line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the given point that the diaphragm line will intersect.

- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the given point that the diaphragm line will intersect.

DIAF ARGUMENT INPUT SCHEME F

This input scheme defines a diaphragm line through a stored point at a given bearing or azimuth.



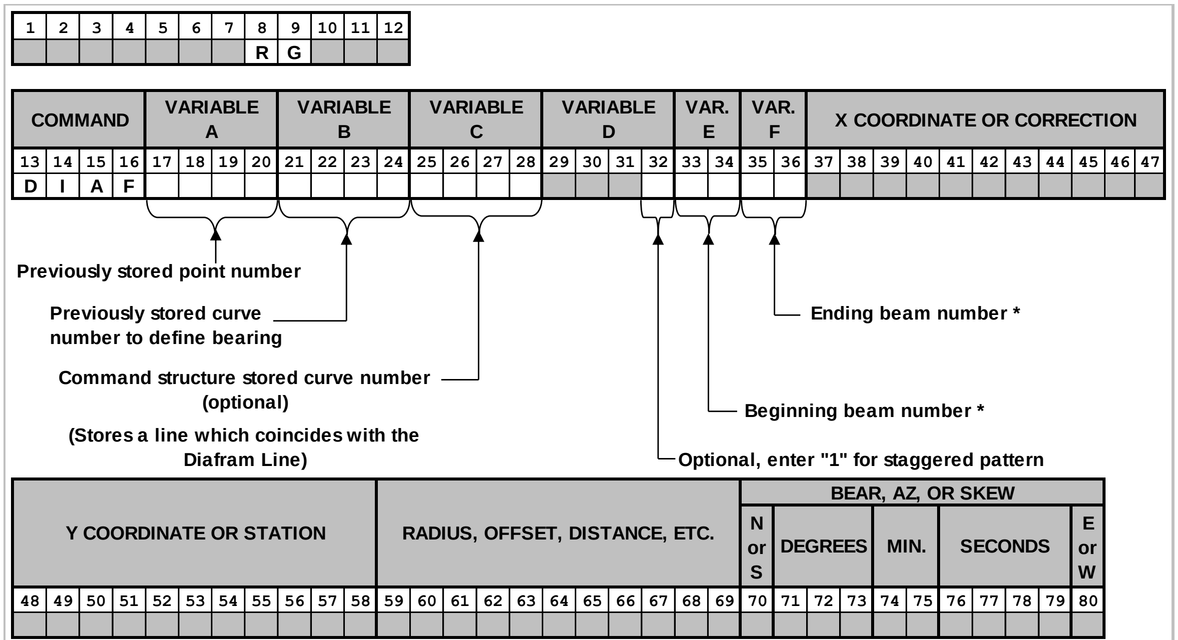
Card 87 - DIAF Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored point that the diaphragm line will intersect.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the diaphragm line.

DIAF ARGUMENT INPUT SCHEME G

This input scheme defines a diaphragm line through a stored point at the bearing of a stored curve.



* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

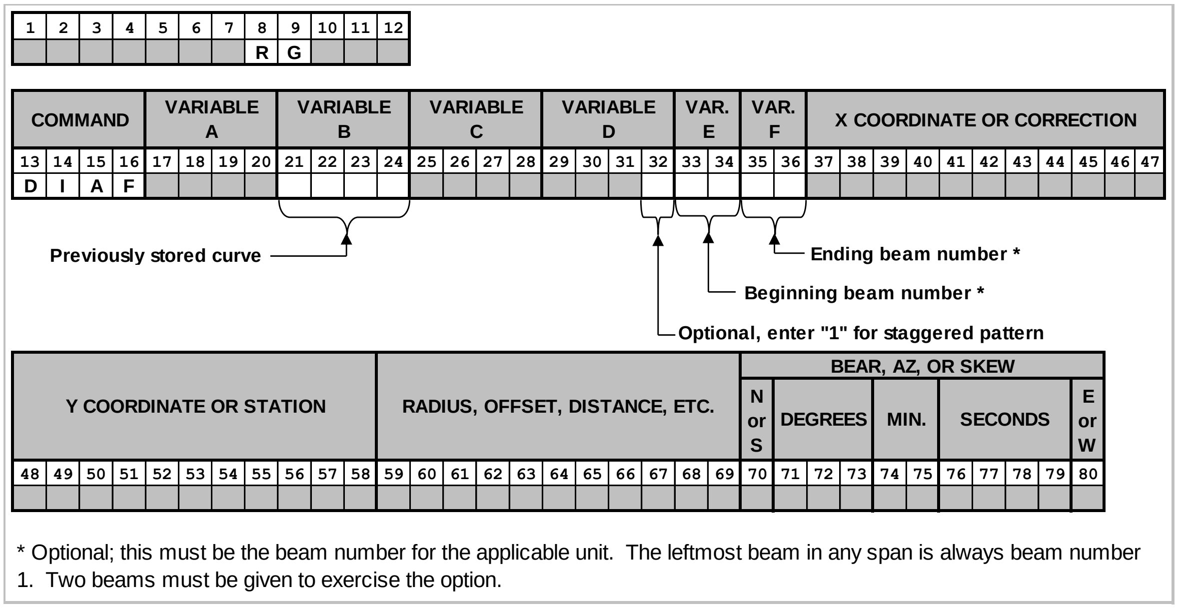
Card 88 - DIAF Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored point that the diaphragm line will intersect.
- *Curve ID (VAR B):* The number of a previously stored curve. The bearing of this curve will be used as the bearing of the diaphragm line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the diaphragm line.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.

DIAF ARGUMENT INPUT SCHEME H

This input scheme defines a diaphragm line that coincides with a stored curve.



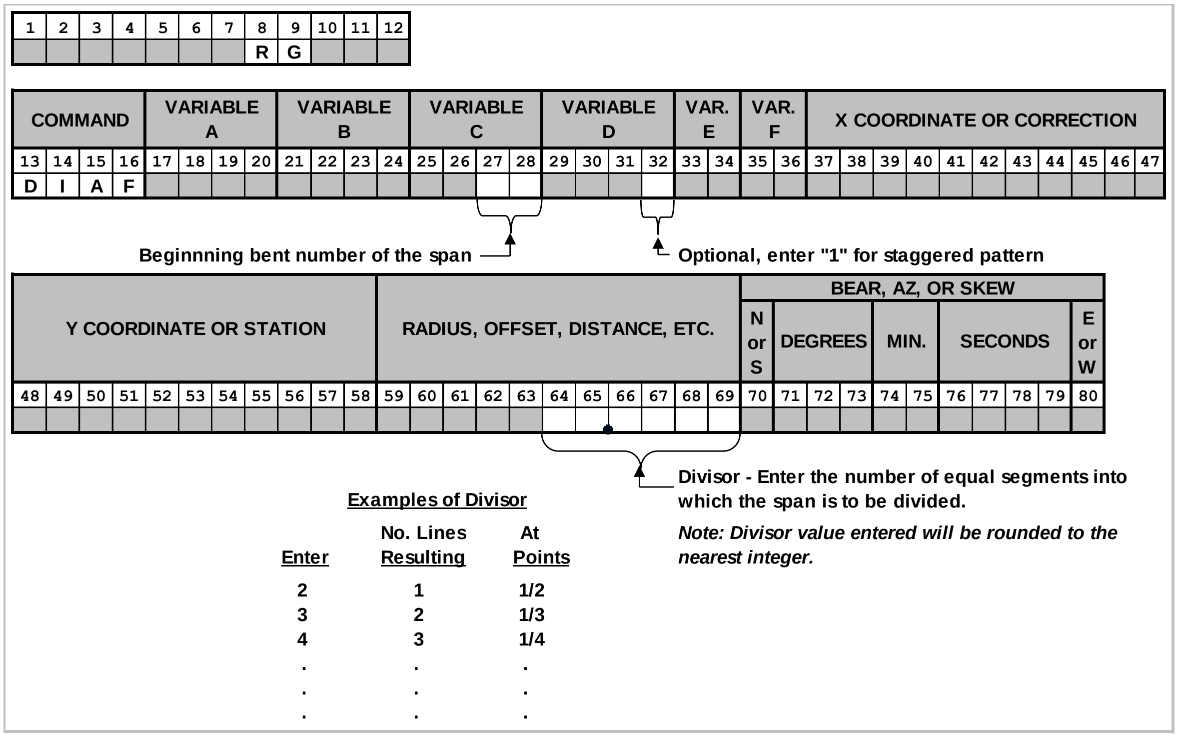
Card 89 - DIAF Argument Input Scheme H Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve. The diaphragm line will coincide with this curve.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Left Beam Number (VAR E) (optional):* The beam where the diaphragm line begins. Not necessarily the Beam Line Number; the leftmost beam is always number one. If blank, the diaphragm line will apply to all the beams in the span.
- *Right Beam Number (VAR F) (optional):* The beam where the diaphragm line ends. This field must be entered if the Left Beam Number is entered. Not necessarily the Beam Line Number; the leftmost beam is always number one.

DIAF ARGUMENT INPUT SCHEME I

This input scheme defines diaphragm lines at equal divisions along exterior beams. In this scheme, diaphragm lines are defined automatically for a given span.



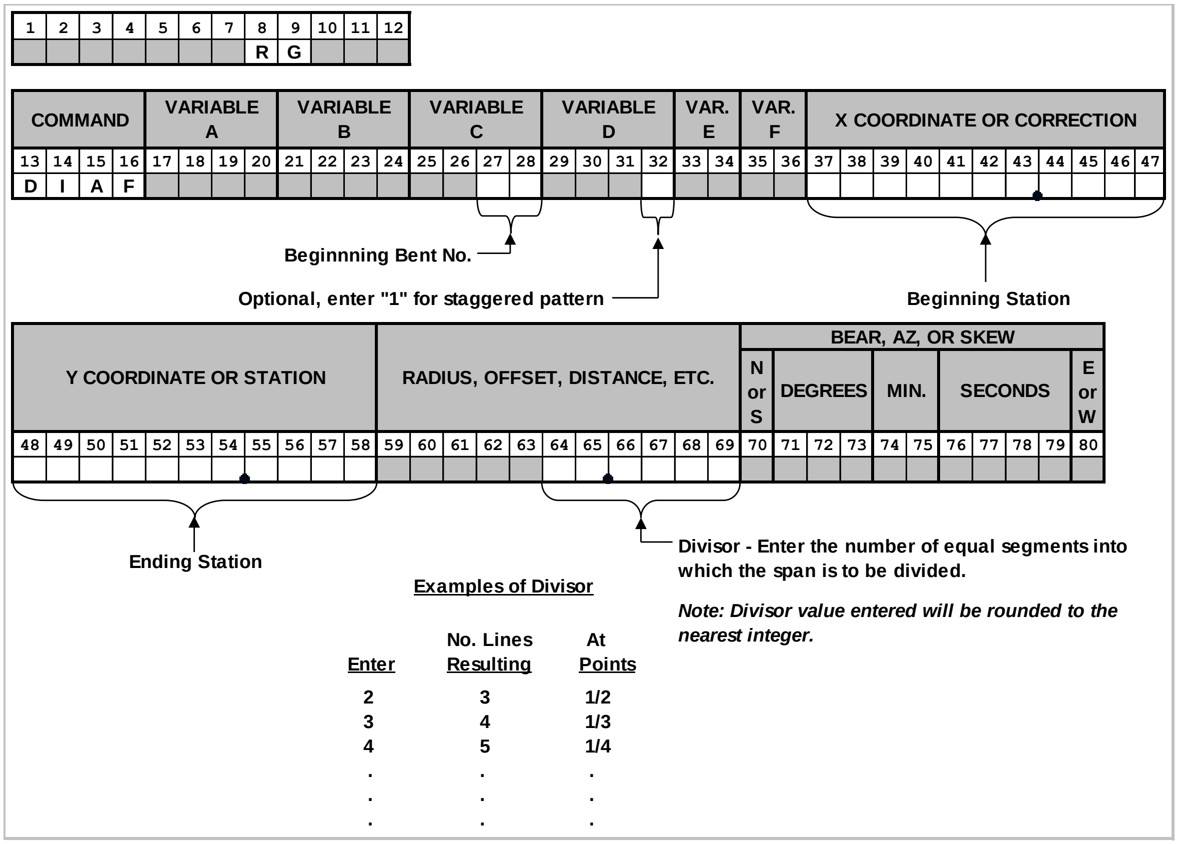
Card 90 - DIAF Argument Input Scheme I Card

This argument input scheme requires the following data:

- *Bent Number (VAR C):* The beginning bent of the span for which diaphragms will be placed.
- *Staggered Pattern (VAR D) (optional):* Enter "1" for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Divisor (RADIUS, OFFSET, ETC):* The number of segments into which the span will be divided. The span is from the centerline of the back bearing seat to the centerline of the forward bearing seat, if defined; otherwise, it is from the centerline of the back bent to the centerline of the forward bent. The total number of diaphragms defined will be one less than this Divisor. The span may be divided into as many as 220 segments (if there are multiple spans this number of segments is the total for all spans so the maximum divisor per span will be reduced) although the **RDS User Manual** puts the max at 60 (i.e. 59 diaphragms).

DIAF ARGUMENT INPUT SCHEME J

This input scheme defines diaphragm lines equally spaced between given beginning and ending stations. This option cannot be used with FOPT options 8 or 15.



Card 91 - DIAF Argument Input Scheme J Card

This argument input scheme requires the following data:

- *Bent Number (VAR C):* The beginning bent of the span for which the diaphragms will be placed.
- *Staggered Pattern (VAR D) (optional):* Enter “1” for a staggered pattern (the diaphragm between every two beams will be perpendicular to the left beam line).
- *Beginning Station (X-COORDINATE OR CORRECTION):* The first station at which the diaphragms will be placed.
- *Ending Station (Y-COORDINATE OR STATION):* The final station at which the diaphragms will be placed. The Beginning and Ending Stations must both lie on the same span.
- *Divisor (RADIUS, OFFSET, ETC):* The number of segments into which the span will be divided. The span is from the centerline of the bearing seat to the centerline of the bearing seat, if the bearing seats are defined; otherwise, it is from the centerline of the back bent to the centerline of the forward bent. The span may be divided into as many as 218 segments (if there are multiple spans this number of segments is the total for all spans so the maximum divisor per span will be reduced) although the **RDS User Manual** puts the max at 58 (i.e. 59 diaphragms).

SPLC (SPLICE LINE)

FUNCTION

This command defines splice lines, which are straight lines indicating the location of beam splices in continuous units. These lines do not apply to simple span units.

USAGE

Use this command to define straight lines which indicate the location of beam splices in continuous units. Their intersection with beam lines determines the location of splice points. The user may specify the limits of a splice line by giving the beam number between which the splice line applies. This feature is optional. If no beam numbers are given, the splice line will be assumed to intersect all beams. When specifying the limits of splice lines, the actual beam numbers of the continuous unit must be used, not beam line numbers. Regardless of beam line numbers which apply to a unit, the system treats the leftmost beam as beam number one; therefore, the third beam from the left would be beam number three. The option to limit the extent of splice lines is illustrated in Figure 68 - **Splice Line Limits**.

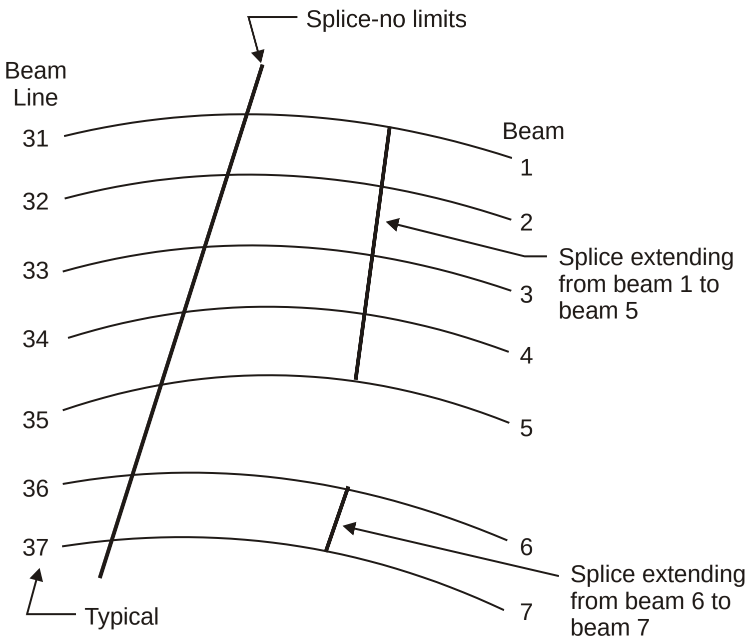


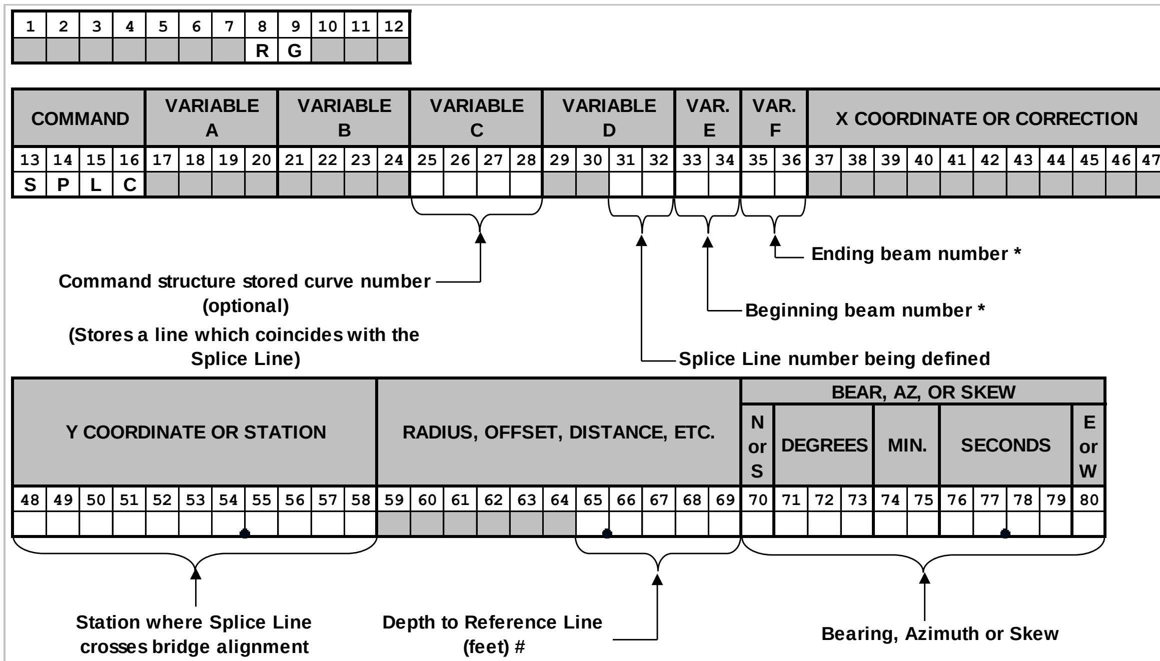
Figure 68 - Splice Line Limits

For each structure, splice lines must be numbered consecutively from the beginning to the end of the structure, beginning with one.

Note: The limits stated in the **RDS User Manual** and any that may be stated in this *BGS User Guide* on the number of TSLBs, SPLCs, DIAFs, and BEAMs are not strict maximums. The user may specify as many of each as needed, as long as their summation does not exceed 219.

SPLC ARGUMENT INPUT SCHEME A

This input scheme defines a splice line that crosses the bridge alignment at a given station. A bearing, azimuth or skew may be entered at the user's option. If no bearing, azimuth or skew is entered, the splice line will be assumed to be perpendicular to the beam line.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

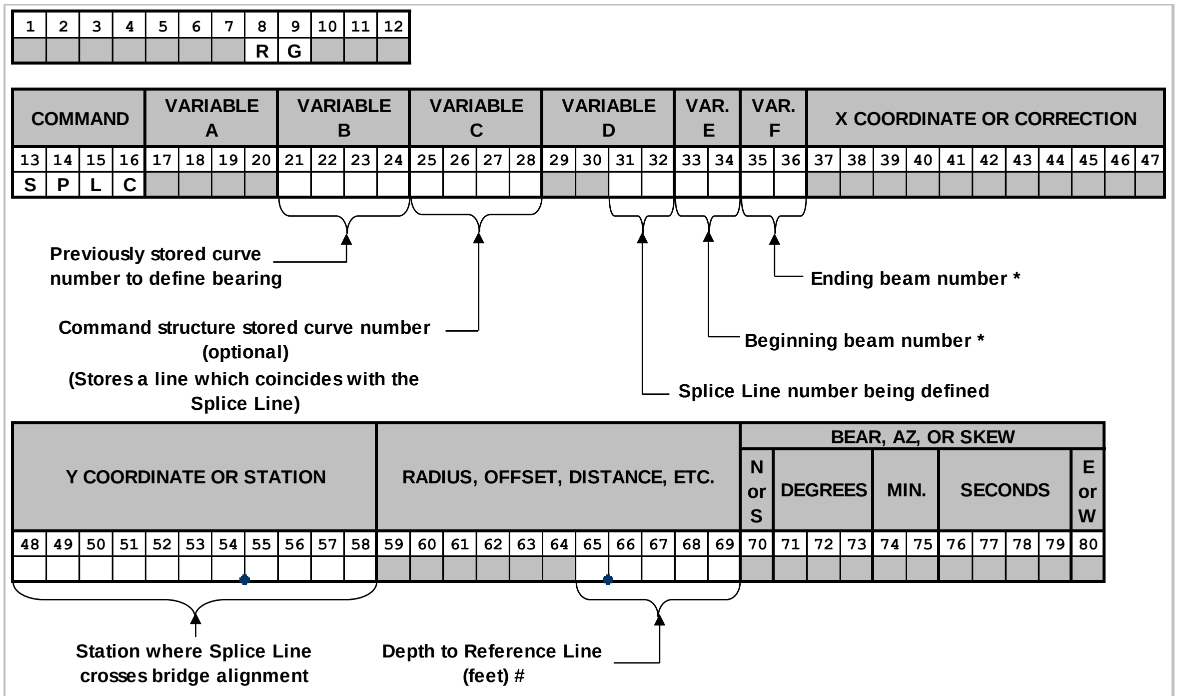
Card 92 - SPLC Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line continues across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line continues across all the beams in the span.
- *Station (Y-COORDINATE OR STATION):* The station where the splice line crosses the bridge alignment.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.
- *Bearing, Azimuth, or Skew (BEAR, AZ, OR SKEW) (optional):* The bearing, azimuth, or skew of the splice line. If blank, the line will be perpendicular to the alignment at the given station.

SPLC ARGUMENT INPUT SCHEME B

This input scheme defines a splice line that crosses the bridge alignment at a given station with the bearing of a given curve.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

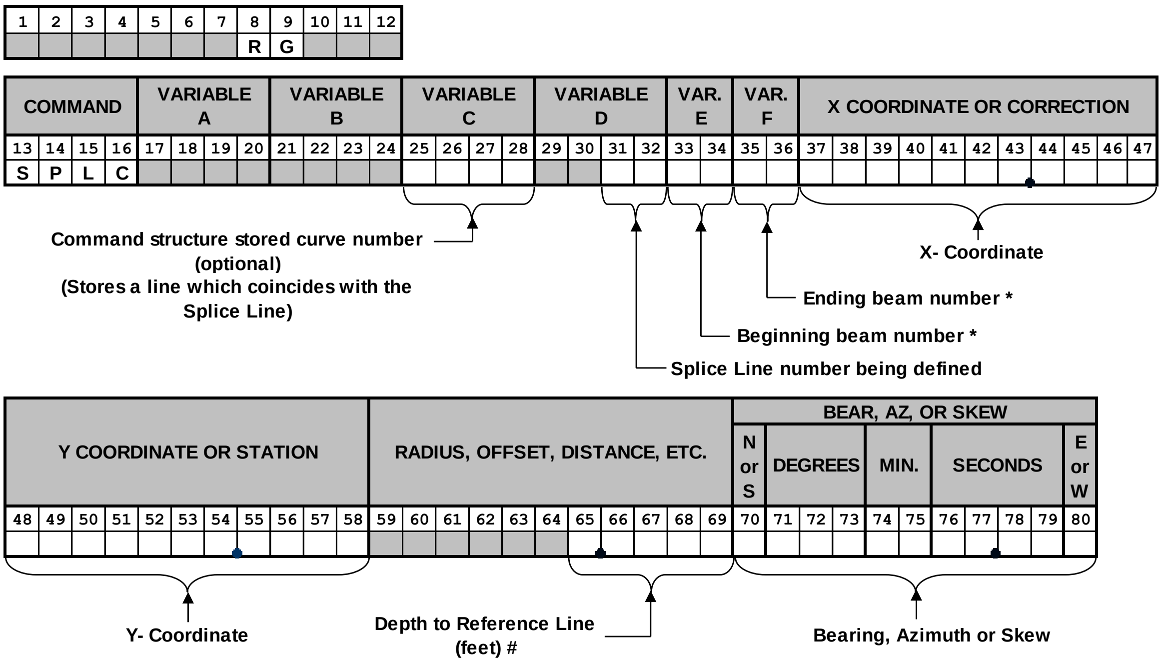
Card 93 - SPLC Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve used to define the bearing of the splice line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending numbers are blank, the splice line will continue across all the beams in the span.
- *Station (Y-COORDINATE OR STATION):* The station where the splice line will cross the bridge alignment.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.

SPLC ARGUMENT INPUT SCHEME C

This input scheme defines a splice line that passes through a given point with a given bearing or azimuth.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

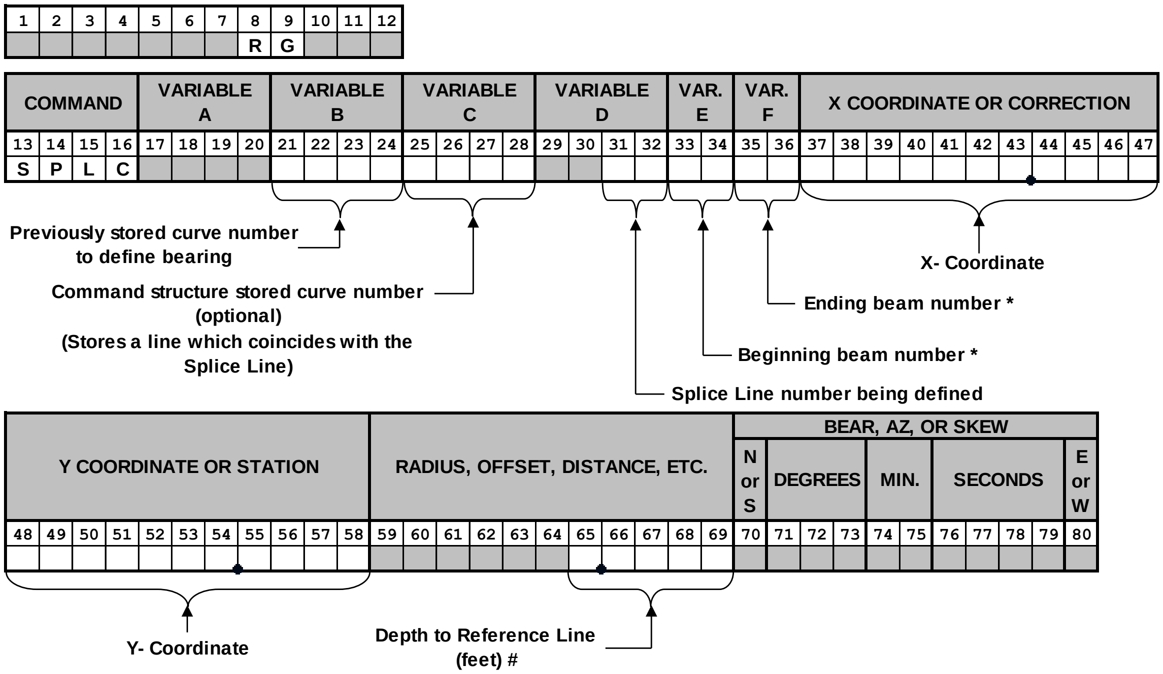
Card 94 - SPLC Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the point through which the splice line is to pass.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the point through which the splice line is to pass.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.
- *Bearing or Azimuth (BEAR, AZ, OR SKEW):* The bearing or azimuth of the splice line.

SPLC ARGUMENT INPUT SCHEME D

This input scheme defines a splice line that passes through a given point with the bearing of a given curve.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

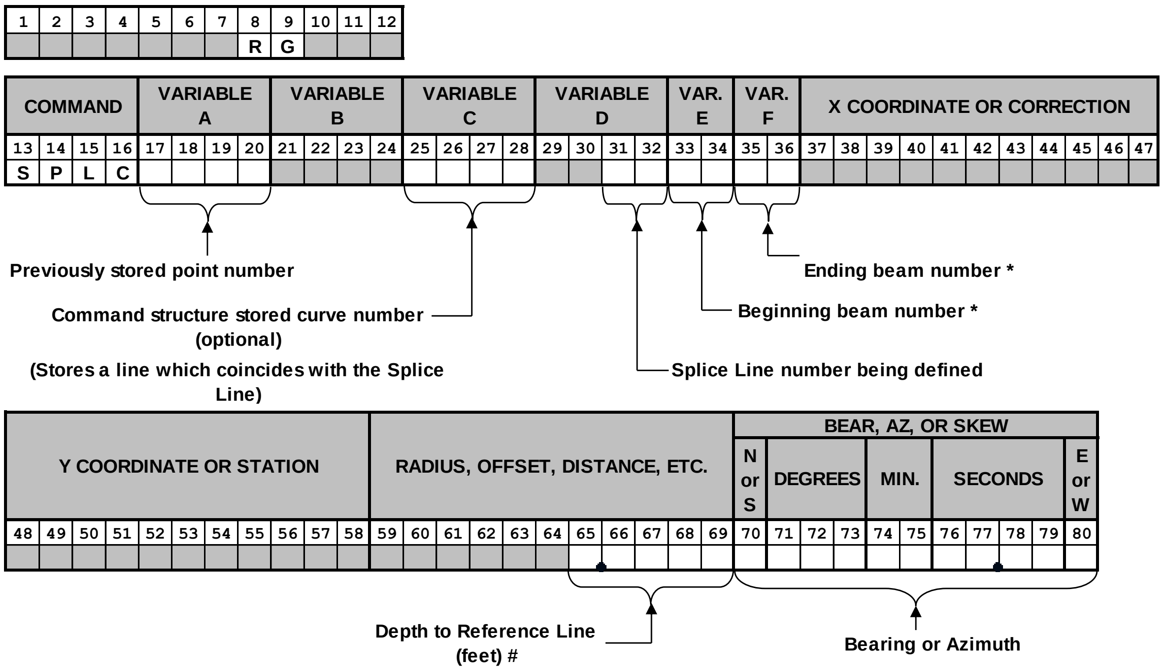
Card 95 - SPLC Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve used to define the bearing of the splice line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the point through which the splice line is to pass.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the point through which the splice line is to pass.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.

SPLC ARGUMENT INPUT SCHEME E

This input scheme defines a splice line that passes through a given point at a given bearing or azimuth.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

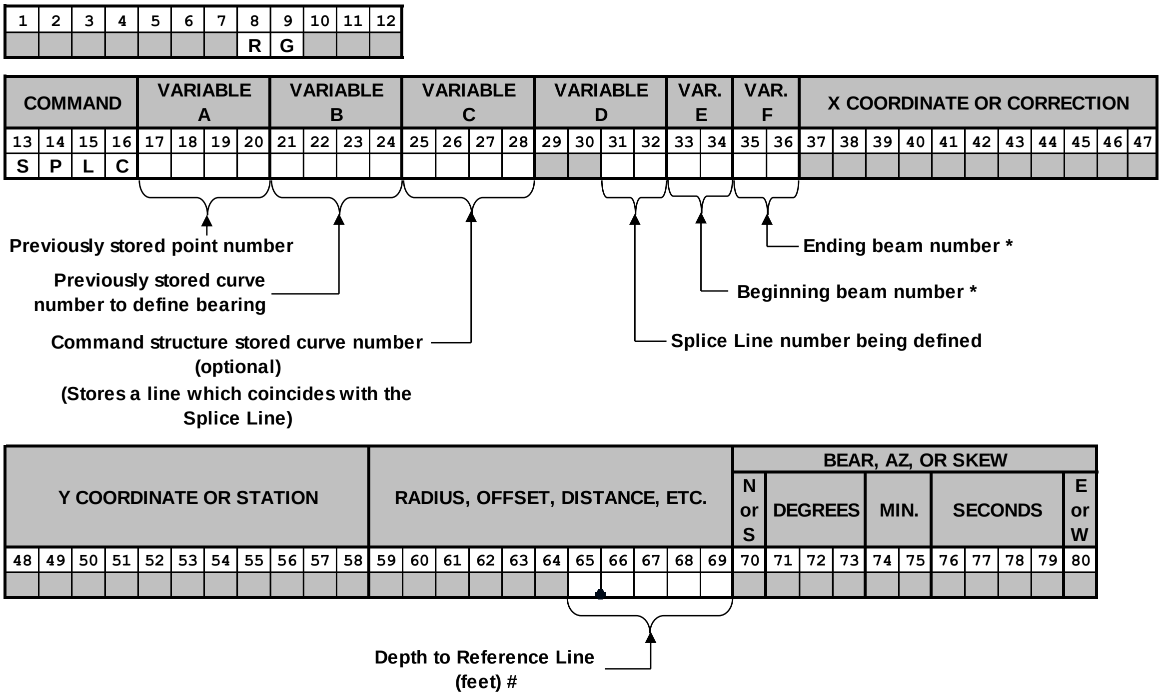
Card 96 - SPLC Argument Input Scheme E Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of the previously stored point through which the splice line is to pass.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.
- *Bearing or Azimuth (BEAR, AZ, SKEW):* The bearing or azimuth of the splice line.

SPLC ARGUMENT INPUT SCHEME F

This input scheme defines a splice line that passes through a given point with the bearing of a given curve.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

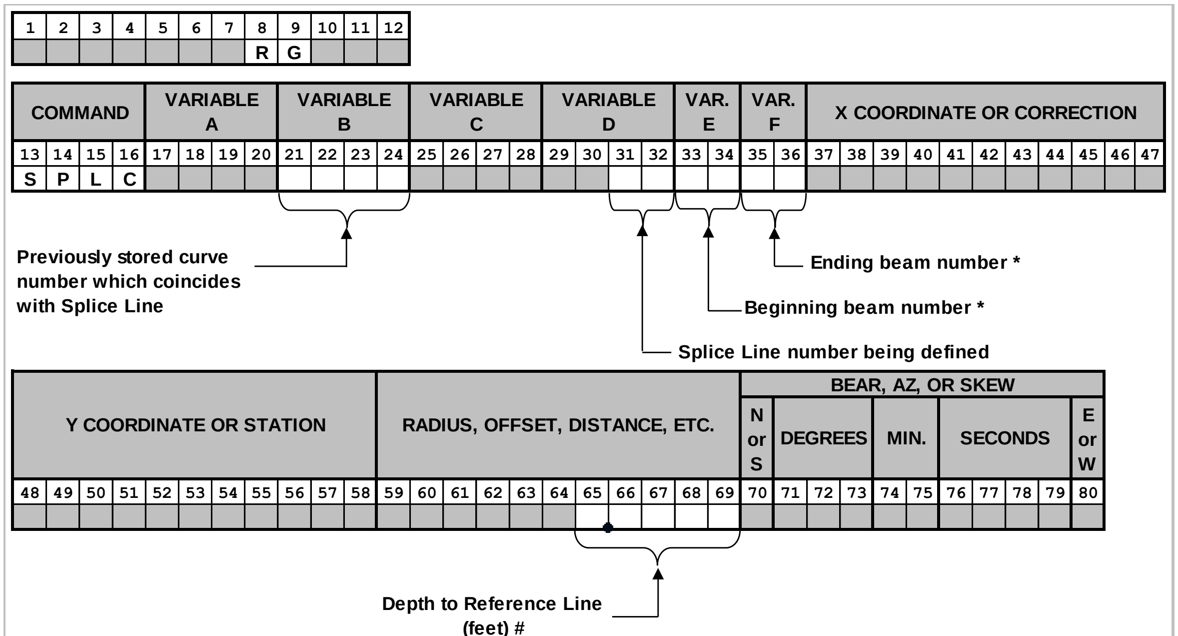
Card 97 - SPLC Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of the previously stored point through which the splice line is to pass.
- *Curve ID (VAR B):* The number of a previously stored curve used to define the bearing of the splice line.
- *Curve ID (VAR C) (optional):* The number assigned to store a curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.

SPLC ARGUMENT INPUT SCHEME G

This input scheme defines a splice line coincident with a previously stored curve.



Refer to the discussion on Reference Line.

* Optional; this must be the beam number for the applicable unit. The leftmost beam in any span is always beam number 1. Two beams must be given to exercise the option.

Card 98 - SPLC Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Curve ID (VAR B):* The number of a previously stored curve coincident with the splice line.
- *Splice Line Number (VAR D):* The number assigned to the splice line being defined.
- *Beginning Beam Number (VAR E):* The beam at which the splice line is to begin, where the leftmost beam is number one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Ending Beam Number (VAR F):* The beam at which the splice line is to end, where the leftmost beam number is one. If either or both beginning and ending beam numbers are blank, the splice line will continue across all the beams in the span.
- *Reference Line Depth (RADIUS, OFFSET, ETC) (optional):* The depth of the reference line below the roadway surface. See Command BENT, Scheme A, for a discussion of the reference line.

BEAM (BEAM LINE)

FUNCTION

This command defines a beam line.

USAGE

Use this command to define beam lines. Beam lines are used in various ways to locate actual beams in the structure as discussed in connection with the FOPT command. Beam lines may be straight lines, circles, or strings of straight lines and circles offset from previously defined PSLB lines, as shown in **Figure 69 - Beam Line Types**.

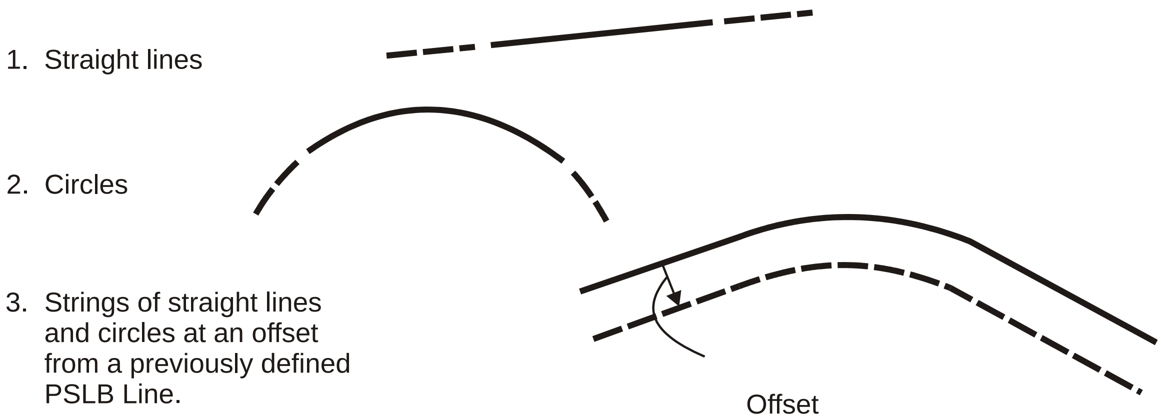


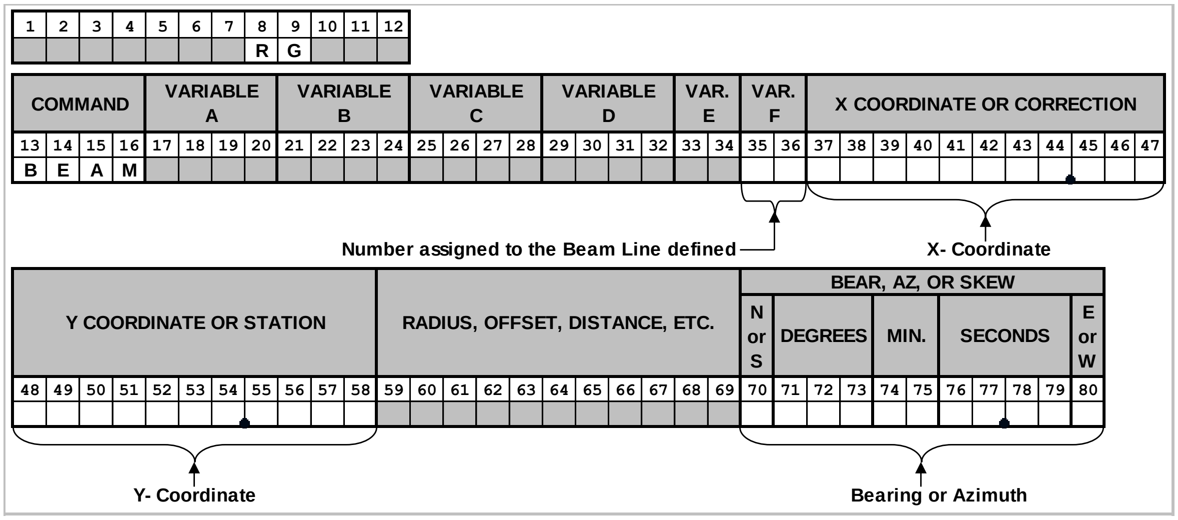
Figure 69 - Beam Line Types

Beam lines must be numbered for future reference consecutively from left to right for each structure; as many as 99 beams may be defined for a given structure. Beam line numbers are structure-dependent—that is, they may be repeated but must be redefined for a different structure under a different NAME command. If more than one beam line with the same number is given for a particular structure, the last one entered will be used. The automatic options for locating interior beams (FOPT command) do not affect these numbers.

Note: The limits stated in the **RDS User Manual** and any that may be stated in this *BGS User Guide* on the number of TSLBs, SPLCs, DIAFs, and BEAMs are not strict maximums. The user may specify as many of each as needed, as long as their summation does not exceed 219.

BEAM ARGUMENT INPUT SCHEME A

This input scheme defines a straight beam line using a user-defined point on the line and a bearing or azimuth.



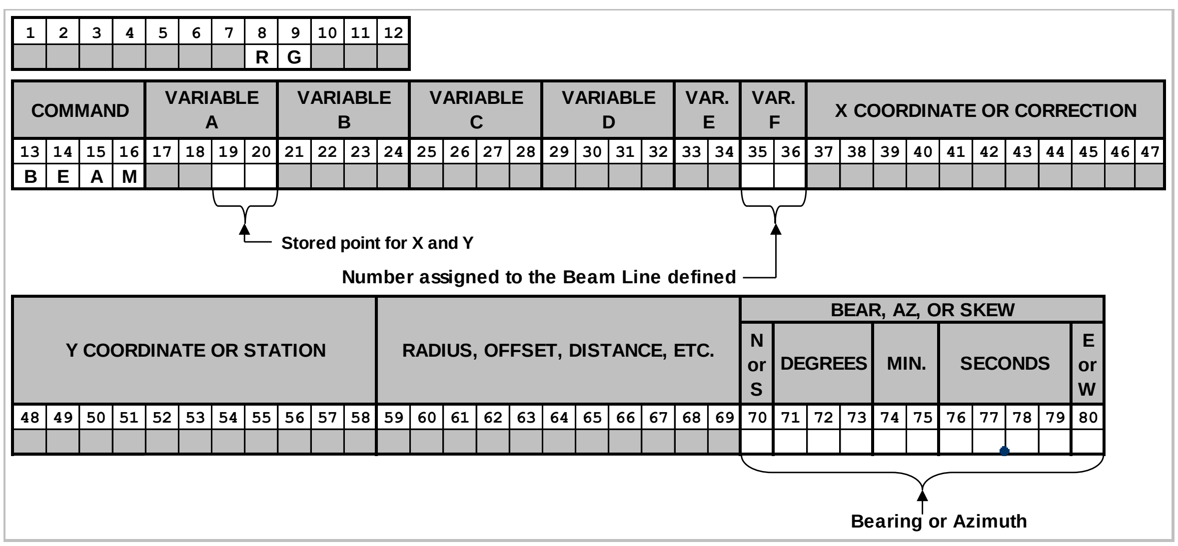
Card 99 - BEAM Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the point on the line.
- *Y-Coordinate (Y-COORDINATE OR CORRECTION):* The Y-coordinate of the point on the line.
- *Bearing (BEAR, AZ, OR SKEW):* The bearing or azimuth of the beam line.

BEAM ARGUMENT INPUT SCHEME B

This input scheme defines a straight beam line using a previously stored point on the line and a bearing or azimuth.



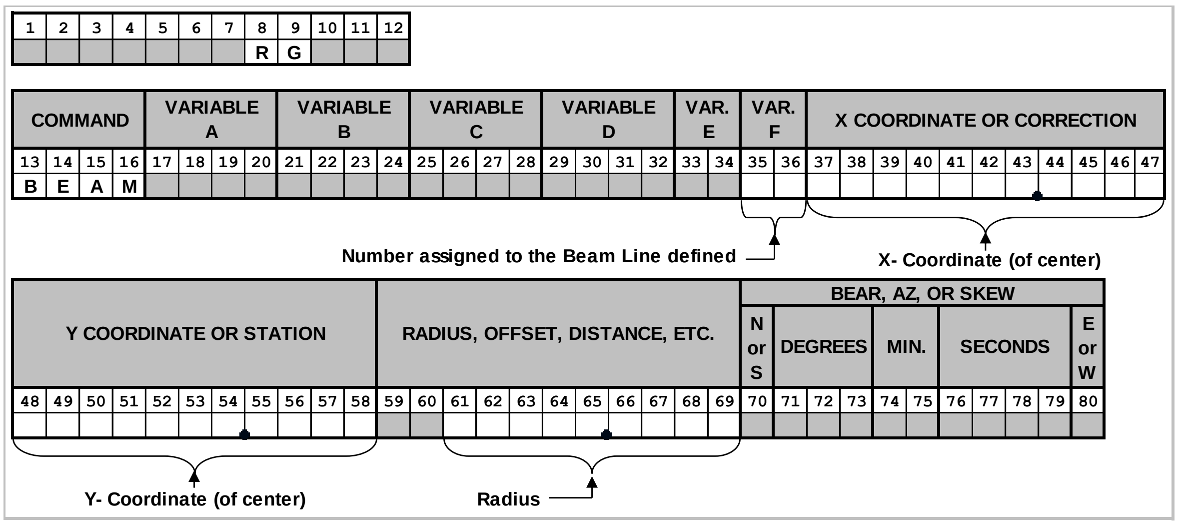
Card 100 - BEAM Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored point on the line.
- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *Bearing (BEAR, AZ, OR SKEW):* The bearing or azimuth of the beam line.

BEAM ARGUMENT INPUT SCHEME C

This input scheme defines circular beam lines using user-defined center-point coordinates for the circle and the radius of the circle.



