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1 Some Common Questions

“Why PGSuper”
PGSuper is a windows bases application to design beams to the current LRFD specifications. The program
- Calculates Loads (Rail and Overlay)
- Calculates Live Load Distribution Factors (No more spreadsheets)
- Designs ANY Beam in a cross section.

“Doesn’t PGSuper require a lot more input and take more time that PSTRS14?”
No, though the program has the ability to model very complex structures, you do not have to use all the program features to reach a beam design. You just need to input the span length, skew, beam spacing, number of beams, and deck width.

“Do we still need PSTRS14?”
PSTRS14 will still be needed for those rare occasions when we are designing to the Standard Specification or to AREMA Specifications.

“Which should I use?”
PGSuper should become your primary tool for beam design for AASHTO LRFD. You can use PSTRS14 to confirm your PGSuper designs. The two programs should result in the same beam design. If they do not, verify that input is matching between the two programs.

2 Basic Design with PGSuper

The steps to design a beam in PGSuper can be simplified to
1. Open a Template for the appropriate beam type.
2. Input Beam Spacing and Number of Beams.
3. Input Span Length and Skew.
4. Input Deck Width.
5. Run the Preliminary Girder Designer.
6. Verify design meets requirements (i.e. $f'_{ci} < 6.0$ ksi; $f'c < 8.5$ ksi).
7. Run the TxDOT Summary Report.
8. Export the Text Data for the Detail Sheet (IBND, IGND, etc.).

These steps are detailed in the design example presented in Appendix A.
3 Additional Features in PGSuper

PGSuper has the ability to model geometrically complex bridges, such as, flared or tapered beams, varying slab widths, and sidewalks. The following sections cover some of these features and the TxDOT Method associated with that feature. This is not a comprehensive guide on how to use every aspect of PGSuper, just a brief introduction to some of the features in PGSuper.

Additional information can be found in the Help menu.

Additional tutorials can be found online at http://www.pgsuper.com/

3.1 Terminology

PGSuper uses the following terminology to determine when to apply loads.
- Casting Yard Stage – The loads modeled in this stage are the girder self weight and prestressing forces.
- Bridge Site Stage 1 – The loads are applied to the non composite section. These loads include the slab, diaphragms, and shear keys.
- Bridge Site Stage 2 – The loads are applied to the short-term composite section. These loads include railing systems, sidewalks, medians, and overlays.
- Bridge Site Stage 3 – The loads are applied to the long-term composite section. These loads include future overlay load, live load, and pedestrian live load.

3.2 Horizontal Curves, Vertical Curves, and Cross-Slope

Commands – Edit: Alignment or Click on .

Horizontal – Under this tab you can model the horizontal curves.

Profile – PGSuper has the capability of modeling vertical curves. However, due to the way PGSuper treats the additional concrete due to a curve, TXDOT has decided NOT to use this feature.

Superelevations – PGSuper can model the cross slope of a bridge. However, the program assumes the cross slope is constant on either side of the crown point. In other words, you can only model one (1) cross slope break. Due to the way PGSuper treats the additional concrete due to a cross slope, TXDOT has decided NOT to use this feature.
3.3 Bridge Geometry, Beam Type, and Beam Spacing

Command – Edit: Bridge or Click 

Bridge Line vs. Alignment – In PGSuper, the Bridge Line defaults at the center of the beams. In addition, the Alignment defaults to be along the Bridge Line. You change the location of the girders relative to the Bridge Line or the Alignment under the General Tab. You can offset the Alignment relative to the Bridge Line on the Framing Tab.

General – Under the General tab, if “Use same type for all girders” is unchecked, if “Use same number of girders in all spans” is unchecked, or if Spacing Type is set to “Spread girders with unique spacing for each span”, then the Girder Type and Spacing may be modified through the Framing Tab: Edit Abutment Details or Edit Span Details.

Framing – This section is where you set the abutment and bent locations and skews. In addition, by clicking the Edit Abutment or Span Details button you can modify the span length, beam connection type, and the girder type and spacing. Girder type and spacing can only be modified if the settings under the General tab meet certain requirements as discussed above.

Railing System – Drop downs allow you to select any of the standard TxDOT Bridge Rails. In addition, you can model sidewalks here. Sidewalk modeling will be discussed in a later section.

Deck Geometry and Materials – In this area, you define the width and depth of the bridge slab.

“Gross Depth” defaults to 8”.

