TECHNICAL REPORT II

STRUCTURAL STUDY OF ALTERNATE FLOOR SYSTEMS

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EXECUTIVE SUMMARY

Technical Report II will investigate alternative solutions for the floor system of Layfield Tower. The report will give preliminary sizes of members, depths, and other pertinent information about each system. Figures from handbooks are present as well as hand calculations and tables.

The four systems analyzed were the current composite steel, non-composite steel, hollow core plank on steel members, and a two-way flat plate with drop panels. From analyzing and evaluating these it was found that the hollow core plank does not work well for this project and will no longer be considered. The non-composite and two-way flat plate systems were found to be feasible solutions and have warranted further consideration. The existing system appears to be the most suitable for this building.

INTRODUCTION

The Layfield Tower is part of an expansion and renovation project at Peninsula Regional Medical Center. It is located at 100 East Carroll Street in Salisbury, MD. It is a 200,000 square foot facility that will house a new emergency/trauma center, pediatric unit, intensive care unit, cardiac and thoracic and vascular unit and a neurosciences and stroke unit. The building also features a helipad on the lower roof with access to the third floor of the main tower. There is a connection to the existing hospital at the northeast corner. Construction on Layfield Tower was completed in 2008.

The structure is divided into two parts: the east side (Area A) with three stories and the west (Area B) with one story. An expansion joint connects the two sections of the building.

This report will evaluate and compare different structural floor systems for the building. First is an analysis and evaluation of the existing system: composite steel frame construction. Then alternate systems were evaluated: two-way flat-plate reinforced concrete, non-composite steel frame, and pre-stressed concrete hollow core plank on steel beams.

LOADS

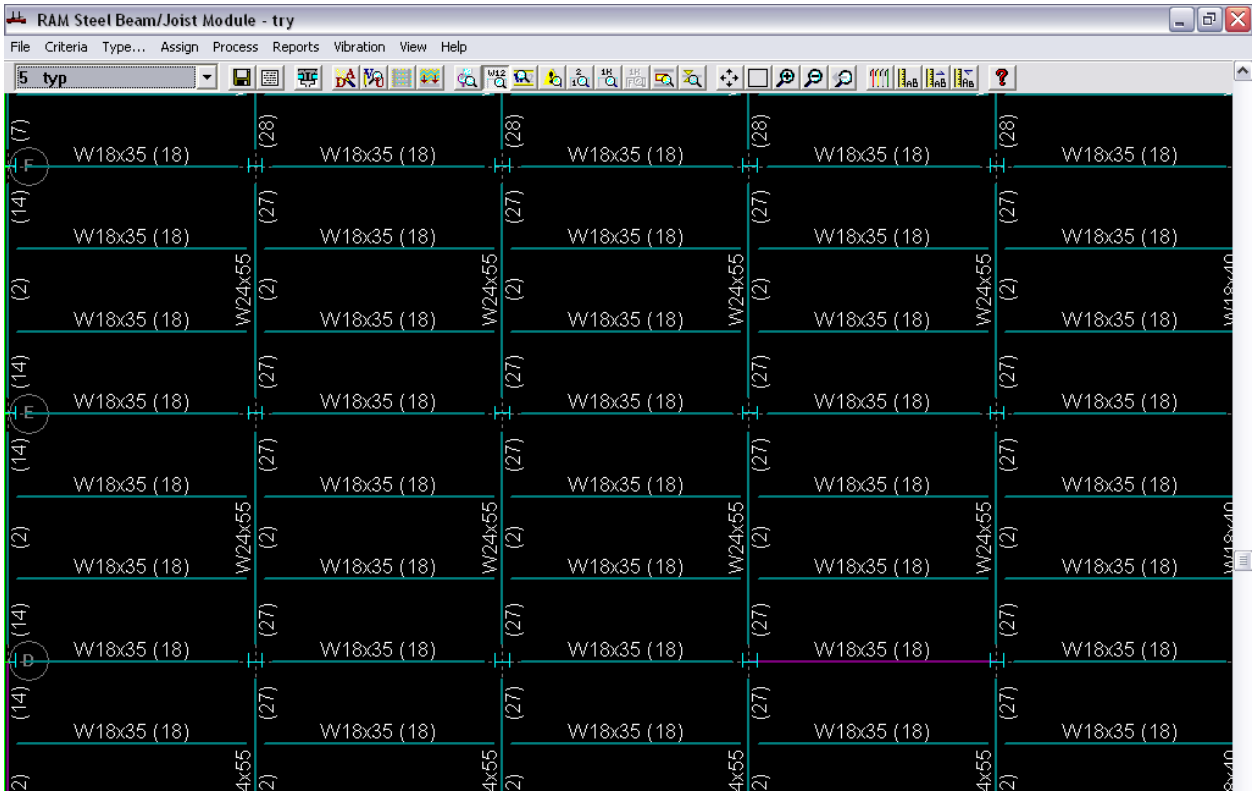
Floor Area	Dead Load (psf)
Partitions	20
Suspended Ceilings	3
Ductwork and Piping	5
Lights	2
Sprinklers	2
Fireproofing	2
Structural Steel Framing	8
6 1/4" Floor Slab (LW)	47
Hanging Load in Mechanical Rooms	65