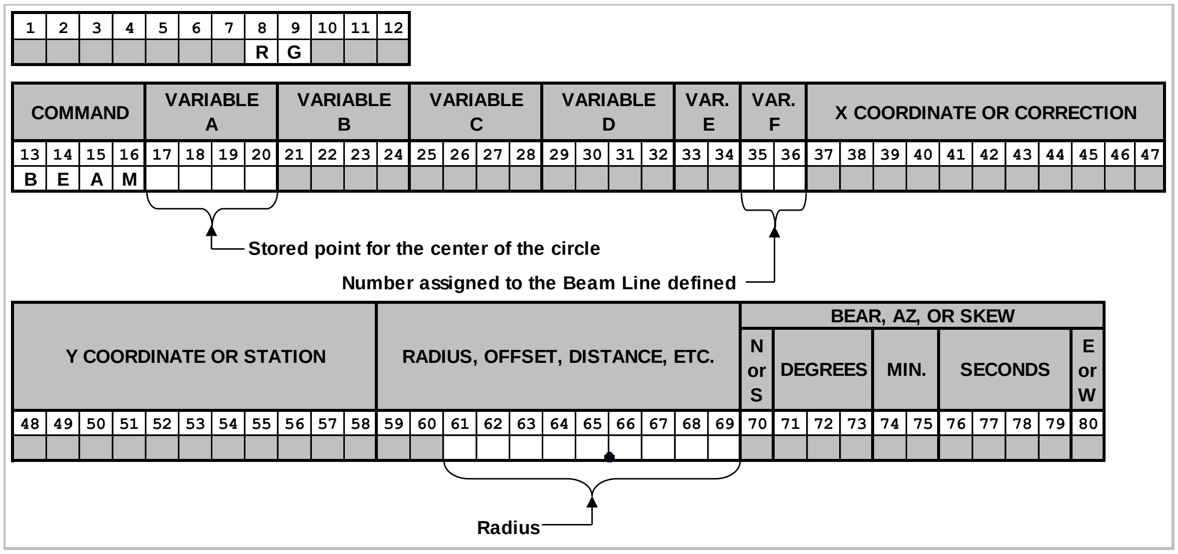
Card 101 - BEAM Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *X-Coordinate (X-COORDINATE OR CORRECTION):* The X-coordinate of the center of the circle.
- *Y-Coordinate (Y-COORDINATE OR STATION):* The Y-coordinate of the center of the circle.
- *Radius (RADIUS, OFFSET, ETC):* The radius of the circle.

BEAM ARGUMENT INPUT SCHEME D

This input scheme defines circular beam lines using a previously stored center-point for the circle and the radius of the circle.



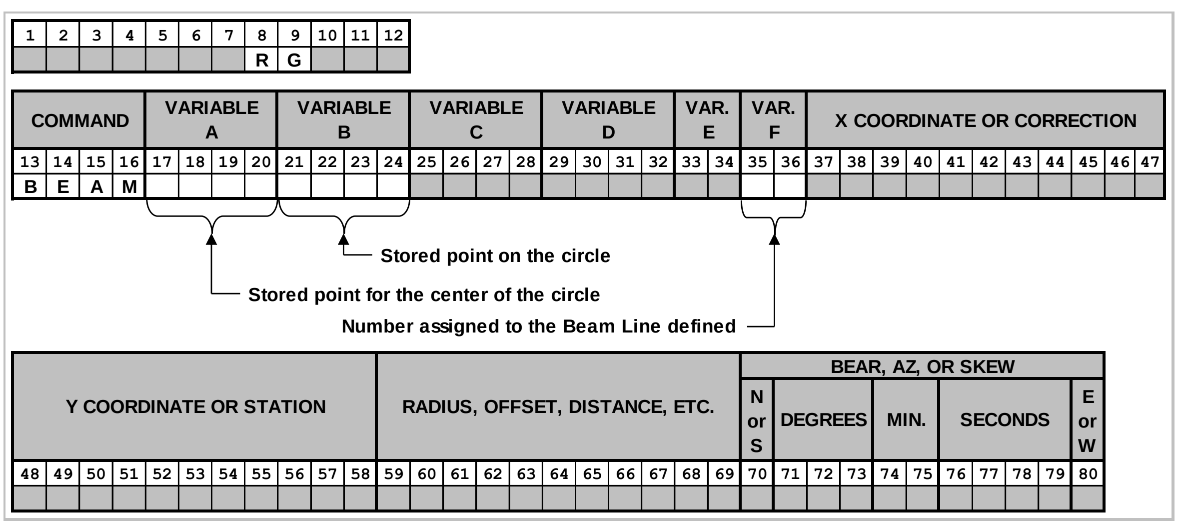
Card 102 - BEAM Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored center point of the circle.
- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *Radius (RADIUS, OFFSET, ETC):* The radius of the circle.

BEAM ARGUMENT INPUT SCHEME E

This input scheme defines circular beam lines using a previously stored center-point for the circle and a previously stored point on the circle.



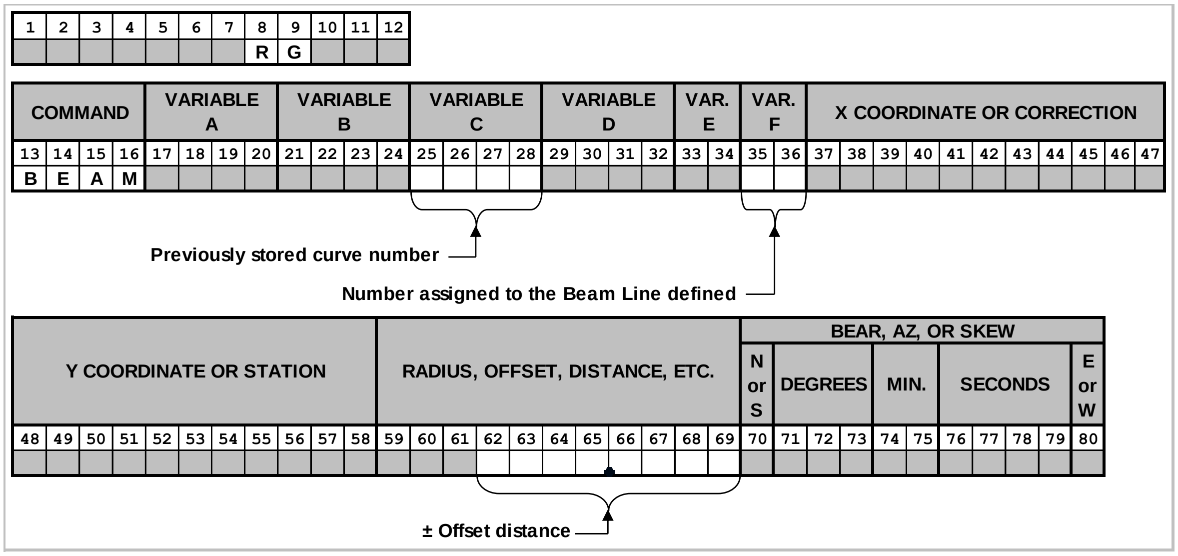
Card 103 - BEAM Argument Input Scheme E Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored center point of the circle.
- *Point ID (VAR B):* The number of a previously stored point on the circle.
- *Beam Line Number (VAR F):* The number assigned to the beam line.

BEAM ARGUMENT INPUT SCHEME F

This input scheme defines a beam line at an offset from a stored curve.



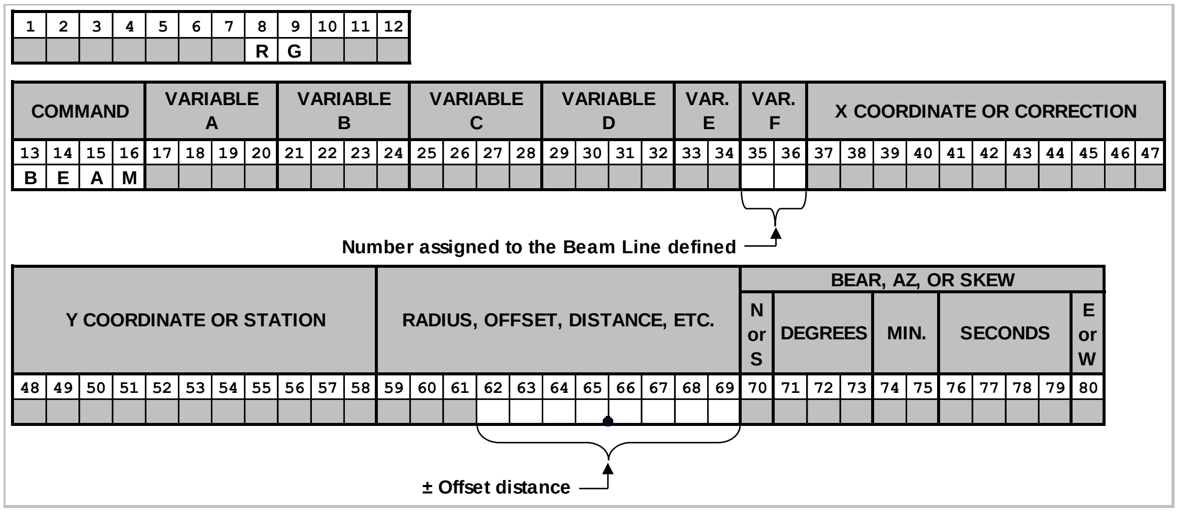
Card 104 - BEAM Argument Input Scheme F Card

This argument input scheme requires the following data:

- *Curve ID (VAR C):* The number of a previously stored curve.
- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *Offset (RADIUS, OFFSET, ETC):* The offset of the beam from the stored curve.

BEAM ARGUMENT INPUT SCHEME G

This input scheme defines a beam line at an offset from the bridge alignment.



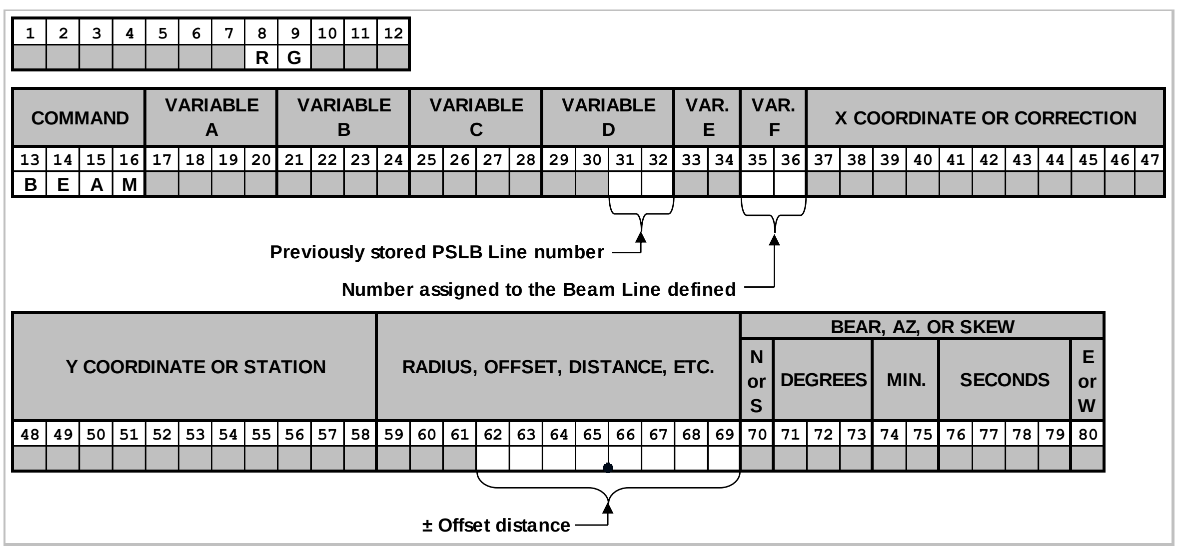
Card 105 - BEAM Argument Input Scheme G Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *Offset (RADIUS, OFFSET, ETC):* The offset of the beam from the bridge alignment.

BEAM ARGUMENT INPUT SCHEME H

This input scheme defines a beam line at an offset from a parallel slab line (PSLB).



Card 106 - BEAM Argument Input Scheme H Card

This argument input scheme requires the following data:

- *Parallel Slab Line Number (VAR D):* The number of a previously stored parallel slab line.

- *Beam Line Number (VAR F):* The number assigned to the beam line.
- *Offset (RADIUS, OFFSET, ETC):* The offset of the beam from the specified parallel slab line.

NOTE ON BEAM COMMAND

Offsets are positive when the beam line is to the right when looking in the direction of increasing stations.

BGRP (BEAM LINE GROUP)

FUNCTION

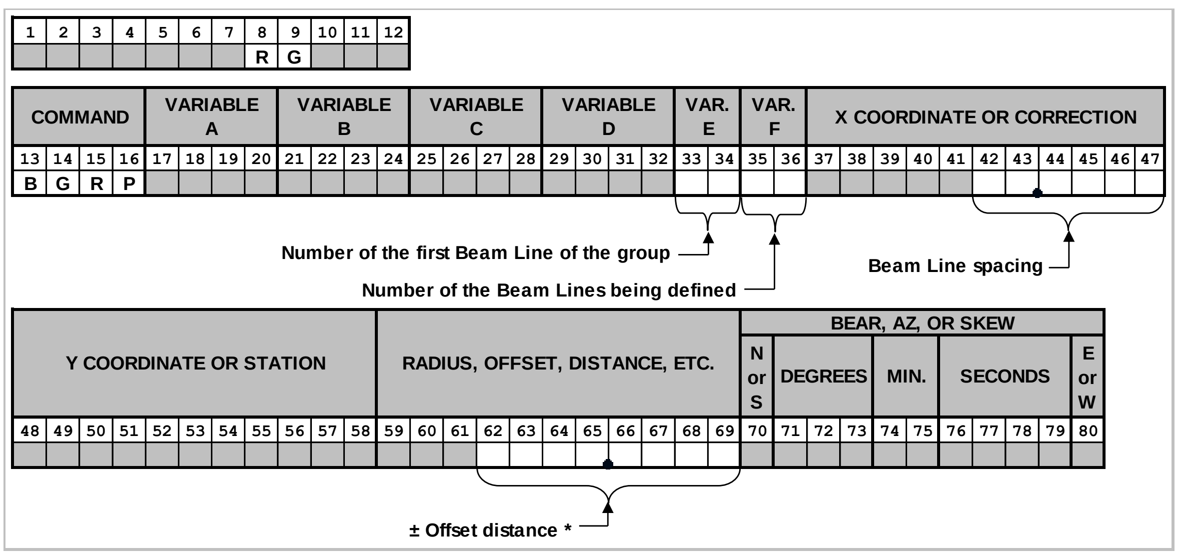
This command defines a group of parallel or concentric beam lines.

USAGE

Use this command to define groups of parallel or concentric beam lines. The user assigns a beam line number to the first (leftmost when looking in the direction of increasing stations) beam in the group and the program assigns consecutive numbers to the succeeding beams; as many as 99 beams may be defined for a given structure. When slab lines are referenced, a SLAB command must precede the entry of the BGRP command. The beam lines will have the limits of the PSLB lines used for the SLAB command. In the case when both slab edges are referenced, the two slab edges must be parallel or concentric and have the same limits. Care should be exercised to assure that the beam lines defined are not unintentionally redefined by other BGRP or BEAM commands. If more than one beam line with the same number is given for a particular structure, the last one entered will be used. The automatic options for locating interior beams (FOPT command) do not affect these numbers. The three options for defining beam line groups are given below.

BGRP ARGUMENT INPUT SCHEME A

This input scheme defines beam lines using the number of beam lines, beam line spacing, and the offset from the bridge alignment.



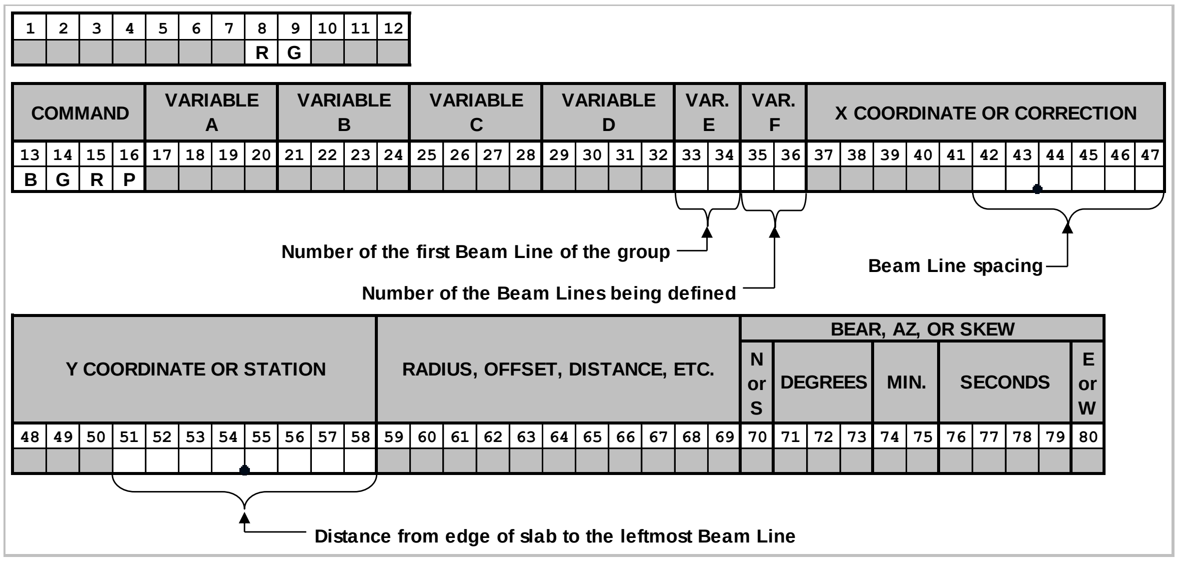
Card 107 - BGRP Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR E):* The number assigned to the first beam line in the group.
- *Number of Beam Lines (VAR F):* The number of beam lines to be defined.
- *Spacing (X-COORDINATE OR CORRECTION):* The spacing between adjacent beam lines.
- *Offset (RADIUS, OFFSET, ETC):* The distance from the alignment to the first (leftmost) beam line. If the offset is zero, a zero must be entered in this field.

BGRP ARGUMENT INPUT SCHEME B

This input scheme defines beam lines given the number of beam lines, the beam line spacing, and the offset from the left slab edge to the leftmost beam line.



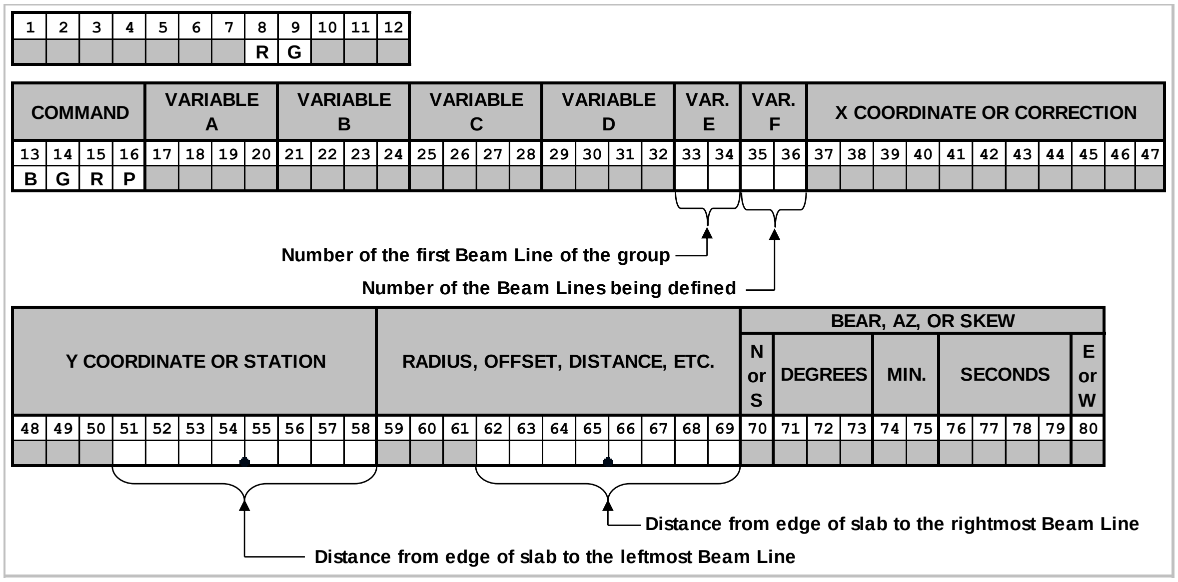
Card 108 - BGRP Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR E):* The number assigned to the first beam line in the group.
- *Number of Beam Lines (VAR F):* The number of beam lines to be defined.
- *Spacing (X-COORDINATE OR CORRECTION):* The spacing between adjacent beam lines.
- *Left Slab Distance (Y-COORDINATE OR STATION):* The distance from the left slab edge to the first (leftmost) beam line.

BGRP ARGUMENT INPUT SCHEME C

This input scheme defines beam lines and determines beam spacing given the distance of the first (leftmost) from the left edge of the slab and the distance of the last (rightmost) from the right edge of the slab.



Card 109 - BGRP Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Beam Line Number (VAR E):* The number assigned to the first beam line in the group.
- *Number of Beam Lines (VAR F):* The number of beam lines to be defined.
- *Left Slab Distance (Y-COORDINATE OR STATION):* The distance from the left slab edge to the first (leftmost) beam line.
- *Right Slab Distance (RADIUS, OFFSET, ETC):* The distance from the right slab edge to the last (rightmost) beam line.

FOPT (FRAME OPTION)

FUNCTION

This command frames beams and bents for the preceding SLAB command.

USAGE

Use this command to frame beams and bents for the preceding SLAB command. This command also calculates and outputs the dimensional aspects of the slab (bridge frame) layout, and plots a plan view of the structure if plot commands are included earlier in the input data. Many frame options are available for automatic beam placement, including specialized functions for specific beam types. The process computes the intersections of bent and splice lines with beam lines. Bearing seat locations and diaphragm intersections are computed on chords between successive bents and splices. An option is available for curved continuous beams. All pertinent bent lines, splice lines, diaphragm lines, bearing seats, and beam lines must be defined prior to executing the FOPT commands.

Each FOPT command may apply to one or more consecutive simple spans (if option and data do not change) or to all of the spans of a continuous unit. It is advisable to first define all the transverse (BENT or TSLB) and longitudinal (PSLB) elements that will be required for the entire structure and then to enter FOPT commands for each unit from beginning to end.

It is important to remember that beam lines may consist of a straight line, a circular arc, or a string of straight lines and/or circular arcs defined by PSLB commands. If the beam line is a straight line, the beam will coincide with the beam line. In the case of non-straight lines, the intersection of the beam lines with a bent or splice line determines points between which a straight beam will be located as illustrated in **Figure 70 - Relationship Between a Non-Straight Beam Line and a Straight Beam**. (In Scheme B, Option 10, the beam coincides with the beam line in every case.)

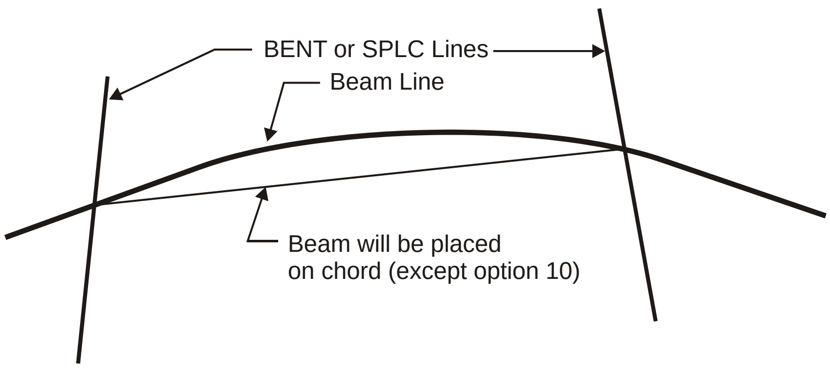


Figure 70 - Relationship Between a Non-Straight Beam Line and a Straight Beam

FOPT ARGUMENT INPUT SCHEME A (OPTIONS1, 2 & 8)

This input scheme automatically defines the outside beams of the slab as the user-defined maximum and minimum overhang dimensions of the left and right edges of the slab. It automatically places interior beams so that all the beams are parallel with equal spacing. See **Figure 71 - Enforcement of Maximum and Minimum Edge Distances** for an illustration of beam placement.

NOTES ON FOPT ARGUMENT SCHEME A

1/ multiple simple spans, 2/ simple span (for one span only), and 8/ continuous unit:

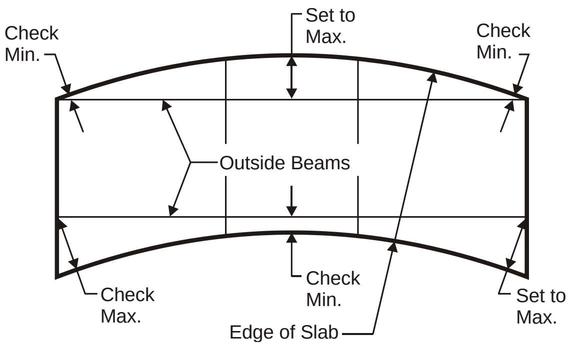
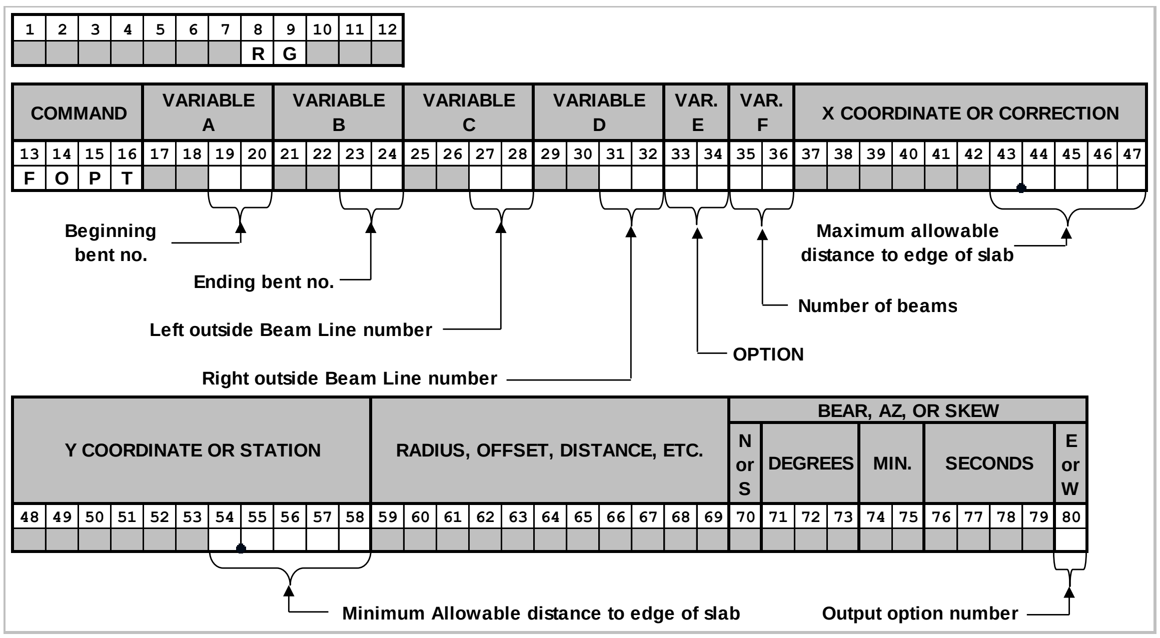


Figure 71 - Enforcement of Maximum and Minimum Edge Distances

The system tries to place the outside beams between the two specified bents such that maximum and minimum distances from the edge of the slab are not violated. Slab edges must have been previously defined by the last SLAB command entered. Outside beam line numbers may be any previously defined beam lines. For storage, both outside and interior beams will be numbered beginning with one. Beam line numbers for interior beams need not be reserved. Outside beam line numbers are used only for cases where no solution is possible and the system defaults to Frame Option 3.

Slab edges must be previously defined by the last SLAB command entered. Outside beam line numbers may be previously defined beam lines. For storage purposes, both outside and interior beams will be numbered beginning with one. Beam line numbers for interior beams need not be reserved. Outside beam line numbers are used only for cases where no solution is possible and the system defaults to Option 3.



Card 110 - FOPT Argument Input Scheme A (Options 1, 2 & 8) Card

This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.

- *Left Outside Beam Line (VAR C):* The number of the previously stored beam line to be the default left outside beam line. This is for the case where no outside beams can be constructed for the slab with the given maximum and minimum overhang dimensions and the program defaults from Frame Option 1 to Frame Option 3.
- *Right Outside Beam Line (VAR D):* The number of the previously stored beam line to be the default right outside beam line. This is for the case where no outside beams can be constructed for the slab with the given maximum and minimum overhang dimensions and the program defaults from Frame Option 1 to Frame Option 3.
- *Frame Option (VAR E):* The option number defining the layout of the beams. Use 1 for a multiple span layout, 2 for a simple span layout, or 8 for a continuous unit layout. See the illustration above.
- *Number of Beams (VAR F):* The number of beams to be placed in each span.
- *Maximum Edge of Slab Distance (X-COORDINATE OR CORRECTION):* The maximum distance the outside beams may be placed from the edge of the slab; that is, the maximum overhang permitted for the left and right edges of the slab.
- *Minimum Edge of Slab Distance (Y-COORDINATE OR STATION):* The minimum distance the outside beams may be placed from the edge of the slab; that is, the minimum overhang permitted for the left and right edges of the slab.
- *Output Option (BEAR, AZ, OR SKEW):* No entry or an entry of zero omits the beam coordinate report and produces the frame plot if the appropriate plot command is specified. An entry of one produces the beam coordinate report and the frame plot. An entry of two produces the beam coordinate report and omits the frame plot. An entry of three omits both the beam coordinate report and the frame plot.

FOPT ARGUMENT INPUT SCHEME B (OPTIONS 4, 9 &10)

Frames the slab using a series of previously defined beam lines numbered consecutively from the left outside beam to the right outside beam. The beam placement is dependent upon the intersection of the beam lines with bent or splice intersections in accordance with the options illustrated below.

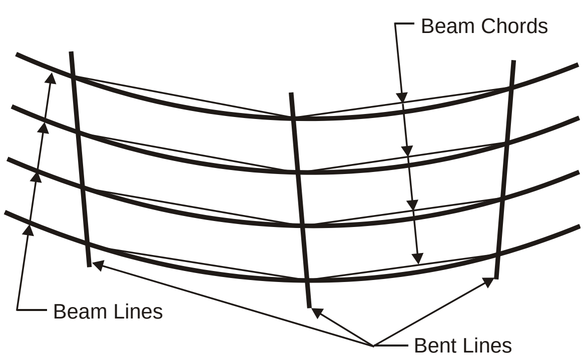


Figure 72 - Frame Option 4/ simple span (Command may refer to more than 1 span)

All beam and bent lines and the bearing scheme(s) and distances for the structure must be previously defined by one of the available methods and must be numbered consecutively from the left outside beam to the right outside beam. The beam placement depends on the intersection of the beam lines with bent or bearing lines.

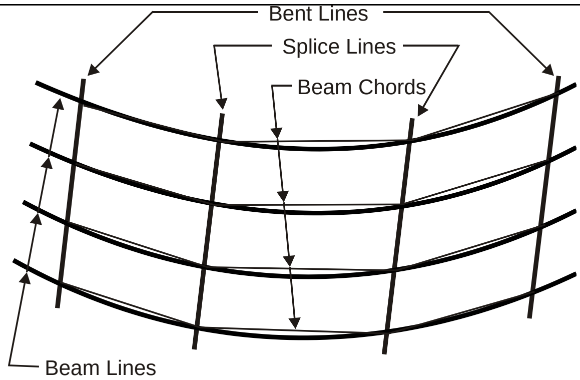


Figure 73 - Frame Option 9 / Continuous (beams on chords from splice to splice)

All beam and bent lines and the bearing scheme(s) and distances for the structure must be previously defined by one of the available methods and must be numbered consecutively from the left outside beam to the right outside beam. The beam placement depends on the intersection of the beam lines with bent, bearing or splice lines.

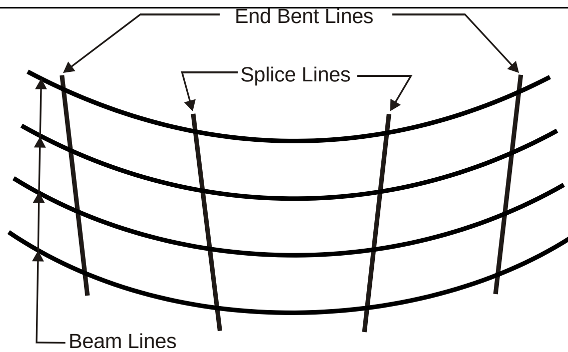
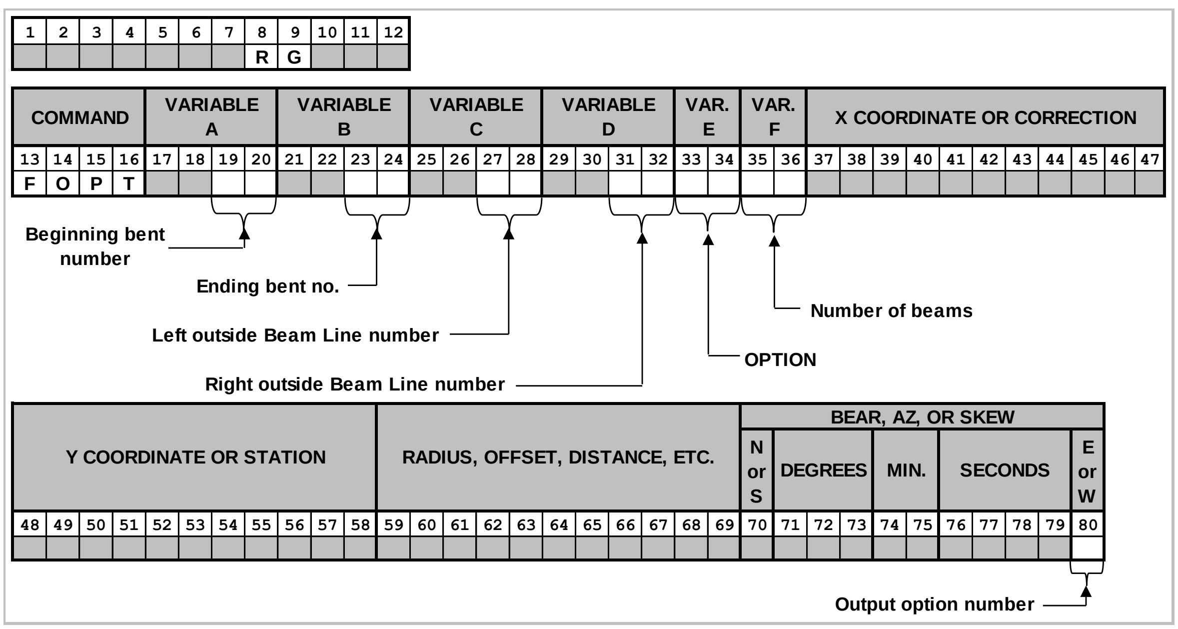


Figure 74 - Frame Option 10 / Continuous (beams follow beam lines)

See explanation for Frame Option 9.



Card 111 - FOPT Argument Input Scheme B (Options 4, 9 &10) Card

This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.
- *Left Outside Beam Line (VAR C):* The number of a previously defined beam line representing the left-most beam in the structure.
- *Right Outside Beam Line (VAR D):* The number of a previously defined beam line representing the right-most beam in the structure.
- *Frame Option (VAR E):* The option number defining the layout of the beams. Enter “4” for a simple span layout (this may refer to more than one span if applicable), “9” for a continuous span layout with the beams on chords from splice to splice, and “10” for a continuous unit layout with the beams following the beam lines.
- *Number of Beams (VAR F):* The number of beams to be placed in each span.
- *Vertical Blocking Option:* Enter “0” (or blank) or “1”, indicating which computation method to use for the depth to reference line (see Command BENT, Scheme A, for a discussion of the reference line) and vertical ordinate calculations. The vertical blocking option may be entered only for Frame Options 9 and 10. See the Notes section below for a description and illustrations.
- *Output Option:* Enter “0” (or blank) to omit the beam coordinate report and produce the frame plot, “1” to produce the beam coordinate report and the frame plot, “2” to produce the beam coordinate report and omit the frame plot or “3” to omit both the beam coordinate report and the frame plot.

NOTES ON FOPT ARGUMENT SCHEME B

- *Horizontal Blocking Report for Continuous Spans (Options 9 and 10):* This report contains layout information for a continuous structure with curved beam lines. The two horizontal blocking diagrams in **Figure 76 - Horizontal Blocking Report Diagram for Option 9** and **Figure 77 - Horizontal Blocking Report for Option 10** will give the user an idea of how to interpret a horizontal blocking report. These diagrams are presented for illustrative purposes only and will not be plotted in an actual BGS run. The diagrams shown on these pages are exaggerated for clarity. The angles and distances for each figure are given by special characters and letters in parentheses. These special characters and letters will not appear in the actual report, but are used here to illustrate where the angles and distances are located on the horizontal blocking diagram.
- *Standard Vertical Blocking (VBLK0) Computations*: The standard or default vertical blocking option used with continuous spans is invoked by entering a “0” or leaving blank column 79 of the FOPT input. Any character other than “1” will default to this option. This option is intended to model straight members connected at splice points, such as rolled or wide flange steel beams. The reference line is linear between vertical blocking control points. (See Command BENT, Scheme A, for a discussion of the reference line.) For VBLK0 these control points are splice points and the centerline of the bearing at the first and last bents in a unit. If no bearing is defined, the control point defaults to the centerline of the bent.

The depth to the reference line specified at an end bent is applied at the centerline of the bearing seat if one exists. At splice points, the reference line elevation is obtained by subtracting the depth to the reference line specified on the splice command from the surface elevation at the splice.

At intermediate bent locations, any depth value input on the command will be ignored. A reference line depth will be calculated by subtracting from the surface elevation a reference line elevation interpolated between the nearest control points on either side of the intermediate bent. Reference line elevations and depths at diaphragm locations are calculated in the same manner. The vertical ordinate is the elevation difference between the reference line at a given point and the lower of the two end bearings. See **Figure 79 - Standard Vertical Blocking Command** for an illustration of the standard vertical blocking command.

- *Alternate Vertical Blocking (VBLK1) Computations*: This option may be used only for Frame Options 9 and 10 and is invoked by placing a “1” in column 79. This option is intended to model a plate girder whose web has been cut to follow at a fixed or linearly varying depth below the roadway surface.

  The reference line follows the roadway surface at a depth that varies linearly between control points. For VBLK1 these are the same as the control points defined for the standard option, VBLK0.

  A calculated reference line depth at a diaphragm or an intermediate bent will be linearly interpolated between the reference line depths input for the control point on either side of the point in question. As with the standard option, a reference line depth input at an intermediate bent will be replaced by a calculated depth.

  Reference line elevations at all points are found by subtracting the reference line depths from the corresponding surface elevations. Vertical ordinates at all points are found by subtracting the reference line elevation of the lower of the two end bearing seats from the reference line elevation of the point in question. See **Figure 80 - Alternate Vertical Blocking Command** for an illustration of the alternate vertical blocking command.

HORIZONTAL BLOCKING REPORT

	CHORD BETWEEN SPLICES							*CHORD TO END BRNGS.*				*CHORD TO ATL. SPLCS.*		
	BEARING & DISTANCE		*DEF ANGLE & OFFSET*											
LOCATION								*DISTANCE*		*OFFSET*		*DISTANCE*		*OFFSET*
BEARING	*N 6 44 16.13 E*						*(a)*	*0.0000*		*0.0000*				
SPLICE	*N 8 16 20.53 E*	*(©)*	*1*	*32*	*4.40*		*(c)*	*53.5173*	*(b)*	*2.3043*	*(j)*	*53.5587*	*(k)*	*0.9349*
SPLICE	*N 10 16 20.53 E*	*(*)*	*2*	*0*	*0.00*		*(e)*	*100.1911*	*(d)*	*3.9322*	*(l)*	*100.1891*	*(m)*	*1.7488*
SPLICE	*N 11 44 16.13 E*	*(*)*	*1*	*27*	*55.60*		*(g)*	*100.1869*	*(f)*	*2.0626*	*(n)*	*100.2010*	*(o)*	*0.8140*
BEARING								*46.5957*	*(h)*	*0.0000*				

Figure 75 - Horizontal Blocking Report for Option 9

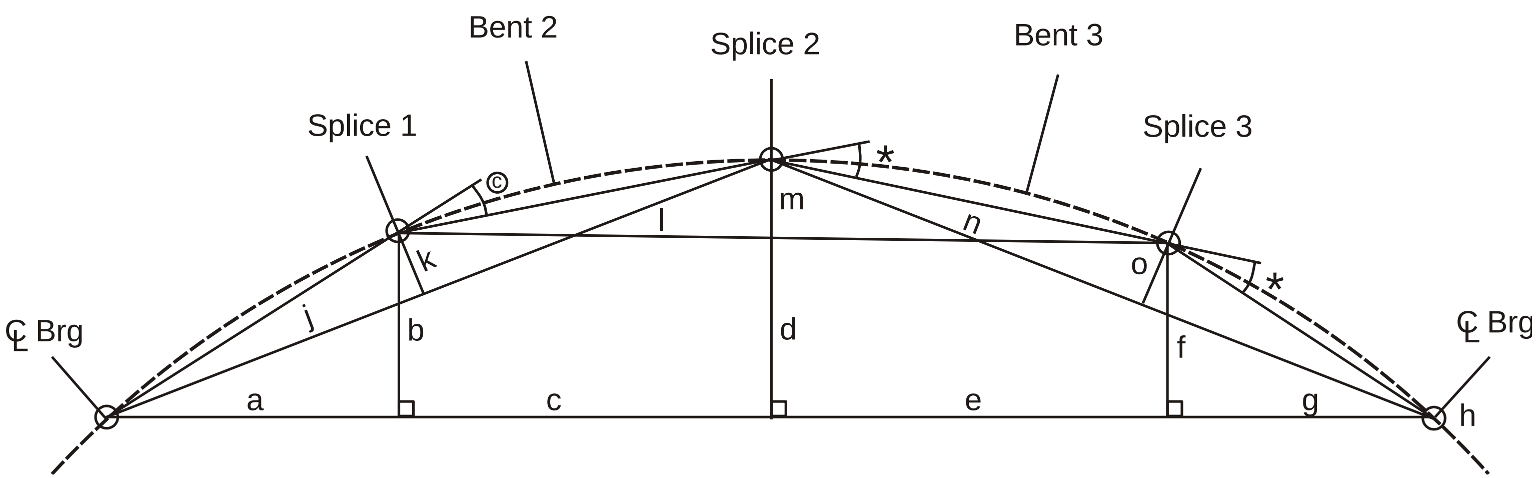


Figure 76 - Horizontal Blocking Report Diagram for Option 9

HORIZONTAL BLOCKING REPORT

LOCATION	*CHORD BETWEEN SPLICES* *BEARING & DISTANCE*	*DEF ANGLE & OFFSET*		*CHORD TO END BRNGS.* *DISTANCE*	*OFFSET*		*CHORD TO ATL. SPLCS.* *DISTANCE*	*OFFSET*
BEARING	*N 6 44 16.13 E*			*0.0000*	*0.0000*			
MID POINT	*(a) 26.7834*	*(b) 0.1249*	*(m)*			*(u)*		
SPLICE	*N 8 16 20.53 E*	*(©) 1 32 4.40 (d) 0.4351*		*53.5173*	*(n) 2.3043*		*53.5587*	*(v) 0.9349*
BEARING	*(c) 46.6393*	*(f) 0.4372*						
MID POINT	*(e) 50.1022*	*(*) 2 0 0.00*	*(o)*			*(w)*		
SPLICE	*N 10 16 20.53 E*	*(h) 0.4351*		*100.1911*	*(p) 3.9322*		*100.1891*	*(x) 1.7488*
BEARING	*(g) 46.6393*	*(j) 0.4372*						
MID POINT	*(i) 50.1022*	*(*) 1 27 55.60*	*(q)*			*(y)*		
SPLICE	*N 11 44 16.13 E*	*(l) 0947*		*100.1869*	*(r) 2.0626*		*100.2010*	*(z) 0.8140*
MID POINT	*(k) 23.3207*		*(s)*					
BEARING				*46.5957*	*(t) 0.0000*			

Figure 77 - Horizontal Blocking Report for Option 10

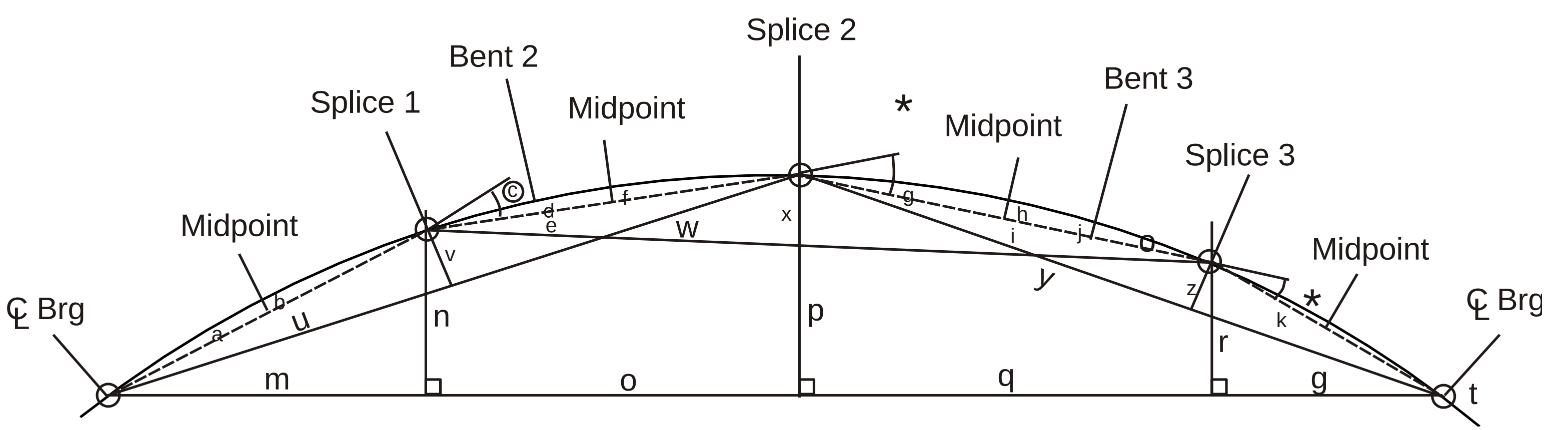


Figure 78 - Horizontal Blocking Report Diagram for Option 10

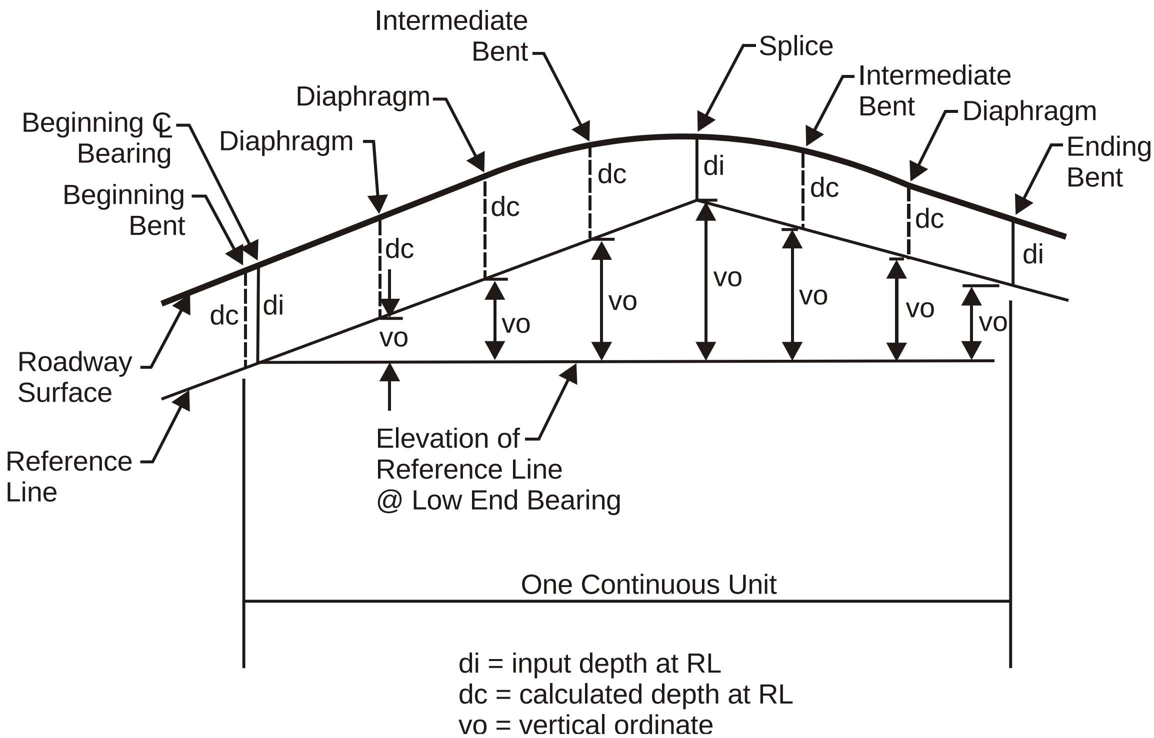


Figure 79 - Standard Vertical Blocking Command

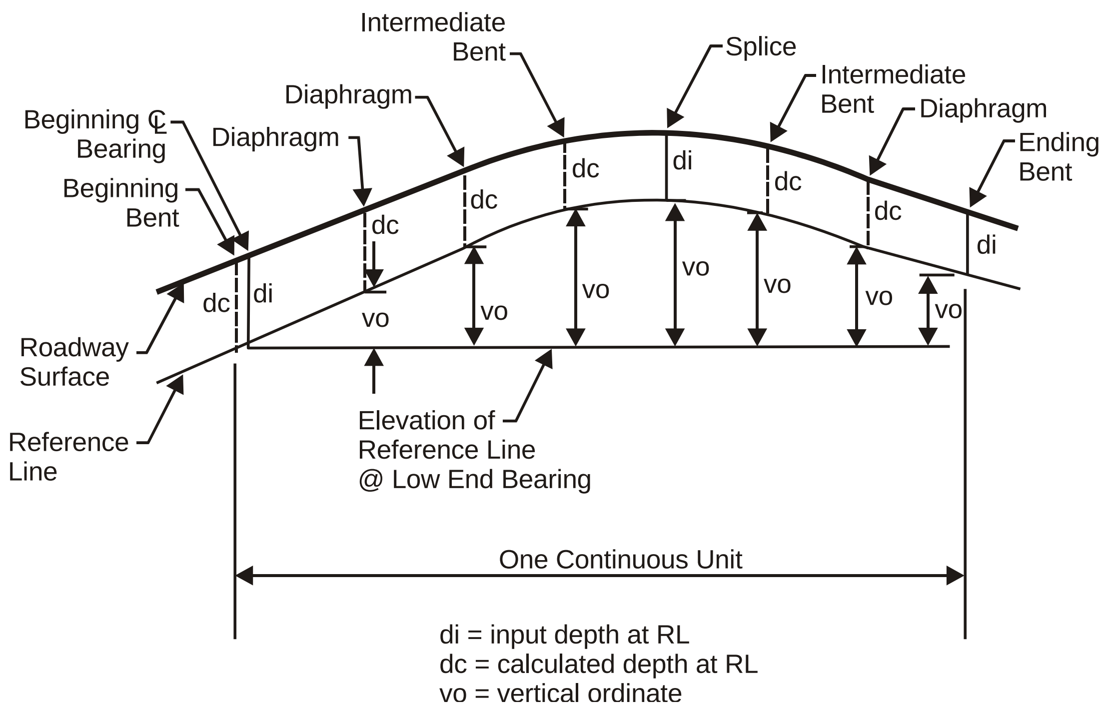


Figure 80 - Alternate Vertical Blocking Command

FOPT ARGUMENT INPUT SCHEME C (OPTIONS 6 &7)

For this input scheme interior beams are automatically spaced based on specified maximum and minimum spacing within the given outside beam lines. Beam spacing at bents and beam flares are determined according to the following options, as illustrated in Error! Reference source not found. and **Figure 82 - 7/ simple span (command may refer to more than 1 span)**.

