TxDOT	County:	xxxxxxxx	Design:	JFH	Date:	9/1/2005
Houston	Hwy:	SH xxx	Ck Dsn:		Date:	
Bridge	CSJ:	11'-2" x 6'-10" Junction Box				
Design	Design for:	CULV5				Sheet 1 of 4

Design Parameters

11'-2" x 6'-10" I.D. Junction Box
Reinf Steel: Fy = 60 ksi
Concrete: f'c = 3600 psi

Fill Height

Top of Manhole Elev =	80.50
Top of Slab Elev =	-76.44
Fill Height =	4.06'

Input Values for CULV5

Clear Span =		11.17'
Clear Height =		6.83'
Top Slab Thickness =		10"
Bottom Slab Thickness =		10"
Wall Thickness =	(Prob 1)	8"
	(Prob 2)	1"

Note: Run two problems. First problem is full box for wall designs and slab negative moment design. Second problem is to model top slab as simply supported for positive moment. (No restraining negative corner moments from sidewalls at culvert penetrations)

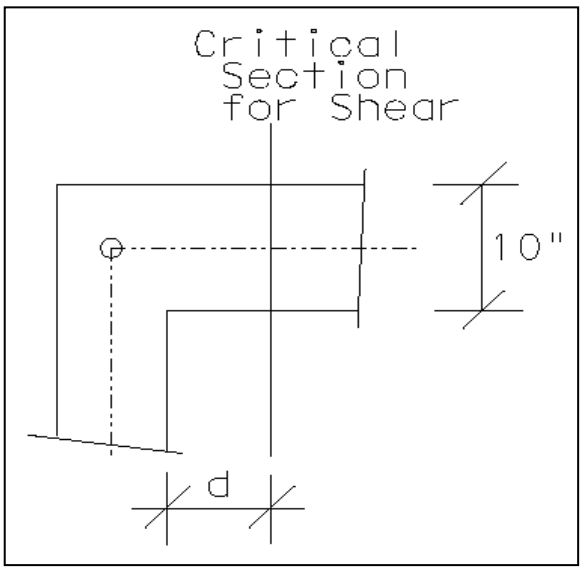
Haunch Thickness = 0"

HS-20 Live Load with 4' Earth Fill

Lateral Soil Pressure:
Max = 40 pcf
Min = 20 pcf

Design Shears & Moments

Top Slab Shear



d = 10" - 2"cover - 3/8"ctrofbar
= 7.62"

Junc Box Span 10th point spacing
Spacing = (11.17' + 8"/12") / 10spaces
= 1.18'

10th point Critical Section
= [(8" / 2) + 7.62"] / 12" / 1.18'
= 0.82 spaces

Shear

10th point	Vu
0	9.460 k
1	7.871 k
@ 0.82 spa >>>	8.157 k = Vu

Bottom Slab Shear
(Similar to top slab shear)

10th point	Vu
0	10.698 k
1	8.683 k
@ 0.82 spa >>>	9.046 k = Vu

Top Slab Positive Moment

Mu = 24.919 k-ft

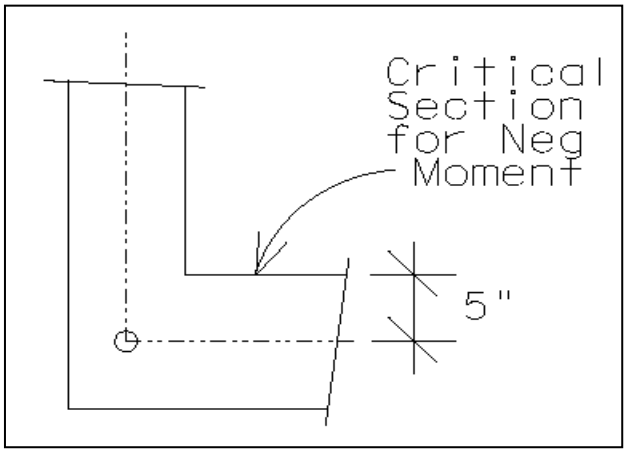
Bottom Slab Positive Moment

Mu = 20.007 k-ft

Wall Positive Moment

Mu = -1.738 k-ft >>> No Positive Moment

Corner Negative Moment



Junc Box Height 10th point spacing

Spacing = (6.83' + 10"/12") / 10spaces
= 0.766'

10th point Critical Section

= 5" / 12" / 0.766'
= 0.54 spaces

Moment

10th point	Mu
9	- 8.954 k-ft
10	-10.590 k-ft
@ 9.46 spa >>>	- 9.70 k-ft = Mu

Check Slab Shear Strength

Note: Concrete must carry all shear.

vc = 3 * (f'c)^0.5
= 180 psi

vu <= phi * vc phi = 0.85
= 0.85 * 180 psi
= 153 psi

Bottom Slab Shear (Controls)

Vu = 9.066 k
d = 10" - 2"cover - 3/8"ctrofbar
= 7.62"
b = 12"

vu = Vu / b / d
= 9.046k * 1000 / 12" / 7.62"
= 99 psi < 153 psi allow --->>> O.K.