The “Slab Offset” is the slab plus haunch value. Due to the way PGSuper models the haunch concrete, TxDOT has chosen NOT to use this feature. Haunch should be set to zero at this point and the “Slab Offset” should match the “Gross Depth. The load due to the haunch concrete can be modeled as a User Defined Load, as discussed in later sections.

The Wearing Surface section is set to default to Future Overlay at 2” for all bridges with concrete decks. For box beams or double T beams that only have an asphalt surface these value are set as Overlay at 2”.

Deck Reinforcement – The deck reinforcement had been set to a default value. This tab does not impact the design of the beam and can be ignored.
PGSuper Design Guide

Condition and Rating – TxDOT has NOT approved PGSuper as a load rating tool. Ignore this entry tab.

Environmental – These settings are set to default to “Normal Exposure Conditions” and an average ambient relative humidity of 60 percent. These values can be used for the majority of beam designs and should not be modified without due cause.

3.4 Beam Design and Modification

As discussed previously, you can do a preliminary design of a beam using the Girder Designer. In addition, you can design a girder or modify a given design using the “Edit a Girder” feature of PGSuper.

Command – Edit: Girder or Click . Then select the Girder you wish to edit.

Long. Reinforcement and Trans. Reinforcement – Under these tabs you can modify the secondary reinforcement in the beam. These values default to the secondary reinforcement shown on TxDOT’s Standard Drawings. If you have to modify any of these values for any reason, the Standard Drawing will have to be modified to match your design. We recommend NOT changing these values, unless you absolutely have to, to meet shear requirements.

Per the memorandum, titled Design Release Strengths for Prestressed Concrete Beams, dated August 26, 2010, “Bridge design engineers will use the .65 design release factor in the design of all prestressed concrete beams on project designed after October 1, 2010, in place of the existing .60 factor.” and “Designers will target 5,500 as their design release strength maximum. Under extreme circumstances where spans length or beam spacing cannot be reduced for reasons of practicality, design release strengths shall not exceed 6,000 psi.”

What are your options when your release strength exceeds 5,500 psi?

1.) Use a deeper beam section (i.e. Tx46 instead of a Tx40)

What if, the vertical clearance prohibits the use of a deeper beam section?

2.) Reduce Span Length

What if, to clear the river, lower roadway or railroad the span length is at the minimum it can go?
PGSuper Design Guide

3.) Reduce Beam Spacing. If the beam spacing is less than 6 feet, we recommend reducing the overhang width to S/2 or less. As a general guideline, the overhang should not be less than 2 feet.

What if, my beam spacing is less than 4 feet and my release strength is still high?

4.) Use a non standard strand pattern. The Edit: Girder feature in PGSuper allows you to manually change the strand pattern to reach a lower release strength. This procedure is shown in Appendix B.

3.5 Project Controls

In the main toolbar, the Project Tab, these items have been set to default TxDOT values as shown below.

Units – Customary U.S. Units

Structural Analysis Method – Simple Span Analysis

Project Criteria – TxDOT *YEAR* The *YEAR* this will reflect the latest AASHTO LRFD Bridge Design Specification that TxDOT has adopted, i.e. TxDOT 2012 refers to the AASHTO LRFD Bridge Design Specification, Sixth Edition, 2012 with modifications for TxDOT policy as outlined in the Bridge Design Manual. If a pure AASHTO LRFD design method is desired, change this selection to LRFD *YEAR*.

The TxDOT 2010 and TxDOT 2012 project criterion defaults to the 0.65 release factor per the memorandum, titled Design Release Strengths for Prestressed Concrete Beams, dated August 26, 2010.

The TxDOT 2012 project criterion defaults to considering transfer length in the design and analysis of a beam.

Load Rating Options – TxDOT has NOT adopted PGSuper as a load rating tool. Ignore this section and any others dealing with load rating.

Environment – Normal Exposure, Average Ambient relative Humidity = 60%

Properties – This field brings up the initial “Project Properties” screen that appears when you first open a new template in PGSuper. The information in this section includes the Bridge Name, Bridge ID, Job Number, Engineer Name, Company, and Comments.
3.6 Loads

3.6.1 User Defined Loads

You can model additional loads, such as medians, light poles, signs, and haunch through the use of user defined loads.

When defining a load, the available load cases are DC (dead load, component), DW (dead load, wearing surface), and LL+IM (live load plus impact). For the DC and DW cases, the available stages are Bridge Site 1 and Bridge Site 2. The LL+IM load can only be applied to the Bridge Site Stage 3.

Discrete objects just as light poles or signs should be modeled using the “Add New Point Load” feature. The load case would be DC, the Stage would be Bridge Site 2.