<table>
<tr>
<td>

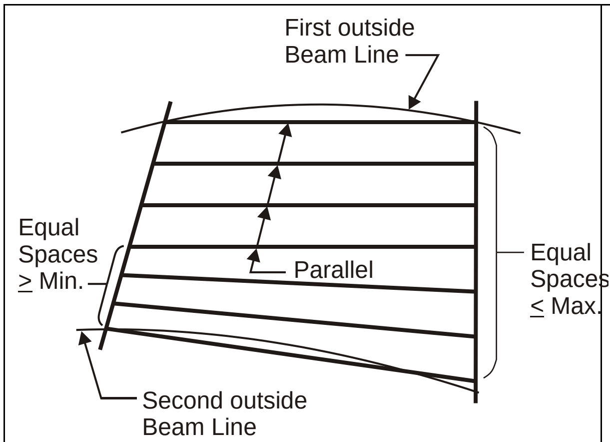


Figure 81 - 6/ simple span (command may refer to more than 1 span)

</td>
<td>

The number of beams is based on maximum (NORMAL) beam spacing on the longest bent. As many beams as possible are placed parallel to the first outside beam without violating minimum beam spacing. Remaining beams are flared.

Outside beam numbers may be any previously defined beam lines. Both outside and interior beams will be numbered beginning with one for storage. Beam line numbers for interior beams need not be reserved.

</td>
</tr>
<tr>
<td>

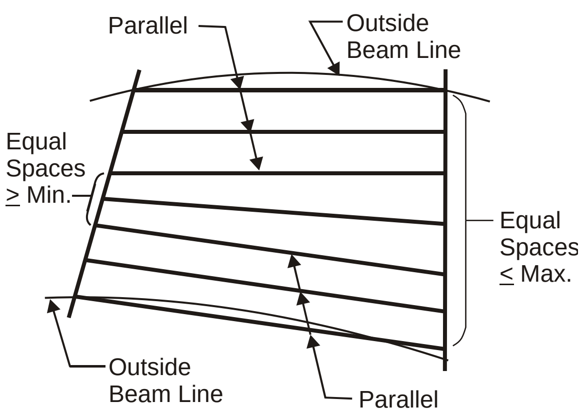


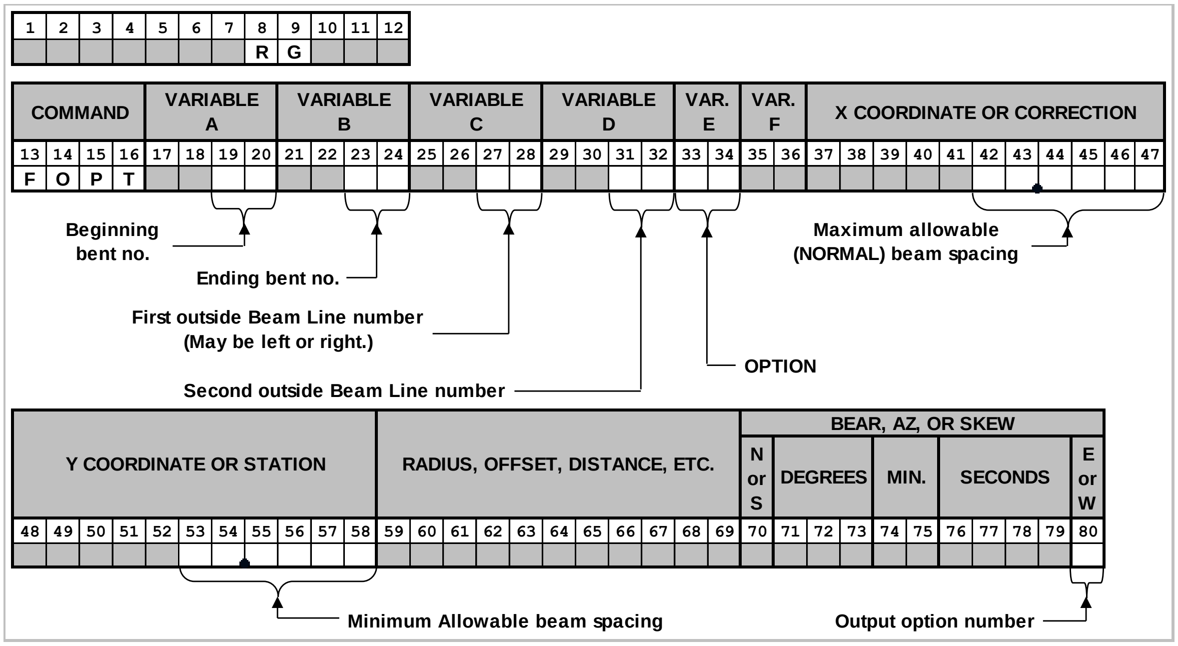
Figure 82 - 7/ simple span (command may refer to more than 1 span)

</td>
<td>

The number of beams is based on maximum (NORMAL) beam spacing on the longest bent. As many beams as possible are placed parallel to both outside beams without violating minimum beam spacing. Remaining beams are flared.

Outside beam numbers may be any previously defined beam lines. Both outside and interior beams will be numbered beginning with one for storage. Beam line numbers for interior beams need not be reserved.

</td>
</tr>
</table>



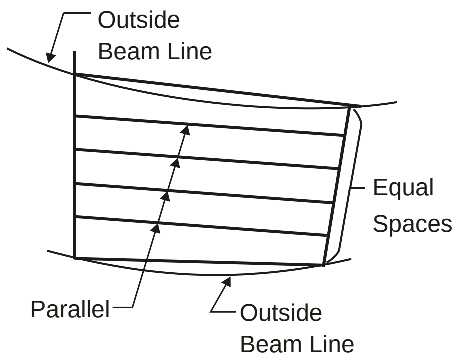
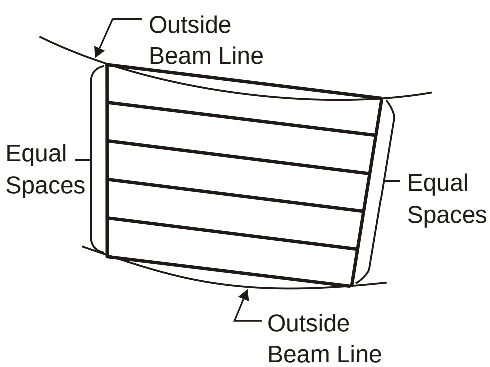
Card 112 - FOPT Argument Input Scheme C (Options 6 &7) Card

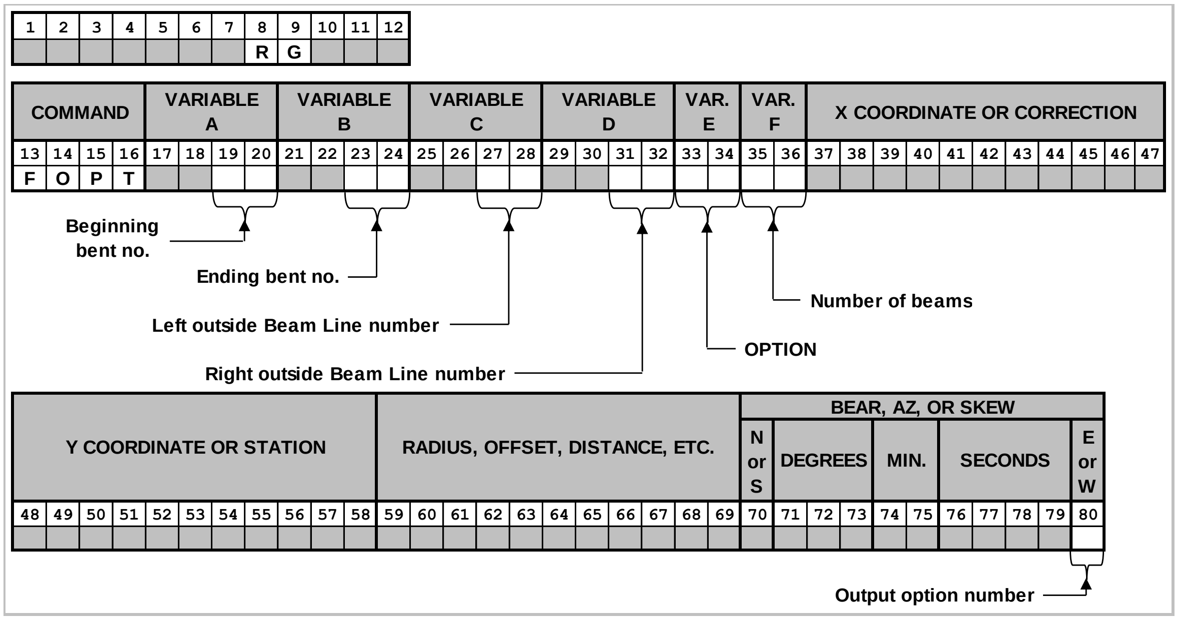
This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.
- *First Outside Beam Line (may be left or right) (VAR C):* The number of a previously defined beam line.
- *Second Outside Beam Line (may be left or right) (VAR D):* The number of a previously defined beam line.
- *Frame Option (VAR E):* The number corresponding to the desired option for controlling the layout of the beams. Use 6 or 7, each a version of the simple span layout.
- *Maximum Allowable Beam Spacing (X-COORDINATE OR CORRECTION):* The maximum distance between any two given beams, measured normal to the beam.
- *Minimum Allowable Beam Spacing (Y-COORDINATE OR CORRECTION):* The minimum distance between any two given beams, measured normal to the beam.
- *Output Option (BEAR, AZ, OR SKEW):* No entry or entry of 0 omits the beam coordinate report and produces the frame plot. Entry of 1 produces the beam coordinate report and the frame plot. Entry of 2 produces the beam coordinate report and omits the frame plot, and entry of 3 omits both the beam coordinate report and the frame plot.

FOPT ARGUMENT INPUT SCHEME D (OPTIONS 3 & 5)

Interior beams are automatically spaced based on the number of required beams between the given outside beam lines and the frame criteria. Frame options are illustrated in the Figure 83 - **3/ simple span (command may refer to more than 1 span)** and **Figure 84** - **5/ simple span (command may refer to more than 1 span)**.

 **Figure 83 -** 3/ simple span (command may refer to more than 1 span)	Beams are spaced equally on the shortest bent. Interior beams are placed parallel to a line that joins the midpoints of the two bents. Outside beam line numbers may be any previously defined beam lines. For storage, both outside and interior beams will be numbered beginning with one. Beam line numbers for interior beams need not be reserved.
 **Figure 84 -** 5/ simple span (command may refer to more than 1 span)	Beams are equally spaced on both the back and forward bent. Outside beam line numbers may be any previously defined beam lines. For storage, both outside and interior beams will be numbered beginning with one. Beam line numbers for interior beams need not be reserved.



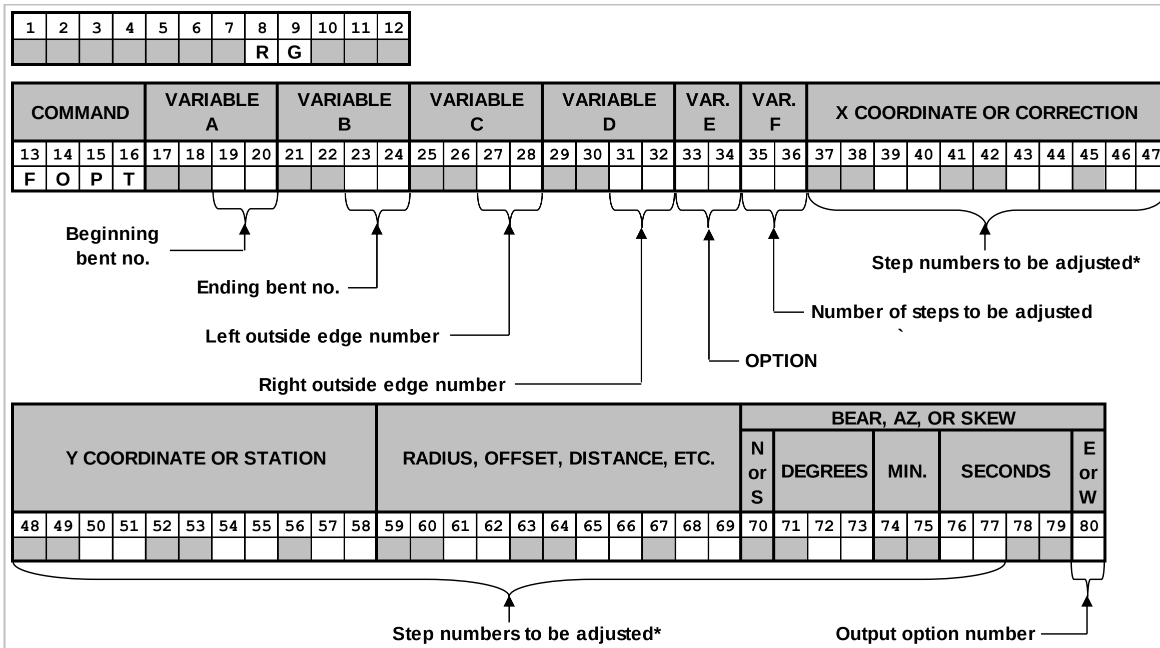
Card 113 - FOPT Argument Input Scheme D (Options 3 & 5) Card

This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.
- *Left Outside Beam Line (VAR C):* The number of a previously defined beam line referring to the leftmost beam in the structure.
- *Right Outside Beam Line (VAR D):* The number of a previously defined beam line referring to the rightmost beam in the structure.
- *Frame Option (VAR E):* The option number defining the layout of the beams. Use 3 or 5, each a version of the simple span layout.
- *Number of Beams (VAR F):* The number of beams to be placed in each span.
- *Output Option (BEAR, AZ, OR SKEW):* Entering blank or "0" omits the beam coordinate report and produces the frame plot. Entering "1" produces the beam coordinate report and the frame plot. Entering "2" produces the beam coordinate report and omits the frame plot. Entering "3" omits both the beam coordinate report and the frame plot.

FOPT ARGUMENT INPUT SCHEME E (OPTION 15)

This input scheme is used for box beams to adjust bearing seat elevations such that the beams will not be subject to torsion due to differing forward and back cross-slopes. The bearing seat elevations are adjusted to make the cross slope of the boxes at the back bent match the forward bent. Differing forward and back slopes typically occur on bridges with skews or super-elevations. Use of the BGRP command is recommended in lieu of the BEAM command to define the beam edge lines (step lines). Unlike other frame options where the beam line represents the centerline of the beam, beam lines defined under Option 15 represent the edge of the beam bottom flange or the center of the joint between adjacent beams. See **Figure 85 - Option 15 Output Interpretation** in the Notes on Argument Scheme E section below for an illustration of beam steps.



* Positive numbers when this step is to be adjusted. Negative numbers when this step is to be kept the same elevation, but the steps before and after are to be adjusted.

Card 114 - FOPT Argument Input Scheme E (Option 15) Card

This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.
- *First Step Line Number (VAR C):* The number that defines the left outside step line.
- *Last Step Line Number (VAR D):* The number that defines the right outside step line.
- *Frame Option (VAR E):* The option number defining the layout of the beams. Use 15, a version of the simple span layout.
- *Number of Steps Adjusted (VAR F):* The number of steps that are to be adjusted to prevent torsion.

- *Step Numbers Adjusted (X-COORDINATE through RADIUS, OFFSET, ETC):* The numbers of the steps to be adjusted. If the step number is positive, that step will be adjusted; but if the step number is negative, the elevation of that step will be held constant and the elevation of adjacent steps will be adjusted.

- *Output Option (BEAR, AZ, OR SKEW):* Entering blank or “0” omits the beam coordinate report and produces the frame plot. Entering “1” produces the beam coordinate report and the frame plot. Entering “2” produces the beam-coordinate report and omits the frame plot. Entering “3” omits both the beam coordinate report and the frame plot.

NOTES ON ARGUMENT SCHEME E

- The VCLR command does not work for Frame Option 15.

- A maximum of two FOPT commands are allowed for this option. A total of 22 steps (total of 21 beams) can be entered.

- Steps should be selected to occur at locations where the template changes slope. This results in a constant overlay or slab thickness. The user may need to experiment with different step locations in order to avoid excessive overlay thickness and achieve a desired step size. Overlay thickness should not exceed 4”, and step sizes should be approximately ½” to 1 ½”.

- The following figure illustrates how to interpret the output for Option 15.

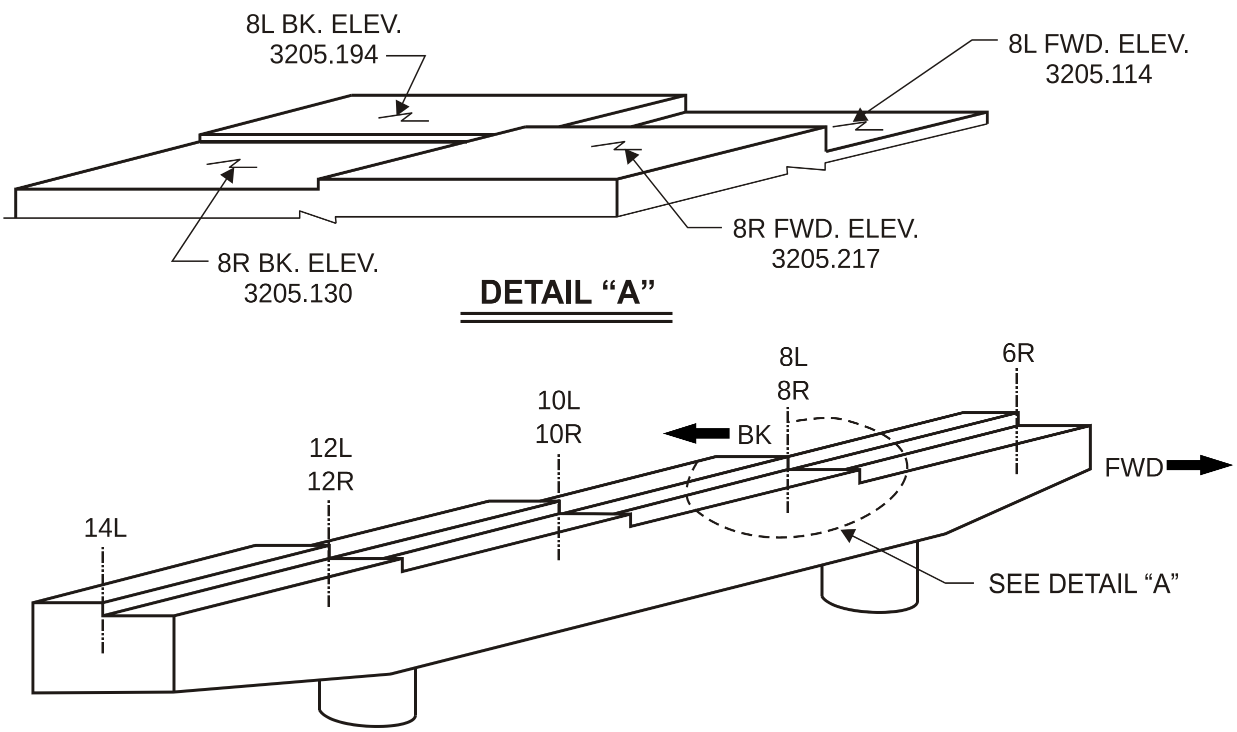


Figure 85 - Option 15 Output Interpretation

FOPT ARGUMENT INPUT SCHEME F (OPTIONS 20, 21 & 22)

This input scheme is reserved for U beams, which are placed to ensure uniform seating on the bearings by balancing the cross slopes at each beam end. Each beam is balanced individually, rather than in groups as in Option 15. Enter the pedestal information in the BRNG command. Coordinate and elevation information is calculated along the right edge of the pedestal, along the left edge of the pedestal, and at the centerline of the beam. Beam framing is in accordance with the options illustrated below.

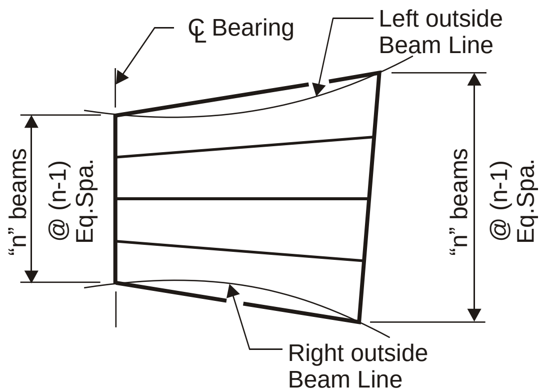
<table>
<tr>
<td>


Figure 86 - 20/ equally spaced beams
</td>
<td>
The left and right exterior beam lines must be defined with the BEAM command. All beams are equally spaced between left and right outside beam lines. Exterior beams are defined along the chord of the exterior beam lines between centerlines of bearing.

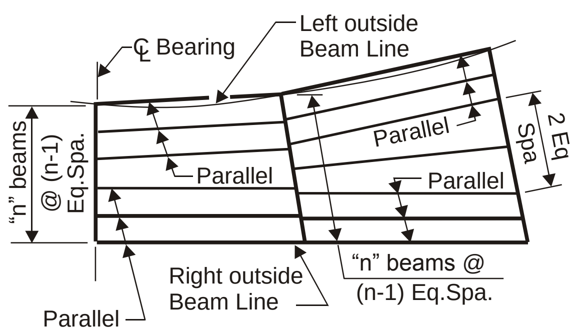
Note: Frame Option 20 spaces U beams the same way Frame Option 5 spaces I beams.
</td>
</tr>
<tr>
<td>


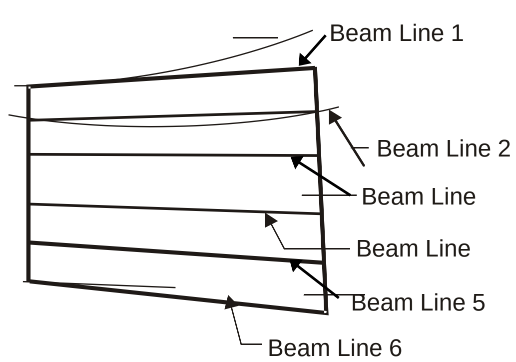
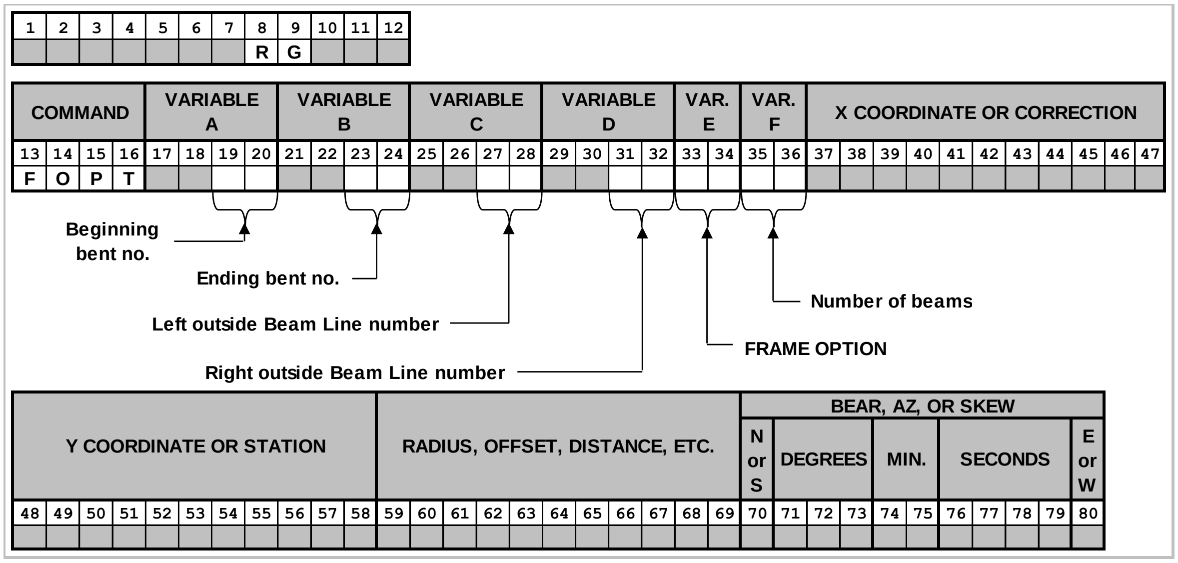
Figure 87 - 21/ parallel beam groups
</td>
<td>
The left and right exterior beam lines must be defined with the BEAM command. Exterior beams will be defined along the chord of the exterior beam lines between the centerlines of bearing. Interior beams will be divided into two groups, each parallel to its adjacent exterior beam. For an odd number of beams, the middle beam will be centered between the two groups. Unlike Frame Option 7, which places beams by checking MIN and MAX allowable beam spacings. Frame Option 21 spaces beams equally along the shorter bent of the span.
</td>
</tr>
<tr>
<td>


Figure 88 - 22/ All beam lines individually defined
</td>
<td>
All beam lines are individually defined with BEAM or BGRP commands. Beam lines must be consecutively numbered from left to right but numbering need not begin at 1. Beams will be defined along the chord of the beam lines between centerlines of bearing.
</td>
</tr>
</table>



Card 115 - FOPT Argument Input Scheme F (Options 20, 21 & 22) Card

This argument input scheme requires the following data:

- *Beginning Bent (VAR A):* The number of the previously stored bent where the back ends of the beams are to be located.
- *Ending Bent (VAR B):* The number of the previously stored bent where the forward ends of the beams are to be located.
- *Left Outside Beam Line (VAR C):* The number of a previously defined beam line.
- *Right Outside Beam Line (VAR D):* The number of a previously defined beam line.
- *Frame Option (VAR E):* The number corresponding to the desired option for controlling the layout of the beams. Use 20 for all beams evenly spaced, 21 for two parallel groups of beams (parallel to left and right outside beams), and 22 for all beam centerlines individually defined.
- *Number of Beams (VAR F):* The number of beams to be placed in each span.

BMGD (BEAM GRADE) – FOR SIMPLE SPANS ONLY

FUNCTION

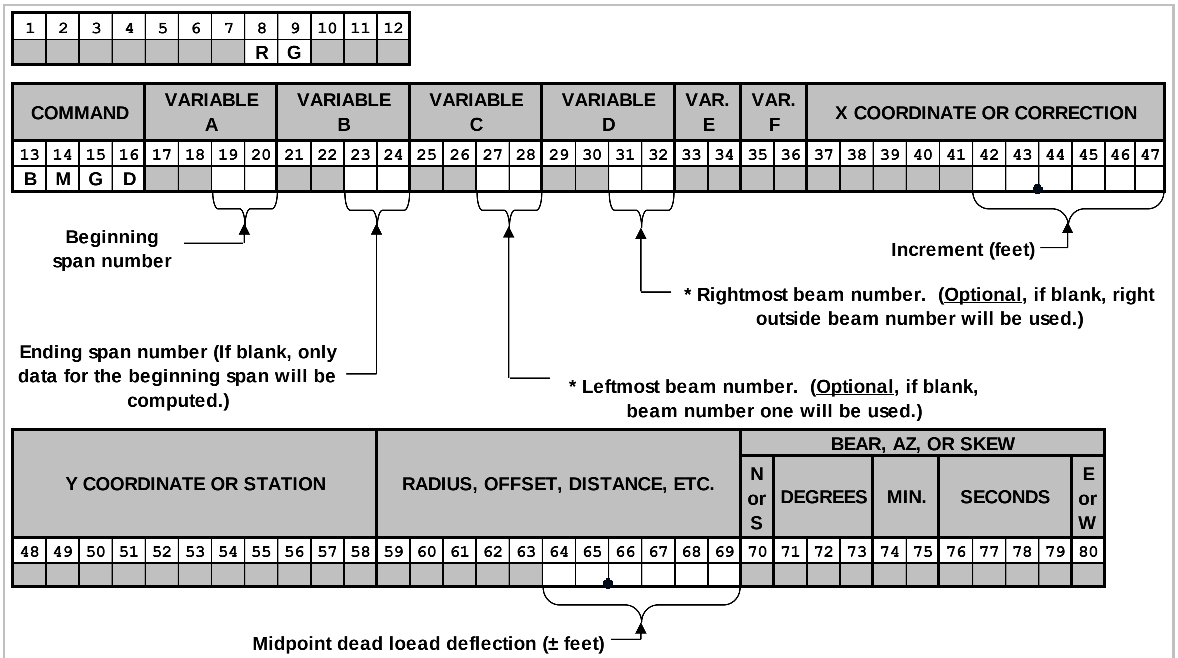
This command calculates and outputs a tabulation of surface elevations, bottom of slab elevations, and bottom of slab elevations plus deflection along the centerline of each beam, from bearing seat to bearing seat.

USAGE

Use this command to produce a tabulation of surface elevations, bottom of slab elevations and bottom of slab elevations plus deflection along the centerline of each beam. May be used only for simple spans, must be preceded by the applicable SLAB and FOPT commands, and applies to the SLAB command that immediately precedes it. If the slab and overhang depths differ, then the outside beams will be tabulated once for each depth. This tabulation may be requested by one of two options as shown below.

BMGD ARGUMENT INPUT SCHEME A

This input scheme calculates elevations at given distance increments along the centerline of the beam between bearing seats.



* If variables C and D are both blank, all beams for the span(s) will be used. This should be used only when all beams have the same midpoint dead load deflection. For a single beam, enter that beam number in both variables C and D.

Card 116 - BMGD Argument Input Scheme A Card

This argument input scheme requires the following data:

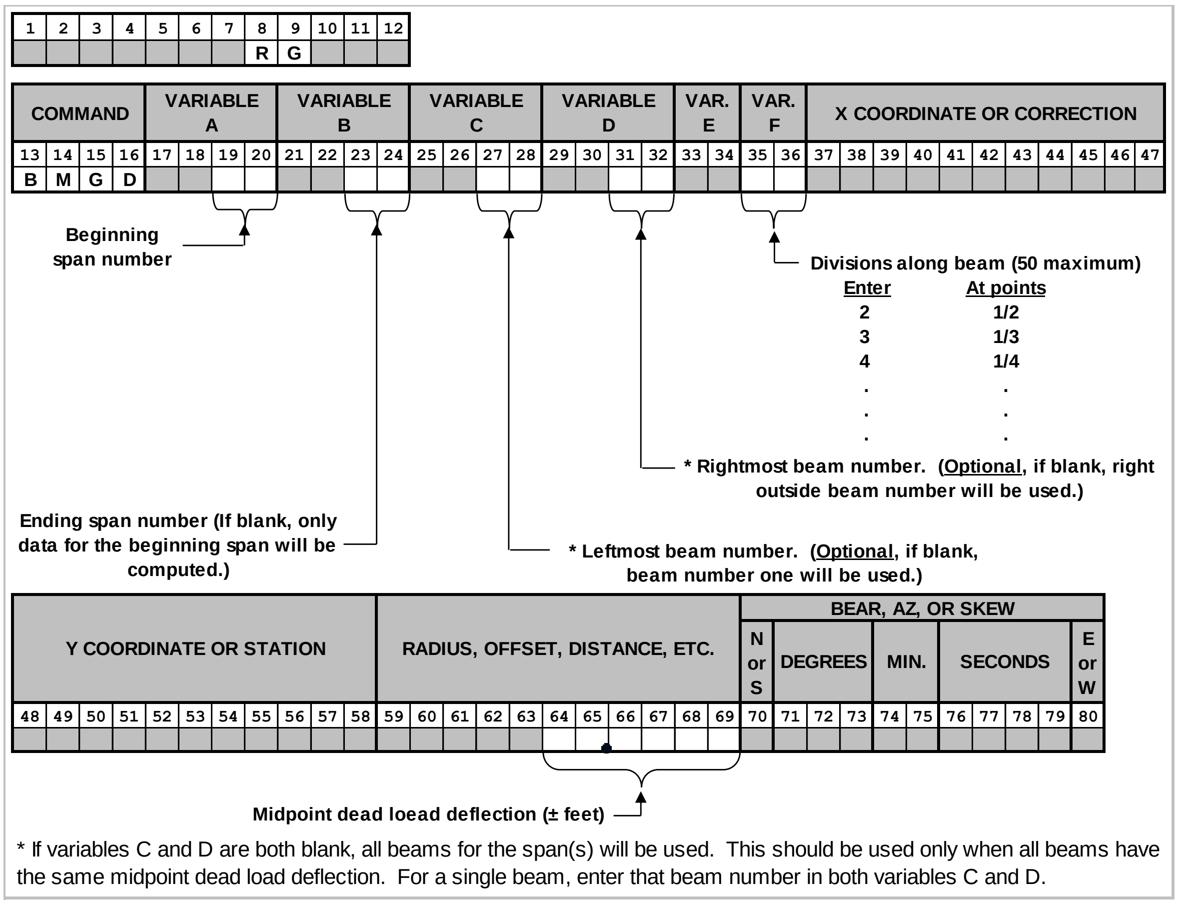
- *Beginning Span (VAR A):* The number of the beginning span.
- *Ending Span (VAR B):* The number of the ending span. If blank, only data for the beginning span will be computed.
- *Left Beam Number (VAR C) (optional):* The first beam for which elevations are to be calculated. Not necessarily the beam line number; the leftmost beam for the span is always number one for this command. If blank, beam number one will be used.
- *Right Beam Number (VAR D) (optional):* The last beam for which elevations are calculated. Not necessarily the beam line number; the leftmost beam for the span is always number one for this command. Elevations will be computed for all the beams between the left beam number and the right beam number, inclusively. If blank, the right outside beam number will be used.
- *Increment (X-COORDINATE OR CORRECTION):* The number of feet or meters along the beam line between elevation calculations. This increment must be large enough that there will be no more than 51 calculation points including beginning and ending points. If the increment causes more than 51 points, then the beam will be divided into 50 equal divisions.
- *Dead Load Deflection (RADIUS, OFFSET, ETC):* The dead load deflection at the midpoint of the beam, in feet or meters.

NOTES ON ARGUMENT INPUT SCHEME A

If Variables C and D (leftmost and rightmost beam numbers) are both blank, all beams for the span(s) will be used. This should be used only when all beams have the same midpoint deadload deflection. For a single beam, enter that beam number for both Variables C and D.

BMGD ARGUMENT INPUT SCHEME B

This input scheme calculates elevations at equal divisions along the centerline of the beam between bearing seats.



Card 117 - BMGD Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Beginning Span (VAR A):* The number of the beginning span.
- *Ending Span (VAR B):* The number of the ending span. If blank, only data for the beginning span will be computed.
- *Left Beam Number (VAR C) (optional):* The first beam for which elevations are to be calculated. Not necessarily the beam line number; the leftmost beam for the span is always number one for this command. If blank, beam number one will be used.

- *Right Beam Number (VAR D) (optional):* The last beam for which elevations are calculated. Not necessarily the beam line number; the leftmost beam for the span is always number one for this command. Elevations will be computed for all the beams between the left beam number and the right beam number, inclusively. If blank, the right outside beam number will be used.
- *Division (VAR F):* The number of equal parts into which the beam will be divided for calculations. There is a maximum of 50 divisions along each beam.
- *Dead Load Deflection (RADIUS, OFFSET, ETC):* The dead load deflection at the midpoint of the beam.

VCLR (VERTICAL CLEARANCE)

FUNCTION

This input scheme creates a tabulation of vertical clearances between structures and lower roadways.

USAGE

Use this command to compute the vertical distances between beam reference lines and a given roadway alignment, assuming the beams have no camber or deflection. See Command BENT, Scheme A, for a discussion of the reference line.

The vertical clearance to the lower roadway surface will be computed at increments along the centerline of the beams. In the case of simple span beams like prestressed concrete beams the clearance will be based on the straight line between the bearing seats. For continuous structures the clearance will be computed on the basis of the distance from the reference line to the floor surface. (Refer to the reference line discussion.) In either case the user may modify the clearance as necessary to take into account deflections or depths of the beam below the reference line. For a simple span, the reference line used to calculate the clearances is a straight line chord from the back bent bearing seat to the forward bent bearing seat.

The vertical clearance command may also be used to assist in determining the required haunch. By calling for vertical clearances of a span to its own roadway alignment, the vertical offset from the roadway surface to the chord through the bearing seats will be produced at increments along each beam. The number of increments may be adjusted by using field VAR D of the VCLR command.

The required haunch is computed along the centerline of the beam. To avoid encroachment of the slab into the beam due to cross-slope effects a calculation using one-half the top of the beam width multiplied by the roadway cross-slope is performed by the user. This value is used in the determination of the required haunch and, like beam camber, is outside the scope of BGS internal calculations and output. **Figure 89 - Required Haunch** illustrates this situation.

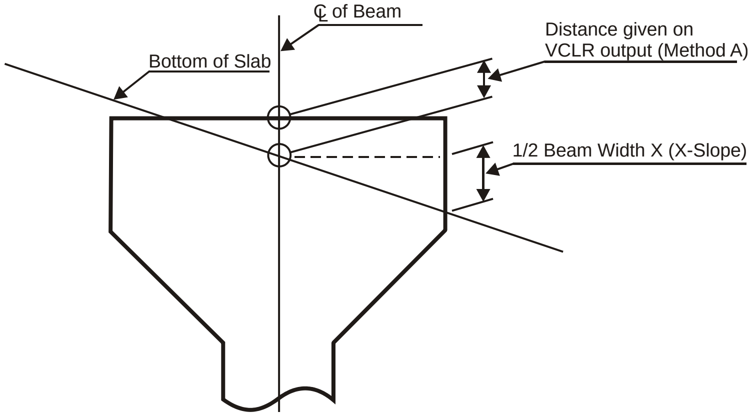
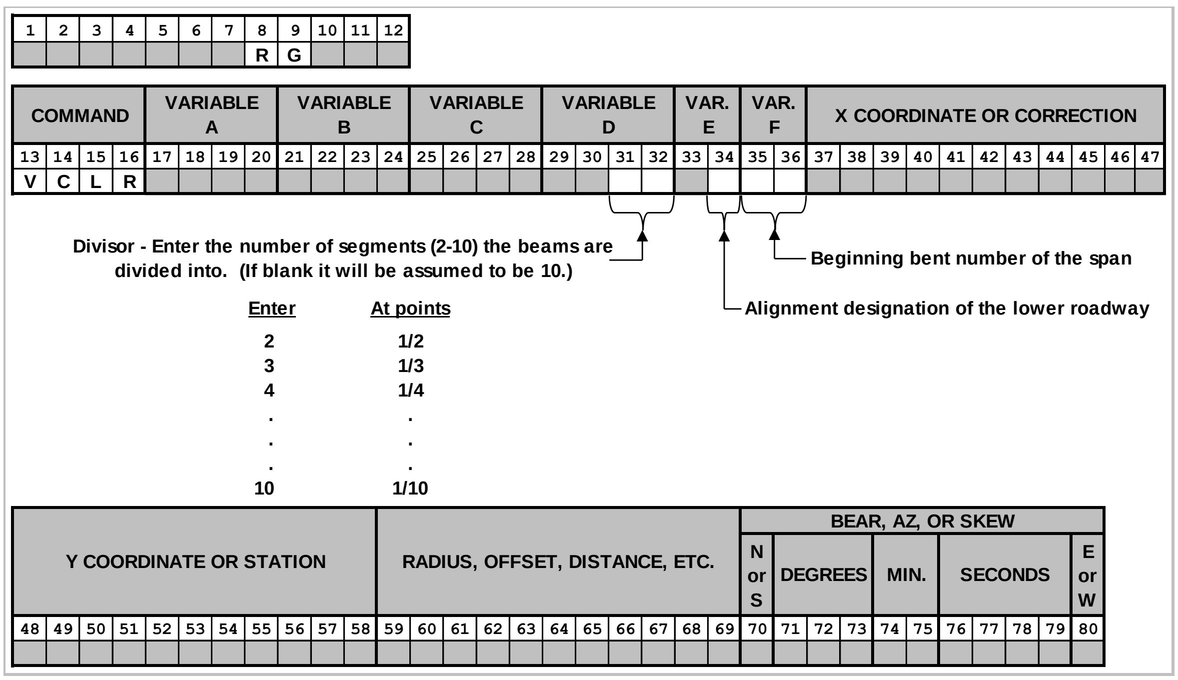


Figure 89 - Required Haunch

VCLR ARGUMENT INPUT SCHEME



Card 118 - VCLR Argument Input Scheme Card

This argument input scheme requires the following data:

- *Divisor (VAR D):* The number of sections the span is to be divided into for clearance calculations. The clearance will be calculated at the beginning of each segment and the end of the span. If this field is left blank, the divisor will be assumed to be 10.
- *Roadway Alignment (VAR E):* The letter (A–Z, but not G) assigned to the roadway alignment relative to which the clearance is to be calculated.
- *Beginning Bent (VAR F):* The number of the beginning bent for the span where the clearances are to be calculated.

NOTES ON VCLR COMMAND

Regardless of the depth below reference line used on the Bearing Command (BRNG), a careful analysis of the relative differences in the tabular values given in the VCLR output will assist in detecting when beams encroach into the slab due to sag vertical curves, slope transitions, horizontal curvature and/or superelevation.

Calculations are based on a straight line between bearing seats. Any permanent cambers in beams or dead load deflections due to slab, are not taken into account in the VCLR command. However, for total required beam haunch, these values must be included in the calculations.

The three methods listed below may be used to determine the required haunch.

Method A. Enter zero deduct on the BRNG command.

Method B. Enter the anticipated haunch as deduct on the BRNG command.

Method C. Enter the total anticipated bearing seat deduct on the BRNG command.