Wall Shear

O.K. by Inspection

Calculate Required Areas of Flexural Reinforcing

Top Slab Positive Moment

Mu = 24.919 k-ft
d = 7.62" b = 12"
Ku = 429 Rho = 0.87 %

As = 0.796 in^2 / ft
-->> Use #6 @ 6" AsProv = 0.88 in^2 / ft
--->>> O.K.

Bottom Slab Positive Moment

Mu = 20.007 k-ft < Top Slab Moment
-->> Use #6 @ 6" AsProv = 0.88 in^2 / ft
--->>> O.K.

TxDOT	County:	xxxxxxxx	Design:	JFH	Date:	9/1/2005
Houston	Hwy:	SH xxx	Ck Dsn:		Date:	
Bridge	CSJ:	11'-2" x 6'-10" Junction Box				
Design	Design for:	CULV5				Sheet 3 of 4

Wall Positive Moment

No Wall Positive Moment

Corner Negative Moment

Mu = -9.70 k-ft

d = = 8" - 2"cover - 3/8"ctrofbar

= 5.62" b = 12"

Ku = 307 Rho = 0.61 %

As = 0.411 in^2 / ft

-->> Use #5 @ 6" AsProv = 0.62 in^2 / ft

--->>> O.K.

Calculate Required Areas of Longitudinal Reinforcing

Top & Bottom Slabs

Use 0.2% Gross Area

As = 0.002 * 10" * 12"

= 0.24 in^2 / ft

-->> Use #5 @ 6" AsProv = 0.62 in^2 / ft

--->>> O.K.

Walls

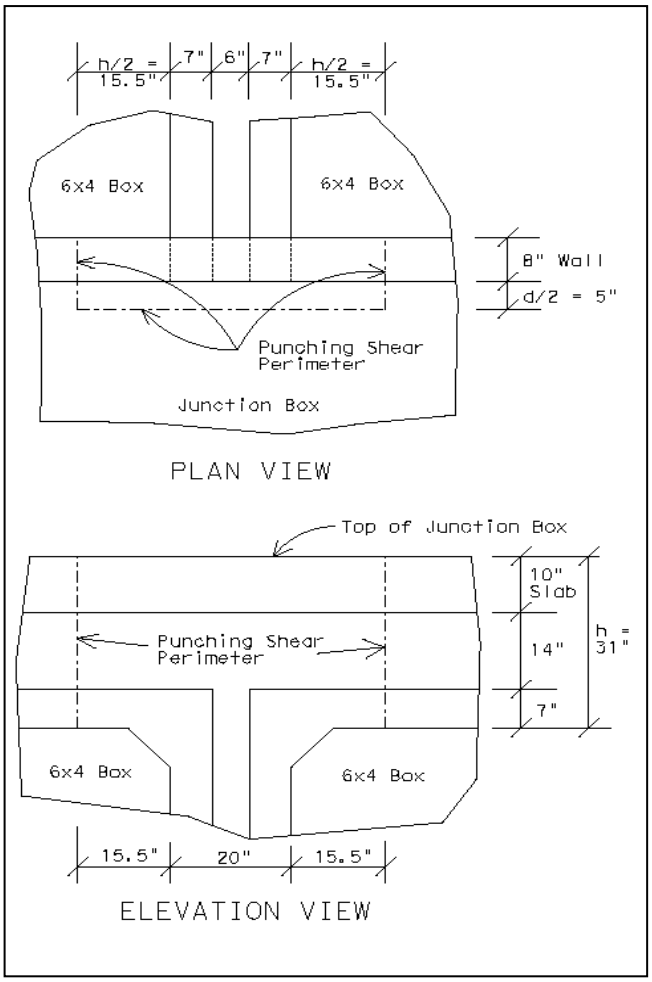
As = 0.002 * 8" * 12"

= 0.19 in^2 / ft

-->> Use #5 @ 6" AsProv = 0.62 in^2 / ft

--->>> O.K.