PGSuper assumes the rail is distributed to the 3 nearest beams and that the sidewalk is distributed to at least 3 nearest beams/mating surfaces or over the total number of beams/mating surfaces under the sidewalk, whichever is greater. U beams have 2 mating surfaces, while the other TxDOT shapes have only one. If you want to distribute the load differently, you can set the rail to “none” and not model a sidewalk, the loads can then be modeled using “User Defined Loads”, specifically the “Add Distributed Load” feature.

3.6.2 Live Loads

The program allows you to select which truck you would like to design for Service and Strength Limit States, Fatigue Limit State, and Permit Limit States. The default settings are HL-93, the Fatigue truck, and nothing, respectively.

Sidewalk Loads - If you model a sidewalk, PGSuper will automatically turn on the Pedestrian on Sidewalk load. The program is set to default to enveloping the sidewalk live load with the vehicular live load. PGSuper distributes the pedestrian live load in the same manner that the sidewalk is distributed.

Engineering judgment and experience should be used to determine if the beam should be designed for concurrent vehicular and pedestrian live load, enveloped vehicular and pedestrian live load, vehicular only, or pedestrian only.

3.6.3 Live Load Distribution Factors

The program defaults to calculating the live load distribution factors using the AASHTO LRFD Bridge Design Specification with modifications for TxDOT policy as outlined in the Bridge Design Manual.
Occasionally, a bridge will fall outside the ranges of applicability as designed by the ASSHTO Specifications. In these cases, when you go to run the Preliminary Girder Designer, the program will give you the warning “Live Load Distribution Factors could not be calculated for the following reason xxxxx. See Table 4.6.2.2b-1. A refined method of analysis in required for this bridge. See Status Center for Details.”

The status center can be accessed by clicking on the Red X or the Yellow !. When you click on the error message in the status center, the program opens the Refined Analysis Options dialogue.

How do you decide which option you should select?

This issue comes down to engineering judgment and experience. Some guidelines are as follows.

- If all the parameters are within the ROA, use the value as calculated by PGSuper.

- If the ROA are violated by a great amount, use the lever rule. An example of this would be $S = 20$ feet, when the range is 3.5 to 16 feet.

- Within a small violation of the ROA, it would probably be acceptable to ignore the ROA. An example of this would be a $t=4''$, when the range is 4.5 to 12 inches.

The Ranges of Applicability (ROA) found in Section 4.6.2.2 reflect the limits of the research that was done to investigate distribution factors. The ROA’s do not
necessarily indicate the range for which the formulas are valid; rather they reflect the limits of what was studied in the development of the formulas.

When a design falls outside the ROA it is left up to the engineer's judgment to decide to apply the formulas or determine the live load distribution factor by some other method. One way to help make that judgment would be to do a simple sensitivity study using the value that is outside the ROA.

You can modify the Live Load Distribution factors at any time through Project: Live Load Distribution Factors. The dialogue that appears offers the same options as shown above.

### 3.7 Modeling Inverted T’s

In order to model an inverted T in PGSuper, you have to create a connection in the library. The steps to modify a beam connection are as follows.

1.) Select "Library" from the toolbar at the top.

2.) Select "Edit Libraries".

3.) From list on left of screen, double click on "Connections". A listing of the preset connections will be shown in the screen on the right.

4.) Click on the one the one that matches the right beam time if you ignore the stem. Right click, select "Duplicate".

5.) Double Click the copied connection, title will be "the original title (Copy 1)".

6.) Right Click, select "Rename". Change to a name you will remember (ie. Inverted T Bent 2.)

7.) Double Click to open the Connection dialog.

8.) Modify the "End Distance" and "Bearing Offset" by increasing by half the Stem Width. End distance is the distance from the centerline of the bearing to the end of the girder. Bearing offset is the distance from the centerline bent to the centerline of bearing. The difference in these two numbers is the value typically shown on our plans (ie. 3"). The diagram on the left side displays these values.

9.) Side note - Measure End Distance and Bearing Offset is always "Normal to Abutment/Pier" for Inverted Ts.
PGSuper Design Guide

10.) Click "Ok" to exit the dialog, "X" out of the library editor. You can now go to the "Bridge Description" dialog and select the connection you just created on the "Piers" tab, "Connection Geometry".

Final note: Changes to the library in this manner will be specific to the project (file) you are working on and will not transfer over when you create a new file from the templates.