These three methods and the associated outputs are illustrated in the following figures and tables:

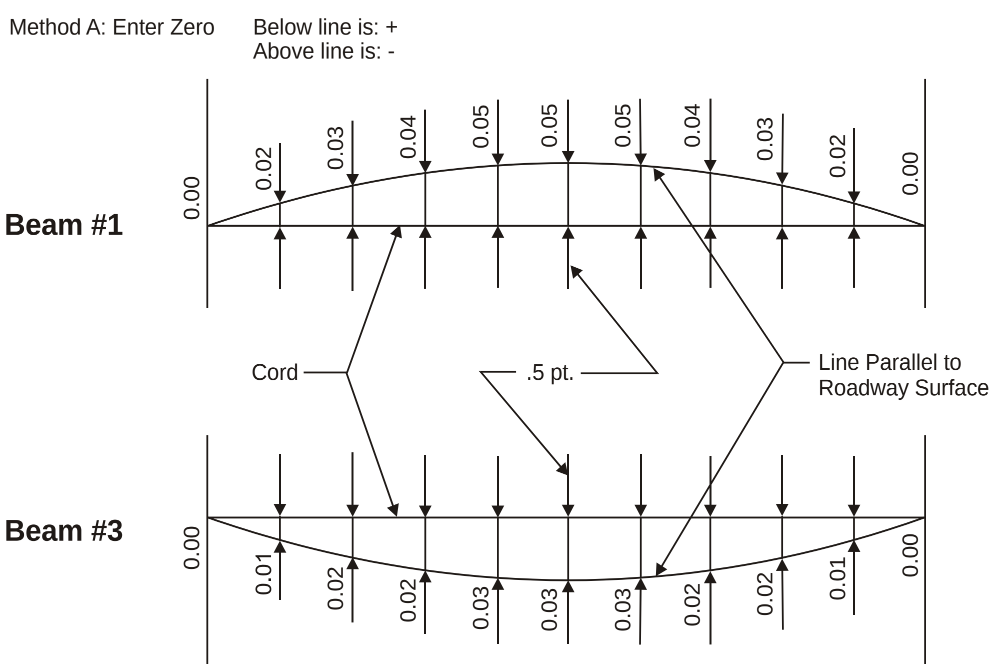


Figure 90 - Method A: Enter Zero

Table 9 - Output for Method A

VERTICAL CLEARANCE BETWEEN SPAN 1 OF ROADWAY H WITH ROADWAY H											
	0.00 L	0.10 L	0.20 L	0.30L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	-0.00	-0.02	-0.03	-0.04	-0.05	-0.05	-0.05	-0.04	-0.03	-0.02	-0.00
BEAM 2	-0.00	-0.01	-0.03	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.01	-0.00
BEAM 3	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.01	0.00
BEAM 4	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.00
BEAM 5	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00

Method B: Enter Anticipated Haunch

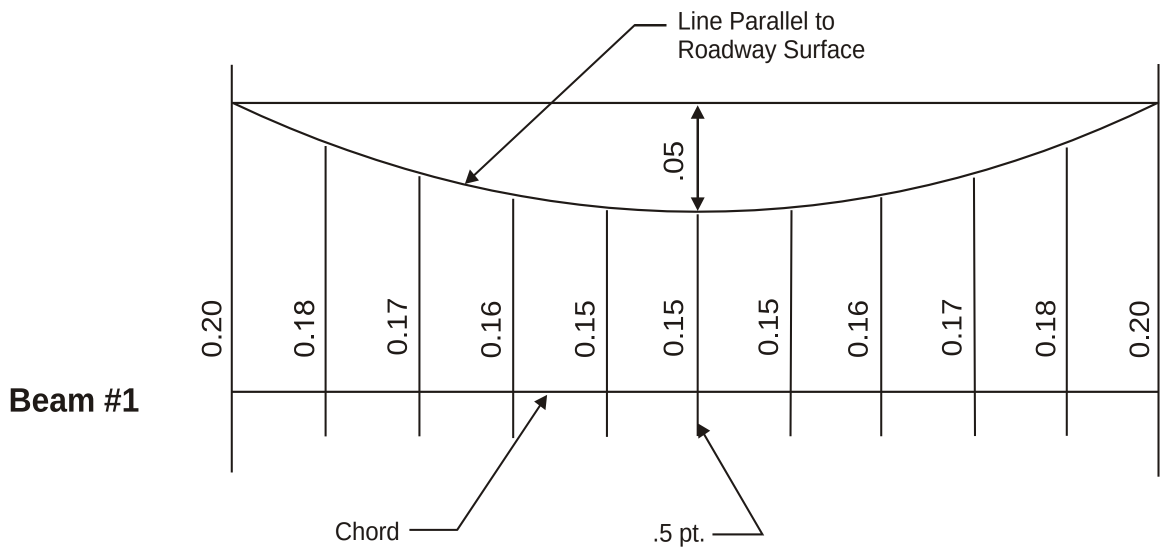


Figure 91 - Method B: Enter Anticipated Haunch

Table 10 - Output for Method B

VERTICAL CLEARANCE BETWEEN SPAN 1 OF ROADWAY H WITH ROADWAY H											
	0.00 L	0.10 L	0.20 L	0.30L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	-0.20	-0.18	-0.17	-0.16	-0.15	-0.15	-0.15	-0.16	-0.17	-0.18	-0.20
BEAM 2	-0.20	-0.19	-0.17	-0.17	-0.16	-0.16	-0.16	-0.17	-0.17	-0.19	-0.20
BEAM 3	-0.20	-0.19	-0.18	-0.18	-0.17	-0.17	-0.17	-0.18	-0.18	-0.19	-0.20
BEAM 4	-0.20	-0.19	-0.19	-0.18	-0.18	-0.18	-0.18	-0.18	-0.19	-0.19	-0.20
BEAM 5	-0.20	-0.20	-0.19	-0.19	-0.19	-0.19	-0.19	-0.19	-0.19	-0.20	-0.20

Method C: Enter Depth of Section

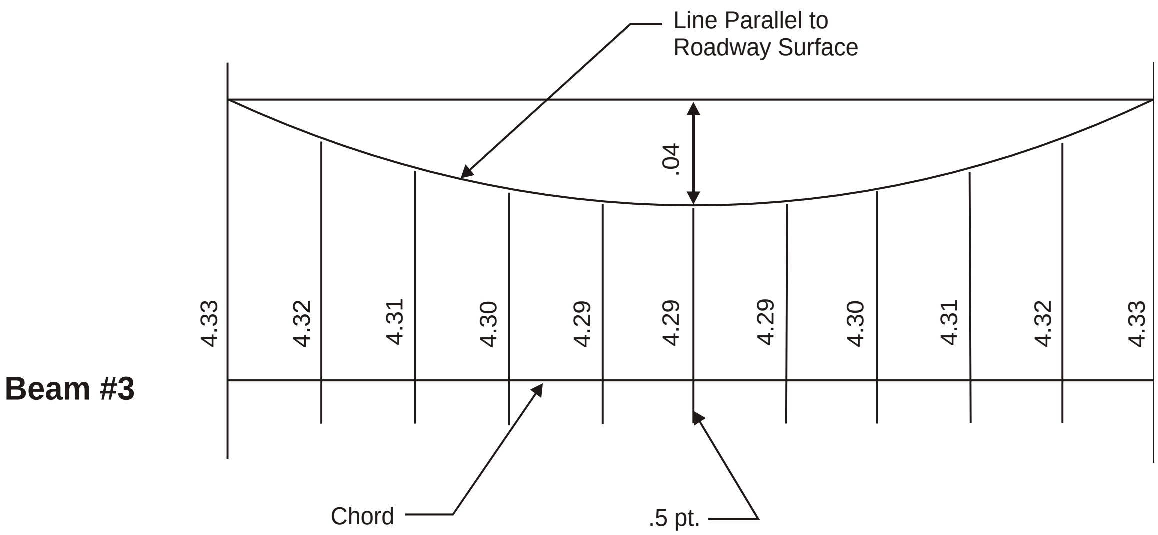


Figure 92 - Method C: Enter Depth of Section

Table 11 - Output for Method C

VERTICAL CLEARANCE BETWEEN SPAN 3 OF ROADWAY H WITH ROADWAY H											
	0.00 L	0.10 L	0.20 L	0.30 L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	-4.33	-4.32	-4.32	-4.31	-4.31	-4.30	-4.30	-4.31	-4.31	-4.32	-4.33
BEAM 2	-4.33	-4.32	-4.31	-4.30	-4.30	-4.30	-4.30	-4.30	-4.31	-4.32	-4.33
BEAM 3	-4.33	-4.32	-4.31	-4.30	-4.29	-4.29	-4.29	-4.30	-4.31	-4.32	-4.33
BEAM 4	-4.33	-4.32	-4.30	-4.29	-4.29	-4.29	-4.29	-4.30	-4.30	-4.32	-4.33
BEAM 5	-4.33	-4.31	-4.30	-4.29	-4.28	-4.28	-4.28	-4.29	-4.30	-4.32	-4.33

CHAPTER 8: COMMAND STRUCTURED INPUT – PLOTTING

PLOTTING

Plotting in BGS is supported when requested by the user. BGS can generate a plot file that is converted to a MicroStation "dgn" file and which will be automatically displaced using the MicroStation software installed on the user's machine. Only the full "stand-alone" version of MicroStation can be automatically invoked by BGS.

GENERAL PLOTTING INSTRUCTIONS

The BGS generated plot will include all the alignments, bridge framing, slab edge elevations and any other elements that the user specifies. Up to four different "line" colors (the legacy term used in the BGS input scheme is "pen" color, referencing the instruments used when the target media for such plots was physical white vellum or paper rather than an electronic file) may be used in a single plot. See the NPEN command for instructions on using pens.

The AXIS command allows the user to establish a coordinate system and "plotting field" for the plot. The limits of the plotting field are only applicable to the legacy system that plotted to physical media and so may be ignored when using the current version of BGS which plots to an electronic file. An unlimited number of points, lines, curves, titles, titles, alignments, areas, and bridge frames and slabs can be drawing on this coordinate system. Another AXIS card can be specified and subsequent plot data plotted on the new specified coordinate system.

The term "width" is a legacy term referring to the 33-inch dimension of the plotting media. The term "length" is a legacy term referring to the dimension of the media taken in the orthogonal direction (i.e. the roll direction). Since the "media" is no longer "paper" but electronic the length and width of the plot field are unlimited.

HORIZONTAL ALIGNMENT PLOTTING

ORIENTING THE PLOT

When using BGS to create a plot file (graphics drawing) the user must first orient the plot. This is done by defining a plot axis; that is, by supplying BGS with a plot bearing and a plot reference point. The user may do this in one of two ways; by automatic orientation, using the APLT command, or by fixed orientation, using the AXIS command. For the APLT command, the user specifies a horizontal alignment to be plotted. BGS will automatically define the plot axis in such a way that the horizontal alignment is displayed across the graphics screen, from the left side of the screen to the right side of the screen, in the direction of increasing stations. All other plot data will be displayed on the screen in the proper relationship to the specified horizontal alignment.

For the AXIS command, the user specifies the reference point and bearing. These should be chosen in such a way that if a line at that bearing is drawn through a sketch of the plot data, and that sketch is rotated at that bearing, the reference point lies near the upper left-hand corner of the rotated sketch. When the data is plotted, it will appear on the screen in the same aspect as it did on the rotated sketch.

The APLT command is easier to use, but the AXIS command gives the user more control over how the data is displayed. In either case, an arrow pointing to true north appears in the upper left-hand corner of the graphics display.

The definition of the plot axis must precede all other plot commands; for example, CPLT, LABL, or PPLT commands. If any of these commands precede the axis definition, BGS will ignore them. There is an exception to this rule: the NPEN command. If the plot axis is being defined by an APLT command, an NPEN command may precede it, and the APLT alignment will be plotted with the color specified by the NPEN command.

For a plot being displayed on the graphics screen, there is no boundary to the display, beyond which items or parts of items are omitted. In consequence, if the user defines an item at an extreme distance from the horizontal alignment which defines the axis, or at an extreme distance from the AXIS reference point, the graphics display will appear to consist of dots of color at opposite ends of the screen.

APLT (ALIGNMENT PLOT: MAY BE USED FOR AUTOMATIC ORIENTATION OF PLOT)

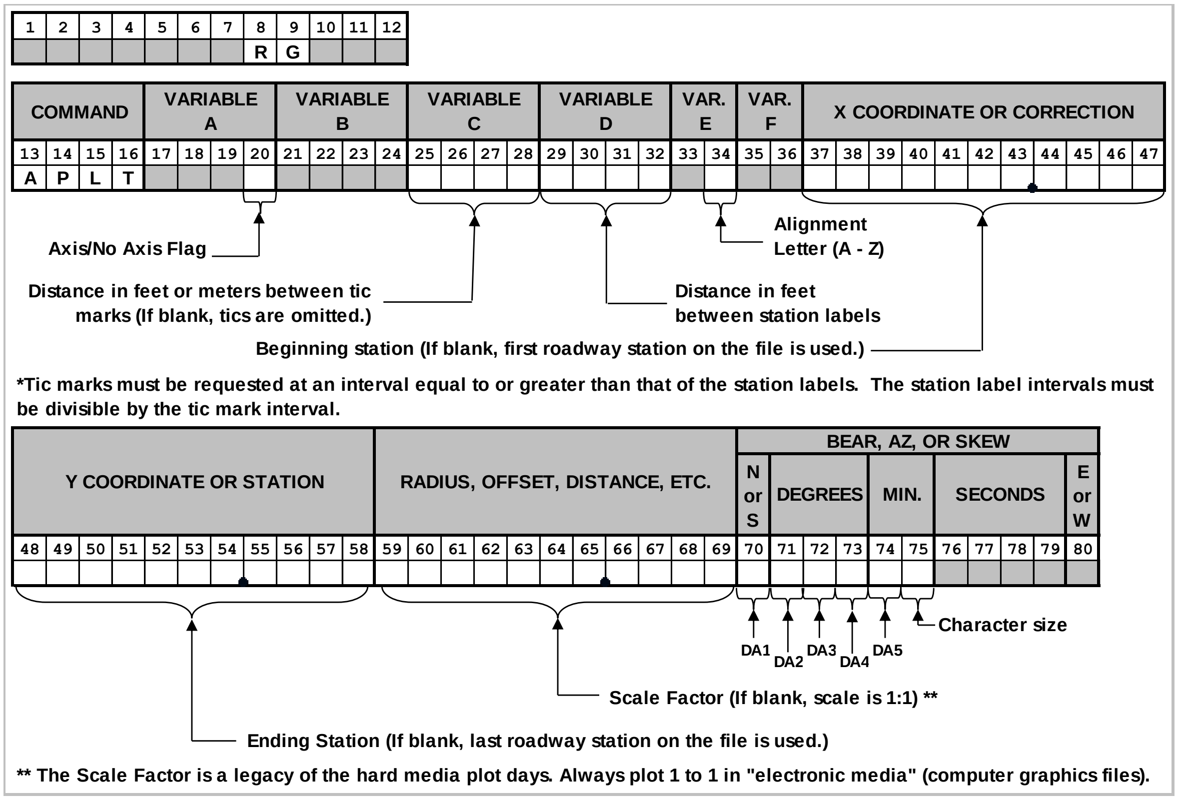
FUNCTION

This command produces an annotated plot of a roadway alignment that has been previously computed and stored. If the first of a series of APLT cards does not immediately follow an AXIS card, BGS performs a linear least-squares fit on the principal points (PIs, PTs, etc.) of the alignment. This produces a plot axis such that the alignment runs across the screen from left to right in the direction of increasing stations. All plotting instructions which occur between the current “First APLT” card and the next “First APLT” or AXIS card will be plotted with reference to this axis.

USAGE

Use this command to establish a reference axis for all of the plotting to be done for one drawing. It also produces an annotated plot of a roadway alignment that has been previously computed and stored. If a supported version of MicroStation is resident, the plot will be displayed in MicroStation.

APLT ARGUMENT INPUT SCHEME



Card 119 - APLT Argument Input Scheme Card

The APLT argument input scheme requires the following data:

- Axis/No Axis Flag: If a “1” is entered in this column, this alignment defines a new axis for the display. This is a “First APLT” card. If this column is blank, this alignment is plotted on the most recent previously-defined axis. (If this column is blank and there is no preceding AXIS or APLT card, then this alignment defines an axis, and is a “First APLT” card.)
- Tick Mark Distance (VAR C): The distance in feet or meters along the alignment between tick marks. If station labels are desired, tick marks must be requested at a distance equal to or less than that of the station labels, and the station label distance must be evenly divisible by the tick mark distance.
- Station Label Distance (VAR D) (optional): The distance in feet or meters along the alignment between station labels. If station labels and tick marks are both desired, the station label distance must be coordinated with the tick mark distance.
- Roadway Alignment (VAR E): The letter (A–Z) assigned to the alignment which is to be plotted.
- Beginning Station (X-COORDINATE OR CORRECTION): The station on the roadway where the axis will begin. If this field is blank, the first station on the roadway is used.
- Ending Station (Y-COORDINATE OR STATION): The station on the roadway where the axis will end. If this field is blank, the last station on the roadway is used.
- DA1: If this field is not blank, all annotation other than station labels and tick marks is omitted.

- DA2: If this field is not blank, radial labels on PI, PC, PT, etc. are omitted.
- DA3: If this field is not blank, beginning labels on tangents are omitted.
- DA4: If this field is not blank, equation labels are omitted.
- DA5: If this field contains the digit 1, 2, or 3, end labels are omitted as follows: Option 1—both end labels, Option 2—start label, Option 3—end label.
- Character Size: If this field contains the digit 1, 2, 3, or 4, the height of the alignment plot labels is 0.75, 1.50, 2.25, or 3.00 feet, respectively, or 0.25, 0.50, 0.75, or 1.00 meters, respectively. If the field is blank or zero, the height of the labels is 1.50 feet or 0.50 meters.

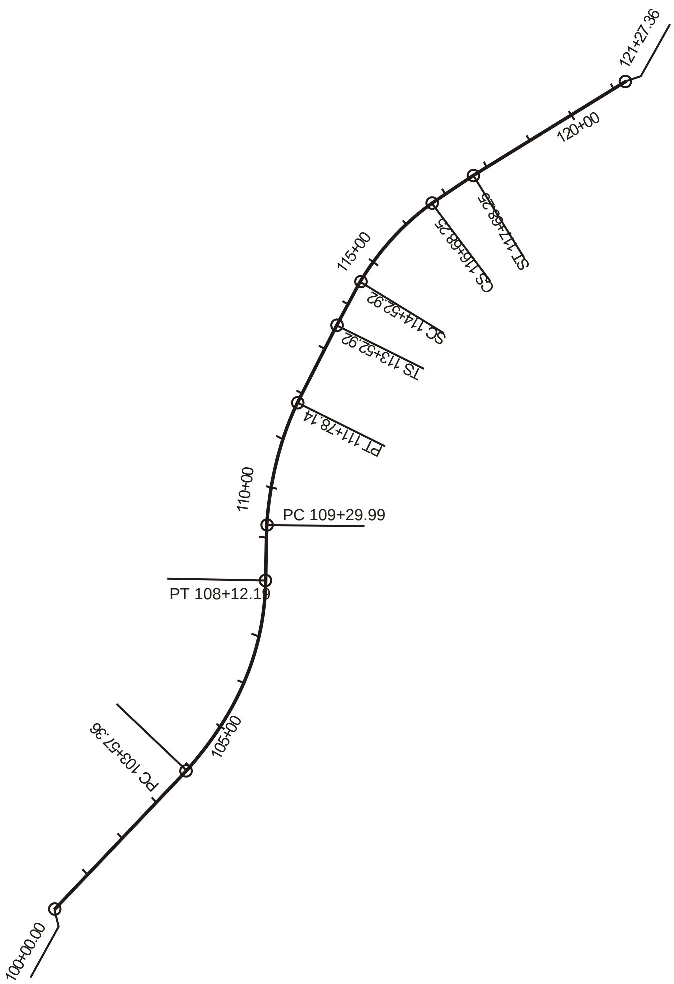


Figure 93 - Example Alignment Plot

NOTES ON EXAMPLE ALIGNMENT PLOT

- All the annotation appears on the plot of this alignment unless the user specifies that it is to be omitted.
- The plot may be oriented on the screen in one of two ways:
- *Fixed Orientation:* When the APLT command is preceded by an AXIS command, which provides the coordinates of the upper left corner and the bearing of the plot axis.
- *Automatic Orientation:* When the APLT command is not preceded by an AXIS command. The system runs a linear least squares curve fit on the principal points (PIs, PTs, etc) of the alignment. This produces a plot axis such that the alignment runs across the screen from left to right in the direction of increasing stations. A north arrow indicates the true direction of the alignment.
- Any succeeding APLT command will be plotted on the axis defined above unless a new axis is defined. A new axis is defined by a subsequent AXIS command or by a subsequent APLT command with the digit 1 in column 20. The system will move the new axis to the right of the old, leaving a space between the two.
- Other plot data such as APLT, CPLT, LABL, or PPLT commands may follow the AXIS command or the “First APLT” command, and will be plotted with reference to this axis.

AXIS (FIXED ORIENTATION OF PLOT)

FUNCTION

This command defines a new plot axis. If a plot axis has been previously defined by a prior AXIS command or by a prior APLT command, the system moves to the right past the previous axis before establishing a new axis. Other plot data such as a CPLT, LABL, or PPLT command may follow the AXIS command and will be plotted with reference to the newly defined axis.

USAGE

Use this command to establish a reference axis for all of the plotting to be done for one drawing. The user should choose this axis and a reference point in such a way that if a line at that bearing is drawn through a sketch of the plot data, and that sketch is rotated at that bearing, the reference point lies near the upper left-hand corner of the rotated sketch. When the data is plotted, it will appear on the screen in the same aspect as it did on the rotated sketch. Each time an AXIS or a “First APLT” instruction is encountered, the system moves to the right, past any previously displayed drawing, before establishing a new axis. All plotting commands which occur between the current AXIS instruction and the next AXIS or “First APLT” command will be plotted with reference to this axis. An illustration of the axis is given in **Figure 94 - Graphics Illustration**.

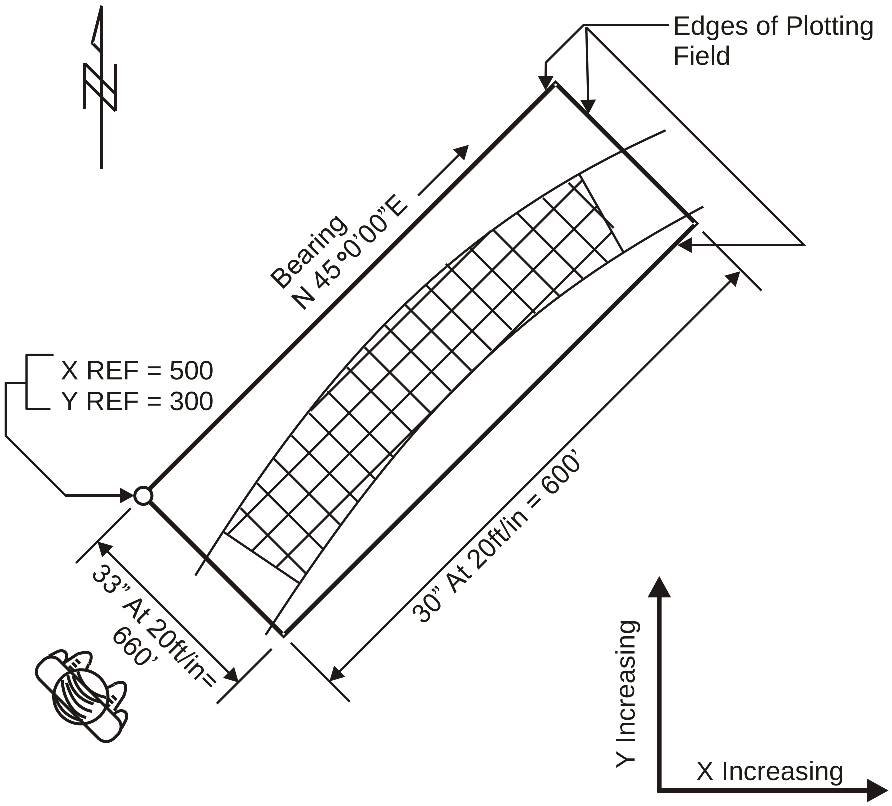


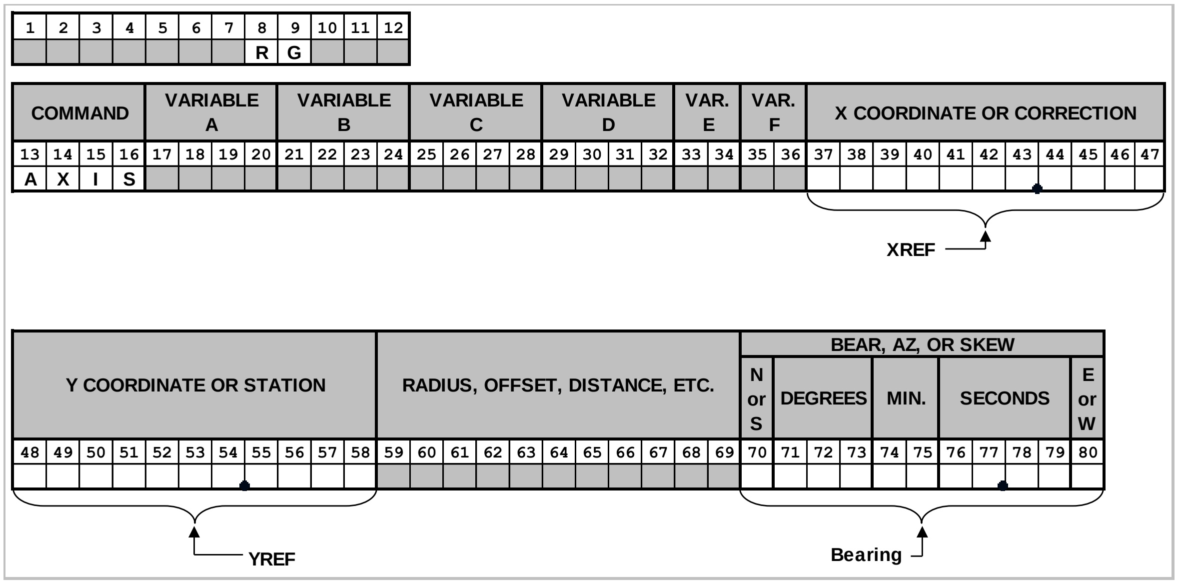
Figure 94 - Graphics Illustration

The drawing will be displayed on the graphics screen with the axis line defined by the AXIS card extending from the left of the screen to the right of the screen. The reference point (XREF, YREF), defined by the user, will be to the upper left of the screen. However, there are no limits on the locations of the plot data which can be displayed on the screen, and some may be nearer the upper left of the screen than (XREF, YREF).

The values for XREF and YREF can be entered on the AXIS card in the X- and Y- coordinate fields or can be taken from a previously stored point by entering the point number in the VAR C field. The value for bearing can be entered on the card in the bearing field or can be taken from a previously stored line by entering the line number in the VAR D field. If either the VAR C OR VAR D fields are used, the corresponding X-COORINATE OR CORRECTION, Y-COORDINATE OR STATION, or BEAR, AZ, OR SKEW field must be left blank.

AXIS ARGUMENT INPUT SCHEME A

This input scheme establishes the plot field using given X- and Y-coordinates and a given bearing.



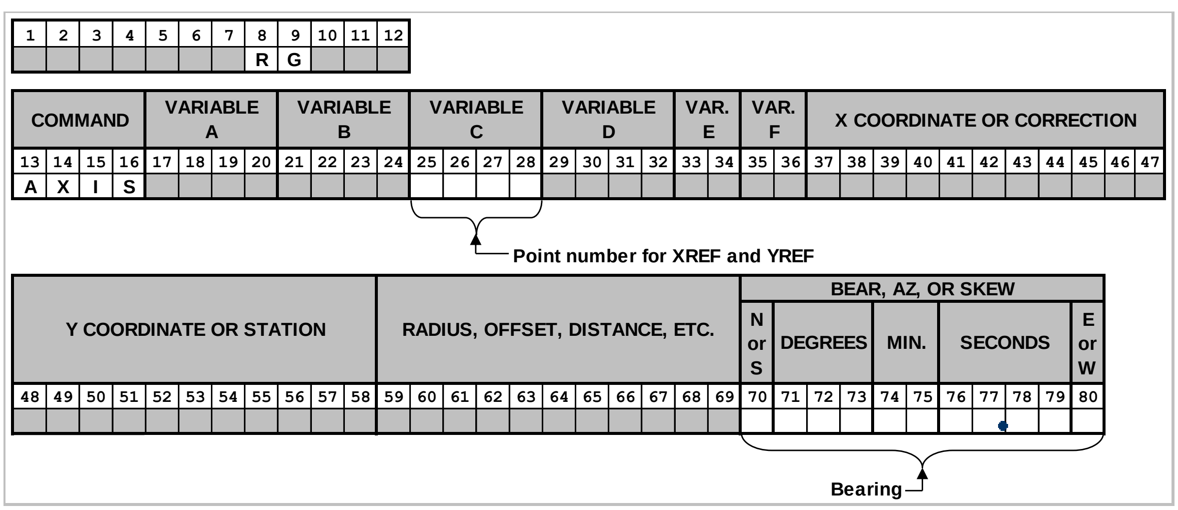
Card 120 - AXIS Argument Input Scheme A Card

This argument input scheme requires the following data:

- *Reference X-Coordinate:* The X-coordinate of the upper left corner of the plot area.
- *Reference Y-Coordinate:* The Y-coordinate of the upper left corner of the plot area.
- *Bearing (BEAR, AZ, OR SKEW):* The bearing of the plot axis.

AXIS ARGUMENT INPUT SCHEME B

This input scheme establishes the plot field using a previously stored point for the X- and Y-coordinates and a given bearing.



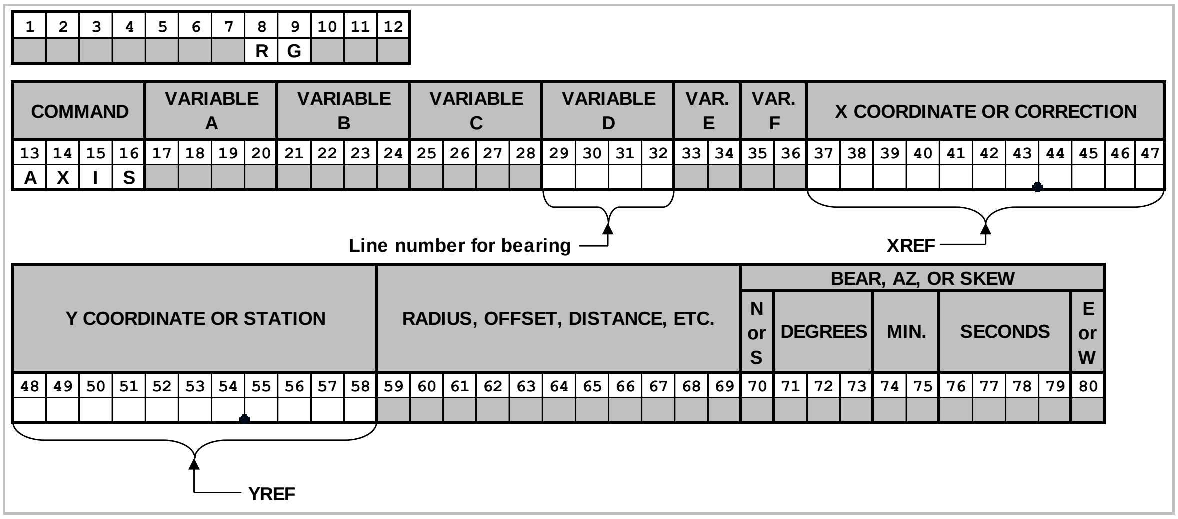
Card 121 - AXIS Argument Input Scheme B Card

This argument input scheme requires the following data:

- *Point ID (VAR C):* The number of a previously stored point located at the upper left corner of the plot area.
- *Bearing (BEAR, AZ, OR SKEW):* The bearing of the plot axis.

AXIS ARGUMENT INPUT SCHEME C

This input scheme establishes the plot field using the given X- and Y-coordinates and a previously stored curve (straight line) for the bearing.



Card 122 - AXIS Argument Input Scheme C Card

This argument input scheme requires the following data:

- *Curve ID (VAR D):* The number of a previously stored curve (straight line) with the desired bearing of the plot axis.
- *Reference X-Coordinate:* The X-coordinate of the upper left corner of the plot area.
- *Reference Y-Coordinate:* The Y-coordinate of the upper left corner of the plot area.

AXIS ARGUMENT INPUT SCHEME D

This input scheme establishes the plot field using a previously stored point for the X- and Y-coordinates and a previously stored curve (straight line) for the bearing.

1	2	3	4	5	6	7	8	9	10	11	12
							R	G			

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
A	X	I	S																															

Point number for XREF and YREF (VARIABLE C) — Line number for bearing (VARIABLE D)

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Card 123 - AXIS Argument Input Scheme D Card

This argument input scheme requires the following data:

- *Point ID (VAR C):* The number of a previously stored point at the upper left corner of the plot area.
- *Curve ID (VAR D):* The number of a previously stored curve (straight line) with the desired bearing of the plot axis.

GENERAL PLOTTING COMMANDS

NPEN

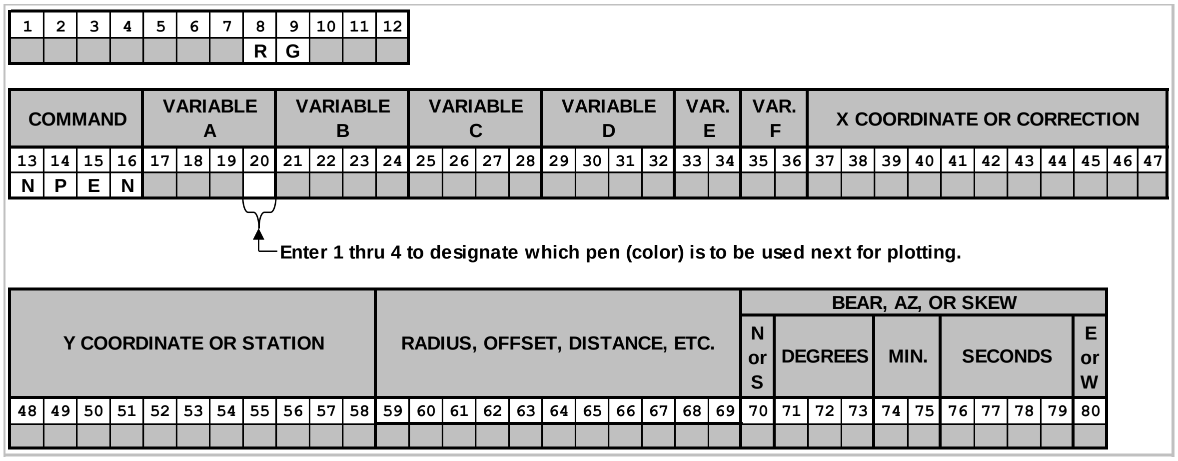
FUNCTION

Use this command to specify the pen (i.e. pen color) to be used for any plotting command.

USAGE

Use this command to designate which pen (1 thru 4) is to be used next for plotting on multiple pen jobs. This pen will be used until another NPEN command is issued. If no NPEN command is issued, plotting will be in white. An NPEN command must precede the plotting command(s) to which it is to apply. Note that if an NPEN command precedes the "First APLT" command, BGS will display this first alignment in the color specified by the NPEN command.

NPEN ARGUMENT INPUT SCHEME



Card 124 - NPEN Argument Input Scheme Card

This argument input scheme requires the following data:

- *Pen Number:* The number assigned to the pen to be used: 1 = white, 2 = blue, 3 = green, 4 = red. The effect when plotting to MicroStation is to display each element of the plot with the color of the pen that was active when the element was plotted by BGS.

PPLT

FUNCTION

This command plots specified points using a given symbol.

USAGE

Use this command to cause each of one to four previously stored points to be plotted using 1 of 16 available symbols. **Figure 94 - Graphics Illustration** illustrates the output of the PPLT command.

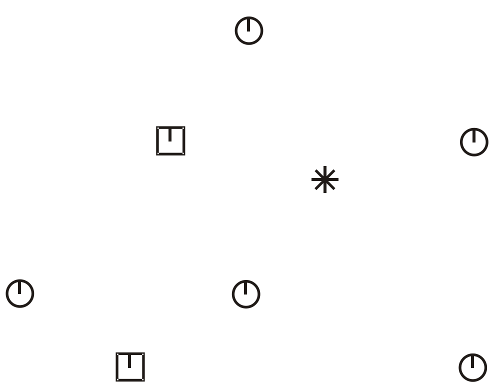
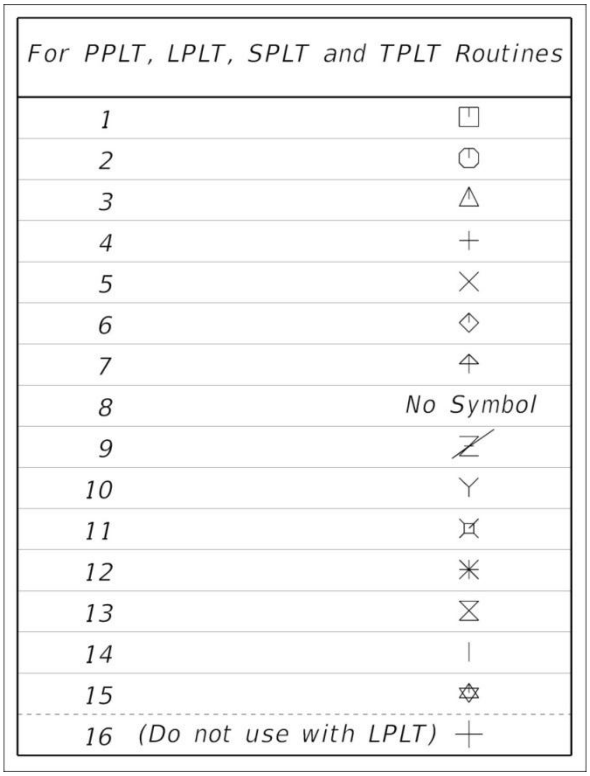


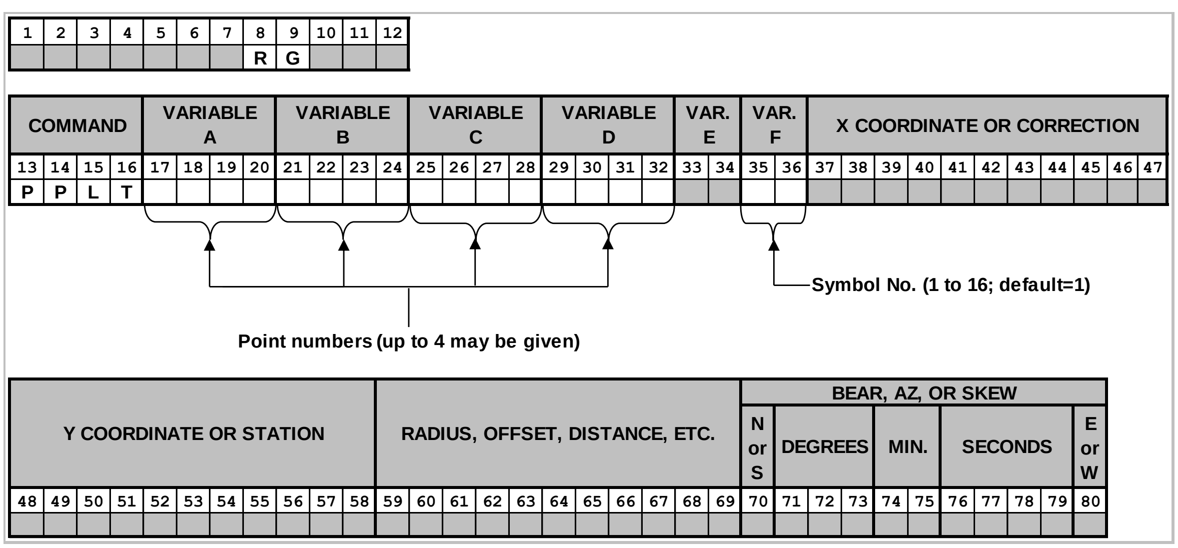
Figure 95 - Example Output of PPLT Command

The points whose numbers are given in the fields of variables A, B, C and D of the PPLT argument input scheme will be plotted using the symbol whose number is given in the variable F field. If no symbol is specified, symbol 1 will be used. See the following table for a list of the 16 symbols (include one blank symbol–i.e. no symbol).

Table 12 - Point Symbols for PPLT, LPLT, SPLT and TPLT Commands



PPLT ARGUMENT INPUT SCHEME



Card 125 - PPLT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of a previously stored point.
- *Point ID (VAR. B) (optional):* The number of a previously stored point.
- *Point Number (VAR. C) (optional):* The number of a previously stored point.
- *Point Number (VAR. D) (optional):* The number of a previously stored point.
- *Symbol Number (VAR F):* The number of the symbol which will be used to mark the points. Enter a symbol number from 1-16. If blank, symbol 1 will be used. See notes for the list of symbols.

SPLT

FUNCTION

Plots a specified series of points using a given symbol.

USAGE

Use this command to cause the series of previously stored points from the number given in the variable A field to the number given in the variable B field to be plotted using the symbol given in the variable F field. If no symbol is given, symbol 1 will be used. See **Table 12 - Point Symbols for PPLT, LPLT, SPLT and TPLT Commands** for the list of available point symbols.

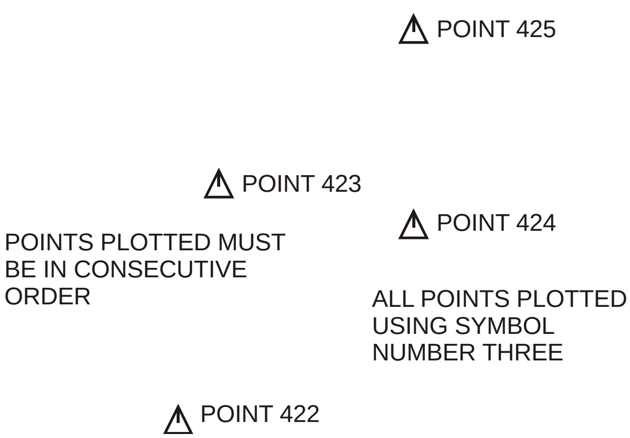
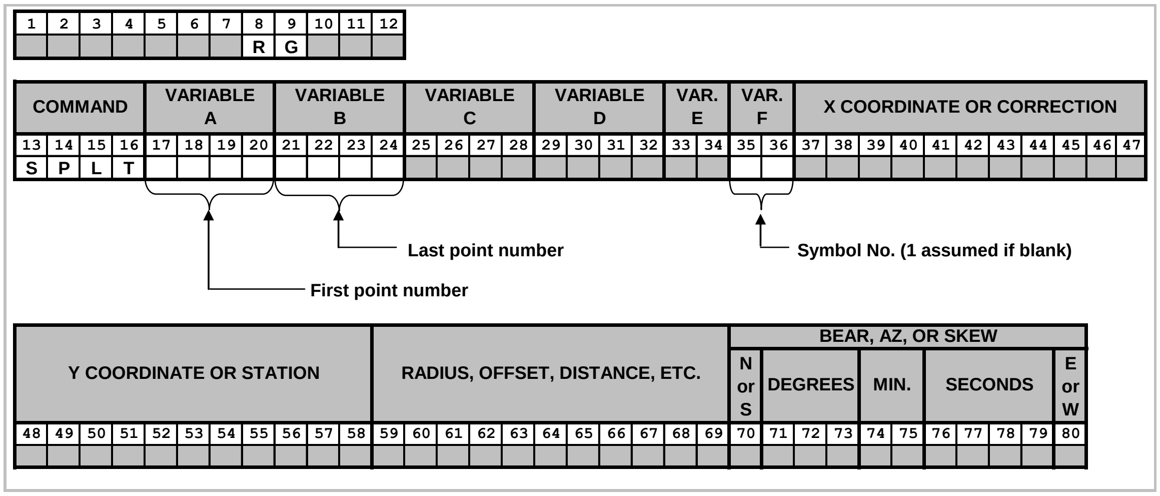


Figure 96 - SPLT Command (Use LABL Command for Labels)

SPLT ARGUMENT INPUT SCHEME



Card 126 – SPLT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of a previously stored point. This will be the first point in the series plotted.
- *Point ID (VAR. B):* The number of a previously stored point. This will be the final point in the series plotted. All stored points from the first Point ID to this Point ID, inclusively, will be plotted.
- *Symbol Number (VAR F):* The number of the symbol which will be used to mark the points. Enter a symbol number from 1-16. If blank, symbol 1 will be used.

LPLT

FUNCTION

Plots lines through given points.

USAGE

Use this command to plot a line through the previously stored points whose numbers are given in the input fields of variables A, B, C and D. A minimum of two points must be entered. If a symbol number is given in the variable F field, this symbol will be plotted at each of the points as the line is drawn through them. If the variable F is blank, no symbol will be plotted. See **Table 12 - Point Symbols for PPLT, LPLT, SPLT and TPLT Commands** for the list of available point symbols.

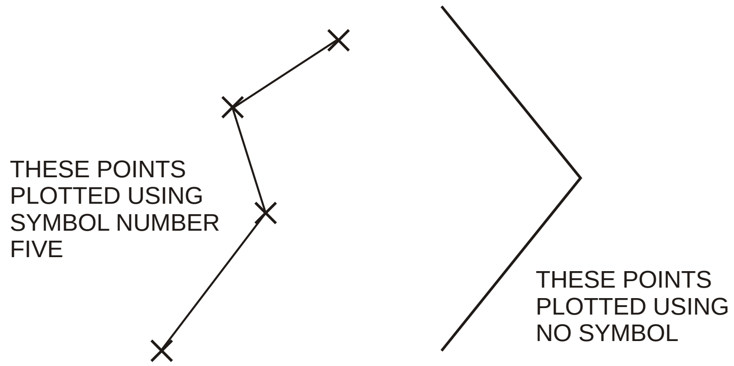
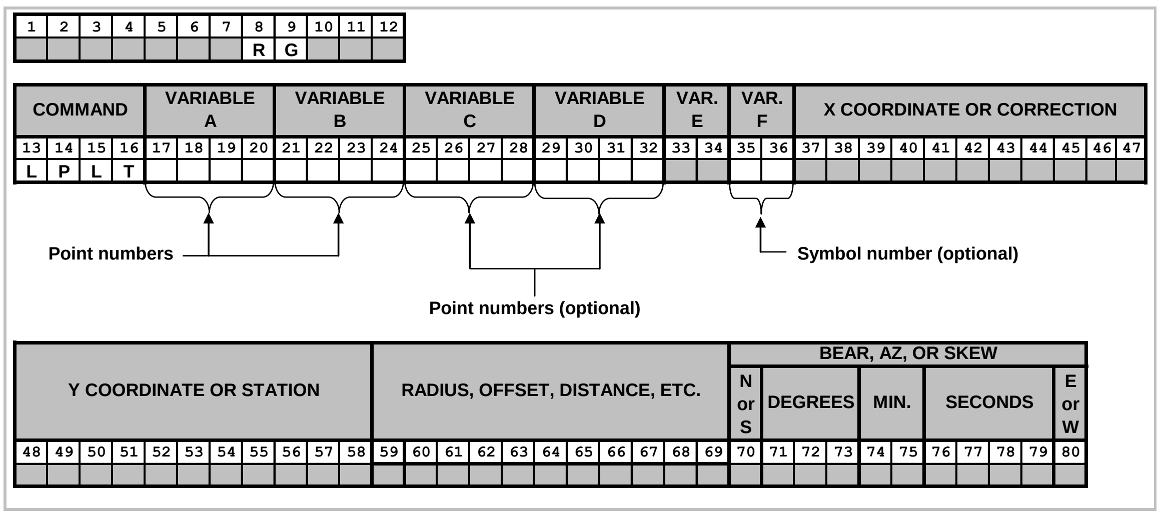


Figure 97 - LPLT Command Plots

LPLT ARGUMENT INPUT SCHEME



Card 127 - LPLT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored point. The first line will start at this point.
- *Point ID (VAR B):* The number of a previously stored point. The first line will end at this point, and a second line will start at this point if the following Point ID (VAR. C) is entered.
- *Point ID (VAR C) (optional):* The number of a previously stored point. The second line will end at this point, and a third line will start at this point if the following Point ID (VAR D) is entered. If no Point ID is entered for VAR C, but a Point ID is entered for VAR D, only the first line will be drawn; the system will not see VAR D.
- *Point ID (VAR D) (optional):* The number of a previously stored point. The third line will end at this point.
- *Line Type (Column 33) (optional):* A variable defining the pattern to be used to draw the line(s) defined by the included points. If this variable is omitted or “0” or “1” is entered, a solid line will be drawn. If “2” or “6” is entered, a dashed line will be drawn. (For “2”, the dashes and spaces will be equal in length; for “6”, the spaces will be half the size of the dashes.) If “3”, “4”, or “5” is entered, and if the distance between the points is great enough, a line with three, two, or one dash(es) at the center will be drawn.