Check Central Column Capacity Between Multiple Boxes



Distance C-C of two ~ 6'x4' boxes = 7.66'

Max Axial Load in Walls = 9.042 k/lf (Prob 1)

Column Reaction = 7.66' * 9.042 k/lf

= 69.3 k

Check Punching Shear

Junc Box Wall Area = 2 * 8" *31"

= 496 in^2

Junc Box Slab Area = 10" * [(2 * 5") + 51"]

= 610 in^2

Total Punch Shear Area = 496 + 610

= 1106 in^2

v = 69.3k * 1000 / 1106in^2

= 63 psi < 153 psi allow --->>> O.K.

TxDOT	County:	xxxxxxxx	Design:	JFH	Date:	9/1/2005
Houston	Hwy:	SH xxx	Ck Dsn:		Date:	
Bridge	CSJ:	11'-2" x 6'-10" Junction Box				
Design	Design for:	CULV5				Sheet 4 of 4

Check Column Compressive Stress

Column Reaction = 69.3 k

Column Area = 6" gap * 8" wall
= 48 in^2

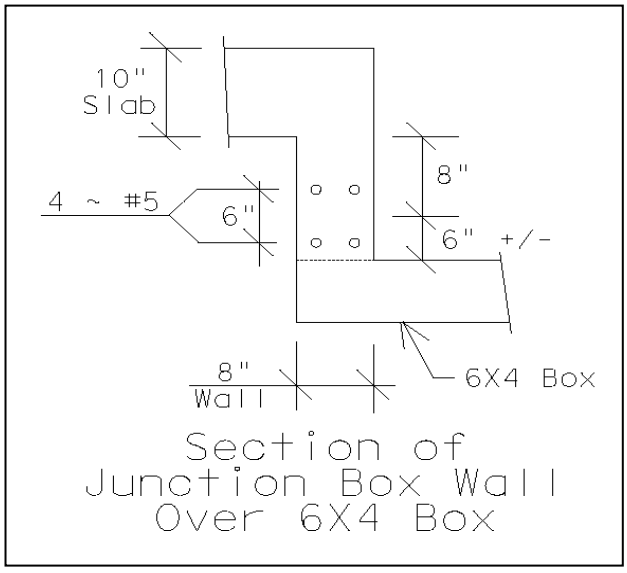
Compressive Stress = 69.3k * 1000 / 48 in^2
= 1444 psi < .75f'c = 2700 psi
--->>> O.K.

Check Wall Flexural Capacity over Boxes

Assume Simple Span = 6.00'

w = Max Axial Load in Junction Box Wall
= 9.042 k/lf

Mu = w * L^2 / 8
= 9.042 k/lf * (6.00')^2 / 8
=40.7 k-ft



d = 18" b = 8"
Ku = 188 Rho = 0.36 %

As = 0.518 in^2 / ft
AsProv = Four #5 = 1.24 in^2
--->>> O.K.

```
            HARRIS            SH 000        0000-00-000    JFH       09/27/2005
Junction Box Example         11-2" x 6'-10" Box                     JB-xmpl.dat
PROB     Junction Box    4' Fill     -->> Actual Walls <<--
SPECE12
CULV 111.26.83 4.00           Y10.0 10.0  8.0          40 20
PROB     Junction Box    4' Fill     -->> Theoretical 1" Walls <<--
SPECE12
CULV 111.26.83 4.00           Y10.0 10.0  1.0          40 20
```