4 TOGA

TxDOT has developed an Optional Girder Analysis plug-in for PGSuper. This plug-in is called TxDOT Optional Girder Analysis (TOGA). TOGA is only configured for I Beams and Tx Girders. You can access TOGA through File: New. At the bottom of the dialogue under “TxDOT Option Girder Analysis” select “Templates”. Then select the girder type you are analyzing. For additional instructions in using TOGA, when you are in TOGA select Help: Help Topics. In the Help Topic, is a very comprehensive guide to the use of TOGA.
5 Additional Information and Questions

Additional information can be found in the PGSuper Help menu. TOGA Help menu

Additional tutorials can be found online at

http://www.pgsuper.com/

Questions or technical support contact the Bridge Division

TxDOT_PGSuperHelp@txdot.gov
Appendix A
TABLE OF SECTION DEPTHS

<table>
<thead>
<tr>
<th>Span</th>
<th>Beam</th>
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**Note:** Theoretical dimension

| TABLE OF ESTIMATED QUANTITIES |

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<th>&quot;B&quot;</th>
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<td>2.0</td>
<td>2.0</td>
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</table>

**Note:** Reinforcing steel weight is calculated using an adjustment factor of 0.93 (as per 60 Kips).

**Warning:** Lengths shown are based on girder frame lengths with adjustments made for beam drops. See STADT LAYOUT for girder lengths.

**DEAD LOAD DEFLECTION DIAGRAM**

**General Notes:**
- See FDOT specifications for sample and quantity adjustments if this section is used.
- See AASHTO standard for uncontrolled RSD lengths.
- See AASHTO standard for uncontrolled RSD lengths for uncontrolled shear when the grade No. Concrete strength fck = 5000 psi.
- For ties, where required, shall be as follows: 1/16 x 3/16

**UL95 LOADING**

**Texas Department of Transportation**

245.00' PRESTRESSED CONCRETE I-GIRDER UNIT

FM 136 OVERPASS
NORTHBOUND MAINLANES

**January 2013**

**TxDOT**
PGSuper Design Guide

STEP 1 - OPEN TEMPLATE

1. Click Here or File: New

2. Select Beam Family

3. Select Beam Type

4. Click OK
PGSuper Design Guide

Fill in Fields and then Click OK

Bridge Name

Bridge ID

Your Name

Any Additional Information

CSJ
STEP 2 - INPUT HORIZONTAL CURVE

Click here or Edit: Alignment
DO NOT input Profile or Superelevation.

Leave as 0 unless curve is not equally divided about the PI.

4. Click OK
STEP 3 - INPUT BEAM SPACING AND NUMBER OF BEAMS

Note the North Arrow has rotated so that the stations increase from left to right and the bridge is mostly square to the page. If it is preferred to always have the North Arrow pointing up, change the setting at View: View Setting: Bridge Model View.
Input Number of Beams

Input Beam Spacing

Input Girder Offset if the CL and PGL are not in the center of the Bridge
STEP 4 - INPUT SPAN LENGTH AND SKEW

To add a Span, click on Span 2 then Click Add Span.

Input Station and Bearing for each bent / abutment.
Default rail settings. Designing for the heaviest standard rail makes it so if the rail type changes a redesign is not necessary. If using a T80HT, T80SS, CTB or SSCB, these rails are heavier and should be used for the design.

Model sidewalks here. Click the “Sidewalk” box, define the width of the sidewalk from the slab edge or back of rail to the edge or curb or toe of rail.

When defining Back Depth and Face Depth take into consideration the variable depth due to the slab and sidewalk cross-slope differences.

Place the barriers on top of sidewalk.

Do not make the sidewalk structurally continuous.

When a sidewalk is modeled, TxDOT templates default to the pedestrian live load being “Enveloped with vehicular live load”, this setting can be changed at Loads: Live Loads.
STEP 5 - INPUT DECK WIDTH

Click here

Input slab width. Offsets can be defined based on the Alignment or the Bridge Line. Offsets are taken to be perpendicular to Alignment or Bridge Line at the Station defined.

The program will assume the slab edge runs parallel to the Alignment or Bridge Line starting at the station defined to the end of the bridge unless the user defines additional slab offsets at other stations.

Default setting of 0 inches of future overlay.

Click OK
The program automatically updates the Plan and Elevation views to reflect the inputted information.
PGSuper Design Guide

STEP 6 - RUN THE DESIGN ALGORITHM

Click once on the beam you want to design.
Defaults to the Design a Single Girder and to the Span and Beam you selected or you can use the dropdown arrows to change to a different span and beam.