- *Symbol Number (optional):* If entered, the specified symbol will be plotted at each previously stored point on the line. Enter a symbol number from 1-16.

TPLT

FUNCTION

Plots a line through a previously stored series of points.

USAGE

Use this command to plot a line through the series of previously stored points from the point number given in A to the point number given in B. If a symbol number is given, this symbol will be plotted at each of the points as the line is drawn through them; if no symbol number is given, no symbol will be plotted. See the PPLT command for a list of available symbols. The stored points must be in consecutive order.

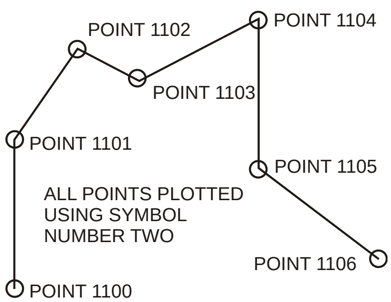
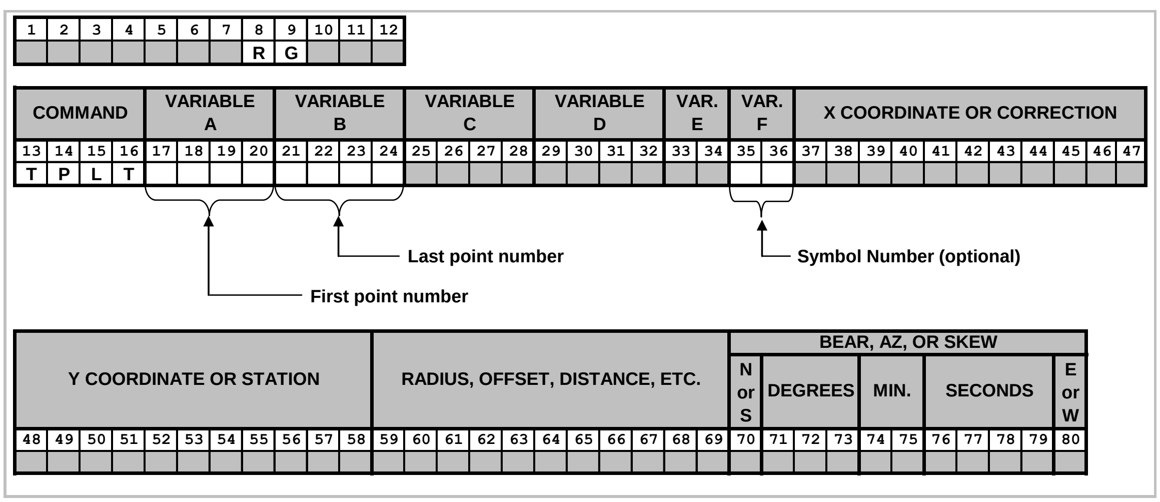


Figure 98 - TPLT Command (Use LABL Command for Labels)

TPLT ARGUMENT INPUT SCHEME



Card 128 - TPLT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR A):* The number of a previously stored point. This will be where the broken line begins.

- *Point ID (VAR B):* The number of a previously stored point. This will be where the broken line ends. Lines will be plotted between all stored points from the first Point ID to this Point ID, inclusively.
- *Symbol Number (VAR F):* Number of symbol which will be used to mark the points. Enter a symbol number from 1-16. If blank, no symbol will be plotted.

CPLT

FUNCTION

Plots a previously stored line or the arc of a previously stored circle.

USAGE

Use this command to cause an arc of the previously stored circle to be plotted from one previously stored point on the circle CLOCKWISE to another previously stored point on the circle. To plot a full circle, the same previously stored point is coded in columns B and C. If points B and C are not on the circle, the curve drawn will still be an arc of the circle specified. It will begin and end at the points where lines from the center of the circle passing through the point specified intersect the circle. This command is intended for drawing circular arcs, but if the curve specified in A is a line instead of a circle, a line will be drawn from point B to point C.

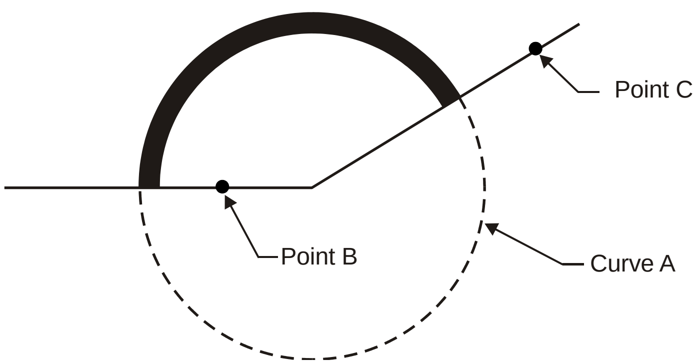


Figure 99 - Plotting Example

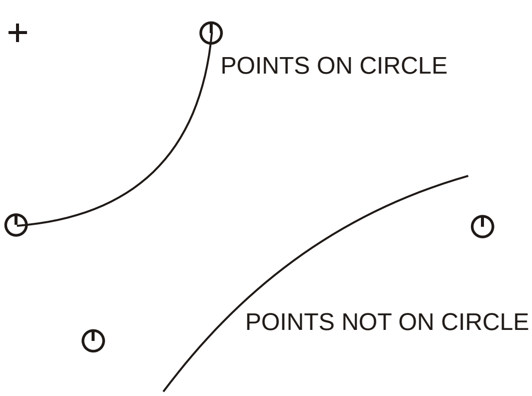
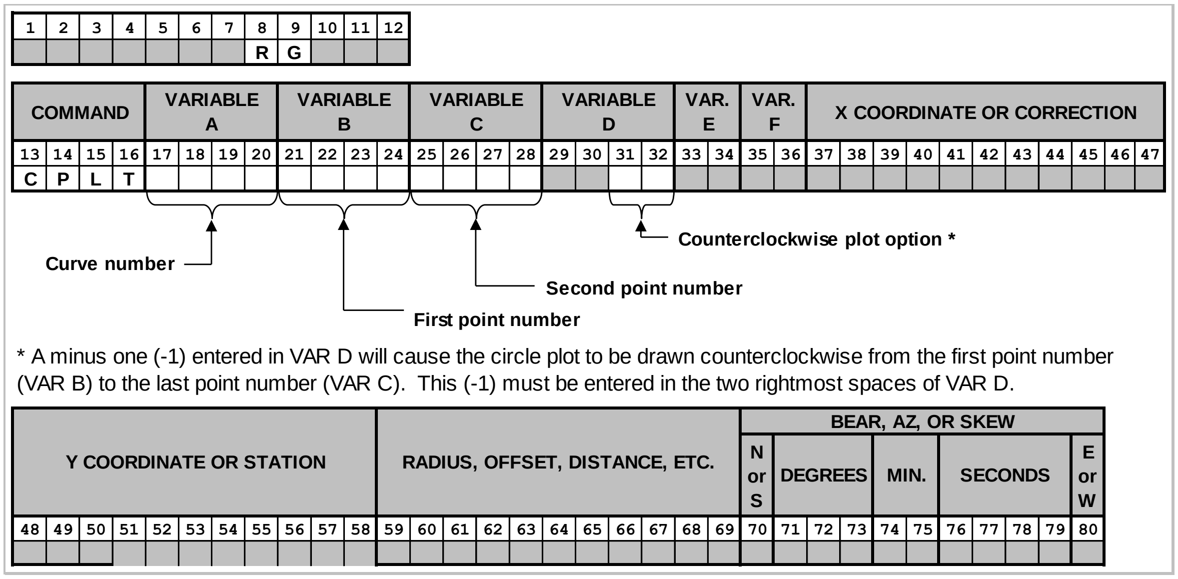


Figure 100 - CPLT Command (Use LABL Command for Labels)

CPLT ARGUMENT INPUT SCHEME



Card 129 - CPLT Argument Input Scheme Card

This argument input scheme requires the following data:

- *Curve ID (VAR A):* The number of a previously stored line or circle.
- *Point ID (VAR B):* The number of the first previously stored point. If the curve is a line, it will start from the point on the line nearest the specified point. If the curve is a circle, the arc will start where a line from the center of the circle, passing through the specified point, intersects the circle.
- *Point ID (VAR C):* The number of the second previously stored point. If the curve is a line, it will end at the point on the line nearest the specified point. If the curve is a circle, the arc will end where a line from the center of the circle, passing through the point specified, intersects the circle.
- *Plot Option***:** If the curve is a circle, enter (–1) right justified for the arc to be plotted counterclockwise from the first point; otherwise, it will be plotted clockwise.
- *Line Type (Column 33) (optional***)***:** A variable giving the pattern to be used to draw the line(s) defined by the included points. See command LPLT for further details.

LABL

FUNCTION

Plots characters of a given size and orientation with reference to a given point.

USAGE

Use this command to cause letters and numbers to be drawn on the plot to form titles, headings, etc.

PLOTS MAY BE ANNOTATED
USING THE LABL COMMAND

THE SIZE AND ORIENTATION
OF THE CHARACTERS IS
VARIABLE

CHARACTER HEIGHT = .7 FT

CHARACTER HEIGHT = 1.4 FT

Figure 101 - LABL Command

Note: The user need not give the number of characters in the character string; the system will count them.

LABL ARGUMENT INPUT SCHEME

This command will instruct the system to plot form titles, headings, etc. within the plot output. A point number is given in VAR A defining a point whose coordinates locate the lower left corner of the first character in the title. VAR B contains the number of characters in the title (from one to fifty); the characters to be plotted should appear in the appropriate columns as illustrated. Column C contains an integer which specifies the size of the letters. The height of the letters, in inches, will be this integer times 0.07 inch. The width will be the size times 0.04 inch, with the size times 0.02 inch of space between adjacent characters. The orientation is an integer from zero to three that controls the orientation of the characters, as shown in the **Card 130 - LABL Argument Input Scheme Card** image below.

1	2	3	4	5	6	7	8	9	10	11	12
							R	G			

COMMAND				VARIABLE A				VARIABLE B				VARIABLE C				VARIABLE D				VAR. E		VAR. F		X COORDINATE OR CORRECTION										
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
L	A	B	L																															

Point number (columns 17–20)

Number of Chracters to be plotted (1 to 50) (columns 21–24)

Size (columns 25–28)

Orientation (column 36): Zero, One, Two, Three

Characters to be plotted (columns 37–47)

Y COORDINATE OR STATION											RADIUS, OFFSET, DISTANCE, ETC.											BEAR, AZ, OR SKEW										
																						N or S	DEGREES			MIN.		SECONDS				E or W
48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

Characters to be plotted (cont'd) (columns 48–80)

Card 130 - LABL Argument Input Scheme Card

This argument input scheme requires the following data:

- *Point ID (VAR. A):* The number of a previously stored point which locates the lower left corner of the first character.
- *Number of Characters (VAR. B):* An integer defining the number of characters to be plotted (1 to 50)
- *Size (VAR. C):* An integer defining the size of the characters: character height is this number times 0. 7 feet or 0.26 meters.
- *Orientation (VAR. F):* The orientation of the label may be specified in any one of three ways. First, the label is oriented with respect to the screen if an integer from zero to three is entered, right justified. If "0" is entered, the bearing of the label is the positive Y-axis of the screen; if "1", the bearing is the negative X-axis; if "2", the negative Y-axis, and if "3", the positive X-axis. Second, the label is oriented with respect to the four cardinal points of the compass, if an integer from four to seven is entered, right justified. If "4" is entered, the bearing of the label is due north; if "5", the bearing is due west; if "6", due south; if "7", due east. Third, the desired bearing in degrees of the character string may be given, entered right justified in columns 34 – 36. (This bearing **must** be 10 degrees or more, so the system does not confuse it with the other ways of orienting the characters.) This bearing will be measured with respect to the screen, not with respect to the user coordinates.
- *Characters:* The characters to be plotted (maximum 44).

TICK

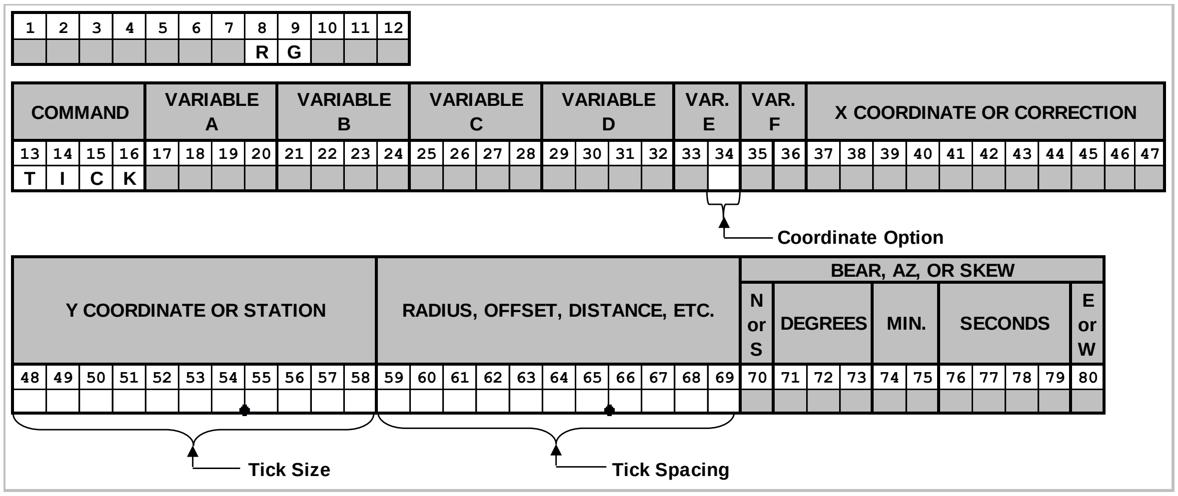
FUNCTION

Plots grid ticks at a given spacing over the body of a plot.

USAGE

Use this command to plot grid ticks (with North orientation) at a given spacing over the body of a plot. Ticks are located on lines evenly divisible by the spacing. Note: the TICK command should be the last plot command for a given plot axis, since the limits of the grid are determined from the previous plot commands for the axis.

TICK ARGUMENT INPUT SCHEME



Card 131 - TICK Argument Input Scheme Card

This argument input scheme requires the following data:

- *Coordinate Option (Column 34):* If a “1” is entered in this column, the grid (user; e.g., state plane) coordinates will be plotted on the tick. If this column is blank, the coordinates will be omitted.
- *Tick Size (Columns 48 – 58):* The desired size of the grid tick in meters or feet may be entered in these columns. If the columns are blank, the tick will be 30 feet or 10 meters high.
- *Tick Spacing (Columns 59 – 69):* The desired spacing between the grid ticks in meters or feet may be entered in these columns. If the columns are blank, the ticks will be 500 feet or 200 meters apart.

CONTOUR PLOTTING

CONT (CONTOUR)

FUNCTION

Adds the contour lines of the roadway surfaces to a plot, generally to a bridge framing plot. Must be preceded by an APLT or AXIS command, which defines the plot axis. Output from other plot or CONT commands may be plotted on the same axis.

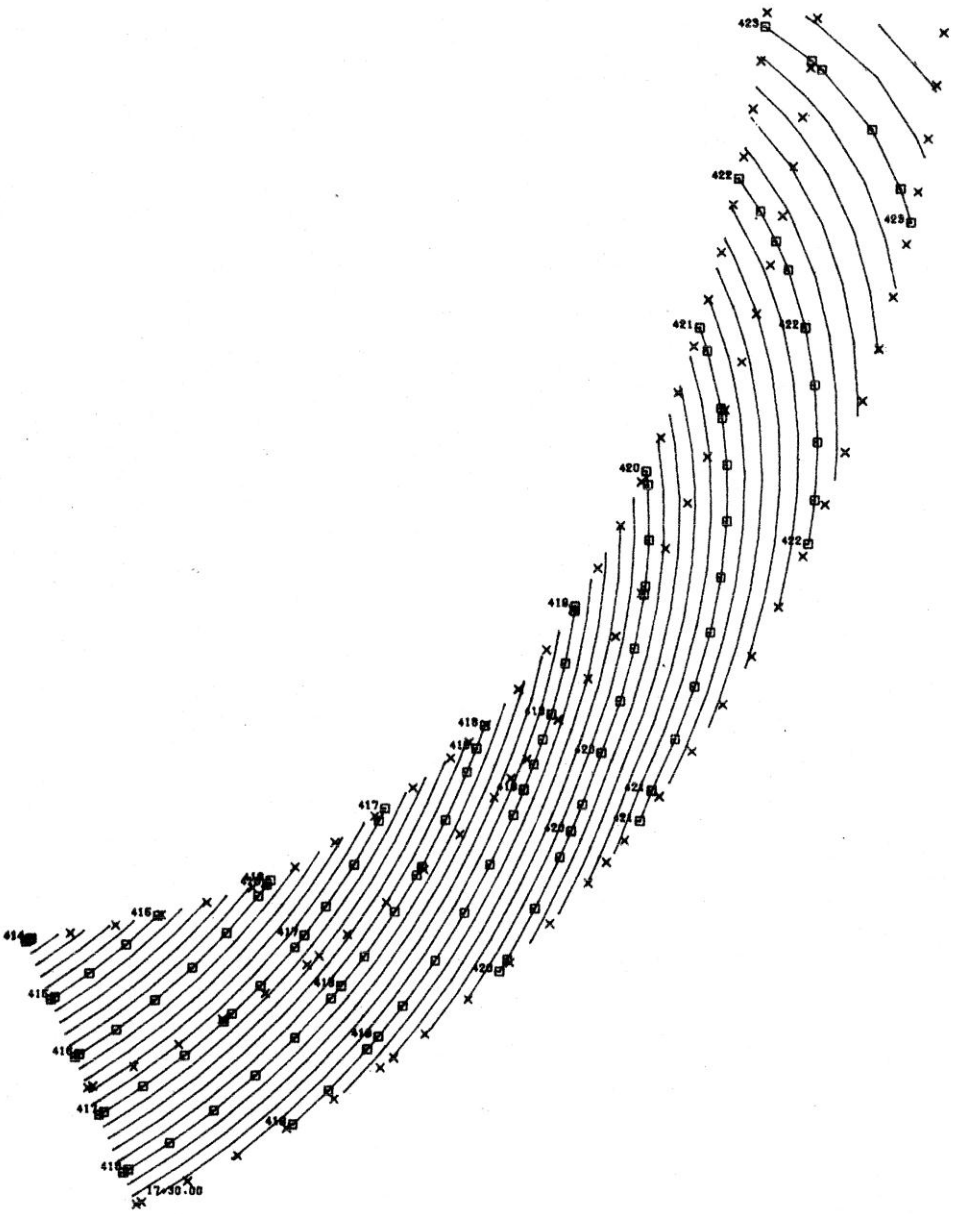
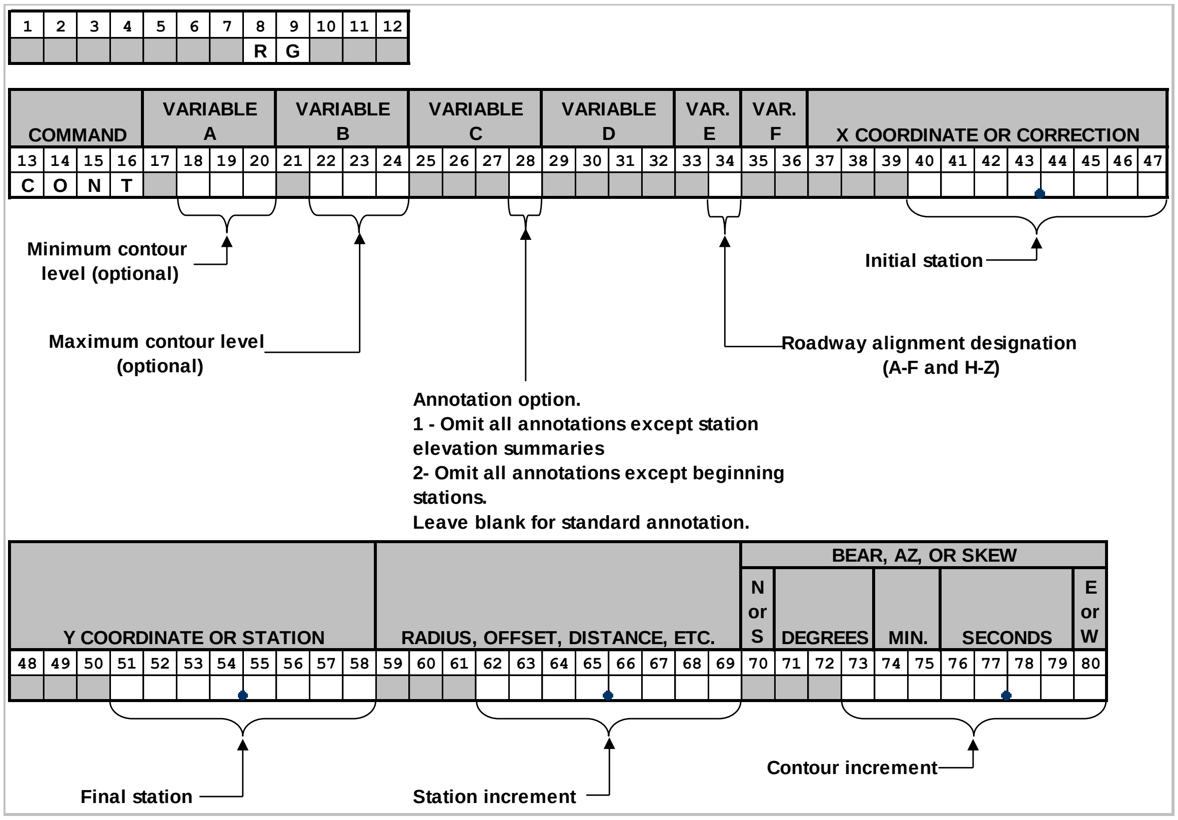


Figure 102 - Example Contour Plot

CONT ARGUMENT INPUT SCHEME



Card 132 - Contour Plotting Card

This argument input scheme requires the following data:

- *Minimum Contour Level:* If this field is blank, the minimum elevation of the roadway surface is used. If it is not blank, the minimum in even feet or meters of the contour elevations that will be plotted. Used to omit contours below a certain elevation.
- *Maximum Contour Level:* If this field is blank, the maximum elevation of the roadway surface is used. If it is not blank, the maximum in even feet or meters of the contour elevations that will be plotted. Used to omit contours above a certain elevation.
- *Annotation Option:* Leave blank for standard annotation: enter 1, right justified, to omit all the annotation except for the station elevation summaries: or enter 2, right justified, to omit all the annotation except for the beginning station.
- *Roadway Alignment:* The letter (A–Z, but not G) assigned to the alignment for which the roadway surface to be contoured has been defined.
- *Initial Station:* Station where the contour lines will begin.
- *Final Station:* Station where the contour lines will end.
- *Station Increment:* The distance between stations where elevation calculations are to be performed. Since the contours are plotted as straight lines between interpolated points, the accuracy of the contour is dependent on the interval at which elevations are calculated. Therefore, large values of the Station

Increment should not be used except in regions where the contour lines are essentially straight lines. A value of 10 feet or 5 meters is generally satisfactory, although smaller values may be needed in extremely warped regions.

- *Contour Increment:* The vertical distance between contour lines.

ALIGNMENT RELATIONSHIP

This section is under construction.

AREL - COMPUTE ALIGNMENT RELATIONSHIP

This section is under construction.

CREATING (PUNCHING) AND LISTING STORED GEOMETRY DATA

This section is under construction.

PLST - CREATE (PUNCH)/LIST STORED POINTS

This section is under construction.

CLST - CREATE (PUNCH)/LIST STORED CURVES

This section is under construction.

BGPN - TRANSFORM COMMAND UNITS AND PUNCH

This section is under construction.

CHAPTER 9: RUNNING BGS TO PROCESS THE INPUT FILE

This chapter is under construction.

STARTING THE BGS PROGRAM

This section is under construction.

DRAG-N-DROP METHOD

This section is under construction.

COMMAND LINE METHOD

This section is under construction.

RUNNING THE PROGRAM

This section is under construction.

BGS LOG FILE

This section is under construction.

PLOT PROCESSING

This section is under construction.

BGS COMMAND-LINE PARAMETERS

This section is under construction.

CHAPTER 10: BGS OUTPUT

This is a place holder for the indicated chapter to be considered for a future edition of this user guide.

SUMMARY OF OUTPUT FILES

This is a place holder for the indicated section to be considered for a future edition of this user guide.

LOG FILE (BGS.LOG)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

REPORT FILES (<FILENAME>.LS1, .LS2, .LS3, .LS4, .LS5)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

DGN PLOT FILE (<FILENAME>.DGN)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PUNCH FILE (<FILENAME>.PCH)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PUNCHING PREVIOUSLY STORED GEOMETRY DATA

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PUNCHING PREVIOUSLY STORED DESIGN DATA

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PUNCH FILE EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PROJECT WORK FILES

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PAGE FILE (<FILENAME>.PAG)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BRIDGE FILE (<FILENAME>.BRI)

This is a place holder for the indicated section to be considered for a future edition of this user guide.

CHAPTER 11: USING BGS PROJECT WORK FILES

This chapter is under construction.

INTRODUCTION

This section is under construction.

PROJECT WORK FILES

This section is under construction.

PAGE FILE

This section is under construction.

BRIDGE FILE

This section is under construction.

CREATING PROJECT WORK FILES

This section is under construction.

USING EXISTING PROJECT WORK FILES

This section is under construction.

USING EXISTING WORK FILES (WITHOUT UPDATING THE FILES)

This section is under construction.

USING EXISTING WORK FILES (AND UPDATING THE FILES)

This section is under construction.

CHAPTER 12: EXAMPLE BRIDGE PROJECTS

This is a place holder for the indicated chapter to be considered for a future edition of this user guide.

SMALL BRIDGE PROJECT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

LARGE BRIDGE PROJECT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

APPENDIX A: BGS INPUT FORMS

This is a place holder for the indicated Appendix to be considered for a future edition of this user guide.

APPENDIX B: EXAMPLE BGS LOG FILE

The BGS log file captures the information that is splashed to the console screen during execution. When something goes wrong, this file will contain helpful hints about the problem encountered during execution. It is a high level view of the process of execution of the BGS run. The name of the log file is conjured to be of this form <inputfilename>.lgc.

EXAMPLE 1 LGC (LOG OF C PROGRAM EXECUTION) OUTPUT FILE

```
##############################################################################

  BEGIN bgs log ...

  START bgs APPLICATION Date~time=2015-10-08~07:37:57 ...
         Program Version Information:
         ..Version query results:
             Texas Department of Transportation (TxDOT)
             TxDOT Bridge Geometry System (bgs)
             Components:
             User Interface (bgs.exe), Version 9.1.5
             Main Program (bgs1.exe), Version 9.1.5
```

The BGS log begins by indicating the date and time of the BGS run along with the version number of the two program components, bgs.exe and bgs1.exe. The bgs.exe program component provides a user interface, including various prompts, a display of the log data on the program console, calls the bgs1.exe program component, then, if plotting is warranted after bgs1.exe completion, calls MicroStation for plotting. The bgs1.exe program component performs file reading, all alignment and bridge geometry calculations, if plotting is warranted, creates the MicroStation plot-instruction file, and otherwise handles output files.

NOTE: The paths in the log listings below have been shorted and the deleted portions represented by an ellipse, thus ". . ."

```
         System Record Check:
         ..Input Data File = C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.dat
         ..Validating input fields:
             Unit Field: Value < > is OK.
             Job Type Field: Value <NEW> is OK.
             Save Results Field: Value < NO> is OK.
             Omit Stored Geometry Data Field: Value <YES> is OK.
             Omit Stored Design Data Field: Value <YES> is OK.
             Omit Stored Bridge Data Field: Value <YES> is OK.
             Print Input Data Field: Value <YES> is OK.

         Primary Processing Parameters:
         ..Input Data File = C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.dat
         ..Project Work Files will not be used.
         ..Results will not be saved.

         Delete Existing Output Files (.ls and .pch files from previous run):
         ..No '.ls' files exist, thus no deletions were performed.
         ..No '.pch' file exists, thus a deletion was not performed.

  START Primary Processing ...
  END Primary Processing.

         Primary Processing Results:
         ..The following output files have been created:
```

```
            C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.ls1
            C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.ls2
            C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.ls3
            C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.ls4
            C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.ls5
        ..Plotting Check:
            Intermediate plot data has been created.
            An output plot will be created from intermediate plot data.

        Establish Plot Processing Parameters:
        ..Plot will be created as a MicroStation Design (DGN) file.
        ..Plot will be created in file: C:\Users\TBRADBER\...\Ex1_v9.1.5\Ex1h.dgn

 START Plot Processing ...
 END Plot Processing.

        Plot Processing Results:
        ..Plotting output completed.

        Display Output Plot File:
        ..MicroStation will open the Output Plot File for viewing.

 END bgs APPLICATION (Date~time: 2015-10-08~07:38:13) ...

 END bgs log.
###############################################################################
```

EXAMPLE 2 LGC (LOG OF C PROGRAM EXECUTION) OUTPUT FILE

```
###############################################################################

 BEGIN bgs log ...

 START bgs APPLICATION Date~time=2015-10-09~07:34:32 ...
        Program Version Information:
        ..Version query results:
            Texas Department of Transportation (TxDOT)
            TxDOT Bridge Geometry System (bgs)
            Components:
            User Interface (bgs.exe), Version 9.1.5
            Main Program (bgs1.exe), Version 9.1.5

        System Record Check:
        ..Input Data File = C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.dat
        ..Validating input fields:
            Unit Field: Value < > is OK.
            Job Type Field: Value <NEW> is OK.
            Save Results Field: Value < NO> is OK.
            Omit Stored Geometry Data Field: Value <YES> is OK.
            Omit Stored Design Data Field: Value <YES> is OK.
            Omit Stored Bridge Data Field: Value <YES> is OK.
            Print Input Data Field: Value <YES> is OK.

        Primary Processing Parameters:
        ..Input Data File = C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.dat
        ..Project Work Files will not be used.
        ..Results will not be saved.

        Delete Existing Output Files (.ls and .pch files from previous run):
        ..No '.ls' files exist, thus no deletions were performed.
        ..No '.pch' file exists, thus a deletion was not performed.
```

```
 START Primary Processing ...
 END Primary Processing.

        Primary Processing Results:
        ..The following output files have been created:
            C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.ls1
            C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.ls2
            C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.ls3
            C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.ls4
            C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.ls5
        ..Plotting Check:
            Intermediate plot data has been created.
            An output plot will be created from intermediate plot data.

        Establish Plot Processing Parameters:
        ..Plot will be created as a MicroStation Design (DGN) file.
        ..Plot will be created in file: C:\Users\TBRADBER\...\Ex2_v9.x\Ex2_v9b.dgn

 START Plot Processing ...
 END Plot Processing.

        Plot Processing Results:
        ..Plotting output completed.

        Display Output Plot File:
        ..MicroStation will open the Output Plot File for viewing.

 END bgs APPLICATION (Date~time: 2015-10-09~07:34:40) ...

 END bgs log.
###############################################################################
```

APPENDIX C: EXAMPLE BGS REPORT OUTPUT

OUTPUT OF BGS OPERATING ON EXAMPLE 1 INPUT FILE

EXAMPLE 1 LS1 OUTPUT FILE

```
                              BRIDGE GEOMETRY SYSTEM
 PC TEXAS V 9.1               MESSAGES PRINTED BY THE             OCT  8, 2015     7:37                            EHEADN
 IDENTIFICATION                    SYSTEM DRIVER                  Example 1                                        EHEADN

                                 BGS INPUT LISTING                                                                 CEDIT

     ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
1           SYSTEM X X      X   NEW NOYESYESYESYES   Example 1
2    $234567890123456789012345678901234567890123456789012345678901234567890123456789 0
2    $  COMMENTS SUCH AS THIS ONE ARE INSERTED THROUGHOUT THIS EXAMPLE INPUT FILE.
2    $  THESE COMMENTS WILL DESCRIBE ALL FOLLOWING CARDS UP TO THE NEXT COMMENT.
2           RG   CMNT                 ********************************************
3           RG   CMNT                        ESTABLISH ROADWAY ALIGNMENT H
4           RG   CMNT                 ********************************************
5    $  THE PONT AND TRVS CARDS ESTABLISH JUST ENOUGH POINTS ALONG THE ALIGNMENT TO
5    $  DEFINE THE CURVES, TANGENTS, AND THE BEGINNING AND END OF THE ALIGNMENT. THE
5    $  TRVS COMMAND LAYS OUT EACH POINT AT THE PROPER BEARING WITH EACH ADJACENT
5    $  POINT.
5           RG   PONT   1                  6000.000    4000.00
6           RG   TRVS   1   2                                  567.26    N 14183294W
7           RG   TRVS   2   3                                  715.97    N 19210500E
8           RG   TRVS   3   4                                  630.07    N  3355356W
9    $  THE RD05H CARDS DEFINE THE HORIZONTAL ALIGNMENT AND ASSIGN THE STATION NUMBER
9    $  206+00.00 TO THE FIRST POINT. THE CURVE IS DEFINED BY DEGREE OF CURVATURE
9    $  WHICH, IN RADIANS, IS EQUIVALENT TO 100 FT ALONG THE CURVE DIVIDED BY THE
9    $  RADIUS IN FEET. THE 7:32:20.11 DEGREE CURVE HERE IS NOT SOME KIND OF FAILURE
9    $  TO USE AN APPROPRIATE NUMBER OF SIGNIFICANT FIGURES, BUT RATHER CORRESPONDS
9    $  EXACTLY TO A RADIUS OF 760 FT (A RATHER SHARP CURVE). THE POINTS 1 THRU 4 ARE
9    $  DEFINED ABOVE USING THE PONT AND TRVS COMMANDS AND ARE BOTH RECALLED AND USED
9    $  FOR STORAGE HERE.
9    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
9           RD05H 1  2060000POT                                                 1
```

```
10          RD05H 2            7322011                                           2
11          RD05H 3            7322011                                           3
12          RD05H 4                                                              4
13    $  THESE CARDS CALCULATE THE VERTICAL ALIGNMENT BY ASSIGNING ELEVATIONS TO
13    $  STATIONS 210+00.00, 21+55.00, AND 22+30.00 OF 2703.17, 2739.94 AND 2713.49,
13    $  RESPECTIVELY. THIS VERTICAL ALIGNMENT HAS A CURVE LENGTH OF 600 FT
13    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
13          RD10H 1  2100000 270317
14          RD10H 2  2155000 272994  600
15          RD10H 3  2230000 271349
16    $  THESE CARDS ESTABLISH THE ROADWAY SURFACE BETWEEN STATIONS 211+00.00 AND
16    $  222+00.00. THIS SURFACE IS CONSTANT.
16    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
16          RD30H  2110000 11F    2 2 2 2         -08  200  08  200
17          RD30H  2132500 1
18          RD30H  2177500 21F    2 2 2 2         -08  200  08  200
19          RD30H  2220000 2
20          RG   CMNT                   *******************************************
21          RG   CMNT                                  BRIDGE COMMANDS
22          RG   CMNT                   *******************************************
23    $  THE NAME CARD SPECIFIES ROADWAY (ALIGNMENT) H AS THE BRIDGE REFERENCE ROADWAY
23    $  AND THAT THE BRIDGE WILL LIE BETWEEN STATIONS 211+00.00 AND 222+00.00
23    $  ON ROADWAY H
23    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
23          RG   NAME   5  13HL93BRIG H     21100.0   22200.0  Example 1
24    $  THE APLT CARDS SPECIFY THAT THE SEGMENT OF ROADWAY H BETWEEN STATIONS
24    $  213+00.00 AND 221+00.00 IS TO BE PLOTTED. EITHER OPTION CAN BE USED IN
24    $  THIS EXAMPLE, BUT THE ALTERNATIVES ARE PRESENTED BELOW. NOTE THAT THE FIRST

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE        OCT  8, 2015     7:37                  EHEADN
  IDENTIFICATION              SYSTEM DRIVER              Example 1                              EHEADN

                             BGS INPUT LISTING                                                  CEDIT

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
24    $  APLT CARD IS NOT USED HERE (IT HAS A '$' IN COLUMN 1).
24    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
24          RG   APLT   1      20 100 H  21300.0    22100.0
25    $     RG   APLT 500  33  20  10 H  21300.0    22100.0     20.0
```

```
25         RG   NPEN   4
26     $THE FOLLOWING USES THE PONT COMMAND TO ESTABLISH POINT 100, AT THE BEGINNING AN
26     $POINT 101 AT END OF THE BRIDGE AND THEN USES THE ZPNT COMMAND TO INSTRUCT BGS T
26     $RETURN THE COORDINATES AND ELEVATION OF THESE POINTS.
26     $234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
26         RG   PONT 100            H               21405.57  0.0
27         RG   PONT 101            H               21725.57  0.0
28         RG   CMNT                   BEGINNING OF BRIDGE
29         RG   ZPNT 100            H
30         RG   CMNT                   END OF BRIDGE
31         RG   ZPNT 101            H
32     $  THE BENT CARDS DEFINE AT WHAT STATIONS THE BENT LINES SHOULD CROSS THE BRIDGE
32     $  ALIGNMENT ESTABLISHED ABOVE WITH THE RD05 CARDS.  ADDITIONALLY SKEW, WHICH IS
32     $  RIGHT 54 DEG. 15 MIN. 53 SEC. BACK (AN UNUSUALLY LARGE ONE), AND BENT TYPE
32     $  ARE DEFINED.
32     $234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
32         RG   BENT         10   1  AB             21405.57          R 54155300B
33         RG   BENT         20   2  IN             21465.57          R 54155300B
34         RG   BENT         30   3  IN             21565.57          R 54155300B
35         RG   BENT         40   4  IN             21665.57          R 54155300B
36         RG   BENT         50   5  AB             21725.57          R 54155300B
37         RG   CMNT                   ********************************************
38         RG   CMNT                   PSLB 1 = LEFT EDGE OF SLAB
39         RG   CMNT                   PSLB 2 = LEFT BREAK LINE
40         RG   CMNT                   PSLB 3 = RIGHT BREAK LINE
41         RG   CMNT                   PSLB 4 = RIGHT EDGE OF SLAB
42         RG   CMNT                   ********************************************
43     $  THESE CARDS DEFINE FOUR LINES PARALLEL TO THE BRIDGE ALIGNMENT WITH AN
43     $  OFFSET OF -9. -7, +17 AND +19.
43     $234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
43         RG   PSLB   1                                       -9.000
44         RG   PSLB   2                                       -7.000
45         RG   PSLB   3                                       17.000
46         RG   PSLB   4                                       19.000
47     $  THESE CARDS DEFINE THE SLAB DEPTH IN THE AREA BOUNDED BY THE BENT LINES AND
47     $  PSLB LINES. A SEPARATE CARD IS USED FOR EVERY SPAN. ALSO THE SLAB EDGES
47     $  ARE BROKEN BY PSLB LINES 2 AND 3 AT THE ABUTMENTS AND AT BENT 3.
47     $234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890
47         RG   SLAB   1   2   1   4 2 3      8.5       8.5              B BX
48         RG   SLAB   2   3   1   4 2 3      8.5       8.5              BXB
49         RG   SLAB   3   4   1   4 2 3      8.5       8.5              B BX
50         RG   SLAB   4   5   1   4 2 3      8.5       8.5              BXB
```

```
51    $  THIS CARD SERIES DEFINES THE BEARING SEAT CENTERLINES ON ALL BENTS RELATIVE
51    $  TO THE BENT LINE. THERE IS A SEPARATE CARD FOR EACH BEARING SEAT CENTERLINE
51    $  TO BE ESTABLISHED.
51    $234567890123456789012345678901234567890123456789012345678901234567890123456789
51           RG   BRNG              1 4FD      12.0      3.0        5.5833
52           RG   BRNG              2 3BO      12.0      3.0        5.5833

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                               BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1               MESSAGES PRINTED BY THE             OCT  8, 2015     7:37                                    EHEADN
  IDENTIFICATION                    SYSTEM DRIVER                  Example 1                                                EHEADN

                                  BGS INPUT LISTING                                                                         CEDIT

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
53           RG   BRNG              3 3BO      12.0      3.0        5.5833
54           RG   BRNG              4 3BO      12.0      3.0        5.5833
55           RG   BRNG              5 4BK      12.0      3.0        5.5833
56    $  THESE CARDS DEFINE BEAM LINES AT AN OFFSET FROM THE BRIDGE ALIGNMENT OF
56    $  PLUS AND MINUS 7.50. BEAMS WILL BE PLACED RELATIVE TO THESE LINES. NOTE
56    $  THAT A BEAM LINE NEED NOT BE DEFINED FOR EVERY BEAM PLACED--THE FOPT CARD
56    $  WILL AUTOMATICALLY PLACE BEAMS IF THE CORRECT FRAME OPTION IS USED.
56    $234567890123456789012345678901234567890123456789012345678901234567890123456789
56           RG   BEAM                  1                            -6.00
57           RG   BEAM                  2                            16.00
58    $  THIS CARD FRAMES THE BRIDGE FROM BENTS 1 TO 5 BETWEEN BEAM LINES 1 AND 2
58    $  WITH FRAME OPTION 4. THIS FRAME OPTION AUTOMATICALLY LAYS THE SPECIFIED
58    $  NUMBER OF BEAMS, 4 IN THIS CASE, BETWEEN THE TWO BEAM LINES.
58    $234567890123456789012345678901234567890123456789012345678901234567890123456789
58           RG   FOPT   1   5   1   2 5 4                                          1
59    $ THIS SERIES OF VCLR CARDS CALCULATES THE DISTANCE BETWEEN THE BOTTOM OF
59    $ THE BEAMS AND THE PROFILE GRADE LINE FOR ROADWAY H AT 5 EQUALLY SPACED POINTS.
59    $234567890123456789012345678901234567890123456789012345678901234567890123456789
59           RG   VCLR             10 H 1
60           RG   VCLR             10 H 2
61           RG   VCLR             10 H 3
62           RG   VCLR             10 H 4

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                               BRIDGE GEOMETRY SYSTEM
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PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  8, 2015     7:37          EHEADN
IDENTIFICATION             GEOMETRY PROCESS              Example 1                      EHEADN


                        BRIDGE GEOMETRY SYSTEM
PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  8, 2015     7:37          EHEADN
IDENTIFICATION       DESIGN EDIT AND STORE PROCESS       Example 1                      EHEADN


                        BRIDGE GEOMETRY SYSTEM
PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  8, 2015     7:37          EHEADN
IDENTIFICATION             GEOMETRY PROCESS              Example 1                      EHEADN

    NOW FITTING A LINE TO POINTS   1 THROUGH   7.                                       ORIEN
```

EXAMPLE 1 LS2 OUTPUT FILE

```
                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE   2
                           BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS  ***
    GENERAL GEOMETRY PROCESS                                               OCT  8, 2015     7:37
    IDENTIFICATION                                                         Example 1
                               GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)     Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    ************************************************

    ****       ESTABLISH ROADWAY ALIGNMENT H

    ************************************************

    PONT     1    0    0    0     0    6000.0000     4000.0000      0.0000             0  0  0.00
                                       6000.0000     4000.0000      0.0000    0.000    0  0  0.00    SP    1

    TRVS     1    2    0    0     0       0.0000        0.0000    567.2600          N 14 18 32.94 W
                                       5859.7996     4549.6615      0.0000    0.000    0  0  0.00    SP    2

    TRVS     2    3    0    0     0       0.0000        0.0000    715.9700          N 19 21  5.00 E
                                       6097.0439     5225.1821      0.0000    0.000    0  0  0.00    SP    3

    TRVS     3    4    0    0     0       0.0000        0.0000    630.0700          N  3 35 53.56 W
                                       6057.5011     5854.0101      0.0000    0.000    0  0  0.00    SP    4

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE   3
                           BRIDGE GEOMETRY SYSTEM (BGS)                *** DESIGN DATA ***
    DESIGN DATA LIST PROCESS                                               OCT  8, 2015     7:37
    IDENTIFICATION                                                         Example 1
                         POINTS STORED OR USED BY ALIGNMENTS


        PI  1, ROADWAY H IS DEFINED BY STORED POINT    1 ( X=    6000.0000, Y=    4000.0000)
```

```
        PI  2, ROADWAY H IS DEFINED BY STORED POINT    2 ( X=    5859.7996, Y=    4549.6615)

        PI  3, ROADWAY H IS DEFINED BY STORED POINT    3 ( X=    6097.0439, Y=    5225.1821)

        PI  4, ROADWAY H IS DEFINED BY STORED POINT    4 ( X=    6057.5011, Y=    5854.0101)

                            TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE   4
                               BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
      HORIZONTAL ALIGNMENT PROCESS                                            OCT  8, 2015     7:37
      IDENTIFICATION                                                          Example 1
                                 HORIZONTAL ALIGNMENT LIST
                                       FOR ROADWAY H
  COMPUTATIONS BASED ON ARC DEFINITION


 P.I.                                                        X             Y

   1    206+00.0000                                     6000.0000     4000.0000
                       N 14 18 32.94 W     567.2600 FT.
        209+37.3643 PC    7 32 20.11 D     229.8957 T     5916.6191     4326.8980
   2    211+67.2600 PI   33 39 37.94 RT    446.4902 L     5859.7996     4549.6615
        213+83.8546 PT      759.9999 R                    5935.9780     4766.5690
                       N 19 21  5.00 E     715.9700 FT.
        217+15.6532 PC    7 32 20.11 D     154.2757 T     6045.9230     5079.6224
   3    218+69.9289 PI   22 56 58.56 LT    304.4150 L     6097.0439     5225.1821
        220+20.0682 PT      759.9999 R                    6087.3617     5379.1537
                       N  3 35 53.56 W     630.0700 FT.
   4    224+95.8626                                     6057.5011     5854.0101
                            TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE   5
                               BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
      DESIGN DATA LIST PROCESS                                                OCT  8, 2015     7:37
      IDENTIFICATION                                                          Example 1
                                    SORTED DESIGN DATA


      CARD TYPE RD05       H O R I Z O N T A L   A L I G N M E N T

           R  P.I.                  DEGREE        RADIUS                                    ROUND
           O   N              BEG.                            SPIRAL
```

```
 A   U                     OF             OR                                              BRNG
 D   M   STATION   STA.                           LENGTHS      P.I. COORDINATES
 W   B                   CURVE        FORWARD                                               OR
 A   E             I.D.
 Y   R                                TANGENT                                              HOLD
                       DEG MIN  SEC                IN    OUT        X             Y


 H   1   206+00.0000 POT   0  0  0.00       0.0000   0.0   0.0    6000.0000     4000.0000   0
 H   2   211+67.2600       7 32 20.11     759.9999   0.0   0.0    5859.7996     4549.6615
 H   3   218+69.9289       7 32 20.11     759.9999   0.0   0.0    6097.0439     5225.1821
 H   4   224+95.8626       0  0  0.00       0.0000   0.0   0.0    6057.5011     5854.0101

                 TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                   PAGE   6
                    BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
DESIGN DATA LIST PROCESS                                           OCT  8, 2015     7:37
IDENTIFICATION                                                     Example 1
                         SORTED DESIGN DATA


CARD TYPE RD10             P R O F I L E   G R A D E

  R  P.I.                            FIRST       SECOND
  O   N      VERTICAL
  A   U                             VERTICAL    VERTICAL   ELEVATION
  D   M        P.I.         P.I.                                           EXTERNAL    GRADE
  W   B                              CURVE       CURVE    CORRECTION
  A   E      STATION     ELEVATION
  Y   R                              LENGTH      LENGTH


  H   1     210+00.00    2703.17        0.          0.        0.00
  H   2     215+50.00    2729.94       600.         0.        0.00       -5.2955   0.048673
  H   3     223+00.00    2713.49        0.          0.        0.00                -0.021933

                 TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                   PAGE   7
                    BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
DESIGN DATA LIST PROCESS                                           OCT  8, 2015     7:37
IDENTIFICATION                                                     Example 1
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                                SORTED DESIGN DATA

    CARD TYPE RD30                    T E M P L A T E

                                R
                                O               TEMPLATE
                                A
                                D     STATION     STORE/
                                W                 RECALL
                                A
                                Y                   NO.


                                H     211+00.00      1
                                H     213+25.00      1
                                H     217+75.00      2
                                H     222+00.00      2

                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE   8
                           BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
    DESIGN DATA LIST PROCESS                                                OCT  8, 2015     7:37
    IDENTIFICATION                                                          Example 1
                                SORTED DESIGN DATA


    CARD TYPE RD30             T E M P L A T E   T A B L E

TEMP S SURF. PROF. CENTR LEFT  RIGHT                SEGMENT        SEGMENT        SEGMENT        SEGMENT
 NO  / DEPTH GRADE LINE  PIVOT PIVOT A   B   C   D  O              O              O              O
     F       POINT POINT POINT POINT                P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST
                                                    T              T              T              T


  1  F  0.00   2     2     2     2                 -0.0800 20.0    0.0800 20.0
  2  F  0.00   2     2     2     2                 -0.0800 20.0    0.0800 20.0

                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE   9
                           BRIDGE GEOMETRY SYSTEM (BGS)               ***  GEOMETRICS  ***
    GENERAL GEOMETRY PROCESS                                                OCT  8, 2015     7:37
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     IDENTIFICATION                                                              Example 1
                                    GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)    Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    ************************************************

    ****              BRIDGE COMMANDS

    ************************************************

                             TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                PAGE  10
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                   OCT  8, 2015     7:37
     IDENTIFICATION                                                              Example 1

                                    BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    NAME     5   13 HL93 BRIG  H  0   21100.0000    22200.0000  Example 1                          STR   1

    APLT     1  20. 100.  H           21300.0000    22100.0000

                             TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                PAGE  11
                                BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
     ALIGNMENT PLOT PROCESS                                                      OCT  8, 2015     7:37
     IDENTIFICATION                                                              Example 1

                        * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

ALIGNMENT  ELEMENT    BEGINNING        EAST (X)      NORTH (Y)        BEARING          RADIUS,
 ELEMENT    TYPE       STATION        BEGINNING      BEGINNING                      SPIRAL LENGTH,
 NUMBER               OR STA. BACK                                                   STA. FORWARD

   1      ARC        213+00.00        5912.6085      4686.0810    N 13  1 46.78 E        760.00
   2      LINE       213+83.85        5935.9780      4766.5690    N 19 21  5.00 E
   3      ARC        217+15.65        6045.9230      5079.6224    N 19 21  5.00 E        760.00
```

4	LINE	220+20.06	6087.3617	5379.1537	N 3 35 53.56 W
5	END STA	221+00.00	6082.3452	5458.9279	N 3 35 53.56 W

* * * TABLE OF CENTERS FOR ALIGNMENT ELEMENTS AND OFFSETS * * *

ALIGNMENT ELEMENT NUMBER	OFFSET LINE NUMBER	PARALLEL TO ALIGNMENT ELEMENT NO.	EAST (X)	NORTH (Y)
1			6653.0410	4514.7349
3			5328.8600	5331.4566

* * * CURVE FIT DATA FOR ALL ALIGNMENT ELEMENTS AND OFFSETS * * *

POINT	STATION	EAST (X)	NORTH (Y)	--------- S O U R C E --------- ALIGNMENT ELEMENT	OFFSET LINE	INTERIOR POINT
1	213+00.00	5912.6085	4686.0810	1		
2	213+41.92	5923.1829	4726.6474	1		*
3	213+83.85	5935.9780	4766.5690	2		
4	217+15.65	6045.9230	5079.6224	3		
5	218+67.86	6081.6897	5227.3063	3		*
6	220+20.06	6087.3617	5379.1537	4		
7	221+00.00	6082.3452	5458.9279	5		

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

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                                                                                                                     PAGE  12
                               BRIDGE GEOMETRY SYSTEM (BGS)                ***  GEOMETRICS  ***
  ALIGNMENT PLOT PROCESS                                                          OCT  8, 2015     7:37
  IDENTIFICATION                                                                  Example 1

                       * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

      THE PLOT SCALE IS   1.0 FEET PER FOOT.