Floor Area	Live Load(psf)
Elevator Penthouse	150
Mechanical Rooms	15
Office Areas	50
Toilets	60
Corridors	80
Minimum for Design	80

EXISTING STRUCTURAL SYSTEM

Description

The current structural system is made up of structural steel W-shape members. Most connections are shear connections. The typical beam size is W18x35 spaced at 10'-0" on center. Girders are typically W24X55. The typical bay size is 30'-0" x 30'-0". Shown below is a typical floor layout.



Floor slabs are 3-1/4" lightweight concrete on 3" deep 20 gage, galvanized composite metal deck for a total thickness of 6-1/4". They are reinforced with 6x6 W2.1xW2.1 welded wire fabric. All shear studs are 3/4" x 5 3/16".

Analysis

An analysis was run using Ram to design the typical members. Only gravity forces were used while wind and seismic were not considered. The analysis produced matching member sizes to the original plans.

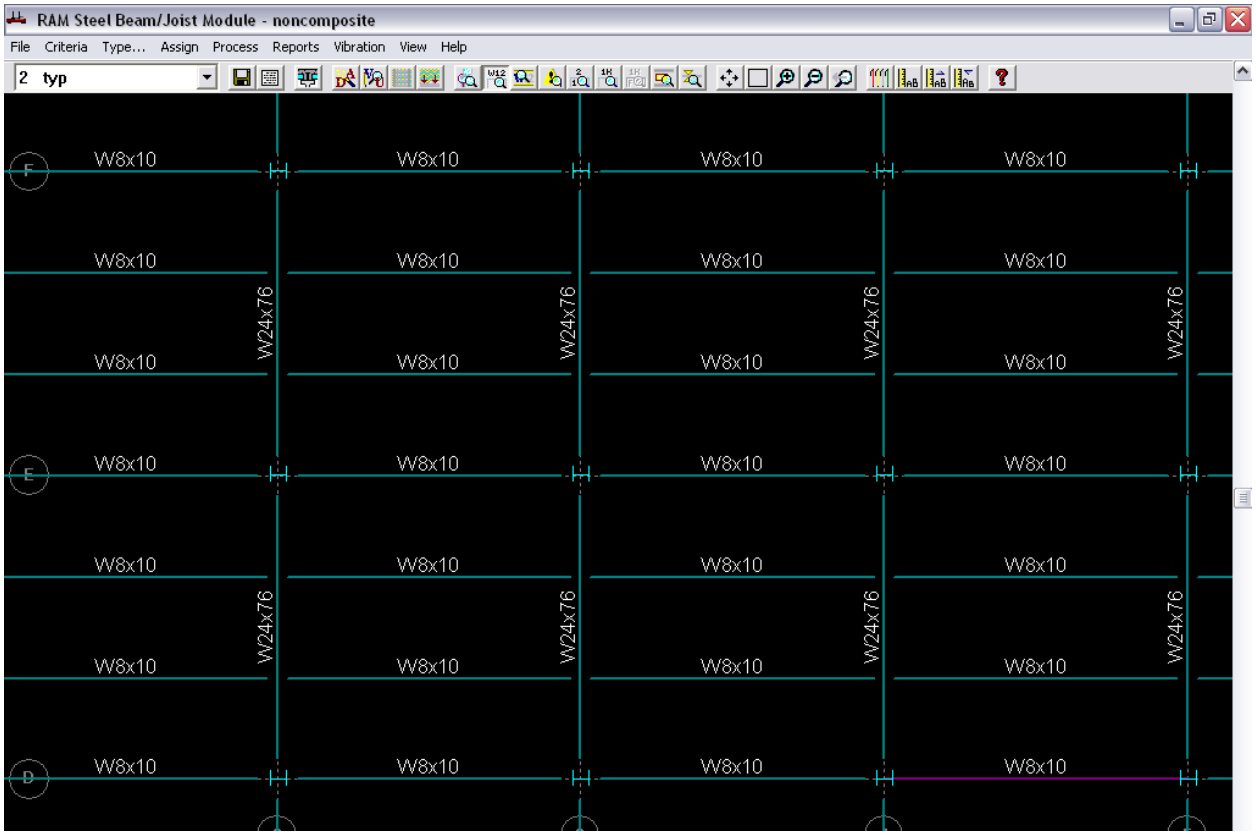
Evaluation

Pros	Cons
Durable	Spray-on Fireproofing required
Speed of construction	
Light Weight	

ALTERNATE SYSTEM 1: Non-Composite Steel

Description

The non-composite structural steel system is made up of structural steel W-shape members. The typical beam size is W8x10 with spaced at 10'-0" on center. Girders are typically W24x76. The typical bay size is 30'-0" x 30'-0". Shown below is a typical floor layout.