Or you can choose to Design Multiple Girders. Click the radial button.
Now select the beams you want to design. You can select all, but be warned this will slow down the program. For this project, the first interior beam controlled the design. Select all of the Girder 2 lines.

Click OK
The shear design algorithm can be used. Be warned that it slows down the program. Always select “Start with Current Stirrup Layout”.

The beam definitions have the TxDOT standard shear reinforcement defined. This pattern should not be changed, unless the beam does not meet shear requirements. If this pattern is changed, a note is added to the reports and the beam standard will have to be modified.

Recommendations:
1.) Initially do not design for shear.
2.) Design for flexure, only.
3.) Run the TxDOT Summary Report.
4.) If there is a shear failure, rerun the design algorithm, this time selecting “Design for Shear”.

Click Run Design
The design algorithm is running.
Click to Accept the Design
STEP 7 - OUTPUT THE REPORT

Click here or View: Reports

All reports have Multi-Girder functionality.

The “TxDOT Girder Schedule Report” will supply the strand pattern, stresses and moments, LLDFs, camber and deflections.

The “TxDOT Summary Report (Long Form)” provides everything in the “TxDOT Girder Schedule Report”, as well as loading conditions and specification checks.

The “TxDOT Summary Report (Short Form)” is the Long Form without the specification checks. This report provides enough information for the bridge design notes and for a checker to verify the design.
Defaults to the Span and Beam you selected. Select all of the Girder 2.

Click OK.
This is the first page.
Girder Schedule

The Specification Check for Span 1, Girder 2 was Successful
The Specification Check for Span 2, Girder 2 was Successful
The Specification Check for Span 3, Girder 2 was Successful

Confirm the design is valid by checking if the Specification Check was successful in this section

Girder Schedule provides the Beam Design.

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<th>Span</th>
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<td>Girder Type</td>
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<td>Prestressing Strands</td>
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<td>NO. (N_{p} + N_{d})</td>
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<td>34</td>
<td>28</td>
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<td>Size</td>
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<td>16.834 in</td>
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<td>Eccentricity @ End</td>
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<td>Y_{0} of Topmost Depressed Strand(s) @ End</td>
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<td>18,500 in</td>
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<td>Optional Design</td>
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<td>Design Load Compressive Stress (Top CL)</td>
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<td>Live Load Distribution Factor for Moment (Strength and Service Limit States)</td>
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NOTE: Stresses shown in the above table reflect the following sign convention: Compressive Stress is positive, Tensile Stress is negative.
Camber and Deflections

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<td>-0.056 ft</td>
</tr>
<tr>
<td>Deflection (Traffic Barrier)</td>
<td>-0.004 ft</td>
<td>-0.005 ft</td>
<td>-0.004 ft</td>
</tr>
<tr>
<td>Deflection (Overlay)</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
</tr>
<tr>
<td>Deflection (User Defined DC)</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
</tr>
<tr>
<td>Deflection (User Defined DW)</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
<td>0.000 ft</td>
</tr>
<tr>
<td>Screed Camber, C</td>
<td>0.089 ft</td>
<td>0.108 ft</td>
<td>0.089 ft</td>
</tr>
<tr>
<td>Excess Camber (Based on Design Camber)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Live Load Deflection (HL93 - Per Lane)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional Live Load Deflection (LRFD 3.6.1.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Use the circled values for determining Haunch.

The deflection circled is the Pnt B (1/2) deflection. To calculate the Pnt A (1/4) deflection multiply Pnt B by 0.7123.

For this example
Pnt B = -0.093 ft.
Pnt A = 0.7123(-0.093) = -0.066 ft.
Defaults to For a Single Girder and to the Span and Beam you selected. Alternately, you can call for multiple reports.

Click OK
The report has the same Girder Schedule and Camber and Deflection table as the TxDOT Girder Schedule Report.
Girder Line Geometry