      TICK MARKS WILL BE DRAWN EVERY  20 FEET ALONG THE CENTERLINE.

      STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

      NOW FITTING A LINE TO POINTS   1 THROUGH   7.                                                                          ORIEN

      THIS PLOT WILL COVER A DISTANCE OF    791.03 FEET.


      THE BEARING OF THE CURVE-FIT LINE IS N 13  46  49.28 E

      THIS SEGMENT WILL START AT ALIGNMENT ELEMENT  1 AND CONTINUE UP TO ELEMENT  5.

      REFERENCE COORDINATES ARE      1064.9298 X,      5875.0229 Y.

      ORIGIN COORDINATES ARE     10777.0899 X,      3493.0180 Y.

      NOW PLOTTING ELEMENTS  1 TO  5.

                            TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                                     PAGE  13
                               BRIDGE GEOMETRY SYSTEM (BGS)                ***  GEOMETRICS  ***
  GENERAL GEOMETRY PROCESS                                                        OCT  8, 2015     7:37
  IDENTIFICATION                                                                  Example 1
                                   GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)    Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    NPEN     4   (RED)

    PONT   100    0    0    0  H  0       0.0000    21405.5700      0.0000             0  0  0.00
                                       5943.1736     4787.0576      0.0000 2721.486    0  0  0.00    SP  100
```

```
    PONT   101    0    0    0  H  0      0.0000    21725.5700      0.0000             0  0  0.00
                                      6049.1479     5089.0001      0.0000 2725.178    0  0  0.00    SP  101

    ****BEGINNING OF BRIDGE

    ZPNT   100    0    0    0  H  0      0.0000        0.0000      0.0000             0  0  0.00
                                      5943.1736     4787.0576      0.0000    0.000    0  0  0.00    NS    0
                                         0.0000    21405.5700     -0.0000 2721.486    0  0  0.00    NS    0

    ****END OF BRIDGE

    ZPNT   101    0    0    0  H  0      0.0000        0.0000      0.0000             0  0  0.00
                                      6049.1479     5089.0001      0.0000    0.000    0  0  0.00    NS    0
                                         0.0000    21725.5700      0.0000 2725.178    0  0  0.00    NS    0

    BENT     0    0   10    1    AB      0.0000    21405.5700      0.0000          R 54 15 53.00 B
                                      5943.1736     4787.0576      0.0000 2721.486 S 16 23  2.00 E  SC   10

    BENT     0    0   20    2    IN      0.0000    21465.5700      0.0000          R 54 15 53.00 B
                                      5963.0553     4843.6679      0.0000 2723.096 S 16 23  2.00 E  SC   20

    BENT     0    0   30    3    IN      0.0000    21565.5700      0.0000          R 54 15 53.00 B
                                      5996.1913     4938.0183      0.0000 2724.838 S 16 23  2.00 E  SC   30

    BENT     0    0   40    4    IN      0.0000    21665.5700      0.0000          R 54 15 53.00 B
                                      6029.3274     5032.3687      0.0000 2725.404 S 16 23  2.00 E  SC   40

    BENT     0    0   50    5    AB      0.0000    21725.5700      0.0000          R 54 15 53.00 B
                                      6049.1479     5089.0001      0.0000 2725.178 S 17  7 53.42 E  SC   50

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                             TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                PAGE  14
                                BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
     GENERAL GEOMETRY PROCESS                                                   OCT  8, 2015     7:37
     IDENTIFICATION                                                             Example 1
                                    GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)     Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S
```

```
****PSLB 1 = LEFT EDGE OF SLAB

****PSLB 2 = LEFT BREAK LINE

****PSLB 3 = RIGHT BREAK LINE

****PSLB 4 = RIGHT EDGE OF SLAB

************************************************

PSLB     1    0    0    0     0       0.0000        0.0000     -9.0000             0  0  0.00

PSLB     2    0    0    0     0       0.0000        0.0000     -7.0000             0  0  0.00

PSLB     3    0    0    0     0       0.0000        0.0000     17.0000             0  0  0.00

PSLB     4    0    0    0     0       0.0000        0.0000     19.0000             0  0  0.00
                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                         PAGE  15
                            BRIDGE GEOMETRY SYSTEM (BGS)            ***  BRIDGE GEOMETRICS  ***
 Example 1                                                                 OCT  8, 2015     7:37
 IDENTIFICATION                                                            Example 1

SLAB     1    2    1    4  2  3       8.5000        8.5000                          B BX

                                             SLAB REPORT

                                               SPAN  1

                         SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                         NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                              BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB  1)   1      62.7797  N 19 21  5.00 E    62.7797      0.0000    62.7797     23.8641

 RIGHT EDGE   (PSLB  4)   1       1.9101  N 19 16 39.15 E     1.9101   -740.9999     1.9101
                          2      55.3085  N 19 21  5.00 E    55.3085      0.0000    57.2186     33.3545


                         SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
```

```
                     NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

                      1        2.000  N 70 38 55.00 W
 BACK EDGE    (BENT  1)   2      41.0972  N 16 23  2.00 W  54 15 53.00    11.9855      26.0000
                      3        2.000  N 70 47 46.70 W

 FORWARD EDGE (BENT  2)   1      47.9418  N 16 23  2.00 W  54 15 53.00    15.4099      28.0000

 SLAB DEPTH =  8.50 IN., OVERHANG DEPTH =  8.50 IN.
 SLAB AREA =   1680.0033 SQ. FT. =   186.6670 SQ. YDS.

                     TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                       PAGE  16
                        BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
 Example 1                                                              OCT  8, 2015     7:37
 IDENTIFICATION                                                         Example 1

SLAB     2    3    1    4  2  3       8.5000        8.5000                        BXB

                                      SLAB REPORT

                                        SPAN  2

                     SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                     NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                          BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB  1)   1      97.2203  N 19 21  5.00 E    97.2203      0.0000    97.2203     63.8641

 RIGHT EDGE   (PSLB  4)   1     102.7797  N 19 21  5.00 E   102.7797      0.0000   102.7797     38.9155


                     SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                     NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

 BACK EDGE    (BENT  2)   1      47.9418  N 16 23  2.00 W  54 15 53.00    15.4099      28.0000

                      1        2.000  N 70 38 55.00 W
 FORWARD EDGE (BENT  3)   2      41.0930  N 16 23  2.00 W  54 15 53.00    11.9855      26.0000
                      3        2.000  N 70 38 55.00 W

 SLAB DEPTH =  8.50 IN., OVERHANG DEPTH =  8.50 IN.
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 SLAB AREA =   2800.0000 SQ. FT. =   311.1111 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE  17
                           BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
 Example 1                                                                  OCT  8, 2015     7:37
 IDENTIFICATION                                                             Example 1

SLAB     3    4    1    4  2  3       8.5000        8.5000                       B BX

                                             SLAB REPORT

                                               SPAN  3

                        SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                        NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                             BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB  1)   1     102.7797  N 19 21  5.00 E   102.7797      0.0000   102.7797     63.8641

 RIGHT EDGE   (PSLB  4)   1      97.2203  N 19 21  5.00 E    97.2203      0.0000    97.2203     33.3562


                        SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                        NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

                          1       2.000   N 70 38 55.00 W
 BACK EDGE    (BENT  3)   2      41.0930  N 16 23  2.00 W  54 15 53.00    11.9855      26.0000
                          3       2.000   N 70 38 55.00 W

 FORWARD EDGE (BENT  4)   1      47.9418  N 16 23  2.00 W  54 15 53.00    15.4099      28.0000

 SLAB DEPTH =  8.50 IN., OVERHANG DEPTH =  8.50 IN.
 SLAB AREA =   2800.0000 SQ. FT. =   311.1111 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE  18
                           BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
 Example 1                                                                  OCT  8, 2015     7:37
 IDENTIFICATION                                                             Example 1

SLAB     4    5    1    4  2  3       8.5000        8.5000                       BXB
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                                   SLAB REPORT

                                     SPAN  4

                       SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                       NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                            BEARING                               LENGTHS    INTERSECT

  LEFT EDGE    (PSLB  1)  1      37.5747  N 19 21  5.00 E    37.5747      0.0000    37.5747     24.4151
                          2      19.5914  N 18 36 14.58 E    19.5908    750.9999    57.1660

  RIGHT EDGE   (PSLB  4)  1      63.3307  N 19 21  5.00 E    63.3307      0.0000    63.3307     38.9155


                       SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                       NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

  BACK EDGE    (BENT  4)  1      47.9418  N 16 23  2.00 W  54 15 53.00    15.4099      28.0000

                          1        2.000  N 72  8 35.84 W
  FORWARD EDGE (BENT  5)  2      40.7953  N 17  7 53.42 W  54 15 53.00    12.0951      26.0000
                          3        2.000  N 70 38 55.00 W

  SLAB DEPTH =  8.50 IN., OVERHANG DEPTH =  8.50 IN.
  SLAB AREA =   1685.0809 SQ. FT. =   187.2312 SQ. YDS.

                       TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                       PAGE  19
                          BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
  Example 1                                                              OCT  8, 2015     7:37
  IDENTIFICATION                                                         Example 1

                              BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)     Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    BRNG     0    0    0    1  4 FD      12.0000        3.0000      5.5833                 0.0000

    BRNG     0    0    0    2  3 BO      12.0000        3.0000      5.5833                 0.0000
```

```
    BRNG     0    0    0    3  3 BO      12.0000        3.0000      5.5833                0.0000

    BRNG     0    0    0    4  3 BO      12.0000        3.0000      5.5833                0.0000

    BRNG     0    0    0    5  4 BK      12.0000        3.0000      5.5833                0.0000

    BEAM     0    0    0    0     1       0.0000        0.0000     -6.0000            0  0  0.00

    BEAM     0    0    0    0     2       0.0000        0.0000     16.0000            0  0  0.00

                             TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                      PAGE  20
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                   OCT  8, 2015     7:37
     IDENTIFICATION                                                              Example 1

                                    BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                OR CORRECTION  OR STATION  DISTANCE,ETC.            D   M   S

    FOPT     1    5    1    2  5  4       0.0000        0.0000                                        1
                               H      21405.5700    21725.5700      320.0000

                             TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                      PAGE  21
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                   OCT  8, 2015     7:37
     IDENTIFICATION                                                              Example 1

                                                  BENT REPORT

                                         BENT NO.  1  (S 16 23  2.00 E)

     DISTANCE BETWEEN STATION LINE AND BEAM 1,       10.2733 L


                          BEAM SPAC.     BEAM ANGLE       DIST CL BENT TO CL BRNG     DIST CL BENT TO END OF BM
                          (CL BENT)       D  M   S          PERP TO        ALONG          PERP TO        ALONG
                                                            CL BENT       CL BEAM         CL BENT       CL BEAM

     SPAN  1  BEAM  1      0.0000       35 44  7.00        1.0000        1.7122          0.2500        0.4281
```

BEAM 2	12.5563	35 44 6.79	1.0000	1.7122	0.2500	0.4281
BEAM 3	12.5563	35 44 6.58	1.0000	1.7122	0.2500	0.4281
BEAM 4	12.5563	35 44 6.37	1.0000	1.7122	0.2500	0.4281
TOTAL	37.6689					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 22
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 1

	COORDINATES, BENT 1 X	Y	SURFACE ELEVATION	COORDINATES, BENT 2 X	Y	SURFACE ELEVATION
BEAM 1 (BENT)	5940.2758	4796.9137	2722.2153	5960.1575	4853.5239	2723.7666
(BRG.)	5940.8432	4798.5292	2722.2654	5959.8261	4852.5804	2723.7441
BEAM 2 (BENT)	5943.8176	4784.8673	2721.5364	5963.6992	4841.4776	2723.1597
(BRG.)	5944.3850	4786.4827	2721.5886	5963.3678	4840.5341	2723.1360
BEAM 3 (BENT)	5947.3594	4772.8208	2721.8049	5967.2410	4829.4313	2723.5002
(BRG.)	5947.9267	4774.4363	2721.8596	5966.9096	4828.4878	2723.4753
BEAM 4 (BENT)	5950.9011	4760.7744	2722.0613	5970.7827	4817.3850	2723.8289
(BRG.)	5951.4685	4762.3899	2722.1179	5970.4513	4816.4415	2723.8030

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 23
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

BEAM REPORT, SPAN 1

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	60.0000	57.2878	59.3417	0.02581	N 19 21 5.00 E
BEAM 2	60.0001	57.2879	59.3437	0.02701	N 19 21 4.79 E
BEAM 3	60.0002	57.2880	59.3457	0.02820	N 19 21 4.58 E

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            BEAM  4      60.0003       57.2880       59.3479      0.02941      N 19 21  4.37 E


                              BEARING SEAT ELEVATIONS FOR BENT    1

       NEAREST    OFFSET                                   DEPTH       DEPTH
       BRIDGE      FROM       BEAM/BENT INTERSECTION        TO         BELOW   REFERENCE    BEARING
BEAM   ROADWAY    BRIDGE            COORDINATES          REF LINE    REF LINE  ELEVATION   SEAT ELEV
       STATION    ROADWAY         X            Y

  1  214+15.6213  -6.0000      5940.8432     4798.5292     0.0000      5.5774  2722.2595   2716.6821
  2  214+05.4290   1.3334      5944.3850     4786.4827     0.0000      5.5774  2721.5828   2716.0054
  3  213+95.2368   8.6668      5947.9267     4774.4363     0.0000      5.5769  2721.8533   2716.2764
  4  213+85.0445  16.0002      5951.4685     4762.3899     0.0000      5.5771  2722.1118   2716.5347


                              BEARING SEAT ELEVATIONS FOR BENT    2

       NEAREST    OFFSET                                   DEPTH       DEPTH
       BRIDGE      FROM       BEAM/BENT INTERSECTION        TO         BELOW   REFERENCE    BEARING
BEAM   ROADWAY    BRIDGE            COORDINATES          REF LINE    REF LINE  ELEVATION   SEAT ELEV
       STATION    ROADWAY         X            Y

  1  214+72.9090  -6.0000      5959.8261     4852.5804     0.0000      7.1311  2725.2920   2718.1609
  2  214+62.7169   1.3333      5963.3678     4840.5341     0.0000      7.2031  2724.7559   2717.5527
  3  214+52.5247   8.6667      5966.9096     4828.4878     0.0000      7.2751  2725.1672   2717.8921
  4  214+42.3325  16.0000      5970.4513     4816.4415     0.0000      7.3472  2725.5669   2718.2197
                               TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                   PAGE  24
                                  BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                     OCT  8, 2015     7:37
     IDENTIFICATION                                                                Example 1

                                                 BENT REPORT

                                           BENT NO.  2  (S 16 23  2.00 E)

     DISTANCE BETWEEN STATION LINE AND BEAM 1,       10.2733 L


                           BEAM SPAC.     BEAM ANGLE       DIST CL BENT TO CL BRNG     DIST CL BENT TO END OF BM
```

		(CL BENT)	D M S	PERP TO CL BENT	ALONG CL BEAM	PERP TO CL BENT	ALONG CL BEAM
SPAN 1	BEAM 1	0.0000	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 2	12.5562	35 44 6.79	0.5840	1.0000	0.1460	0.2500
	BEAM 3	12.5562	35 44 6.58	0.5840	1.0000	0.1460	0.2500
	BEAM 4	12.5562	35 44 6.37	0.5840	1.0000	0.1460	0.2500
	TOTAL	37.6686					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 25

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

BENT REPORT

BENT NO. 2 (S 16 23 2.00 E)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2733 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 2	BEAM 1	0.0000	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 2	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 3	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 4	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	TOTAL	37.6686					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 26

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 2

		COORDINATES, BENT 2 X	Y	SURFACE ELEVATION	COORDINATES, BENT 3 X	Y	SURFACE ELEVATION
BEAM 1	(BENT)	5960.1575	4853.5239	2723.7666	5993.2935	4947.8744	2725.4106
	(BRG.)	5960.4888	4854.4674	2723.7888	5992.9622	4946.9309	2725.3999
BEAM 2	(BENT)	5963.6992	4841.4776	2723.1597	5996.8353	4935.8280	2724.9236
	(BRG.)	5964.0306	4842.4211	2723.1831	5996.5039	4934.8845	2724.9116
BEAM 3	(BENT)	5967.2410	4829.4313	2723.5002	6000.3770	4923.7817	2725.3840
	(BRG.)	5967.5723	4830.3748	2723.5249	6000.0457	4922.8382	2725.3711
BEAM 4	(BENT)	5970.7827	4817.3850	2723.8289	6003.9188	4911.7354	2725.8328
	(BRG.)	5971.1141	4818.3285	2723.8547	6003.5874	4910.7919	2725.8186

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 27

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

BEAM REPORT, SPAN 2

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	100.0000	98.0000	99.5134	0.01644	N 19 21 5.00 E
BEAM 2	100.0000	98.0000	99.5155	0.01764	N 19 21 5.00 E
BEAM 3	100.0000	98.0000	99.5177	0.01884	N 19 21 5.00 E
BEAM 4	100.0000	98.0000	99.5200	0.02004	N 19 21 5.00 E

BEARING SEAT ELEVATIONS FOR BENT 2

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	214+74.9090	-6.0000	5960.4888	4854.4674	0.0000	5.5774	2723.7830	2718.2056
2	214+64.7169	1.3333	5964.0306	4842.4211	0.0000	5.5774	2723.1772	2717.5999
3	214+54.5247	8.6667	5967.5723	4830.3748	0.0000	5.5774	2723.5190	2717.9417

4	214+44.3325	16.0000	5971.1141	4818.3285	0.0000	5.5774	2723.8489	2718.2715

BEARING SEAT ELEVATIONS FOR BENT 3

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	215+72.9090	-6.0000	5992.9622	4946.9309	0.0000	7.2217	2727.0383	2719.8167
2	215+62.7169	1.3333	5996.5039	4934.8845	0.0000	7.3416	2726.6699	2719.3284
3	215+52.5247	8.6667	6000.0457	4922.8382	0.0000	7.4612	2727.2490	2719.7878
4	215+42.3325	16.0000	6003.5874	4910.7919	0.0000	7.5813	2727.8167	2720.2354

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 28
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

BENT REPORT

BENT NO. 3 (S 16 23 2.00 E)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2733 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	DIST CL BENT TO CL BRNG ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	DIST CL BENT TO END OF BM ALONG CL BEAM
SPAN 2	BEAM 1	0.0000	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 2	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 3	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 4	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	TOTAL	37.6686					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 29

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

BENT REPORT

BENT NO. 3 (S 16 23 2.00 E)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2733 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	DIST CL BENT TO CL BRNG ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	DIST CL BENT TO END OF BM ALONG CL BEAM
SPAN 3	BEAM 1	0.0000	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 2	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 3	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	BEAM 4	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	TOTAL	37.6686					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 30
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 3

	COORDINATES, BENT 3 X	COORDINATES, BENT 3 Y	SURFACE ELEVATION	COORDINATES, BENT 4 X	COORDINATES, BENT 4 Y	SURFACE ELEVATION
BEAM 1 (BENT)	5993.2935	4947.8744	2725.4106	6026.4296	5042.2248	2725.8777
(BRG.)	5993.6249	4948.8179	2725.4209	6026.0983	5041.2813	2725.8789
BEAM 2 (BENT)	5996.8353	4935.8280	2724.9236	6029.9714	5030.1784	2725.5107
(BRG.)	5997.1666	4936.7715	2724.9353	6029.6400	5029.2349	2725.5105
BEAM 3 (BENT)	6000.3770	4923.7817	2725.3840	6033.5131	5018.1321	2726.0913
(BRG.)	6000.7084	4924.7252	2725.3970	6033.1817	5017.1886	2726.0901
BEAM 4 (BENT)	6003.9188	4911.7354	2725.8328	6037.0549	5006.0858	2726.6597

(BRG.)	6004.2501	4912.6789	2725.8467	6036.7235	5005.1423	2726.6572

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 31

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

BEAM REPORT, SPAN 3

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	100.0000	98.0000	99.5011	0.00467	N 19 21 5.00 E
BEAM 2	100.0000	98.0000	99.5017	0.00587	N 19 21 5.00 E
BEAM 3	100.0000	98.0000	99.5025	0.00707	N 19 21 5.00 E
BEAM 4	100.0000	98.0000	99.5034	0.00827	N 19 21 5.00 E

BEARING SEAT ELEVATIONS FOR BENT 3

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	215+74.9090	-6.0000	5993.6249	4948.8179	0.0000	5.5776	2725.4153	2719.8376
2	215+64.7169	1.3333	5997.1666	4936.7715	0.0000	5.5774	2724.9294	2719.3521
3	215+54.5247	8.6667	6000.7084	4924.7252	0.0000	5.5774	2725.3911	2719.8137
4	215+44.3325	16.0000	6004.2501	4912.6789	0.0000	5.5776	2725.8411	2720.2634

BEARING SEAT ELEVATIONS FOR BENT 4

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	216+72.9090	-6.0000	6026.0983	5041.2813	0.0000	6.0444	2726.3401	2720.2957
2	216+62.7169	1.3333	6029.6400	5029.2349	0.0000	6.1648	2726.0920	2719.9272
3	216+52.5247	8.6667	6033.1817	5017.1886	0.0000	6.2847	2726.7915	2720.5068

```
4  216+42.3325  16.0000      6036.7235     5005.1423     0.0000     6.4043  2727.4783   2721.0740

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                      PAGE  32
                            BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
   Example 1                                                                OCT  8, 2015     7:37
   IDENTIFICATION                                                           Example 1

                                                 BENT REPORT

                                        BENT NO.  4  (S 16 23  2.00 E)

   DISTANCE BETWEEN STATION LINE AND BEAM 1,       10.2733 L


                    BEAM SPAC.     BEAM ANGLE       DIST CL BENT TO CL BRNG     DIST CL BENT TO END OF BM
                    (CL BENT)       D  M   S          PERP TO        ALONG          PERP TO        ALONG
                                                      CL BENT       CL BEAM         CL BENT       CL BEAM

   SPAN  3  BEAM  1     0.0000       35 44  7.00        0.5840        1.0000          0.1460        0.2500
            BEAM  2    12.5562       35 44  7.00        0.5840        1.0000          0.1460        0.2500
            BEAM  3    12.5562       35 44  7.00        0.5840        1.0000          0.1460        0.2500
            BEAM  4    12.5562       35 44  7.00        0.5840        1.0000          0.1460        0.2500
             TOTAL     37.6686


                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                      PAGE  33
                            BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
   Example 1                                                                OCT  8, 2015     7:37
   IDENTIFICATION                                                           Example 1

                                                 BENT REPORT

                                        BENT NO.  4  (S 16 23  2.00 E)

   DISTANCE BETWEEN STATION LINE AND BEAM 1,       10.2733 L


                    BEAM SPAC.     BEAM ANGLE       DIST CL BENT TO CL BRNG     DIST CL BENT TO END OF BM
                    (CL BENT)       D  M   S          PERP TO        ALONG          PERP TO        ALONG
```

				CL BENT	CL BEAM	CL BENT	CL BEAM
SPAN 4	BEAM 1	0.0000	35 31 28.18	0.5811	1.0000	0.1453	0.2500
	BEAM 2	12.5562	35 35 42.60	0.5821	1.0000	0.1455	0.2500
	BEAM 3	12.5562	35 39 55.53	0.5831	1.0000	0.1458	0.2500
	BEAM 4	12.5562	35 44 7.00	0.5840	1.0000	0.1460	0.2500
	TOTAL	37.6686					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 34

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 4

	COORDINATES, BENT 4 X	Y	SURFACE ELEVATION	COORDINATES, BENT 5 X	Y	SURFACE ELEVATION
BEAM 1 (BENT)	6026.4296	5042.2248	2725.8777	6046.0981	5098.8942	2725.5920
(BRG.)	6026.7575	5043.1695	2725.8767	6045.5439	5097.2974	2725.6086
BEAM 2 (BENT)	6029.9714	5030.1784	2725.5107	6049.7676	5086.9896	2725.2888
(BRG.)	6030.3004	5031.1228	2725.5105	6049.2124	5085.3961	2725.2996
BEAM 3 (BENT)	6033.5131	5018.1321	2726.0913	6053.4371	5075.0850	2725.9429
(BRG.)	6033.8433	5019.0760	2726.0923	6052.8808	5073.4949	2725.9529
BEAM 4 (BENT)	6037.0549	5006.0858	2726.6597	6057.1066	5063.1804	2726.5886
(BRG.)	6037.3862	5007.0293	2726.6621	6056.5493	5061.5936	2726.5967

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 35

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

Example 1 OCT 8, 2015 7:37

IDENTIFICATION Example 1

BEAM REPORT, SPAN 4

HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING

BEAM 1	59.9856	57.2953	59.3137	-0.00468	N 19 8 26.18 E
BEAM 2	60.1615	57.4740	59.4900	-0.00367	N 19 12 40.60 E
BEAM 3	60.3374	57.6528	59.6664	-0.00242	N 19 16 53.53 E
BEAM 4	60.5134	57.8316	59.8430	-0.00113	N 19 21 5.00 E

BEARING SEAT ELEVATIONS FOR BENT 4

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	216+74.9090	-6.0037	6026.7575	5043.1695	0.0000	5.5793	2725.8728	2720.2935
2	216+64.7169	1.3309	6030.3004	5031.1228	0.0000	5.5798	2725.5071	2719.9272
3	216+54.5247	8.6654	6033.8433	5019.0760	0.0000	5.5798	2726.0889	2720.5090
4	216+44.3325	16.0000	6037.3862	5007.0293	0.0000	5.5796	2726.6584	2721.0789

BEARING SEAT ELEVATIONS FOR BENT 5

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	217+32.3378	-6.0328	6045.5439	5097.2974	0.0000	5.2891	2725.3145	2720.0254
2	217+22.1803	1.2184	6049.2124	5085.3961	0.0000	5.3567	2725.0730	2719.7163
3	217+12.1774	8.5952	6052.8808	5073.4949	0.0000	5.4290	2725.7986	2720.3696
4	217+02.1641	16.0000	6056.5493	5061.5936	0.0000	5.5061	2726.5195	2721.0134

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 36
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
Example 1 OCT 8, 2015 7:37
IDENTIFICATION Example 1

BENT REPORT

BENT NO. 5 (S 17 7 53.42 E)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.3534 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	DIST CL BENT TO CL BRNG ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	DIST CL BENT TO END OF BM ALONG CL BEAM
SPAN 4	BEAM 1	0.0000	36 16 19.60	1.0000	1.6903	0.2500	0.4226
	BEAM 2	12.4573	36 20 34.02	1.0000	1.6874	0.2500	0.4219
	BEAM 3	12.4573	36 24 46.96	1.0000	1.6846	0.2500	0.4212
	BEAM 4	12.4573	36 28 58.42	1.0000	1.6819	0.2500	0.4205
	TOTAL	37.3719					

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                    TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                PAGE  37
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
Example 1                                                               OCT  8, 2015     7:37
IDENTIFICATION                                                          Example 1
```

BRIDGE GEOMETRY LIST

CD NO	COMMAND	A	B	C	D	E	F	X(EAST) OR CORRECTION	Y(NORTH) OR STATION	RADIUS,OFFSET DISTANCE,ETC.	ELEV.	BEAR,AZ,SKEW D M S	STORE
	VCLR	0	0	0	10	H	1						

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                    TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                PAGE  38
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
Example 1                                                               OCT  8, 2015     7:37
IDENTIFICATION                                                          Example 1
```

VERTICAL CLEARANCE BETWEEN SPAN 1 OF ROADWAY H WITH ROADWAY H

	0.00 L	0.10 L	0.20 L	0.30 L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	-5.58	-5.60	-5.61	-5.62	-5.63	-5.63	-5.63	-5.62	-5.61	-5.60	-5.58
BEAM 2	-5.58	-5.60	-5.61	-5.62	-5.63	-5.63	-5.63	-5.62	-5.61	-5.60	-5.58
BEAM 3	-5.58	-5.60	-5.61	-5.62	-5.63	-5.63	-5.63	-5.62	-5.61	-5.60	-5.58

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     BEAM  4      -5.58   -5.60   -5.61   -5.62   -5.63   -5.63   -5.63   -5.62   -5.61   -5.60   -5.58


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                               PAGE  39
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                              OCT  8, 2015     7:37
     IDENTIFICATION                                                         Example 1

                               BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  2


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                               PAGE  40
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                              OCT  8, 2015     7:37
     IDENTIFICATION                                                         Example 1

               VERTICAL CLEARANCE BETWEEN SPAN  2 OF ROADWAY H WITH ROADWAY H

                   0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  2      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  3      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  4      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                               PAGE  41
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                              OCT  8, 2015     7:37
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     IDENTIFICATION                                                  Example 1

                                BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  3


                             TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                                PAGE  42
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                 OCT  8, 2015     7:37
     IDENTIFICATION                                                            Example 1

               VERTICAL CLEARANCE BETWEEN SPAN  3 OF ROADWAY H WITH ROADWAY H

                   0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  2      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  3      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58

     BEAM  4      -5.58   -5.63   -5.67   -5.70   -5.72   -5.72   -5.72   -5.70   -5.67   -5.63   -5.58


                             TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                                PAGE  43
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     Example 1                                                                 OCT  8, 2015     7:37
     IDENTIFICATION                                                            Example 1

                                BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  4
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                  TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                 PAGE  44
                     BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
Example 1                                                            OCT  8, 2015     7:37
IDENTIFICATION                                                       Example 1

          VERTICAL CLEARANCE BETWEEN SPAN  4 OF ROADWAY H WITH ROADWAY H

              0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


BEAM  1      -5.58   -5.60   -5.62   -5.63   -5.64   -5.64   -5.64   -5.63   -5.63   -5.61   -5.58

BEAM  2      -5.58   -5.60   -5.61   -5.62   -5.63   -5.63   -5.63   -5.62   -5.61   -5.60   -5.58

BEAM  3      -5.58   -5.60   -5.61   -5.62   -5.63   -5.63   -5.63   -5.62   -5.61   -5.60   -5.58

BEAM  4      -5.58   -5.60   -5.61   -5.62   -5.63   -5.63   -5.63   -5.62   -5.61   -5.60   -5.58
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                  TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                 PAGE  45
                     BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
Example 1                                                            OCT  8, 2015     7:37
IDENTIFICATION                                                       Example 1

                       BEARING SEAT ELEVATIONS


                  BEAM  1    BEAM  2    BEAM  3    BEAM  4
BENT  1 (FWD)    2716.682   2716.005   2716.276   2716.535


                  BEAM  1    BEAM  2    BEAM  3    BEAM  4
BENT  2 (BK)     2718.161   2717.553   2717.892   2718.220
        (FWD)    2718.206   2717.600   2717.942   2718.271


                  BEAM  1    BEAM  2    BEAM  3    BEAM  4
BENT  3 (BK)     2719.817   2719.328   2719.788   2720.235
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        (FWD)    2719.838   2719.352   2719.814   2720.263


                  BEAM  1    BEAM  2    BEAM  3    BEAM  4
BENT  4 (BK)     2720.296   2719.927   2720.507   2721.074
        (FWD)    2720.293   2719.927   2720.509   2721.079


                  BEAM  1    BEAM  2    BEAM  3    BEAM  4
BENT  5 (BK)     2720.025   2719.716   2720.370   2721.013
```

EXAMPLE 1 LS3 OUTPUT FILE

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                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE  11
                           BRIDGE GEOMETRY SYSTEM (BGS)               ***  GEOMETRICS  ***
     ALIGNMENT PLOT PROCESS                                              OCT  8, 2015     7:37
     IDENTIFICATION                                                      Example 1

                   * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

 ALIGNMENT  ELEMENT    BEGINNING        EAST (X)      NORTH (Y)         BEARING          RADIUS,
  ELEMENT    TYPE       STATION        BEGINNING      BEGINNING                       SPIRAL LENGTH,
  NUMBER               OR STA. BACK                                                    STA. FORWARD

    1      ARC         213+00.00        5912.6085      4686.0810    N 13  1 46.78 E        760.00
    2      LINE        213+83.85        5935.9780      4766.5690    N 19 21  5.00 E
    3      ARC         217+15.65        6045.9230      5079.6224    N 19 21  5.00 E        760.00
    4      LINE        220+20.06        6087.3617      5379.1537    N  3 35 53.56 W
    5      END STA     221+00.00        6082.3452      5458.9279    N  3 35 53.56 W



              * * * TABLE OF CENTERS FOR ALIGNMENT ELEMENTS AND OFFSETS * * *

     ALIGNMENT      OFFSET    PARALLEL TO     EAST (X)        NORTH (Y)
      ELEMENT        LINE      ALIGNMENT
      NUMBER        NUMBER    ELEMENT NO.


         1                                     6653.0410       4514.7349

         3                                     5328.8600       5331.4566



             * * * CURVE FIT DATA FOR ALL ALIGNMENT ELEMENTS AND OFFSETS * * *

  POINT       STATION             EAST (X)          NORTH (Y)       --------- S O U R C E ---------
                                                                     ALIGNMENT     OFFSET    INTERIOR
```

				ELEMENT	LINE	POINT
1	213+00.00	5912.6085	4686.0810	1		
2	213+41.92	5923.1829	4726.6474	1		*
3	213+83.85	5935.9780	4766.5690	2		
4	217+15.65	6045.9230	5079.6224	3		
5	218+67.86	6081.6897	5227.3063	3		*
6	220+20.06	6087.3617	5379.1537	4		
7	221+00.00	6082.3452	5458.9279	5		

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                    TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                  PAGE  12
                       BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
ALIGNMENT PLOT PROCESS                                                OCT  8, 2015     7:37
IDENTIFICATION                                                        Example 1

               * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

    THE PLOT SCALE IS   1.0 FEET PER FOOT.

    TICK MARKS WILL BE DRAWN EVERY  20 FEET ALONG THE CENTERLINE.

    STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

    THIS PLOT WILL COVER A DISTANCE OF    791.03 FEET.


    THE BEARING OF THE CURVE-FIT LINE IS N 13  46  49.28 E

    REFERENCE COORDINATES ARE      1064.9298 X,      5875.0229 Y.

    ORIGIN COORDINATES ARE     10777.0899 X,      3493.0180 Y.