CULV5 CONCRETE BOX CULVERT ANALYSIS Win32 Ver 1.71 Aug 2003

PSF NO	COUNTY	HIGHWAY NO	CONTROL-SECTION-JOB	CODED BY	DATE
	HARRIS	SH 000	0000-00-000	JFH	09/27/2005

Junction Box Example 11-2" x 6'-10" Box JB-xmpl.dat

PROB Junction Box 4' Fill -->> Actual Walls <<--

-- CULVERT, SPEC DATA (* DENOTES DEFAULT) --

LOAD FACTOR DESIGN			ANALYSIS PROBLEM		
LIVE LOADING	=	HS20	OMIT LIVE LOAD AS PER SPECS	=	NO
GAMMA FACTOR	=	1.30 *	AXLE WT FOR OVERLOAD (LB)	=	.00 *
BETA FACTOR FOR DL	=	1.00 *	PRINT 10TH PT MOMTS & SHRS	=	YES *
BETA FACTOR FOR LL	=	1.67 *	PRINT INFLUENCE LINES	=	NO *
SOIL WEIGHT (PCF)	=	120.00 *	CONCRETE WEIGHT (PCF)	=	150.00 *
IMPACT FACTOR	=	.00			
NUMBER OF BARRELS	=	1	FLOOR SPPORT	=	FULL
CLEAR SPAN (FT)	=	11.20	CLEAR HEIGHT (FT)	=	6.83
TOP SLAB THICKNESS (IN)	=	10.00	BOTTOM SLAB THICKNESS (IN)	=	10.00
EXT WALL THICKNESS (IN)	=	8.00	INT WALL THICKNESS (IN)	=	8.00
DEPTH OF FILL (FT)	=	4.00	LIVE LOAD SURCHARGE (FT)	=	2.00 *
MAX LAT SOIL PRESSURE (PCF)	=	40.00	MIN LAT SOIL PRESSURE (PCF)	=	20.00
TOP HAUNCH WIDTH (IN)	=	.00 *	BOTTOM HAUNCH WIDTH (IN)	=	.00 *

-- EXTRA DEAD LOAD AND SPECIAL LIVE LOAD --

NONE

PSF NO	COUNTY	HIGHWAY NO	CONTROL-SECTION-JOB	CODED BY	DATE
	HARRIS	SH 000	0000-00-000	JFH	09/27/2005

Junction Box Example 11-2" x 6'-10" Box JB-xmpl.dat

PROB Junction Box 4' Fill -->> Actual Walls <<--

-- SUMMARY OF MAXIMUM FACTORED MOMENTS, SHEARS AND AXIAL FORCES --

BM NO	10TH PT	MOMENTS (KFT) LDNG #1	LDNG #2	LDNG #3	SHEARS (K) LDNG #1	LDNG #2	LDNG #3	@AXIAL FORCES (K) LDNG #1	LDNG #2	LDNG #3	
1 -	0	-5.822	-8.753	-6.909	1.137	2.311	2.758	-4.667	-9.042	-4.667	
1 -	1	-5.041	-7.203	-5.026	.904	1.712	2.159	-4.667	-9.042	-4.667	
1 -	2	-4.433	-6.102	-3.592	.686	1.143	1.590	-4.667	-9.042	-4.667	
1 -	3	-3.986	-5.424	-2.581	.483	.605	1.052	-4.667	-9.042	-4.667	
1 -	4	-3.688	-5.147	-1.971	.296	.097	.545	-4.667	-9.042	-4.667	JUNCTION BOX WALL
1 -	5	-3.528	-5.248	-1.738	.124	-.380	.068	-4.667	-9.042	-4.667	
1 -	6	-3.494	-5.702	-1.860	-.033	-.826	-.379	-4.667	-9.042	-4.667	
1 -	7	-3.574	-6.487	-2.311	-.174	-1.242	-.795	-4.667	-9.042	-4.667	
1 -	8	-3.757	-7.579	-3.070	-.300	-1.628	-1.180	-4.667	-9.042	-4.667	
1 -	9	-4.031	-8.954	-4.113	-.411	-1.983	-1.535	-4.667	-9.042	-4.667	
1 -	10	-4.383	-10.590	-5.416	-.507	-2.307	-1.860	-4.667	-9.042	-4.667	
2 -	0	-4.383	-10.595	-5.416	9.460	9.113	4.667	-.507	-2.294	-1.860	
2 -	1	1.651	-1.696	-.432	7.871	7.286	3.733	-.722	-2.187	-1.860	
2 -	2	8.574	3.445	3.445	5.984	5.542	2.800	-.811	-1.860	-1.860	
2 -	3	14.120	6.214	6.214	4.317	3.965	1.867	-.945	-1.860	-1.860	
2 -	4	17.571	7.875	7.875	2.767	2.419	.933	-.941	-1.860	-1.860	TOP SLAB
2 -	5	18.791	8.429	8.429	1.079	-.938	.000	-.941	-1.860	-1.860	
2 -	6	17.571	7.875	7.875	-2.767	-2.419	-.933	-.941	-1.860	-1.860	
2 -	7	14.120	6.214	6.214	-4.317	-3.965	-1.867	-.945	-1.860	-1.860	
2 -	8	8.574	3.445	3.445	-5.984	-5.542	-2.800	-.811	-1.860	-1.860	
2 -	9	1.651	-1.696	-.432	-7.871	-7.286	-3.733	-.722	-2.187	-1.860	
2 -	10	-4.383	-10.595	-5.416	-9.460	-9.113	-4.667	-.507	-2.294	-1.860	
4 -	0	-5.822	-8.753	-6.909	9.451	10.698	5.663	-1.137	-3.193	-2.758	
4 -	1	2.354	-.861	-.861	7.436	8.683	4.530	-1.571	-2.758	-2.758	
4 -	2	9.982	3.843	3.843	5.421	6.668	3.398	-1.571	-2.758	-2.758	
4 -	3	15.220	7.203	7.203	3.406	4.653	2.265	-1.571	-2.758	-2.758	
4 -	4	18.066	9.219	9.219	1.391	2.638	1.133	-1.571	-2.758	-2.758	BOTTOM SLAB
4 -	5	18.522	9.891	9.891	.000	-.624	.000	-1.571	-2.758	-2.758	
4 -	6	18.066	9.219	9.219	-1.391	-2.638	-1.133	-1.571	-2.758	-2.758	
4 -	7	15.220	7.203	7.203	-3.406	-4.653	-2.265	-1.571	-2.758	-2.758	
4 -	8	9.982	3.843	3.843	-5.421	-6.668	-3.398	-1.571	-2.758	-2.758	
4 -	9	2.354	-.861	-.861	-7.436	-8.683	-4.530	-1.571	-2.758	-2.758	
4 -	10	-5.822	-8.753	-6.909	-9.451	-10.698	-5.663	-1.137	-3.193	-2.758	