<table>
<thead>
<tr>
<th>Girder Type</th>
<th>Tx46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span Length, CL Bearing to CL Bearing</td>
<td>75.570 ft</td>
</tr>
<tr>
<td>Girder Length</td>
<td>78.170 ft</td>
</tr>
<tr>
<td>Number of Girders</td>
<td>5</td>
</tr>
<tr>
<td>Girder Spacing Datum Start of Span</td>
<td>Measured normal to alignment at centerline pier</td>
</tr>
<tr>
<td>Left Girder Spacing Start of Span</td>
<td>8.500 ft</td>
</tr>
<tr>
<td>Right Girder Spacing Start of Span</td>
<td>8.500 ft</td>
</tr>
<tr>
<td>Girder Spacing Datum End of Span</td>
<td>Measured normal to alignment at centerline pier</td>
</tr>
<tr>
<td>Left Girder Spacing End of Span</td>
<td>8.500 ft</td>
</tr>
<tr>
<td>Right Girder Spacing End of Span</td>
<td>8.500 ft</td>
</tr>
<tr>
<td>Slab Thickness for Design</td>
<td>8.000 in</td>
</tr>
<tr>
<td>Slab Thickness for Construction</td>
<td>8.000 in</td>
</tr>
<tr>
<td>Slab Offset at Start (&quot;A&quot; Dimension)</td>
<td>8.000 in</td>
</tr>
<tr>
<td>Slab Offset at End (&quot;A&quot; Dimension)</td>
<td>8.000 in</td>
</tr>
<tr>
<td>Overlay</td>
<td>0.000 PSF</td>
</tr>
<tr>
<td>Left Traffic Barrier</td>
<td>T551</td>
</tr>
<tr>
<td>Right Traffic Barrier</td>
<td>T551</td>
</tr>
<tr>
<td>Traffic Barrier Weight (per girder)</td>
<td>0.153 kip/ft</td>
</tr>
<tr>
<td>Connection type at Pier 1</td>
<td>I Girders Abutment</td>
</tr>
<tr>
<td>Connection type at Pier 2</td>
<td>I Girders Interior Bents</td>
</tr>
</tbody>
</table>

Loading Details

Uniform Loads Applied Along the Entire Girder

<table>
<thead>
<tr>
<th>Load Type</th>
<th>w (kip/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girder</td>
<td>0.793</td>
</tr>
</tbody>
</table>

Distribution of Uniform Barrier, Sidewalk, and Pedestrian Loads to Girder

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Total Weight (kip/ft)</th>
<th>Fraction to Girder</th>
<th>Girder Load (kip/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left Ext. Barrier</td>
<td>0.382</td>
<td>0.200</td>
<td>0.076</td>
</tr>
<tr>
<td>Right Ext. Barrier</td>
<td>0.382</td>
<td>0.200</td>
<td>0.076</td>
</tr>
</tbody>
</table>

Additional information in the Short Form report.

Slab LoadApplied Between Bearings

Slab Load is uniform along entire girder length.

<table>
<thead>
<tr>
<th>Load Type</th>
<th>w (kip/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Slab Weight</td>
<td>0.850</td>
</tr>
</tbody>
</table>

Overlay

Overlay load is uniform along entire girder length.

<table>
<thead>
<tr>
<th>Load Type</th>
<th>Wt (ft)</th>
<th>w (kip/ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlay Weight</td>
<td>8.499</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Overlay load is distributed using tributary width.

Live Load Details

Live Loads used for Design

The following live loads were applied to the design (Service and Strength I) limit states:

AASHTO LRFD 3.6.1.2: HL-83 Design Vehicular Live Load

Live Loads Used for Fatigue Limit States

The following live loads were applied to the Fatigue I limit state:

AASHTO LRFD 3.6.1.4: Fatigue Vehicular Live Load

Live Loads Used for Design Permit Limit State

No live loads were applied to the design permit (Strength II) limit state

User Defined Loads

Locations are measured from left support.

Point loads were not defined for this girder.

Distributed loads were not defined for this girder.

Moment loads were not defined for this girder.
Verify the beam design works for the other beams. By copying the girder design to the other girders and reviewing the summary report for the critical beams. In this case, check the exterior beam and the center beam.

Defaults to the Span and Beam you selected or you can use the dropdown arrows to change to a different span and beam.

Select the beam or beams you would like to copy the design to.

Click to copy the design to a different beam.
STEP 8 - OUTPUT THE TEXT DATA FOR THE DETAIL SHEET (IBND, IGND, ETC.)

Click File:
Export:
TxDOT CAD Data
Defaults to the Span and Beam you selected. Select all the Girder 2.

Click OK.
Selection a location and file name. The file will save as a *.txt file. This file can then be imported into Microstation.
The process has completed. Click OK.
This is what the output looks like.
Appendix B
PGSuper Design Guide

METHOD FOR DEVELOPING NON STANDARD STRAND PATTERN

Select a Beam and Run the Preliminary Girder Designer.

Then Click

Click
Accept the Design. Notice $f'_{ci}$ is greater than 6.0 ksi.
The program notifies you if the threshold is exceeded. You can click on the Exclamation Point to view the value exceeded.
Run the TxDOT Summary Report.

At ½” diameter, there are a significant number of strands. Try 0.6” strands to reduce the number of strands.