                    TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                  PAGE  46
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                    BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
PLOT SUMMARY                                                         OCT  8, 2015     7:37
IDENTIFICATION                                                       Example 1

                       PLOTTER SUMMARY REPORT                                                   PLRPT


                        *** GRAPHICS PLOT ***


          PLOT     PLOT   ROAD-    LENGTH    WIDTH    ACTIVE PENS (*)                           PLRPT
        COMMAND    TYPE    WAY     (FEET)    (FEET)   1 2 3 4 5 6 7 8                           PLRPT
         -----------------------------------------------------------                            PLRPT
             1     APLT     H         0.0       0.0   * - - - - - - -                           PLRPT
             2     SLAB     H         0.0       0.0   - - - * - - - -                           PLRPT
             3     SLAB     H         0.0       0.0   - - - * - - - -                           PLRPT
             4     SLAB     H         0.0       0.0   - - - * - - - -                           PLRPT
             5     SLAB     H         0.0       0.0   - - - * - - - -                           PLRPT
             6     FOPT     H       813.0      73.0   - - - * - - - -                           PLRPT
```

EXAMPLE 1 LS4 OUTPUT FILE

```
Identification            Project: Example 1                              Date: OCT  8, 2015              BGS  PC TEXAS V 9.1


                       BENT REPORT

             BENT NO.  1  (S 16 23  2.00 E)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
    SPAN  1  BEAM  1     0.000       35 44   7
             BEAM  2    12.556       35 44   7
             BEAM  3    12.556       35 44   7
             BEAM  4    12.556       35 44   6
              TOTAL     37.669

             BENT NO.  2  (S 16 23  2.00 E)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
    SPAN  1  BEAM  1     0.000       35 44   7
             BEAM  2    12.556       35 44   7
             BEAM  3    12.556       35 44   7
             BEAM  4    12.556       35 44   6
              TOTAL     37.669

             BENT NO.  2  (S 16 23  2.00 E)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
    SPAN  2  BEAM  1     0.000       35 44   7
             BEAM  2    12.556       35 44   7
             BEAM  3    12.556       35 44   7
             BEAM  4    12.556       35 44   7
              TOTAL     37.669

             BENT NO.  3  (S 16 23  2.00 E)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
```

```
   SPAN  2  BEAM  1     0.000       35 44   7
            BEAM  2    12.556       35 44   7
            BEAM  3    12.556       35 44   7
            BEAM  4    12.556       35 44   7
             TOTAL     37.669

            BENT NO.  3  (S 16 23  2.00 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)      D  M   S
   SPAN  3  BEAM  1     0.000       35 44   7
            BEAM  2    12.556       35 44   7
            BEAM  3    12.556       35 44   7
            BEAM  4    12.556       35 44   7
             TOTAL     37.669

            BENT NO.  4  (S 16 23  2.00 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)      D  M   S
   SPAN  3  BEAM  1     0.000       35 44   7
            BEAM  2    12.556       35 44   7
            BEAM  3    12.556       35 44   7
            BEAM  4    12.556       35 44   7
             TOTAL     37.669

            BENT NO.  4  (S 16 23  2.00 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.273 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)      D  M   S
   SPAN  4  BEAM  1     0.000       35 31  28
            BEAM  2    12.556       35 35  43
            BEAM  3    12.556       35 39  56
            BEAM  4    12.556       35 44   7
             TOTAL     37.669

            BENT NO.  5  (S 17  7 53.42 E)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.353 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)      D  M   S
   SPAN  4  BEAM  1     0.000       36 16  20
            BEAM  2    12.457       36 20  34
```

```
          BEAM  3    12.457       36 24  47
          BEAM  4    12.457       36 28  58
           TOTAL     37.372


                    BEAM REPORT

         BEAM REPORT, SPAN  1
         HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
       C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1   60.000        57.288        59.34       0.0258
BEAM  2   60.000        57.288        59.34       0.0270
BEAM  3   60.000        57.288        59.35       0.0282
BEAM  4   60.000        57.288        59.35       0.0294

         BEAM REPORT, SPAN  2
         HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
       C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1  100.000        98.000        99.51       0.0164
BEAM  2  100.000        98.000        99.52       0.0176
BEAM  3  100.000        98.000        99.52       0.0188
BEAM  4  100.000        98.000        99.52       0.0200

         BEAM REPORT, SPAN  3
         HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
       C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1  100.000        98.000        99.50       0.0047
BEAM  2  100.000        98.000        99.50       0.0059
BEAM  3  100.000        98.000        99.50       0.0071
BEAM  4  100.000        98.000        99.50       0.0083

         BEAM REPORT, SPAN  4
         HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
       C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1   59.986        57.295        59.31      -0.0047
BEAM  2   60.161        57.474        59.49      -0.0037
BEAM  3   60.337        57.653        59.67      -0.0024
BEAM  4   60.513        57.832        59.84      -0.0011
```

EXAMPLE 1 LS5 OUTPUT FILE

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                          TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                 PAGE  47
                            BRIDGE GEOMETRY SYSTEM (BGS)                    ***  SYSTEM  ***
    BRIDGE GEOMETRY SYSTEM REQUEST                                           OCT  8, 2015     7:37
    IDENTIFICATION                                                           Example 1
                                     RUN REPORT




   UNITS - ENGLISH (DEFAULT)

   JOB TYPE (OLD OR NEW) - NEW

   SAVE RESULTS (YES OR NO) - NO


         DATA                                ROADWAY
         TYPE                   .....................................................
                                .A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P.Q.R.S.T.U.V.W.X.Y.Z.
                                .....................................................
  HORIZONTAL ALIGNMENT          . . . . . . . .X. . . . . . . . . . . . . . . . . . .
                                .....................................................
  VERTICAL ALIGNMENT            . . . . . . .-.X. . . . . . . . . . . . . . . . . . .
    (PROFILE GRADE)             .....................................................
  TEMPLATE                      . . . . . . .-.X. . . . . . . . . . . . . . . . . . .
                                .....................................................
  SUPERELEVATION                . . . . . . .-. . . . . . . . . . . . . . . . . . . .
                                .....................................................
  WIDENING                      . . . . . . .-. . . . . . . . . . . . . . . . . . . .
                                .....................................................
```

OUTPUT OF BGS OPERATING ON EXAMPLE 2 INPUT FILE

EXAMPLE 2 LS1 OUTPUT FILE

```
                              BRIDGE GEOMETRY SYSTEM
 PC TEXAS V 9.1               MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                             EHEADN
 IDENTIFICATION                    SYSTEM DRIVER               Example 2                                         EHEADN

                                 BGS INPUT LISTING                                                               CEDIT

     ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
   1        SYSTEM X X      X   NEW NOYESYESYESYES   Example 2
   2     $234567890123456789012345678901234567890123456789012345678901234567890123456789O
   2     $  COMMENTS SUCH AS THE FOLLOWING ARE INSERTED THROUGHOUT THIS EXAMPLE INPUT
   2     $  FILE. THESE COMMENTS WILL DESCRIBE FOLLOWING CARDS UP TO THE NEXT COMMENT.
   2        RG   CMNT                    ********************************************
   3        RG   CMNT                           ESTABLISH ROADWAY ALIGNMENT H
   4        RG   CMNT                    ********************************************
   5     $  THE PONT AND TRVS CARDS ESTABLISH TWO POINTS AT THE ENDS OF THE ALIGNMENT
   5     $  THESE ARE PLACED FAR ENOUGH APART TO ACCOMMODATE THE BRIDGE, 1000 FT. THE
   5     $  LINE TRAVERSED THROUGH THE POINTS IS AT A BEARING OF NORTH 19 DEG. 12 MIN.
   5     $  11 SEC. EAST.
   5        RG   PONT   1                 6000000000 4000000000
   6        RG   TRVS   1   2                                        1000.00N019121100E
   7     $  THESE CARDS ARE USED TO ESTABLISH HORIZONTAL ALIGNMENT H ASSIGNING THE
   7        STATION 20+00.00 TO THE FIRST POINT.
   8     $234567890123456789012345678901234567890123456789012345678901234567890123456789O
   8        RD05H 1   200000POT                                                     1
   9        RD05H 2                                                                 2
  10     $  THESE CARDS ARE USED CALCULATE THE VERTICAL ALIGNMENT BY ASSIGNING ELEVATIONS
  10     $  TO STATIONS 20+55.67 AND 28+47.13. THIS VERTICAL ALIGNMENT IS STRAIGHT.
  10     $234567890123456789012345678901234567890123456789012345678901234567890123456789O
  10        RD10H 1   205567 665.82
  11        RD10H 2   284713 670.43
  12     $  THESE CARDS ESTABLISH THE ROADWAY SURFACE BETWEEN STATIONS 20+55.67 AND
  12     $  28+47.13. THIS SURFACE IS SLOPED 0.08 FT/FT TO THE LEFT FOR THE FIRST 122.5
  12     $  FT. OF THE ALIGNMENT, TRANSITIONS FROM THIS LEFT SLOPE TO 0.08 FT/FT SLOPE
  12     $  TO THE RIGHT OF OVER 45 FT. IS CONSTANT.
  12     $234567890123456789012345678901234567890123456789012345678901234567890123456789O
  12        RD30H   211000 11F    2 2 2 2         -0800200 -0800200
```

```
13          RD30H   213250 1
14          RD30H   217750 21F    2 2 2 2          0800200  0800200
15          RD30H   284713 2
16          RG   CMNT                    ********************************************
17          RG   CMNT                           ESTABLISH ROADWAY ALIGNMENT I
18          RG   CMNT                    ********************************************
19    $  THE FOLLOWING CARDS ESTABLISH THE POINTS FOR THE SECOND ROADWAY ALIGNMENT.
19    $  THE ZPNT CARD IS USED TO PLACE THE BEGINNING POINT OF THE SECOND ALIGNMENT
19    $  THE POINT ON TANGENT. THE TEMPLATE DOES NOT EXTEND OUT TO THIS POINT FROM THE
19    $  FIRST ALIGNMENT SO THE ZPNT COMMAND WILL NOT RETURN AN ELEVATION FOR THE
19    $  POINT. THE TRVS CARDS SET THE NEXT TWO POINTS RELATIVE TO THE FIRST. THE
19    $  SECOND POINT IS THE PI OF THE CURVE.
19    $234567890123456789012345678901234567890123456789012345678901234567890123456789O
19          RG   ZPNT  10            H            2429.26    -210.44
20          RG   TRVS  10  11                                642.25     S070473100E
21          RG   TRVS  11  12                                542.25     S049211864E
22    $  THE FOLLOWING CARDS ESTABLISH THE HORIZONTAL ALIGNMENT AND ASSIGN THE STATION
22    $  287+55.78 TO ITS BEGINNING. THE RADIUS OF THE ARC CONNECTING THE TWO TANGENTS
22    $  IS 28647.3 FT WHICH DETERMINES THE CURVATURE.
22          RD05I 1  2875578POT                                             10
23          RD05I 2                28647300                                 11
24          RD05I 3                                                         12
25    $234567890123456789012345678901234567890123456789012345678901234567890123456789O
25    $  THE FOLLOWING CARDS CALCULATE THE VERTICAL ALIGNMENT BY ASSIGNING ELEVATIONS

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                          BRIDGE GEOMETRY SYSTEM
 PC TEXAS V 9.1           MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
 IDENTIFICATION                SYSTEM DRIVER               Example 2                                          EHEADN

                             BGS INPUT LISTING                                                                CEDIT

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
25    $  TO STATIONS 288+55.78 AND 299+27.62. THIS VERTICAL ALIGNMENT IS FLAT.
25          RD10I 1  2885578 642.82
26          RD10I 2  2992762 642.82
27    $  THESE CARDS ESTABLISH THE ROADWAY SURFACE BETWEEN STATIONS 288+55.78 AND
27    $  299+27.62. THIS SURFACE IS COMPLEX HAVING 6 SEGMENTS WITH VARIOUS LENGTHS AND
27    $  SLOPES.
27    $234567890123456789012345678901234567890123456789012345678901234567890123456789O
27          RD30I  2885578 31F    4 4 4 4         +03  289 -0423700 +04  57  +04  57
```

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28         RD30I  2885578 32F    4 4 4 4         +0064749 -020 29
29         RD30I  2992762 31
30         RD30I  2992762 32
31         RG   CMNT                  *******************************************
32         RG   CMNT                                 BRIDGE COMMANDS
33         RG   CMNT                  *******************************************
34    $  THE NAME CARD SPECIFIES THAT THE BRIDGE WILL LIE BETWEEN STATIONS 21+55.67
34    $  AND 27+47.13 ON ALIGNMENT H.
34         RG   NAME   5   2HS20BRIG H    2155.67    2747.13  EXAMPLE 2 BRIDGE
35    $  THE APLT CARDS SPECIFY THAT THE SEGMENT OF ROADWAY I BETWEEN STATIONS
35    $  288+10.00 AND 292+00.00 AND THE SEGMENT OF ROADWAY H BETWEEN STATIONS
35    $  22+00 AND 27+00 SHOULD BE PLOTTED. USING THE SET OF OPTIONS BELOW WILL FORCE
35    $  THE ROADWAYS TO BE PLOTTED ON THE SAME COORDINATE SYSTEM.
35    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
35         RG   APLT          10 100 I     28810.00   29200.00
36         RG   APLT          10 100 H      2200.00    2700.00
37    $  THIS CONT CARDS ADD ELEVATION CONTOUR LINES TO ROADWAY I BETWEEN STATIONS
37    $  289+10.00 AND 290+00.00 AND TO ROADWAY H FROM STATION 22+50 AND 26+50 WITH
37    $  10 FT. HORIZONTAL DISTANCE BETWEEN EACH LINE AND ELEVATION CALCULATIONS EVERY
37    $  0.5 FT.
37    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
37         RG   CONT                I     28910.00   29000.00       10.0        1.0
38         RG   CONT                H      2250.00    2650.00       10.0        1.0
39         RG   NPEN   4
40    $  THESE BENT CARD DEFINE WHAT STATIONS THE BENT LINES CROSS THE BRIDGE ALIGNMEN
40    $  ESTABLISHED ABOVE. ADDITIONALLY SKEW, WHICH IS LEFT 0 DEG. FORWARD AND BENT
40    $  TYPE (ABUTMENT OR INTERIOR BENT) ARE DEFINED.
40    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
40         RG   BENT              1  AB            2255.67            L000000000F
41         RG   BENT              2  IN            2317.13            L000000000F
42         RG   BENT              3  IN            2427.13            L000000000F
43         RG   BENT              4  IN            2537.13            L000000000F
44         RG   BENT              5  AB            2647.13            L000000000F
45    $  THE PSLB CARDS DEFINE TWO LINES PARALLEL TO THE BRIDGE ALIGNMENT WITH AN
45    $  OFFSET OF PLUS AND MINUS 10.25 FEET.
45    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
45         RG   PSLB  10                                          -10.25
46         RG   PSLB  20                                          +10.25
47         RG   CMNT                  *******************************************
48         RG   CMNT                  PSLB 10 = LEFT EDGE OF SLAB
49         RG   CMNT                  PSLB 20 = RIGHT EDGE OF SLAB
50         RG   CMNT                  *******************************************
```

```
51    $  THE SLAB CARDS DEFINE THE SLAB DEPTH IN THE AREA BOUNDED BY THE BENT LINES AN
51    $  PSLB LINES. A SEPARATE CARD IS USED FOR EVERY SPAN.

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                                BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1                MESSAGES PRINTED BY THE              OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION                     SYSTEM DRIVER                   Example 2                                          EHEADN

                                   BGS INPUT LISTING                                                                    CEDIT

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8
51    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
51           RG   SLAB   1   2  10  20          24.0                      B B
52           RG   SLAB   2   3  10  20          24.0                      B B
53           RG   SLAB   3   4  10  20          24.0                      B B
54           RG   SLAB   4   5  10  20          24.0                      B B
55    $  THE BRNG CARD SERIES DEFINES THE BEARING SEAT CENTERLINES ON ALL BENTS
55    $  RELATIVE TO THE BENT LINE. THERE IS A SEPARATE CARD FOR EACH BEARING SEAT
55    $  CENTERLINE TO BE ESTABLISHED.
55    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
55           RG   BRNG              1 4FD        8.5        2.0      5.375
56           RG   BRNG              2 1BK        8.5        2.0      5.375
57           RG   BRNG              2 1FD        8.5        2.0      5.375
58           RG   BRNG              3 1BK        8.5        2.0      5.375
59           RG   BRNG              3 1FD        8.5        2.0      5.375
60           RG   BRNG              4 1BK        8.5        2.0      5.375
61           RG   BRNG              4 1FD        8.5        2.0      5.375
62           RG   BRNG              5 4BK        8.5        2.0      5.375
63    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
63    $  THE BEAM CARDS DEFINE BEAM LINES AT AN OFFSET FROM THE BRIDGE ALIGNMENT OF
63    $  PLUS AND MINUS 10.25. BEAMS WILL BE PLACED RELATIVE TO THESE LINES.
63    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
63           RG   BEAM                  1                           -10.25
64           RG   BEAM                  2                           +10.25
65    $  THE FOPT CARD FRAMES THE BRIDGE FROM BENTS 1 TO 5 BETWEEN BEAM LINES 1 AND 2
65    $  WITH FRAME OPTION 5 HAVING 6 BEAMS.
65    $2345678901234567890123456789012345678901234567890123456789012345678901234567890
65           RG   FOPT   1   5   1   2 5 6                                           1
66    $  THE TWO SERIES OF VCLR CARDS, ONE FOR ROADWAY H AND ONE FOR ROADWAY I,
66    $  CALCULATE THE DISTANCE BETWEEN THE BOTTOM OF THE BEAMS AND THE PROFILE GRADE
66    $  LINE DEFINED FOR THE GIVEN ROADWAY AT 11 EQUALLY SPACED POINTS.
```

```
66          RG   VCLR             10 H 1
67          RG   VCLR             10 H 2
68          RG   VCLR             10 H 3
69          RG   VCLR             10 H 4
70          RG   VCLR             10 I 1
71          RG   VCLR             10 I 2
72          RG   VCLR             10 I 3
73          RG   VCLR             10 I 4
74          RG   VCLR             10 H 2
75          RG   VCLR             10 H 3
76          RG   VCLR             10 H 4

      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+----8

                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION             GEOMETRY PROCESS              Example 2                                          EHEADN


      THE FOLLOWING CARD HAS AN UNRECOGNIZABLE CARD TYPE.  THE CARD WAS SKIPPED.                              CEDIT
              STATION 20+00.00 TO THE FIRST POINT.

                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION       DESIGN EDIT AND STORE PROCESS       Example 2                                          EHEADN


                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION             GEOMETRY PROCESS              Example 2                                          EHEADN


                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION       DESIGN EDIT AND STORE PROCESS       Example 2                                          EHEADN


                          BRIDGE GEOMETRY SYSTEM
  PC TEXAS V 9.1          MESSAGES PRINTED BY THE          OCT  9, 2015     7:34                              EHEADN
  IDENTIFICATION             GEOMETRY PROCESS              Example 2                                          EHEADN

      NOW FITTING A LINE TO POINTS   1 THROUGH   4.                                                           ORIEN
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EXAMPLE 2 LS2 OUTPUT FILE

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                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE   2
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
     GENERAL GEOMETRY PROCESS                                                 OCT  9, 2015     7:34
     IDENTIFICATION                                                           Example 2
                               GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)     Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    ************************************************

    ****       ESTABLISH ROADWAY ALIGNMENT H

    ************************************************

    PONT     1    0    0    0     0  600000.0000   400000.0000      0.0000             0  0  0.00
                                     600000.0000   400000.0000      0.0000    0.000    0  0  0.00    SP    1

    TRVS     1    2    0    0     0       0.0000        0.0000   1000.0000          N 19 12 11.00 E
                                     600328.9170   400944.3588      0.0000    0.000    0  0  0.00    SP    2
                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE   3
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  DESIGN DATA ***
     DESIGN DATA LIST PROCESS                                                 OCT  9, 2015     7:34
     IDENTIFICATION                                                           Example 2
                        POINTS STORED OR USED BY ALIGNMENTS


         PI  1, ROADWAY H IS DEFINED BY STORED POINT    1 ( X=  600000.0000, Y=  400000.0000)

         PI  2, ROADWAY H IS DEFINED BY STORED POINT    2 ( X=  600328.9170, Y=  400944.3588)
                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE   4
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  DESIGN DATA ***
```

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    HORIZONTAL ALIGNMENT PROCESS                                               OCT  9, 2015     7:34
    IDENTIFICATION                                                             Example 2
                             HORIZONTAL ALIGNMENT LIST
                                   FOR ROADWAY H
COMPUTATIONS BASED ON ARC DEFINITION


P.I.                                                      X             Y

  1     20+00.0000                                   600000.0000   400000.0000
                 N 19 12 11.00 E    1000.0000 FT.
  2     30+00.0000                                   600328.9170   400944.3588

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                         PAGE   5
                            BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
    DESIGN DATA LIST PROCESS                                                   OCT  9, 2015     7:34
    IDENTIFICATION                                                             Example 2
                                SORTED DESIGN DATA


    CARD TYPE RD05       H O R I Z O N T A L   A L I G N M E N T

         R  P.I.                  DEGREE        RADIUS                                       ROUND
         O   N             BEG.                              SPIRAL
         A   U                      OF            OR                                          BRNG
         D   M    STATION   STA.                            LENGTHS       P.I. COORDINATES
         W   B                    CURVE        FORWARD                                         OR
         A   E             I.D.
         Y   R                                 TANGENT                                        HOLD
                                DEG MIN  SEC                 IN   OUT        X             Y



         H   1    20+00.0000 POT   0  0  0.00       0.0000   0.0   0.0   600000.0000   400000.0000   0
         H   2    30+00.0000       0  0  0.00       0.0000   0.0   0.0   600328.9170   400944.3588

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                         PAGE   6
                            BRIDGE GEOMETRY SYSTEM (BGS)               ***  DESIGN DATA ***
    DESIGN DATA LIST PROCESS                                                   OCT  9, 2015     7:34
    IDENTIFICATION                                                             Example 2
```

```
                              SORTED DESIGN DATA


CARD TYPE RD10              P R O F I L E   G R A D E

  R  P.I.                             FIRST       SECOND
  O   N      VERTICAL
  A   U                              VERTICAL    VERTICAL   ELEVATION
  D   M        P.I.         P.I.                                                EXTERNAL    GRADE
  W   B                               CURVE       CURVE    CORRECTION
  A   E      STATION     ELEVATION
  Y   R                               LENGTH      LENGTH


  H   1      20+55.67     665.82         0.          0.        0.00
  H   2      28+47.13     670.43         0.          0.        0.00                0.005825

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                              PAGE   7
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  DESIGN DATA ***
DESIGN DATA LIST PROCESS                                                    OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2
                              SORTED DESIGN DATA


CARD TYPE RD30                   T E M P L A T E

                             R
                             O                TEMPLATE
                             A
                             D     STATION     STORE/
                             W                 RECALL
                             A
                             Y                   NO.


                             H      21+10.00      1
                             H      21+32.50      1
                             H      21+77.50      2
                             H      28+47.13      2

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
```

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                                                                                                                    PAGE   8
                             BRIDGE GEOMETRY SYSTEM (BGS)                ***  DESIGN DATA ***
     DESIGN DATA LIST PROCESS                                                OCT  9, 2015     7:34
     IDENTIFICATION                                                          Example 2
                                  SORTED DESIGN DATA


     CARD TYPE RD30            T E M P L A T E   T A B L E

TEMP S SURF. PROF. CENTR LEFT  RIGHT               SEGMENT        SEGMENT        SEGMENT        SEGMENT
 NO  / DEPTH GRADE LINE  PIVOT PIVOT A  B  C  D  O              O              O              O
     F       POINT POINT POINT POINT             P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST
                                                 T              T              T              T


  1  F  0.00   2     2     2     2                -0.0800 20.0   -0.0800 20.0
  2  F  0.00   2     2     2     2                 0.0800 20.0    0.0800 20.0

                          TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                                    PAGE   9
                             BRIDGE GEOMETRY SYSTEM (BGS)                ***  GEOMETRICS  ***
     GENERAL GEOMETRY PROCESS                                                OCT  9, 2015     7:34
     IDENTIFICATION                                                          Example 2
                                 GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)     Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    ************************************************

    ****      ESTABLISH ROADWAY ALIGNMENT I

    ************************************************

    ZPNT    10    0    0    0  H  0       0.0000     2429.2600   -210.4400             0  0  0.00
                                     599942.4600   400474.5928      0.0000    0.000    0  0  0.00    SP   10
                       * OFF TEMPLATE     0.0000    2429.2600    -210.4400  666.396*   0  0  0.00    NS    0

    TRVS    10   11    0    0     0       0.0000        0.0000    642.2500          S 70 47 31.00 E
                                     600548.9561   400263.2929      0.0000    0.000    0  0  0.00    SP   11

    TRVS    11   12    0    0     0       0.0000        0.0000    542.2500          S 49 21 18.64 E
```

```
                         600960.3947   399910.0886      0.0000    0.000    0  0  0.00    SP   12

                 TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                        PAGE  10
                    BRIDGE GEOMETRY SYSTEM (BGS)              ***  DESIGN DATA ***
  DESIGN DATA LIST PROCESS                                       OCT  9, 2015     7:34
  IDENTIFICATION                                                 Example 2
                 POINTS STORED OR USED BY ALIGNMENTS



      PI  1, ROADWAY I IS DEFINED BY STORED POINT   10 ( X=  599942.4600, Y=  400474.5928)

      PI  2, ROADWAY I IS DEFINED BY STORED POINT   11 ( X=  600548.9561, Y=  400263.2929)

      PI  3, ROADWAY I IS DEFINED BY STORED POINT   12 ( X=  600960.3947, Y=  399910.0886)

                 TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                        PAGE  11
                    BRIDGE GEOMETRY SYSTEM (BGS)              ***  DESIGN DATA ***
  HORIZONTAL ALIGNMENT PROCESS                                   OCT  9, 2015     7:34
  IDENTIFICATION                                                 Example 2
                         HORIZONTAL ALIGNMENT LIST
                               FOR ROADWAY I
 COMPUTATIONS BASED ON ARC DEFINITION


P.I.                                                   X             Y

  1    287+55.7800                                 599942.4600   400474.5928
                  S 70 47 31.00 E     642.2500 FT.
       288+55.7816 PC    2  0  0.15 D     542.2484 T   600036.8946   400441.6923
  2    293+98.0300 PI   21 26 12.36 RT   1071.8163 L   600548.9561   400263.2929
       299+27.5979 PT     2864.7300 R                  600960.3935   399910.0897
                  S 49 21 18.64 E     542.2500 FT.
  3    299+27.5995                                     600960.3947   399910.0886

                 TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                        PAGE  12
                    BRIDGE GEOMETRY SYSTEM (BGS)              ***  DESIGN DATA ***
  DESIGN DATA LIST PROCESS                                       OCT  9, 2015     7:34
  IDENTIFICATION                                                 Example 2
```

SORTED DESIGN DATA

CARD TYPE RD05 H O R I Z O N T A L A L I G N M E N T

ROADWAY	P.I. NUMBER	STATION	BEG. STA. I.D.	DEGREE OF CURVE DEG	MIN	SEC	RADIUS OR FORWARD TANGENT	SPIRAL LENGTHS IN	OUT	P.I. COORDINATES X	Y	ROUND BRNG OR HOLD
H	1	20+00.0000	POT	0	0	0.00	0.0000	0.0	0.0	600000.0000	400000.0000	0
H	2	30+00.0000		0	0	0.00	0.0000	0.0	0.0	600328.9170	400944.3588	
I	1	287+55.7800	POT	0	0	0.00	0.0000	0.0	0.0	599942.4600	400474.5928	0
I	2	293+98.0300		2	0	0.15	2864.7300	0.0	0.0	600548.9561	400263.2929	
I	3	299+27.5995		0	0	0.00	0.0000	0.0	0.0	600960.3947	399910.0886	

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 13

BRIDGE GEOMETRY SYSTEM (BGS) *** DESIGN DATA ***

DESIGN DATA LIST PROCESS OCT 9, 2015 7:34

IDENTIFICATION Example 2

SORTED DESIGN DATA

CARD TYPE RD10 P R O F I L E G R A D E

ROADWAY	P.I. NUMBER	VERTICAL P.I. STATION	P.I. ELEVATION	FIRST VERTICAL CURVE LENGTH	SECOND VERTICAL CURVE LENGTH	ELEVATION CORRECTION	EXTERNAL	GRADE
H	1	20+55.67	665.82	0.	0.	0.00		

```
  H   2      28+47.13     670.43         0.          0.        0.00                 0.005825
  I   1     288+55.78     642.82         0.          0.        0.00
  I   2     299+27.62     642.82         0.          0.        0.00                 0.000000

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE  14
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  DESIGN DATA ***
DESIGN DATA LIST PROCESS                                                    OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2
                                SORTED DESIGN DATA


CARD TYPE RD30                    T E M P L A T E

                              R
                              O                TEMPLATE
                              A
                              D     STATION     STORE/
                              W                 RECALL
                              A
                              Y                   NO.


                              H      21+10.00      1
                              H      21+32.50      1
                              H      21+77.50      2
                              H      28+47.13      2
                              I     288+55.78      3
                              I     299+27.62      3
                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                PAGE  15
                           BRIDGE GEOMETRY SYSTEM (BGS)                 ***  DESIGN DATA ***
DESIGN DATA LIST PROCESS                                                    OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2
                                SORTED DESIGN DATA


CARD TYPE RD30             T E M P L A T E   T A B L E

TEMP S SURF. PROF. CENTR LEFT  RIGHT                SEGMENT        SEGMENT        SEGMENT        SEGMENT
 NO  / DEPTH GRADE LINE  PIVOT PIVOT A  B  C  D  O              O              O              O
```

```
     F       POINT POINT POINT POINT             P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST  P SLOPE  DIST
                                                 T              T              T              T


  1  F  0.00   2     2     2     2                -0.0800 20.0   -0.0800 20.0
  2  F  0.00   2     2     2     2                 0.0800 20.0    0.0800 20.0
  3  F  0.00   4     4     4     4                 0.0300 28.9   -0.0423 70.0    0.0400 57.0    0.0400 57.0
                                                   0.0064 74.9   -0.0200 29.0

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                                  PAGE  16
                            BRIDGE GEOMETRY SYSTEM (BGS)               ***  GEOMETRICS  ***
     GENERAL GEOMETRY PROCESS                                                  OCT  9, 2015     7:34
     IDENTIFICATION                                                            Example 2
                                GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)    Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    ************************************************

    ****              BRIDGE COMMANDS

    ************************************************

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                                  PAGE  17
                            BRIDGE GEOMETRY SYSTEM (BGS)            ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
     IDENTIFICATION                                                            Example 2

                                BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    NAME     5    2 HS20 BRIG  H  0    2155.6700     2747.1300  EXAMPLE 2 BRIDGE                     STR   1

    APLT     1  10. 100.  I          28810.0000    29200.0000

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                                  PAGE  18
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                              BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
     ALIGNMENT PLOT PROCESS                                                   OCT  9, 2015     7:34
     IDENTIFICATION                                                           Example 2
```

* * * ALIGNMENT PLOT DATA FOR ROADWAY I * * *

ALIGNMENT ELEMENT NUMBER	ELEMENT TYPE	BEGINNING STATION OR STA. BACK	EAST (X) BEGINNING	NORTH (Y) BEGINNING	BEARING	RADIUS, SPIRAL LENGTH, STA. FORWARD
1	LINE	288+10.00	599993.6616	400456.7544	S 70 47 31.00 E	
2	ARC	288+55.78	600036.8946	400441.6923	S 70 47 31.00 E	2864.73
3	END STA	292+00.00	600354.3732	400309.2115	S 63 54 26.77 E	

* * * TABLE OF CENTERS FOR ALIGNMENT ELEMENTS AND OFFSETS * * *

ALIGNMENT ELEMENT NUMBER	OFFSET LINE NUMBER	PARALLEL TO ALIGNMENT ELEMENT NO.	EAST (X)	NORTH (Y)
2			599094.4001	397736.4415

* * * CURVE FIT DATA FOR ALL ALIGNMENT ELEMENTS AND OFFSETS * * *

POINT	STATION	EAST (X)	NORTH (Y)	--------- S O U R C E --------- ALIGNMENT ELEMENT	OFFSET LINE	INTERIOR POINT
1	288+10.00	599993.6616	400456.7544	1		
2	288+55.78	600036.8946	400441.6923	2		
3	290+27.89	600197.6243	400380.2218	2		*

```
   4     292+00.00           600354.3732        400309.2115             3

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                              PAGE  19
                            BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
    ALIGNMENT PLOT PROCESS                                                 OCT  9, 2015     7:34
    IDENTIFICATION                                                         Example 2

                      * * * ALIGNMENT PLOT DATA FOR ROADWAY I * * *

        THE PLOT SCALE IS   1.0 FEET PER FOOT.

        TICK MARKS WILL BE DRAWN EVERY  10 FEET ALONG THE CENTERLINE.

        STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

        NOW FITTING A LINE TO POINTS   1 THROUGH   4.                                                           ORIEN

        THIS PLOT WILL COVER A DISTANCE OF    389.72 FEET.


        THE BEARING OF THE CURVE-FIT LINE IS S 67  47  53.44 E

        THIS SEGMENT WILL START AT ALIGNMENT ELEMENT  1 AND CONTINUE UP TO ELEMENT  3.

        REFERENCE COORDINATES ARE    601883.7970 X,    405087.9690 Y.

        ORIGIN COORDINATES ARE    598105.0948 X,    395829.3833 Y.

        NOW PLOTTING ELEMENTS  1 TO  3.

   APLT     2  10. 100.  H            2200.0000     2700.0000

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                              PAGE  20
                            BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
    ALIGNMENT PLOT PROCESS                                                 OCT  9, 2015     7:34
    IDENTIFICATION                                                         Example 2

                      * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

ALIGNMENT  ELEMENT    BEGINNING        EAST (X)      NORTH (Y)         BEARING          RADIUS,
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```
ELEMENT    TYPE       STATION        BEGINNING      BEGINNING                      SPIRAL LENGTH,
NUMBER              OR STA. BACK                                                    STA. FORWARD

  1      LINE        22+00.00      600065.7834    400188.8718    N 19 12 11.00 E
  2      END STA     27+00.00      600230.2419    400661.0512    N 19 12 11.00 E

                            TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                  PAGE  21
                               BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
    ALIGNMENT PLOT PROCESS                                                    OCT  9, 2015     7:34
    IDENTIFICATION                                                            Example 2

                       * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

        THE PLOT SCALE IS   1.0 FEET PER FOOT.

        TICK MARKS WILL BE DRAWN EVERY  10 FEET ALONG THE CENTERLINE.

        STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

        NOW PLOTTING ELEMENTS   1 TO   2.

                            TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                  PAGE  22
                               BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
    GENERAL GEOMETRY PROCESS                                                  OCT  9, 2015     7:34
    IDENTIFICATION                                                            Example 2

   CONT     0    0    0       I      28910.0000    29000.0000     10.0000                1.0000

   CONT     0    0    0       H       2250.0000     2650.0000     10.0000                1.0000

   NPEN     4   (RED)

   BENT     0    0    0    1    AB        0.0000     2255.6700      0.0000          L  0  0  0.00 F
                                   600084.0942   400241.4442      0.0000  666.985 N 70 47 49.00 W

   BENT     0    0    0    2    IN        0.0000     2317.1300      0.0000          L  0  0  0.00 F
                                   600104.3095   400299.4845      0.0000  667.343 N 70 47 49.00 W

   BENT     0    0    0    3    IN        0.0000     2427.1300      0.0000          L  0  0  0.00 F
                                   600140.4903   400403.3640      0.0000  667.984 N 70 47 49.00 W
```

```
    BENT     0    0    0    4    IN       0.0000     2537.1300      0.0000         L  0  0  0.00 F
                                     600176.6712   400507.2435      0.0000  668.624 N 70 47 49.00 W

    BENT     0    0    0    5    AB       0.0000     2647.1300      0.0000         L  0  0  0.00 F
                                     600212.8521   400611.1229      0.0000  669.265 N 70 47 49.00 W

    PSLB    10    0    0    0     0       0.0000        0.0000    -10.2500            0  0  0.00

    PSLB    20    0    0    0     0       0.0000        0.0000     10.2500            0  0  0.00

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE  23
                            BRIDGE GEOMETRY SYSTEM (BGS)               ***  GEOMETRICS  ***
     GENERAL GEOMETRY PROCESS                                              OCT  9, 2015     7:34
     IDENTIFICATION                                                        Example 2
                                GENERAL GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X (EAST)    Y (NORTH)  RADIUS,OFFSET  ELEV   BEAR,AZ,SKEW     STORE
NO                                OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    ************************************************

    ****PSLB 10 = LEFT EDGE OF SLAB

    ****PSLB 20 = RIGHT EDGE OF SLAB

    ************************************************

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE  24
                            BRIDGE GEOMETRY SYSTEM (BGS)            ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                      OCT  9, 2015     7:34
     IDENTIFICATION                                                        Example 2

    SLAB     1    2   10   20  0  0     24.0000        0.0000                        B B

                                           SLAB REPORT

                                             SPAN  1

                         SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
```

```
                        NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                             BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB 10)   1      61.4600  N 19 12 11.00 E    61.4600      0.0000    61.4600

 RIGHT EDGE   (PSLB 20)   1      61.4600  N 19 12 11.00 E    61.4600      0.0000    61.4600


                        SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                        NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

 BACK EDGE    (BENT  1)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 FORWARD EDGE (BENT  2)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 SLAB DEPTH = 24.00 IN., OVERHANG DEPTH = 24.00 IN.
 SLAB AREA =   1259.9300 SQ. FT. =   139.9922 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                          PAGE  25
                           BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
 EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
 IDENTIFICATION                                                            Example 2

SLAB     2    3   10   20  0  0      24.0000       0.0000                       B B

                                             SLAB REPORT

                                               SPAN  2

                        SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                        NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                             BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB 10)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000

 RIGHT EDGE   (PSLB 20)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000


                        SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                        NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE
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```
 BACK EDGE    (BENT  2)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 FORWARD EDGE (BENT  3)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 SLAB DEPTH = 24.00 IN., OVERHANG DEPTH = 24.00 IN.
 SLAB AREA =   2255.0000 SQ. FT. =   250.5556 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                 PAGE  26
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
 EXAMPLE 2 BRIDGE                                                           OCT  9, 2015     7:34
 IDENTIFICATION                                                             Example 2

SLAB     3    4   10   20  0  0      24.0000        0.0000                       B B

                                             SLAB REPORT

                                               SPAN  3

                        SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                        NO.     LENGTH       OR CHORD        LENGTH                SEGMENT    TO RADIAL
                                             BEARING                               LENGTHS    INTERSECT

 LEFT EDGE    (PSLB 10)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000

 RIGHT EDGE   (PSLB 20)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000


                        SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                        NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

 BACK EDGE    (BENT  3)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 FORWARD EDGE (BENT  4)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 SLAB DEPTH = 24.00 IN., OVERHANG DEPTH = 24.00 IN.
 SLAB AREA =   2255.0000 SQ. FT. =   250.5556 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                 PAGE  27
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
 EXAMPLE 2 BRIDGE                                                           OCT  9, 2015     7:34
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 IDENTIFICATION                                                            Example 2

SLAB     4    5   10   20  0  0      24.0000        0.0000                        B B

                                              SLAB REPORT

                                                SPAN  4

                        SEG.    SEGMENT      SEGMENT         CHORD     RADIUS    ACCUMULATED  DISTANCE
                        NO.     LENGTH       OR CHORD        LENGTH               SEGMENT    TO RADIAL
                                             BEARING                              LENGTHS    INTERSECT

 LEFT EDGE    (PSLB 10)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000

 RIGHT EDGE   (PSLB 20)   1     110.0000  N 19 12 11.00 E   110.0000      0.0000   110.0000

                        SEG.    SEGMENT      SEGMENT         SKEW     DISTANCE TO     RADIAL
                        NO.     LENGTH       BEARING         ANGLE    STATION LINE   DISTANCE

 BACK EDGE    (BENT  4)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 FORWARD EDGE (BENT  5)   1      20.5000  N 70 47 49.00 W   0  0  0.00    10.2500

 SLAB DEPTH = 24.00 IN., OVERHANG DEPTH = 24.00 IN.
 SLAB AREA =   2255.0000 SQ. FT. =   250.5556 SQ. YDS.

                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                          PAGE  28
                           BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
 EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
 IDENTIFICATION                                                            Example 2

                                  BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    BRNG     0    0    0    1  4 FD       8.5000        2.0000      5.3750                 0.0000

    BRNG     0    0    0    2  1 BK       8.5000        2.0000      5.3750                 0.0000
```

```
    BRNG     0    0    0    2  1 FD      8.5000       2.0000      5.3750                 0.0000

    BRNG     0    0    0    3  1 BK      8.5000       2.0000      5.3750                 0.0000

    BRNG     0    0    0    3  1 FD      8.5000       2.0000      5.3750                 0.0000

    BRNG     0    0    0    4  1 BK      8.5000       2.0000      5.3750                 0.0000

    BRNG     0    0    0    4  1 FD      8.5000       2.0000      5.3750                 0.0000

    BRNG     0    0    0    5  4 BK      8.5000       2.0000      5.3750                 0.0000

    BEAM     0    0    0    0     1      0.0000       0.0000    -10.2500             0  0  0.00

    BEAM     0    0    0    0     2      0.0000       0.0000     10.2500             0  0  0.00

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                    PAGE  29
                            BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
     IDENTIFICATION                                                         Example 2

                               BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                OR CORRECTION  OR STATION  DISTANCE,ETC.            D   M   S

    FOPT     1    5    1    2  5  6      0.0000       0.0000                                        1
                               H      2255.6700    2647.1300      391.4600

                         TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                    PAGE  30
                            BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
     IDENTIFICATION                                                         Example 2

                                                 BENT REPORT

                                        BENT NO.  1  (N 70 47 49.00 W)

     DISTANCE BETWEEN STATION LINE AND BEAM 1,       10.2500 L
```

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	DIST CL BENT TO CL BRNG ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	DIST CL BENT TO END OF BM ALONG CL BEAM
SPAN 1	BEAM 1	0.0000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000					

TEXAS DEPARTMENT OF TRANSPORTATION   PC TEXAS V 9.1

PAGE 31

BRIDGE GEOMETRY SYSTEM (BGS)   *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE   OCT 9, 2015   7:34

IDENTIFICATION   Example 2

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 1

		COORDINATES, BENT 1 X	COORDINATES, BENT 1 Y	SURFACE ELEVATION	COORDINATES, BENT 2 X	COORDINATES, BENT 2 Y	SURFACE ELEVATION
BEAM 1	(BENT)	600074.4145	400244.8156	666.1649	600094.6298	400302.8559	666.5229
	(BRG.)	600074.6475	400245.4845	666.1691	600094.3968	400302.1870	666.5188
BEAM 2	(BENT)	600078.2864	400243.4671	666.4929	600098.5016	400301.5074	666.8510
	(BRG.)	600078.5194	400244.1360	666.4971	600098.2687	400300.8384	666.8468
BEAM 3	(BENT)	600082.1583	400242.1185	666.8209	600102.3735	400300.1588	667.1789
	(BRG.)	600082.3913	400242.7874	666.8251	600102.1405	400299.4899	667.1748
BEAM 4	(BENT)	600086.0301	400240.7699	667.1489	600106.2454	400298.8102	667.5069
	(BRG.)	600086.2631	400241.4389	667.1531	600106.0124	400298.1413	667.5028
BEAM 5	(BENT)	600089.9020	400239.4214	667.4769	600110.1173	400297.4617	667.8349
	(BRG.)	600090.1350	400240.0903	667.4811	600109.8843	400296.7928	667.8308
BEAM 6	(BENT)	600093.7739	400238.0728	667.8049	600113.9891	400296.1131	668.1629
	(BRG.)	600094.0069	400238.7417	667.8091	600113.7561	400295.4442	668.1588

BEAM REPORT, SPAN 1

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E
BEAM 2	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E
BEAM 3	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E
BEAM 4	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E
BEAM 5	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E
BEAM 6	61.4600	60.0433	61.1277	0.00582	N 19 12 11.00 E

BEARING SEAT ELEVATIONS FOR BENT 1

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	22+56.3783	-10.2500	600074.6475	400245.4845	0.0000	5.3750	666.1691	660.7941
2	22+56.3783	-6.1500	600078.5194	400244.1360	0.0000	5.3750	666.4971	661.1221
3	22+56.3783	-2.0500	600082.3913	400242.7874	0.0000	5.3750	666.8251	661.4501
4	22+56.3783	2.0500	600086.2631	400241.4389	0.0000	5.3750	667.1531	661.7781
5	22+56.3783	6.1500	600090.1350	400240.0903	0.0000	5.3750	667.4811	662.1061
6	22+56.3783	10.2500	600094.0069	400238.7417	0.0000	5.3750	667.8091	662.4341

BEARING SEAT ELEVATIONS FOR BENT 2

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	23+16.4217	-10.2500	600094.3968	400302.1870	0.0000	5.7330	666.8768	661.1438

2	23+16.4217	-6.1500	600098.2687	400300.8384	0.0000	5.7330	667.2048	661.4718
3	23+16.4217	-2.0500	600102.1405	400299.4899	0.0000	5.7329	667.5327	661.7998
4	23+16.4217	2.0500	600106.0124	400298.1413	0.0000	5.7329	667.8607	662.1278
5	23+16.4217	6.1500	600109.8843	400296.7928	0.0000	5.7329	668.1887	662.4558
6	23+16.4217	10.2500	600113.7561	400295.4442	0.0000	5.7329	668.5167	662.7838

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                    TEXAS DEPARTMENT OF TRANSPORTATION             PC TEXAS V 9.1
                                                                                      PAGE  33
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
IDENTIFICATION                                                         Example 2
```

BENT REPORT

BENT NO. 2 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1,   10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D	M	S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 1	BEAM 1	0.0000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000							

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                    TEXAS DEPARTMENT OF TRANSPORTATION             PC TEXAS V 9.1
                                                                                      PAGE  34
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
IDENTIFICATION                                                         Example 2
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BENT REPORT

BENT NO. 2 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 2	BEAM 1	0.0000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 35
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
EXAMPLE 2 BRIDGE OCT 9, 2015 7:34
IDENTIFICATION Example 2

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 2

		COORDINATES, BENT 2 X	Y	SURFACE ELEVATION	COORDINATES, BENT 3 X	Y	SURFACE ELEVATION
BEAM 1	(BENT)	600094.6298	400302.8559	666.5229	600130.8106	400406.7354	667.1636
	(BRG.)	600094.8628	400303.5248	666.5270	600130.5777	400406.0665	667.1595
BEAM 2	(BENT)	600098.5016	400301.5074	666.8510	600134.6825	400405.3868	667.4916
	(BRG.)	600098.7346	400302.1763	666.8550	600134.4495	400404.7179	667.4875
BEAM 3	(BENT)	600102.3735	400300.1588	667.1789	600138.5544	400404.0383	667.8196
	(BRG.)	600102.6065	400300.8277	667.1830	600138.3214	400403.3693	667.8155
BEAM 4	(BENT)	600106.2454	400298.8102	667.5069	600142.4263	400402.6897	668.1476
	(BRG.)	600106.4784	400299.4792	667.5110	600142.1933	400402.0208	668.1435
BEAM 5	(BENT)	600110.1173	400297.4617	667.8349	600146.2981	400401.3411	668.4756
	(BRG.)	600110.3502	400298.1306	667.8391	600146.0651	400400.6722	668.4715

BEAM 6 (BENT)	600113.9891	400296.1131	668.1629	600150.1700	400399.9926	668.8036
(BRG.)	600114.2221	400296.7820	668.1671	600149.9370	400399.3237	668.7995

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 36

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE OCT 9, 2015 7:34

IDENTIFICATION Example 2

BEAM REPORT, SPAN 2

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 2	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 3	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 4	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 5	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 6	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E

BEARING SEAT ELEVATIONS FOR BENT 2

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	23+17.8383	-10.2500	600094.8628	400303.5248	0.0000	5.3751	666.5271	661.1520
2	23+17.8383	-6.1500	600098.7346	400302.1763	0.0000	5.3751	666.8551	661.4800
3	23+17.8383	-2.0500	600102.6065	400300.8277	0.0000	5.3750	667.1830	661.8080
4	23+17.8383	2.0500	600106.4784	400299.4792	0.0000	5.3750	667.5110	662.1360
5	23+17.8383	6.1500	600110.3502	400298.1306	0.0000	5.3750	667.8391	662.4641
6	23+17.8383	10.2500	600114.2221	400296.7820	0.0000	5.3750	668.1671	662.7921

BEARING SEAT ELEVATIONS FOR BENT 3

BEAM	NEAREST BRIDGE ROADWAY	OFFSET FROM BRIDGE	BEAM/BENT INTERSECTION COORDINATES	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV

	STATION	ROADWAY	X	Y				
1	24+26.4217	-10.2500	600130.5777	400406.0665	0.0000	6.0157	667.8002	661.7845
2	24+26.4217	-6.1500	600134.4495	400404.7179	0.0000	6.0157	668.1282	662.1125
3	24+26.4217	-2.0500	600138.3214	400403.3693	0.0000	6.0157	668.4562	662.4405
4	24+26.4217	2.0500	600142.1933	400402.0208	0.0000	6.0157	668.7842	662.7685
5	24+26.4217	6.1500	600146.0651	400400.6722	0.0000	6.0157	669.1122	663.0965
6	24+26.4217	10.2500	600149.9370	400399.3237	0.0000	6.0157	669.4402	663.4245

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 37
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
EXAMPLE 2 BRIDGE OCT 9, 2015 7:34
IDENTIFICATION Example 2

BENT REPORT

BENT NO. 3 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D	M	S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 2	BEAM 1	0.0000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000							

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 38
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
EXAMPLE 2 BRIDGE OCT 9, 2015 7:34
IDENTIFICATION Example 2

BENT REPORT

BENT NO. 3 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	DIST CL BENT TO CL BRNG ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	DIST CL BENT TO END OF BM ALONG CL BEAM
SPAN 3	BEAM 1	0.0000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000					

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 39

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE OCT 9, 2015 7:34

IDENTIFICATION Example 2

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN 3

		COORDINATES, BENT 3 X	COORDINATES, BENT 3 Y	SURFACE ELEVATION	COORDINATES, BENT 4 X	COORDINATES, BENT 4 Y	SURFACE ELEVATION
BEAM 1	(BENT)	600130.8106	400406.7354	667.1636	600166.9915	400510.6149	667.8043
	(BRG.)	600131.0436	400407.4043	667.1678	600166.7585	400509.9459	667.8002
BEAM 2	(BENT)	600134.6825	400405.3868	667.4916	600170.8634	400509.2663	668.1323
	(BRG.)	600134.9155	400406.0557	667.4958	600170.6304	400508.5974	668.1282
BEAM 3	(BENT)	600138.5544	400404.0383	667.8196	600174.7353	400507.9177	668.4603
	(BRG.)	600138.7874	400404.7072	667.8238	600174.5023	400507.2488	668.4562
BEAM 4	(BENT)	600142.4263	400402.6897	668.1476	600178.6071	400506.5692	668.7883
	(BRG.)	600142.6592	400403.3586	668.1518	600178.3741	400505.9003	668.7842

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BEAM  5 (BENT)     600146.2981     400401.3411     668.4756     600182.4790     400505.2206     669.1163
        (BRG.)     600146.5311     400402.0101     668.4798     600182.2460     400504.5517     669.1122

BEAM  6 (BENT)     600150.1700     400399.9926     668.8036     600186.3509     400503.8721     669.4443
        (BRG.)     600150.4030     400400.6615     668.8078     600186.1179     400503.2031     669.4402
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                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                         PAGE  40
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                        OCT  9, 2015     7:34
IDENTIFICATION                                                          Example 2
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BEAM REPORT, SPAN 3

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 2	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 3	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 4	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 5	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 6	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E

BEARING SEAT ELEVATIONS FOR BENT 3

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	24+27.8383	-10.2500	600131.0436	400407.4043	0.0000	5.3750	667.1678	661.7928
2	24+27.8383	-6.1500	600134.9155	400406.0557	0.0000	5.3750	667.4958	662.1208
3	24+27.8383	-2.0500	600138.7874	400404.7072	0.0000	5.3750	667.8238	662.4488
4	24+27.8383	2.0500	600142.6592	400403.3586	0.0000	5.3750	668.1518	662.7768
5	24+27.8383	6.1500	600146.5311	400402.0101	0.0000	5.3750	668.4798	663.1048
6	24+27.8383	10.2500	600150.4030	400400.6615	0.0000	5.3750	668.8078	663.4328

BEARING SEAT ELEVATIONS FOR BENT 4

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	25+36.4217	-10.2500	600166.7585	400509.9459	0.0000	6.0156	668.4409	662.4252
2	25+36.4217	-6.1500	600170.6304	400508.5974	0.0000	6.0156	668.7689	662.7532
3	25+36.4217	-2.0500	600174.5023	400507.2488	0.0000	6.0156	669.0969	663.0812
4	25+36.4217	2.0500	600178.3741	400505.9003	0.0000	6.0156	669.4249	663.4092
5	25+36.4217	6.1500	600182.2460	400504.5517	0.0000	6.0157	669.7529	663.7372
6	25+36.4217	10.2500	600186.1179	400503.2031	0.0000	6.0157	670.0809	664.0652

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 41

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE OCT 9, 2015 7:34

IDENTIFICATION Example 2

BENT REPORT

BENT NO. 4 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D	M	S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 3	BEAM 1	0.0000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000							

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 42

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE   OCT 9, 2015   7:34
IDENTIFICATION   Example 2