NOTE: LDNG #1 = 100%(VERT DL) + 100%(+VERT LL) + 50%(LAT DL)
LDNG #2 = 100%(VERT DL) + 100%(-VERT LL) + 100%(LAT DL) + 100%(LAT LL)
LDNG #3 = 100%(VERT DL) + 100%(LAT DL) + 100%(LAT LL)
@ = AXIAL FORCES CORRESPONDING WITH MAXIMUM MOMENTS AT SAME SECTION

PSF NO	COUNTY	HIGHWAY NO	CONTROL-SECTION-JOB	CODED BY	DATE
	HARRIS	SH 000	0000-00-000	JFH	09/27/2005

Junction Box Example 11-2" x 6'-10" Box JB-xmpl.dat

PROB Junction Box 4' Fill -->> Theoretical 1" Walls <<--

-- CULVERT, SPEC DATA (* DENOTES DEFAULT) --

LOAD FACTOR DESIGN			ANALYSIS PROBLEM		
LIVE LOADING	=	HS20	OMIT LIVE LOAD AS PER SPECS	=	NO
GAMMA FACTOR	=	1.30 *	AXLE WT FOR OVERLOAD (LB)	=	.00 *
BETA FACTOR FOR DL	=	1.00 *	PRINT 10TH PT MOMTS & SHRS	=	YES *
BETA FACTOR FOR LL	=	1.67 *	PRINT INFLUENCE LINES	=	NO *
SOIL WEIGHT (PCF)	=	120.00 *	CONCRETE WEIGHT (PCF)	=	150.00 *
IMPACT FACTOR	=	.00			
NUMBER OF BARRELS	=	1	FLOOR SPPORT	=	FULL
CLEAR SPAN (FT)	=	11.20	CLEAR HEIGHT (FT)	=	6.83
TOP SLAB THICKNESS (IN)	=	10.00	BOTTOM SLAB THICKNESS (IN)	=	10.00
EXT WALL THICKNESS (IN)	=	1.00	INT WALL THICKNESS (IN)	=	1.00
DEPTH OF FILL (FT)	=	4.00	LIVE LOAD SURCHARGE (FT)	=	2.00 *
MAX LAT SOIL PRESSURE (PCF)	=	40.00	MIN LAT SOIL PRESSURE (PCF)	=	20.00
TOP HAUNCH WIDTH (IN)	=	.00 *	BOTTOM HAUNCH WIDTH (IN)	=	.00 *