Close the report.
Click here or Edit: Girder

Defaults to the Span and Beam you selected or you can use the dropdown arrows to change to a different span and beam.
Change to Grade 270 Low Relaxation 0.6”

Click OK
Then Run the Preliminary Girder Designer
Accept the Design. Notice f'ci is greater than 6.0 ksi.
Run the TxDOT Summary Report.

There are significantly fewer strands, but the release strength is higher.
Scroll Down to the Stress Checks.

Casting Yard Stage controls the release strength.

The program provides you with the minimum release strength required.

Edit the Girder to reduce the release strength.
Click here or Edit: Girder

Defaults to the Span and Beam you selected or you can use the dropdown arrows to change to a different span and beam.
Click: Strands Tab

Change to
Number of Harped and Number of Straight Strands
The simplest way to develop a non standard strand pattern is by shifting stands from straight strands to harped strands.

To reduce the release strength required for a given number of strands, click the arrows next to the numbers to reduce the number of straight strands by 2 and increase the number of harped strands by 2.
Stress Checks

Specification = TxDOT 2010

Stress Check for Service I for...

PGSuper Design Guide

Click OK
The program will automatically update the report for the new values.
The release strength requirement has been reduced.

Edit Girder to reduce the release strength.
Under the General Tab, modify the release strength.
Click OK.
The program automatically updated.

Scroll up to check the Girder Design.

### PGSuper Design Guide

### Stress Checks

**Specification = TxDOT 2010**

#### Stress Check for Service I for Casting Yard Stage (At Release) [5.9.4.1.2]

For temporary stresses before losses in pretensioned components:

<table>
<thead>
<tr>
<th>Location from End of Girder (ft)</th>
<th>Prestress $f_p$ (KSI)</th>
<th>Service I $f_o$ (KSI)</th>
<th>Demand $f_o$ (KSI)</th>
<th>Tension Status w/o rebar (C/D)</th>
<th>Tension Status w/ rebar (C/D)</th>
<th>Compression Status (C/D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.010</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>0.012</td>
<td>0.025</td>
<td>-0.038</td>
<td>-0.039</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>0.750</td>
<td>-0.245</td>
<td>-0.456</td>
<td>-0.395</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>3.333</td>
<td>-0.204</td>
<td>-0.125</td>
<td>-0.342</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>4.625</td>
<td>-0.164</td>
<td>-0.159</td>
<td>-0.304</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>10.185</td>
<td>0.009</td>
<td>-0.502</td>
<td>-0.521</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>10.750</td>
<td>0.027</td>
<td>-0.518</td>
<td>-0.535</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>20.300</td>
<td>0.326</td>
<td>-1.119</td>
<td>-0.703</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>20.750</td>
<td>0.340</td>
<td>-1.137</td>
<td>-0.709</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>30.450</td>
<td>0.841</td>
<td>-1.486</td>
<td>-1.214</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
<tr>
<td>30.750</td>
<td>0.851</td>
<td>-1.482</td>
<td>-1.229</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
<td>Pass (-)</td>
</tr>
</tbody>
</table>
Check this section to see if the other checks are successful.

The release strength has been reduced, but is still above 6.0 ksi.

Keep switching straight strands to harped strands until you have reduced the release strength to below 6.0 ksi or as much as possible without raising the final strength to above 8.5 ksi.
For this bridge, the final strand arrangement is shown.
This strand arrangement reduced the release strength to 5.5 ksi. What did it do to the final strength? Check the report.
We are good here.
Specification Check Summary

The Specification Check Was Not Successful

Tensile stress check failed for Service III for the Final with Live Load Stage (Bridge Site 3).