Analysis

For this system Ram was again used to find member sizes. Beams were found to be similar to the original design but need camber and girders increased to W24x76. This system consists of a 3" lightweight concrete slab placed on 20 gage 2" high x 6-1/8" pitch x 24-1/2" wide Versa-Deck S.

Evaluation

Pros	Cons
Durable	Spray-on Fireproofing required
Speed of construction	Susceptible to vibration
Light Weight	Increase in floor depth

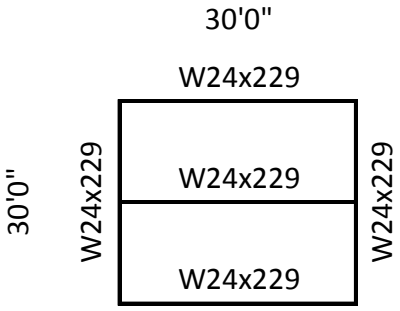
ALTERNATE SYSTEM 2: Hollow Core Plank

Description

Hollow core planking is a type of precast concrete system. The planks are cast in long lengths and cut to size to accommodate the project. The hollow cores can be filled with grout for added strength if need be. A topping slab may also be added for either structural purposes or strictly leveling. For this system, the precast will be supported by structural steel members. The system analyzed has a two-inch topping for both structural integrity and to ensure the floor is level. The Nitterhouse Concrete Products website provided free specifications and details for their typical planks.

Analysis

Based upon the factored loads and spans the hollow core plank chosen using the Nitterhouse specifications was 6" x 4'0" with 4 ½"ϕ 270K strands. This system was analyzed with beams spaced at 15'0" on center instead of 10'0". Beams and girders were found to be W24x229 to optimize floor depth.



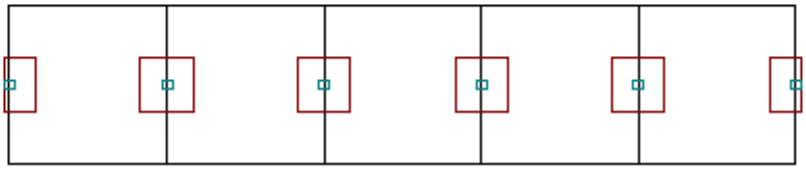
Evaluation

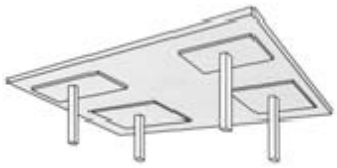
Pros	Cons
Durable	Spray-on Fireproofing required
Speed of construction	Susceptible to vibration
	Increase in floor depth
	High weight

ALTERNATE SYSTEM 3: Two-Way Flat Plate with Drop Panels

Description

This is a cast-in-place reinforced concrete two-way flat plate system with drop panels at column locations. It consists of a 10" slab and 8.5" drop panels. Although lateral forces were not considered for this system, shear walls would be required.





Analysis

From the CRSI Handbook it was found that for a 30'0" span drop panels were needed that are 10'0" square and 8.5" deep. Columns are to be 24" square. PCA Slab was run to evaluate this system and it was found to satisfy all conditions, including reinforcement and deflection.

Evaluation

Pros	Cons
Durable	Redesign of foundation
Smaller floor depth	Longer erection time
No extra fireproofing	Large columns

Overall Evaluation

	Existing	Non-Composite	Hollow Core Plank	Two-way Flat Slab
Floor Thickness	Moderate	Moderate	Large	Smallest
Fireproofing	Yes	Yes	Yes	No
Fast Erection	Yes	Yes	Yes	No
Lead Time	Long	Long	Long	Short
Further Evaluation	Yes	Yes	No	Yes

CONCLUSION

After analyzing these four systems it was found that the existing system is the most suitable. The hollow core plank is the worst system due to its weight and size of the supporting members. Non-composite steel and the two-way flat slab can considered further. Both work well with the existing layout and have unique advantages. Although these two systems will be investigated further the existing structural system is probably the best for this project.

APPENDIX

Existing System Beam Design

Gravity Beam Design

RAM Steel v11.0
DataBase: try
Building Code: IBC

12/21/08 12:19:36
Steel Code: ASD 9th Ed.