-- EXTRA DEAD LOAD AND SPECIAL LIVE LOAD --

NONE

PSF NO	COUNTY	HIGHWAY NO	CONTROL-SECTION-JOB	CODED BY	DATE
	HARRIS	SH 000	0000-00-000	JFH	09/27/2005

Junction Box Example 11-2" x 6'-10" Box JB-xmpl.dat

PROB Junction Box 4' Fill -->> Theoretical 1" Walls <<--

-- SUMMARY OF MAXIMUM FACTORED MOMENTS, SHEARS AND AXIAL FORCES --

BM NO	10TH PT	MOMENTS (KFT) LDNG #1	LDNG #2	LDNG #3	SHEARS (K) LDNG #1	LDNG #2	LDNG #3	@AXIAL FORCES (K) LDNG #1	LDNG #2	LDNG #3	
1 -	0	-1.156	-3.152	-3.152	.974	2.611	2.614	-7.458	-8.213	-4.437	
1 -	1	-.502	-1.382	-1.380	.741	2.012	2.015	-4.437	-8.742	-4.437	
1 -	2	-.018	-.060	-.056	.524	1.444	1.446	-4.437	-8.742	-4.437	
1 -	3	.305	.838	.845	.321	.905	.908	-4.437	-8.742	-4.437	
1 -	4	.478	1.336	1.344	.134	.398	.401	-4.437	-8.742	-4.437	JUNCTION BOX WALL
1 -	5	.514	1.456	1.466	-.038	-.079	-.076	-4.437	-8.742	-4.437	
1 -	6	.424	1.222	1.235	-.195	-.526	-.523	-4.437	-8.742	-4.437	
1 -	7	.219	.658	.673	-.336	-.942	-.939	-4.437	-8.742	-4.437	
1 -	8	-.088	-.213	-.196	-.462	-1.327	-1.324	-4.437	-8.742	-4.437	
1 -	9	-.486	-1.368	-1.349	-.573	-1.682	-1.679	-4.437	-8.742	-4.437	
1 -	10	-.963	-2.783	-2.762	-.669	-2.006	-2.004	-4.437	-8.742	-4.437	
2 -	0	-.963	-2.789	-2.762	9.159	8.956	4.437	-.670	-2.009	-2.006	
2 -	1	8.307	1.743	1.743	7.616	7.174	3.550	-.673	-2.006	-2.006	
2 -	2	15.526	5.248	5.248	5.774	5.476	2.662	-.673	-2.006	-2.006	
2 -	3	20.735	7.751	7.751	4.191	3.939	1.775	-.673	-2.006	-2.006	
2 -	4	23.866	9.253	9.253	2.700	2.448	.887	-.673	-2.006	-2.006	TOP SLAB
2 -	5	24.919	9.754	9.754	1.057	-1.007	.000	-.673	-2.006	-2.006	
2 -	6	23.866	9.253	9.253	-2.700	-2.448	-.887	-.673	-2.006	-2.006	
2 -	7	20.735	7.751	7.751	-4.191	-3.939	-1.775	-.673	-2.006	-2.006	
2 -	8	15.526	5.248	5.248	-5.774	-5.476	-2.662	-.673	-2.006	-2.006	
2 -	9	8.307	1.743	1.743	-7.616	-7.174	-3.550	-.673	-2.006	-2.006	
2 -	10	-.963	-2.789	-2.762	-9.159	-8.956	-4.437	-.670	-2.009	-2.006	
4 -	0	-1.156	-3.152	-3.152	8.238	9.708	4.562	-.977	-2.616	-2.614	
4 -	1	7.125	1.481	1.481	6.444	7.914	3.649	-.977	-2.614	-2.614	
4 -	2	13.383	5.084	5.084	4.649	6.119	2.737	-.977	-2.614	-2.614	
4 -	3	17.616	7.657	7.657	2.854	4.324	1.825	-.977	-2.614	-2.614	
4 -	4	19.824	9.201	9.201	1.060	2.530	.912	-.977	-2.614	-2.614	BOTTOM SLAB
4 -	5	20.007	9.716	9.716	.000	-.735	.000	-.977	-2.614	-2.614	
4 -	6	19.824	9.201	9.201	-1.060	-2.530	-.912	-.977	-2.614	-2.614	
4 -	7	17.616	7.657	7.657	-2.854	-4.324	-1.825	-.977	-2.614	-2.614	
4 -	8	13.383	5.084	5.084	-4.649	-6.119	-2.737	-.977	-2.614	-2.614	
4 -	9	7.125	1.481	1.481	-6.444	-7.914	-3.649	-.977	-2.614	-2.614	
4 -	10	-1.156	-3.152	-3.152	-8.238	-9.708	-4.562	-.977	-2.616	-2.614	

NOTE: LDNG #1 = 100%(VERT DL) + 100%(+VERT LL) + 50%(LAT DL)
LDNG #2 = 100%(VERT DL) + 100%(-VERT LL) + 100%(LAT DL) + 100%(LAT LL)
LDNG #3 = 100%(VERT DL) + 100%(LAT DL) + 100%(LAT LL)
@ = AXIAL FORCES CORRESPONDING WITH MAXIMUM MOMENTS AT SAME SECTION