Girder Summary

Note: A Non-Standard Strand Fill was Used For This Design

TxDOT Girder Schedule

<table>
<thead>
<tr>
<th>Span</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girder</td>
<td>2</td>
</tr>
<tr>
<td>Girder Type</td>
<td>T40</td>
</tr>
<tr>
<td>Prestressing Strands</td>
<td>Total</td>
</tr>
<tr>
<td>N0 (Nt + Np)</td>
<td>40</td>
</tr>
<tr>
<td>Size</td>
<td>0.800 in DFA</td>
</tr>
<tr>
<td>Strength</td>
<td>Grade 279 Low Relaxation</td>
</tr>
<tr>
<td>Eccentricity @ CL</td>
<td>12.701 in</td>
</tr>
<tr>
<td>Eccentricity @ End</td>
<td>5.001 in</td>
</tr>
<tr>
<td>Prestressing Strands</td>
<td>Depressed</td>
</tr>
<tr>
<td>NO. (# of Hapred Strands)</td>
<td>14</td>
</tr>
<tr>
<td>Yc, of Topmost Depressed Strand(s) @ End</td>
<td>36.500 in</td>
</tr>
<tr>
<td>Concrete</td>
<td></td>
</tr>
<tr>
<td>Release Strength ( f_{rl} )</td>
<td>5.500 KSI</td>
</tr>
<tr>
<td>Minimum 28 day compressive strength ( f_{c} )</td>
<td>7.000 KSI</td>
</tr>
<tr>
<td>Optional Design</td>
<td></td>
</tr>
<tr>
<td>Design Load Compressive Stress (Top CL)</td>
<td>3.898 KSI</td>
</tr>
<tr>
<td>Design Load Tensile Stress (Bottom CL)</td>
<td>-4.456 KSI</td>
</tr>
<tr>
<td>Required minimum ultimate moment capacity</td>
<td>5328.09 kip-ft</td>
</tr>
<tr>
<td>Live Load Distribution Factor for Moment (Strength and Service Limit States)</td>
<td>0.45503</td>
</tr>
<tr>
<td>Live Load Distribution Factor for Shear (Strength and Service Limit States)</td>
<td>0.84202</td>
</tr>
<tr>
<td>Live Load Distribution Factor for Moment (Fatigue Limit)</td>
<td>0.29604</td>
</tr>
</tbody>
</table>

Scroll up to check the Specification Check Summary.

Tensile Stress fails. Scroll down to get to the Tensile Stress Check.
Final strength needs to be 7.8 ksi.  
Edit Girder to change this value.
Under the General Tab, modify the final strength.

Click OK.
The program automatically updated the report.

Scroll up to check the Girder Design.

<table>
<thead>
<tr>
<th>Location from Left Support (ft)</th>
<th>Prestress $f_p$ (ksi)</th>
<th>Service III $f_e$ (ksi)</th>
<th>Demand $f_d$ (ksi)</th>
<th>Tension Status (C/D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(0.0L)$ 0.000</td>
<td>-2.675</td>
<td>0.000</td>
<td>-2.675</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>2.533</td>
<td>0.456</td>
<td>-2.298</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>$(H)$ 3.875</td>
<td>0.674</td>
<td>-2.119</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>9.400</td>
<td>1.540</td>
<td>-1.423</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>$(0.1L)$ 10.000</td>
<td>1.527</td>
<td>-1.355</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>19.550</td>
<td>2.835</td>
<td>-0.440</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>$(0.2L)$ 20.000</td>
<td>2.884</td>
<td>-0.405</td>
<td>Pass (-)</td>
</tr>
<tr>
<td></td>
<td>29.700</td>
<td>3.750</td>
<td>0.179</td>
<td>Pass (2.07)</td>
</tr>
<tr>
<td></td>
<td>$(0.3L)$ 30.000</td>
<td>3.771</td>
<td>0.192</td>
<td>Pass (2.77)</td>
</tr>
<tr>
<td></td>
<td>39.050</td>
<td>4.296</td>
<td>0.470</td>
<td>Pass (1.13)</td>
</tr>
<tr>
<td></td>
<td>$(0.4L)$ 40.000</td>
<td>4.301</td>
<td>0.472</td>
<td>Pass (1.13)</td>
</tr>
<tr>
<td></td>
<td>$(HP)$ 45.000</td>
<td>4.431</td>
<td>0.500</td>
<td>Pass (1.13)</td>
</tr>
<tr>
<td></td>
<td>$(0.5L)$ 50.000</td>
<td>4.468</td>
<td>0.530</td>
<td>Pass (1.06)</td>
</tr>
<tr>
<td></td>
<td>$(HP)$ 55.000</td>
<td>4.431</td>
<td>0.500</td>
<td>Pass (1.06)</td>
</tr>
<tr>
<td></td>
<td>$(0.6L)$ 60.000</td>
<td>4.301</td>
<td>0.472</td>
<td>Pass (1.13)</td>
</tr>
<tr>
<td></td>
<td>60.150</td>
<td>4.296</td>
<td>0.470</td>
<td>Pass (1.13)</td>
</tr>
</tbody>
</table>
Everything looks good here.
The specification check is good.
The release strength is at 5.5 ksi.
The final strength is below 8.5 ksi.
Click here
or View: Girder View
To strand arrangement
This is what the CAD Export looks like.
This is how a non-standard strand is reported on the IGND.