BENT REPORT

BENT NO. 4 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1,   10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D M S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 4	BEAM 1	0.0000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90 0 0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000					

TEXAS DEPARTMENT OF TRANSPORTATION   PC TEXAS V 9.1
PAGE 43
BRIDGE GEOMETRY SYSTEM (BGS)   *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE   OCT 9, 2015   7:34
IDENTIFICATION   Example 2

COORDINATES AT CENTERLINE OF BENTS AND BEARINGS, SPAN   4

		COORDINATES, BENT 4 X	Y	SURFACE ELEVATION	COORDINATES, BENT 5 X	Y	SURFACE ELEVATION
BEAM 1	(BENT)	600166.9915	400510.6149	667.8043	600203.1724	400614.4943	668.4451
	(BRG.)	600167.2245	400511.2838	667.8085	600202.9394	400613.8254	668.4409
BEAM 2	(BENT)	600170.8634	400509.2663	668.1323	600207.0443	400613.1458	668.7731
	(BRG.)	600171.0964	400509.9352	668.1365	600206.8113	400612.4768	668.7689
BEAM 3	(BENT)	600174.7353	400507.9177	668.4603	600210.9161	400611.7972	669.1011
	(BRG.)	600174.9682	400508.5867	668.4645	600210.6831	400611.1283	669.0969

BEAM 4	(BENT)	600178.6071	400506.5692	668.7883	600214.7880	400610.4487	669.4291
	(BRG.)	600178.8401	400507.2381	668.7925	600214.5550	400609.7797	669.4249
BEAM 5	(BENT)	600182.4790	400505.2206	669.1163	600218.6599	400609.1001	669.7571
	(BRG.)	600182.7120	400505.8895	669.1205	600218.4269	400608.4312	669.7529
BEAM 6	(BENT)	600186.3509	400503.8721	669.4443	600222.5317	400607.7515	670.0851
	(BRG.)	600186.5839	400504.5410	669.4485	600222.2988	400607.0826	670.0809

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1
PAGE 44
BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***
EXAMPLE 2 BRIDGE OCT 9, 2015 7:34
IDENTIFICATION Example 2

BEAM REPORT, SPAN 4

	HORIZONTAL DISTANCE C-C BENT	C-C BRG.	TRUE DISTANCE BOT. BM. FLG.	BEAM SLOPE	BEAM BEARING
BEAM 1	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 2	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 3	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 4	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 5	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E
BEAM 6	110.0000	108.5833	109.6685	0.00582	N 19 12 11.00 E

BEARING SEAT ELEVATIONS FOR BENT 4

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	25+37.8383	-10.2500	600167.2245	400511.2838	0.0000	5.3750	667.8085	662.4335
2	25+37.8383	-6.1500	600171.0964	400509.9352	0.0000	5.3750	668.1365	662.7615
3	25+37.8383	-2.0500	600174.9682	400508.5867	0.0000	5.3750	668.4645	663.0895
4	25+37.8383	2.0500	600178.8401	400507.2381	0.0000	5.3750	668.7925	663.4175
5	25+37.8383	6.1500	600182.7120	400505.8895	0.0000	5.3750	669.1205	663.7455
6	25+37.8383	10.2500	600186.5839	400504.5410	0.0000	5.3750	669.4485	664.0735

BEARING SEAT ELEVATIONS FOR BENT 5

BEAM	NEAREST BRIDGE ROADWAY STATION	OFFSET FROM BRIDGE ROADWAY	BEAM/BENT INTERSECTION COORDINATES X	Y	DEPTH TO REF LINE	DEPTH BELOW REF LINE	REFERENCE ELEVATION	BEARING SEAT ELEV
1	26+46.4217	-10.2500	600202.9394	400613.8254	0.0000	6.0157	669.0817	663.0659
2	26+46.4217	-6.1500	600206.8113	400612.4768	0.0000	6.0157	669.4097	663.3939
3	26+46.4217	-2.0500	600210.6831	400611.1283	0.0000	6.0157	669.7377	663.7219
4	26+46.4217	2.0500	600214.5550	400609.7797	0.0000	6.0157	670.0657	664.0499
5	26+46.4217	6.1500	600218.4269	400608.4312	0.0000	6.0157	670.3937	664.3779
6	26+46.4217	10.2500	600222.2988	400607.0826	0.0000	6.0157	670.7217	664.7059

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 45

BRIDGE GEOMETRY SYSTEM (BGS) *** BRIDGE GEOMETRICS ***

EXAMPLE 2 BRIDGE OCT 9, 2015 7:34

IDENTIFICATION Example 2

BENT REPORT

BENT NO. 5 (N 70 47 49.00 W)

DISTANCE BETWEEN STATION LINE AND BEAM 1, 10.2500 L

		BEAM SPAC. (CL BENT)	BEAM ANGLE D	M	S	DIST CL BENT TO CL BRNG PERP TO CL BENT	ALONG CL BEAM	DIST CL BENT TO END OF BM PERP TO CL BENT	ALONG CL BEAM
SPAN 4	BEAM 1	0.0000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 2	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 3	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 4	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 5	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	BEAM 6	4.1000	90	0	0.00	0.7083	0.7083	0.1667	0.1667
	TOTAL	20.5000							

TEXAS DEPARTMENT OF TRANSPORTATION PC TEXAS V 9.1

PAGE 46

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                              BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
     IDENTIFICATION                                                            Example 2

                                  BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  1


                           TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                PAGE  47
                              BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
     IDENTIFICATION                                                            Example 2

               VERTICAL CLEARANCE BETWEEN SPAN  1 OF ROADWAY H WITH ROADWAY H

                   0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.38   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.37   -5.38   -5.37

     BEAM  2      -5.38   -5.37   -5.38   -5.37   -5.38   -5.38   -5.37   -5.38   -5.37   -5.38   -5.37

     BEAM  3      -5.38   -5.37   -5.38   -5.37   -5.38   -5.38   -5.37   -5.38   -5.37   -5.38   -5.37

     BEAM  4      -5.38   -5.37   -5.38   -5.37   -5.38   -5.37   -5.37   -5.38   -5.37   -5.38   -5.37

     BEAM  5      -5.38   -5.37   -5.38   -5.37   -5.38   -5.37   -5.37   -5.38   -5.37   -5.38   -5.37

     BEAM  6      -5.38   -5.37   -5.38   -5.37   -5.38   -5.37   -5.37   -5.38   -5.37   -5.38   -5.37


                           TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                PAGE  48
                              BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                          OCT  9, 2015     7:34
     IDENTIFICATION                                                            Example 2
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                                 BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  2


                             TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                    PAGE  49
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
     IDENTIFICATION                                                              Example 2

               VERTICAL CLEARANCE BETWEEN SPAN  2 OF ROADWAY H WITH ROADWAY H

                   0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.38   -5.38   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38

     BEAM  2      -5.38   -5.38   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  3      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  4      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  5      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  6      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38


                             TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                    PAGE  50
                                BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
     IDENTIFICATION                                                              Example 2

                                 BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S
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    VCLR      0     0     0   10  H  3

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                  PAGE  51
                            BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                        OCT  9, 2015     7:34
     IDENTIFICATION                                                          Example 2

               VERTICAL CLEARANCE BETWEEN SPAN  3 OF ROADWAY H WITH ROADWAY H

                   0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.37   -5.37   -5.37

     BEAM  2      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.37   -5.37   -5.37

     BEAM  3      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.37   -5.37   -5.37

     BEAM  4      -5.37   -5.37   -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.37   -5.37   -5.37

     BEAM  5      -5.37   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38

     BEAM  6      -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38


                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                  PAGE  52
                            BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                        OCT  9, 2015     7:34
     IDENTIFICATION                                                          Example 2

                                BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.          D   M   S

    VCLR      0     0     0   10  H  4
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                    TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                          PAGE  53
                       BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
IDENTIFICATION                                                         Example 2

          VERTICAL CLEARANCE BETWEEN SPAN  4 OF ROADWAY H WITH ROADWAY H

              0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


BEAM  1      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

BEAM  2      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

BEAM  3      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

BEAM  4      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38

BEAM  5      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38

BEAM  6      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38


                    TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                          PAGE  54
                       BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
IDENTIFICATION                                                         Example 2

                                    BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  I  1


                    TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                          PAGE  55
                       BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
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IDENTIFICATION                                                                          Example 2

          VERTICAL CLEARANCE BETWEEN SPAN  1 OF ROADWAY H WITH ROADWAY I

              0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


BEAM  1      15.79   15.83   15.83   15.74   15.66   15.57   15.49   15.48   15.55   15.62   15.70

BEAM  2      16.12   16.16   16.15   16.07   15.98   15.90   15.81   15.81   15.88   15.95   16.03

BEAM  3      16.45   16.49   16.48   16.39   16.31   16.22   16.14   16.14   16.21   16.28   16.36

BEAM  4      16.78   16.81   16.80   16.72   16.63   16.55   16.46   16.47   16.54   16.61   16.69

BEAM  5      17.11   17.14   17.13   17.04   16.96   16.87   16.79   16.79   16.87   16.94   17.01

BEAM  6      17.43   17.47   17.45   17.36   17.28   17.19   17.11   17.12   17.20   17.27   17.34

                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                           PAGE  56
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2

                               BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

   VCLR     0    0    0   10  I  2


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                           PAGE  57
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2

          VERTICAL CLEARANCE BETWEEN SPAN  2 OF ROADWAY H WITH ROADWAY I
```

	0.00 L	0.10 L	0.20 L	0.30 L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	15.72	15.85	15.98	16.11	16.25	16.44	16.93	17.43	17.93	18.42	18.92
BEAM 2	16.04	16.18	16.31	16.44	16.58	16.77	17.27	17.76	18.26	18.76	19.26
BEAM 3	16.37	16.51	16.64	16.77	16.90	17.10	17.60	18.10	18.60	19.09	19.59
BEAM 4	16.70	16.84	16.97	17.10	17.23	17.44	17.94	18.43	18.93	19.43	19.92
BEAM 5	17.03	17.16	17.30	17.43	17.56	17.77	18.27	18.77	19.26	19.76	20.26
BEAM 6	17.36	17.49	17.63	17.76	17.89	18.11	18.60	19.10	19.60	20.10	20.59

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                    TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                   PAGE  58
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                        OCT  9, 2015     7:34
IDENTIFICATION                                                          Example 2

                              BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  I  3


                    TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                   PAGE  59
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                        OCT  9, 2015     7:34
IDENTIFICATION                                                          Example 2

          VERTICAL CLEARANCE BETWEEN SPAN  3 OF ROADWAY H WITH ROADWAY I
```

	0.00 L	0.10 L	0.20 L	0.30 L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	18.99	19.48	19.98	20.48	20.98	21.47	21.27	20.88	20.48	20.09	19.69

```
     BEAM  2      19.32   19.82   20.32   20.81   21.31   21.81   21.60   21.20   20.80   20.41   20.01

     BEAM  3      19.65   20.15   20.65   21.15   21.64   22.14   21.92   21.52   21.13   20.73   20.34

     BEAM  4      19.99   20.49   20.98   21.48   21.98   22.48   22.24   21.84   21.45   21.05   20.66

     BEAM  5      20.32   20.82   21.32   21.82   22.31   22.81   22.56   22.16   21.77   21.37   20.98

     BEAM  6      20.66   21.16   21.65   22.15   22.65   23.14   22.88   22.49   22.09   21.69   21.30


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                              PAGE  60
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
     IDENTIFICATION                                                         Example 2

                               BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  I  4


                        TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                              PAGE  61
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                       OCT  9, 2015     7:34
     IDENTIFICATION                                                         Example 2

              VERTICAL CLEARANCE BETWEEN SPAN  4 OF ROADWAY H WITH ROADWAY I

                  0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      19.64   19.24   19.21   19.60   19.99   20.12   20.18   20.24   20.31   20.37   20.43

     BEAM  2      19.96   19.57   19.54   19.93   20.32   20.44   20.51   20.57   20.63   20.70   20.76

     BEAM  3      20.28   19.89   19.87   20.26   20.65   20.77   20.83   20.90   20.96   21.02   21.09
```

BEAM 4	20.60	20.21	20.21	20.59	20.98	21.10	21.16	21.23	21.29	21.35	21.42
BEAM 5	20.93	20.53	20.54	20.93	21.32	21.43	21.49	21.55	21.62	21.68	21.74
BEAM 6	21.25	20.85	20.87	21.26	21.65	21.76	21.82	21.88	21.95	22.01	22.07

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                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                      PAGE  62
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2

                              BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                   OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

   VCLR     0    0    0   10  H  2


                        TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                      PAGE  63
                           BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
EXAMPLE 2 BRIDGE                                                            OCT  9, 2015     7:34
IDENTIFICATION                                                              Example 2

               VERTICAL CLEARANCE BETWEEN SPAN  2 OF ROADWAY H WITH ROADWAY H
```

	0.00 L	0.10 L	0.20 L	0.30 L	0.40 L	0.50 L	0.60 L	0.70 L	0.80 L	0.90 L	1.00 L
BEAM 1	-5.38	-5.38	-5.37	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38	-5.38
BEAM 2	-5.38	-5.38	-5.37	-5.38	-5.38	-5.38	-5.38	-5.38	-5.37	-5.38	-5.38
BEAM 3	-5.38	-5.38	-5.37	-5.37	-5.38	-5.38	-5.38	-5.38	-5.37	-5.38	-5.38
BEAM 4	-5.38	-5.38	-5.37	-5.37	-5.38	-5.38	-5.38	-5.38	-5.37	-5.38	-5.38
BEAM 5	-5.38	-5.38	-5.37	-5.37	-5.38	-5.38	-5.38	-5.38	-5.37	-5.38	-5.38

```
    BEAM  6      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38


                            TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                               PAGE  64
                               BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
    EXAMPLE 2 BRIDGE                                                           OCT  9, 2015     7:34
    IDENTIFICATION                                                             Example 2

                                   BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                 OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

   VCLR     0    0    0   10  H  3


                            TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                               PAGE  65
                               BRIDGE GEOMETRY SYSTEM (BGS)             ***  BRIDGE GEOMETRICS  ***
    EXAMPLE 2 BRIDGE                                                           OCT  9, 2015     7:34
    IDENTIFICATION                                                             Example 2

              VERTICAL CLEARANCE BETWEEN SPAN  3 OF ROADWAY H WITH ROADWAY H

                  0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


    BEAM  1      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.37   -5.37   -5.37

    BEAM  2      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.37   -5.37   -5.37

    BEAM  3      -5.37   -5.38   -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.37   -5.37   -5.37

    BEAM  4      -5.37   -5.37   -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.37   -5.37   -5.37

    BEAM  5      -5.37   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38

    BEAM  6      -5.37   -5.37   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.38   -5.38
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                    TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE  66
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                   OCT  9, 2015     7:34
     IDENTIFICATION                                                     Example 2

                              BRIDGE GEOMETRY LIST

CD COMMAND  A    B    C    D   E  F    X(EAST)    Y(NORTH)    RADIUS,OFFSET  ELEV.   BEAR,AZ,SKEW     STORE
NO                                  OR CORRECTION  OR STATION  DISTANCE,ETC.           D   M   S

    VCLR     0    0    0   10  H  4


                    TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE  67
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                   OCT  9, 2015     7:34
     IDENTIFICATION                                                     Example 2

          VERTICAL CLEARANCE BETWEEN SPAN  4 OF ROADWAY H WITH ROADWAY H

              0.00 L  0.10 L  0.20 L  0.30 L  0.40 L  0.50 L  0.60 L  0.70 L  0.80 L  0.90 L  1.00 L


     BEAM  1      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  2      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  3      -5.38   -5.38   -5.37   -5.37   -5.38   -5.38   -5.38   -5.38   -5.37   -5.38   -5.38

     BEAM  4      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38

     BEAM  5      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38

     BEAM  6      -5.38   -5.38   -5.37   -5.37   -5.37   -5.38   -5.38   -5.38   -5.37   -5.37   -5.38


                    TEXAS DEPARTMENT OF TRANSPORTATION              PC TEXAS V 9.1
                                                                                       PAGE  68
                       BRIDGE GEOMETRY SYSTEM (BGS)              ***  BRIDGE GEOMETRICS  ***
     EXAMPLE 2 BRIDGE                                                   OCT  9, 2015     7:34
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IDENTIFICATION Example 2

BEARING SEAT ELEVATIONS

	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT 1 (FWD)	660.794	661.122	661.450	661.778	662.106	662.434

	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT 2 (BK)	661.144	661.472	661.800	662.128	662.456	662.784
(FWD)	661.152	661.480	661.808	662.136	662.464	662.792

	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT 3 (BK)	661.784	662.112	662.440	662.768	663.096	663.424
(FWD)	661.793	662.121	662.449	662.777	663.105	663.433

	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT 4 (BK)	662.425	662.753	663.081	663.409	663.737	664.065
(FWD)	662.433	662.761	663.089	663.417	663.745	664.073

	BEAM 1	BEAM 2	BEAM 3	BEAM 4	BEAM 5	BEAM 6
BENT 5 (BK)	663.066	663.394	663.722	664.050	664.378	664.706

EXAMPLE 2 LS3 OUTPUT FILE

```
                              TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                    PAGE  18
                                BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
     ALIGNMENT PLOT PROCESS                                                      OCT  9, 2015     7:34
     IDENTIFICATION                                                              Example 2

                           * * * ALIGNMENT PLOT DATA FOR ROADWAY I * * *

  ALIGNMENT  ELEMENT    BEGINNING        EAST (X)      NORTH (Y)         BEARING          RADIUS,
   ELEMENT    TYPE       STATION        BEGINNING      BEGINNING                       SPIRAL LENGTH,
   NUMBER               OR STA. BACK                                                    STA. FORWARD

     1      LINE        288+10.00      599993.6616    400456.7544    S 70 47 31.00 E
     2      ARC         288+55.78      600036.8946    400441.6923    S 70 47 31.00 E        2864.73
     3      END STA     292+00.00      600354.3732    400309.2115    S 63 54 26.77 E



                      * * * TABLE OF CENTERS FOR ALIGNMENT ELEMENTS AND OFFSETS * * *

       ALIGNMENT      OFFSET    PARALLEL TO     EAST (X)        NORTH (Y)
        ELEMENT        LINE      ALIGNMENT
        NUMBER        NUMBER    ELEMENT NO.


           2                                   599094.4001      397736.4415



                     * * * CURVE FIT DATA FOR ALL ALIGNMENT ELEMENTS AND OFFSETS * * *

   POINT       STATION             EAST (X)          NORTH (Y)       --------- S O U R C E ---------
                                                                      ALIGNMENT    OFFSET    INTERIOR
                                                                       ELEMENT      LINE       POINT


     1      288+10.00          599993.6616        400456.7544             1
```

```
   2     288+55.78          600036.8946       400441.6923             2

   3     290+27.89          600197.6243       400380.2218             2                      *

   4     292+00.00          600354.3732       400309.2115             3

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                 PAGE  19
                            BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
    ALIGNMENT PLOT PROCESS                                                   OCT  9, 2015     7:34
    IDENTIFICATION                                                           Example 2

                    * * * ALIGNMENT PLOT DATA FOR ROADWAY I * * *

        THE PLOT SCALE IS   1.0 FEET PER FOOT.

        TICK MARKS WILL BE DRAWN EVERY  10 FEET ALONG THE CENTERLINE.

        STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

        THIS PLOT WILL COVER A DISTANCE OF    389.72 FEET.


        THE BEARING OF THE CURVE-FIT LINE IS S 67  47  53.44 E

        REFERENCE COORDINATES ARE    601883.7970 X,    405087.9690 Y.

        ORIGIN COORDINATES ARE    598105.0948 X,    395829.3833 Y.

                         TEXAS DEPARTMENT OF TRANSPORTATION                PC TEXAS V 9.1
                                                                                                 PAGE  20
                            BRIDGE GEOMETRY SYSTEM (BGS)                 ***  GEOMETRICS  ***
    ALIGNMENT PLOT PROCESS                                                   OCT  9, 2015     7:34
    IDENTIFICATION                                                           Example 2

                    * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

 ALIGNMENT  ELEMENT    BEGINNING        EAST (X)      NORTH (Y)        BEARING          RADIUS,
  ELEMENT    TYPE       STATION         BEGINNING     BEGINNING                      SPIRAL LENGTH,
  NUMBER               OR STA. BACK                                                   STA. FORWARD
```

```
1      LINE         22+00.00      600065.7834    400188.8718    N 19 12 11.00 E
2      END STA      27+00.00      600230.2419    400661.0512    N 19 12 11.00 E

                   TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                      PAGE  21
                      BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
 ALIGNMENT PLOT PROCESS                                             OCT  9, 2015     7:34
 IDENTIFICATION                                                     Example 2

              * * * ALIGNMENT PLOT DATA FOR ROADWAY H * * *

    THE PLOT SCALE IS   1.0 FEET PER FOOT.

    TICK MARKS WILL BE DRAWN EVERY  10 FEET ALONG THE CENTERLINE.

    STATION VALUES WILL BE LABELED EVERY  100 FEET ALONG THE CENTERLINE.

                   TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                      PAGE  69
                      BRIDGE GEOMETRY SYSTEM (BGS)                *** GEOMETRICS ***
 PLOT SUMMARY                                                       OCT  9, 2015     7:34
 IDENTIFICATION                                                     Example 2

                         PLOTTER SUMMARY REPORT                                                   PLRPT


                          *** GRAPHICS PLOT ***


              PLOT     PLOT   ROAD-   LENGTH    WIDTH    ACTIVE PENS (*)                          PLRPT
            COMMAND    TYPE    WAY    (FEET)    (FEET)   1 2 3 4 5 6 7 8                          PLRPT
            -----------------------------------------------------------                          PLRPT
                 1     APLT     I        0.0       0.0   * - - - - - - -                          PLRPT
                 2     APLT     H        0.0       0.0   * - - - - - - -                          PLRPT
                 3     CONT     I        0.0       0.0   * - - - - - - -                          PLRPT
                 4     CONT     H        0.0       0.0   * - - - - - - -                          PLRPT
                 5     SLAB     H        0.0       0.0   - - - * - - - -                          PLRPT
                 6     SLAB     H        0.0       0.0   - - - * - - - -                          PLRPT
                 7     SLAB     H        0.0       0.0   - - - * - - - -                          PLRPT
                 8     SLAB     H        0.0       0.0   - - - * - - - -                          PLRPT
                 9     FOPT     H      411.0     502.0   - - - * - - - -                          PLRPT
```

EXAMPLE 2 LS4 OUTPUT FILE

```
Identification            Project: Example 2                             Date: OCT  9, 2015              BGS  PC TEXAS V 9.1


                       BENT REPORT

             BENT NO.  1  (N 70 47 49.00 W)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)       D  M   S
    SPAN  1  BEAM  1     0.000       90  0   0
             BEAM  2     4.100       90  0   0
             BEAM  3     4.100       90  0   0
             BEAM  4     4.100       90  0   0
             BEAM  5     4.100       90  0   0
             BEAM  6     4.100       90  0   0
              TOTAL     20.500

             BENT NO.  2  (N 70 47 49.00 W)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)       D  M   S
    SPAN  1  BEAM  1     0.000       90  0   0
             BEAM  2     4.100       90  0   0
             BEAM  3     4.100       90  0   0
             BEAM  4     4.100       90  0   0
             BEAM  5     4.100       90  0   0
             BEAM  6     4.100       90  0   0
              TOTAL     20.500

             BENT NO.  2  (N 70 47 49.00 W)
 DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                     BEAM SPAC.     BEAM ANGLE
                    (C.L. BENT)       D  M   S
    SPAN  2  BEAM  1     0.000       90  0   0
             BEAM  2     4.100       90  0   0
             BEAM  3     4.100       90  0   0
             BEAM  4     4.100       90  0   0
             BEAM  5     4.100       90  0   0
             BEAM  6     4.100       90  0   0
```

```
              TOTAL     20.500

             BENT NO.  3  (N 70 47 49.00 W)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
   SPAN  2  BEAM  1     0.000       90  0   0
            BEAM  2     4.100       90  0   0
            BEAM  3     4.100       90  0   0
            BEAM  4     4.100       90  0   0
            BEAM  5     4.100       90  0   0
            BEAM  6     4.100       90  0   0
             TOTAL     20.500

             BENT NO.  3  (N 70 47 49.00 W)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
   SPAN  3  BEAM  1     0.000       90  0   0
            BEAM  2     4.100       90  0   0
            BEAM  3     4.100       90  0   0
            BEAM  4     4.100       90  0   0
            BEAM  5     4.100       90  0   0
            BEAM  6     4.100       90  0   0
             TOTAL     20.500

             BENT NO.  4  (N 70 47 49.00 W)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
   SPAN  3  BEAM  1     0.000       90  0   0
            BEAM  2     4.100       90  0   0
            BEAM  3     4.100       90  0   0
            BEAM  4     4.100       90  0   0
            BEAM  5     4.100       90  0   0
            BEAM  6     4.100       90  0   0
             TOTAL     20.500

             BENT NO.  4  (N 70 47 49.00 W)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
```

```
   SPAN  4  BEAM  1     0.000       90  0   0
            BEAM  2     4.100       90  0   0
            BEAM  3     4.100       90  0   0
            BEAM  4     4.100       90  0   0
            BEAM  5     4.100       90  0   0
            BEAM  6     4.100       90  0   0
             TOTAL     20.500

            BENT NO.  5  (N 70 47 49.00 W)
DISTANCE BETWEEN STATION LINE AND BEAM 1,        10.250 L
                      BEAM SPAC.     BEAM ANGLE
                     (C.L. BENT)       D  M   S
   SPAN  4  BEAM  1     0.000       90  0   0
            BEAM  2     4.100       90  0   0
            BEAM  3     4.100       90  0   0
            BEAM  4     4.100       90  0   0
            BEAM  5     4.100       90  0   0
            BEAM  6     4.100       90  0   0
             TOTAL     20.500



                       BEAM REPORT

           BEAM REPORT, SPAN  1
           HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
         C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1   61.460        60.043         61.13       0.0058
BEAM  2   61.460        60.043         61.13       0.0058
BEAM  3   61.460        60.043         61.13       0.0058
BEAM  4   61.460        60.043         61.13       0.0058
BEAM  5   61.460        60.043         61.13       0.0058
BEAM  6   61.460        60.043         61.13       0.0058

           BEAM REPORT, SPAN  2
           HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
         C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1  110.000       108.583        109.67       0.0058
BEAM  2  110.000       108.583        109.67       0.0058
BEAM  3  110.000       108.583        109.67       0.0058
```

```
BEAM  4  110.000       108.583        109.67       0.0058
BEAM  5  110.000       108.583        109.67       0.0058
BEAM  6  110.000       108.583        109.67       0.0058

           BEAM REPORT, SPAN  3
           HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
         C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1  110.000       108.583        109.67       0.0058
BEAM  2  110.000       108.583        109.67       0.0058
BEAM  3  110.000       108.583        109.67       0.0058
BEAM  4  110.000       108.583        109.67       0.0058
BEAM  5  110.000       108.583        109.67       0.0058
BEAM  6  110.000       108.583        109.67       0.0058

           BEAM REPORT, SPAN  4
           HORIZONTAL DISTANCE    TRUE DISTANCE     BEAM
         C-C BENT      C-C BRG.   BOT. BM. FLG.     SLOPE

BEAM  1  110.000       108.583        109.67       0.0058
BEAM  2  110.000       108.583        109.67       0.0058
BEAM  3  110.000       108.583        109.67       0.0058
BEAM  4  110.000       108.583        109.67       0.0058
BEAM  5  110.000       108.583        109.67       0.0058
BEAM  6  110.000       108.583        109.67       0.0058
```

EXAMPLE 2 LS5 OUTPUT FILE

```
                              TEXAS DEPARTMENT OF TRANSPORTATION               PC TEXAS V 9.1
                                                                                                     PAGE  70
                                 BRIDGE GEOMETRY SYSTEM (BGS)                  ***  SYSTEM  ***
   BRIDGE GEOMETRY SYSTEM REQUEST                                                OCT  9, 2015     7:34
   IDENTIFICATION                                                                Example 2
                                          RUN REPORT



 UNITS - ENGLISH (DEFAULT)

 JOB TYPE (OLD OR NEW) - NEW

 SAVE RESULTS (YES OR NO) - NO


       DATA                              ROADWAY
       TYPE                 .....................................................
                            .A.B.C.D.E.F.G.H.I.J.K.L.M.N.O.P.Q.R.S.T.U.V.W.X.Y.Z.
                            .....................................................
HORIZONTAL ALIGNMENT        . . . . . . . .X.X. . . . . . . . . . . . . . . . . .
                            .....................................................
VERTICAL ALIGNMENT          . . . . . . .-.X.X. . . . . . . . . . . . . . . . . .
  (PROFILE GRADE)           .....................................................
TEMPLATE                    . . . . . . .-.X.X. . . . . . . . . . . . . . . . . .
                            .....................................................
SUPERELEVATION              . . . . . . .-. . . . . . . . . . . . . . . . . . . .
                            .....................................................
WIDENING                    . . . . . . .-. . . . . . . . . . . . . . . . . . . .
                            .....................................................
```

SYSTEM CARD REPORT OUTPUT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

DIAGNOSTIC MESSAGES REPORT OUTPUT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

COMMAND (RG) REPORT OUTPUT EXAMPLES

This is a place holder for the indicated section to be considered for a future edition of this user guide.

GENERAL GEOMETRY COMMAND REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BRIDGE GEOMETRY COMMAND REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

VARIOUS EXAMPLE BRIDGE GEOMETRY REPORTS

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BEARING SEAT ELEVATIONS REPORT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PLOTTING COMMAND REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

ROADWAY ELEVATIONS REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

ALIGNMENT RELATIONSHIP REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

ROADWAY DESIGN DATA (RD) REPORT OUTPUT EXAMPLES

This is a place holder for the indicated section to be considered for a future edition of this user guide.

HORIZONTAL ALIGNMENT REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PARALLEL ALIGNMENT REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

PROFILE GRADE (VERTICAL ALIGNMENT) REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

TEMPLATE REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

SUPERELEVATION REPORT OUTPUT

This is a place holder for the indicated section to be considered for a future edition of this user guide.

WIDENING REPORT OUTPUT

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APPENDIX D: EXAMPLE BGS PLOT OUTPUT

EXAMPLE 1 DGN (MICROSTATION/PLOT OUTPUT) FILE

NOTE: The plot output shown for this example was actually created with BGS development version 9.0 but the plot produced by v9.1 is identical, except for the version number.

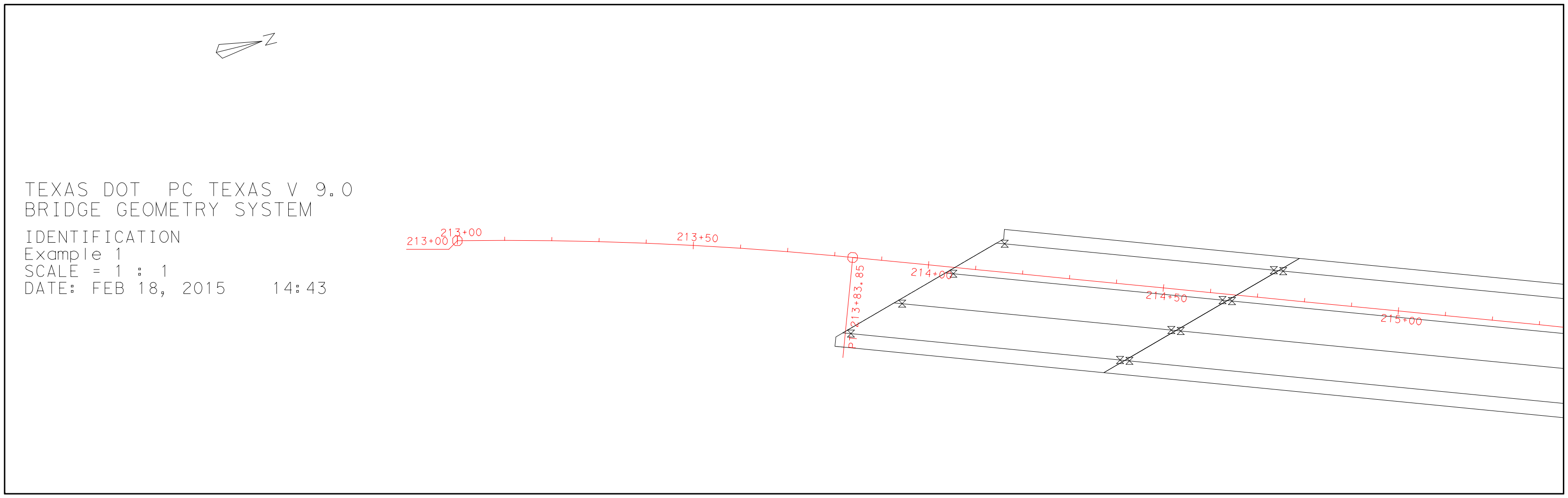

Figure 103 – Part A of Plot from DGN file for Example 1

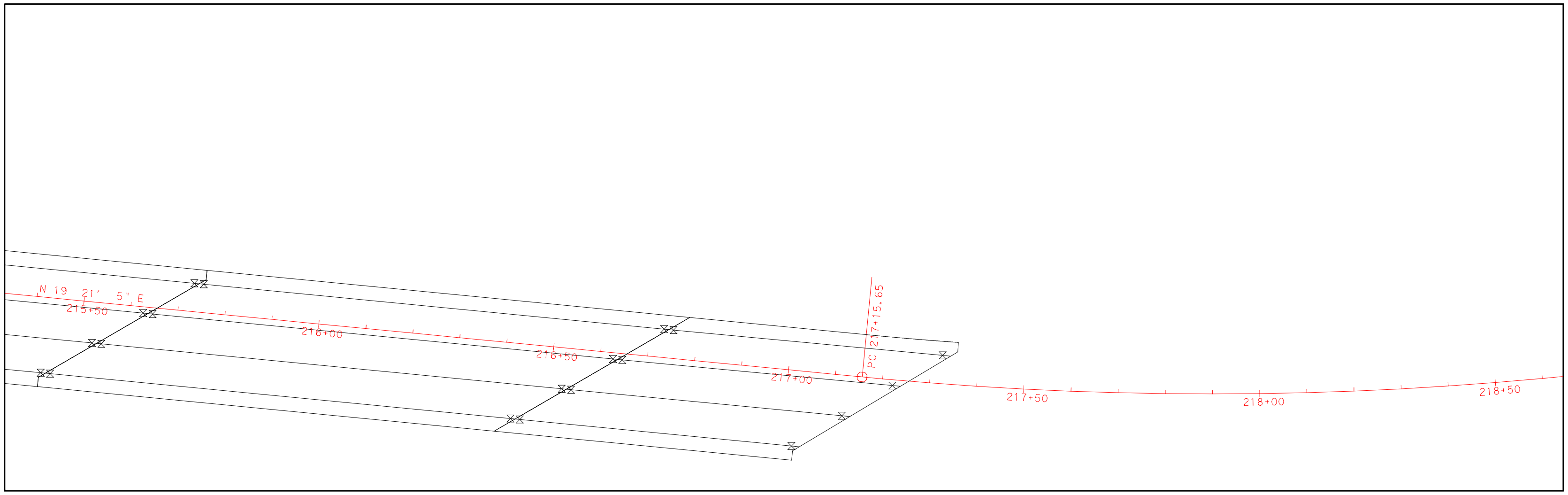

Figure 104 – Part B of Plot from DGN file for Example 1

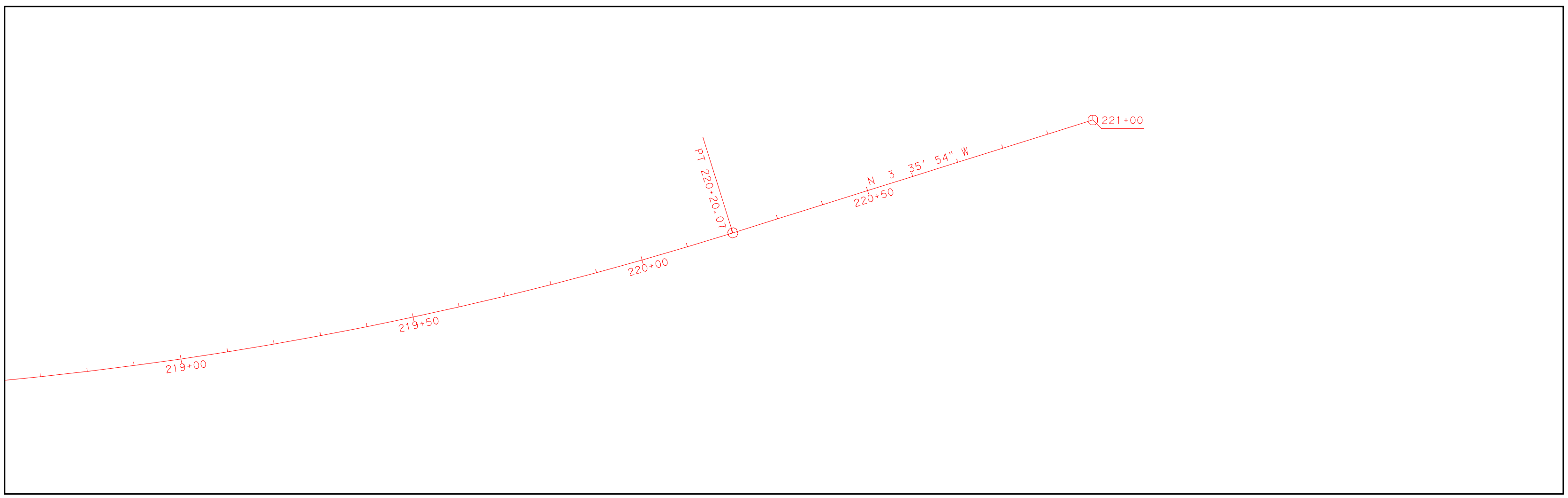

Figure 105 – Part C of Plot from DGN file for Example 1

EXAMPLE 2 DGN (MICROSTATION/PLOT OUTPUT) FILE

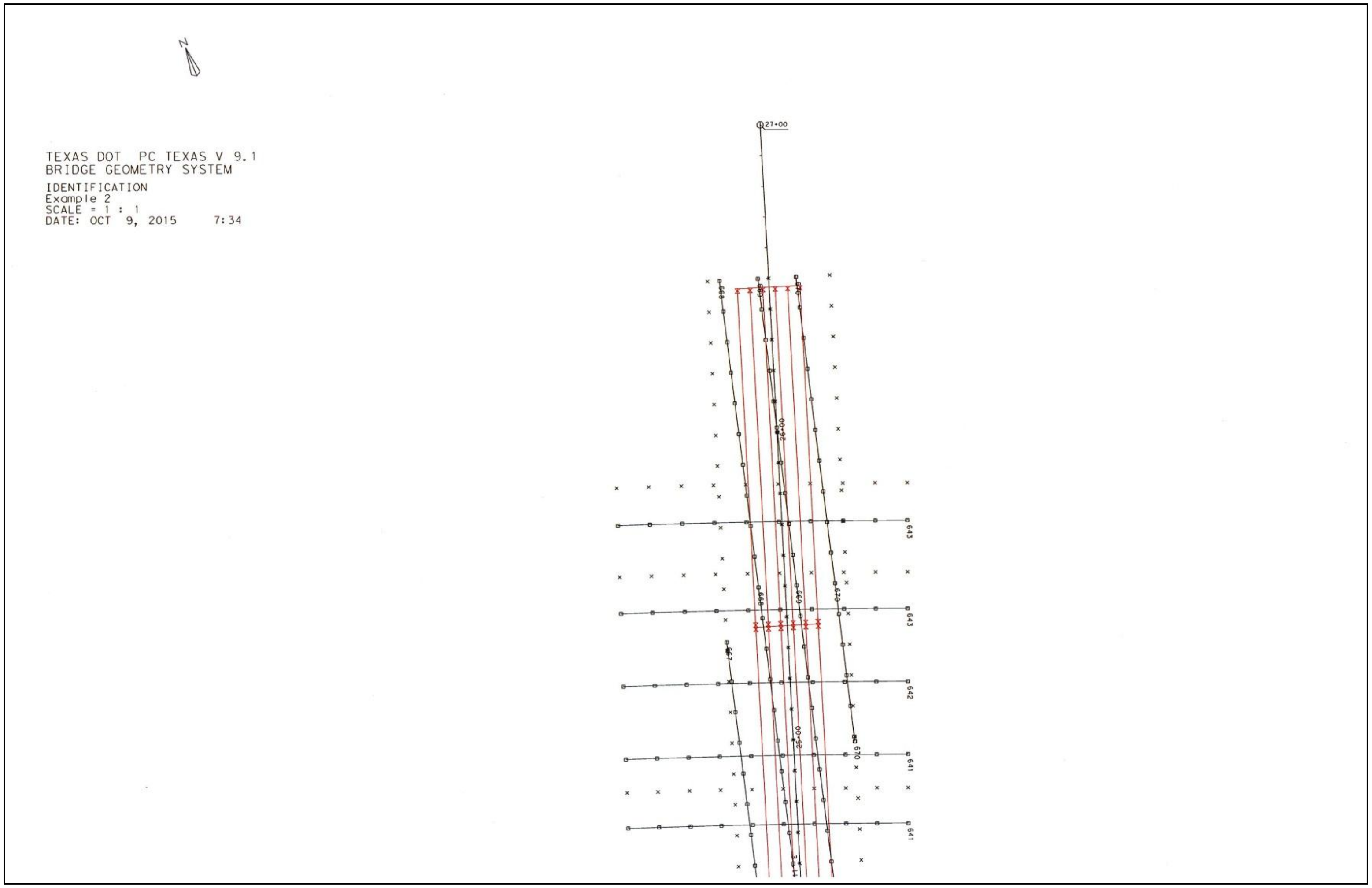

Figure 106 - Part A of Plot from DGN file for Example 2

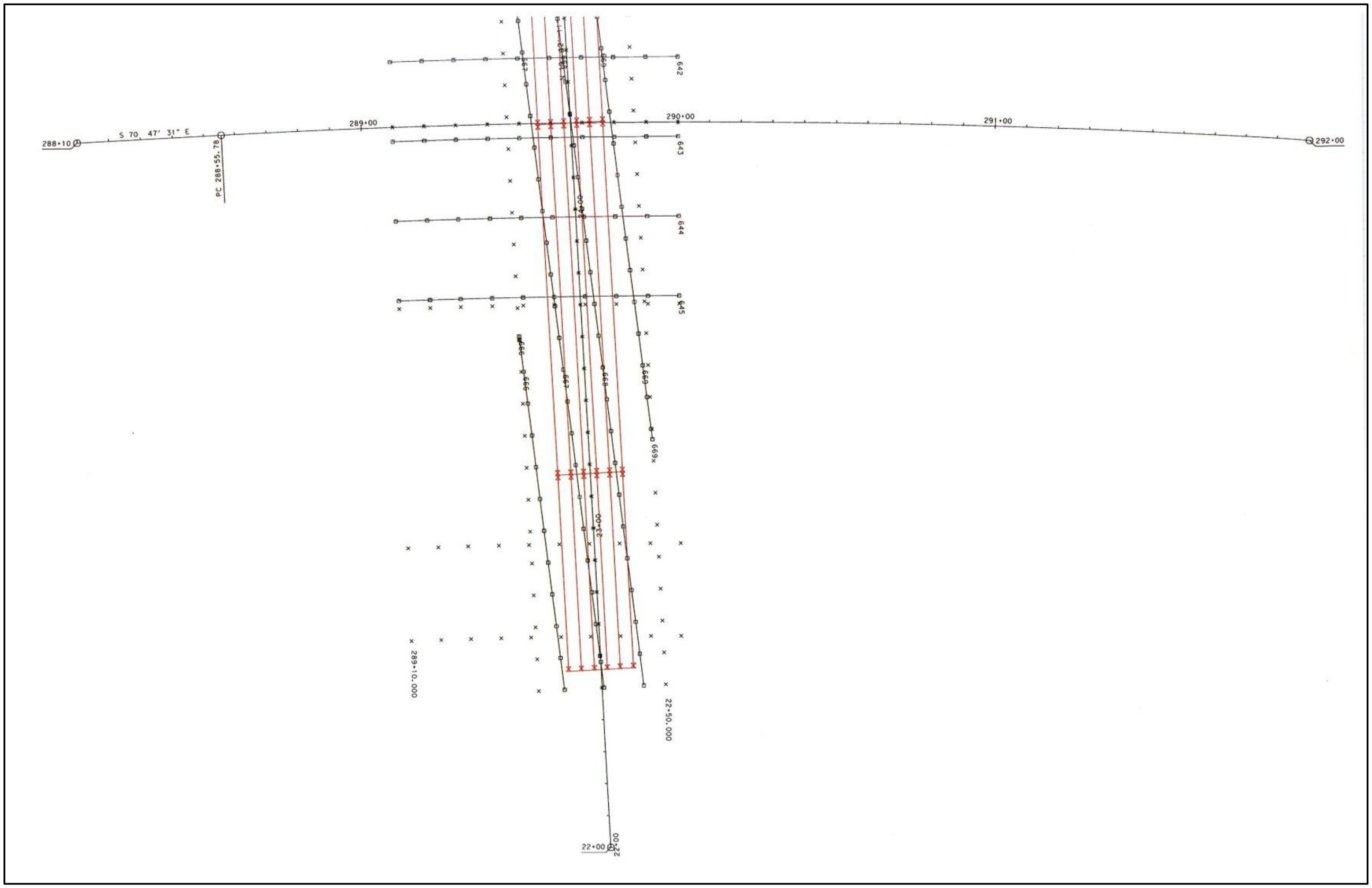

Figure 107 - Part B of Plot from DGN file for Example 2

POINT AND CURVE PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

HORIZONTAL ALIGNMENT PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

CONTOUR PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

CLOSED AREA PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BRIDGE FRAME PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BRIDGE SLAB PLAN PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

BRIDGE SLAB PROFILE PLOT EXAMPLE

This is a place holder for the indicated section to be considered for a future edition of this user guide.

DOCUMENT HISTORY

The following table summarizes the history of this document:

Date	**Initials**	**Description**
01-JAN-2008	SW, KJ, TEB	Completed first draft.
18-NOV-2011	AJ, KJ, TEB	Published a revised draft on TxDOT web site at following URL in hopes of getting review comments (one review received 19-01-2012): https://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/bridge/bgs_users_guide.pdf
02-OCT-2012	TEB, KJ	Generated PDF of working draft containing revisions to date.
14-JAN-2014	TEB, KJ	Generated PDF of working draft containing revisions to date.
22-JUL-2015	TEB	Generated PDF of working draft containing revisions to date.
04-NOV-2015	TEB	Generated PDF of working draft containing revisions to date.
14-JAN-2016	TEB	Printed to PDF and published final revised version for use with BGS v9.1.5: http://ftp.dot.state.tx.us/pub/txdot-info/isd/txdotapps/support/userguide_bgs.pdf
29-JAN-2016	TEB	Revised for BGS v9.1.6 and printed to PDF for publication on the FPT server for user access: http://ftp.dot.state.tx.us/pub/txdot-info/isd/txdotapps/support/userguide_bgs.pdf