Floor Type: typ **Beam Number = 95**

SPAN INFORMATION (ft): I-End (60.00,106.00) J-End (90.00,106.00)

Minimum Depth specified = 17.00 in
Beam Size (User Selected) = W18X35 Fy = 50.0 ksi
Total Beam Length (ft) = 30.00

COMPOSITE PROPERTIES (Not Shored):

	Left	Right
Concrete thickness (in)	3.25	3.25
Unit weight concrete (pcf)	115.00	115.00
f'c (ksi)	3.00	3.00
Decking Orientation	perpendicular	perpendicular
Decking type	ASC 3W	ASC 3W

beff (in)	=	90.00	Y bar(in)	=	18.09
Seff (in3)	=	80.45	Str (in3)	=	102.52
Ieff (in4)	=	1172.43	Itr (in4)	=	1812.41
Stud length (in)	=	5.19	Stud diam (in)	=	0.75

Stud Capacity (kips) q = 7.4
# of studs: Full = 60 Partial = 18 Actual = 18
Number of Stud Rows = 1 Percent of Full Composite Action = 25.87

LINE LOADS (k/ft):

Load	Dist	DL	CDL	LL	Red%	Type	CLL
1	0.000	0.990	0.000	0.800	13.8%	Red	0.000
	30.000	0.990	0.000	0.800			0.000
2	0.000	0.035	0.035	0.000	---	NonR	0.000
	30.000	0.035	0.035	0.000			0.000

SHEAR: Max V (DL+LL) = 25.72 kips fv = 5.09 ksi Fv = 19.13 ksi

MOMENTS:

Span	Cond	Moment kip-ft	@ ft	Lb ft	Cb	Tension Flange fb	Tension Flange Fb	Compr Flange fb	Compr Flange Fb
Center	PreCmp+	3.9	15.0	0.0	1.00	0.82	33.00	0.82	33.00
	Max +	192.9	15.0	---	---				
	Mmax/Seff					28.78	33.00	---	---
	Mconst/Sx+Mpost/Seff					29.01	45.00	---	---
Controlling		192.9	15.0	---	---	28.78	33.00	---	---

fc (ksi) = 0.62 Fc = 1.35

REACTIONS (kips):

	Left	Right
Initial reaction	0.53	0.53
DL reaction	15.38	15.38
Max +LL reaction	10.35	10.35
Max +total reaction	25.72	25.72

DEFLECTIONS:

Initial load (in) at 15.00 ft = -0.043 L/D = 8336

Existing System Girder Design

Gravity Beam Design

RAM Steel v11.0
DataBase: try
Building Code: IBC

12/21/08 12:19:36
Steel Code: ASD 9th Ed.

Floor Type: typ **Beam Number = 13**

SPAN INFORMATION (ft): I-End (60.00,86.00) J-End (60.00,116.00)

Minimum Depth specified = 17.00 in
Beam Size (Optimum) = W24X55 Fy = 50.0 ksi
Total Beam Length (ft) = 30.00

COMPOSITE PROPERTIES (Not Shored):

	Left	Right
Concrete thickness (in)	3.25	3.25
Unit weight concrete (pcf)	115.00	115.00
f'c (ksi)	3.00	3.00
Decking Orientation	parallel	parallel
Decking type	ASC 3W	ASC 3W

beff (in)	=	90.00	Y bar(in)	=	22.14
Seff (in3)	=	174.99	Str (in3)	=	187.86
Ieff (in4)	=	3577.09	Itr (in4)	=	4052.40
Stud length (in)	=	5.19	Stud diam (in)	=	0.75

Stud Capacity (kips) q = 9.9
# of studs per stud segment: Full = 42,1,42
Partial = 27,2,27
Actual = 27,2,27
Number of Stud Rows = 2 Percent of Full Composite Action = 65.63

POINT LOADS (kips):

Dist	DL	CDL	RedLL	Red%	NonRLL	StorLL	Red%	RoofLL	Red%	CLL
10.000	15.38	0.53	12.00	31.7	0.00	0.00	0.0	0.00	Snow	0.00
10.000	15.38	0.53	12.00	31.7	0.00	0.00	0.0	0.00	Snow	0.00
20.000	15.38	0.53	12.00	31.7	0.00	0.00	0.0	0.00	Snow	0.00
20.000	15.38	0.53	12.00	31.7	0.00	0.00	0.0	0.00	Snow	0.00

LINE LOADS (k/ft):

Load	Dist	DL	CDL	LL	Red%	Type	CLL
1	0.000	0.055	0.055	0.000	---	NonR	0.000
	30.000	0.055	0.055	0.000			0.000

SHEAR: Max V (DL+LL) = 47.97 kips fv = 5.38 ksi Fv = 18.78 ksi

MOMENTS:

Span	Cond	Moment	@	Lb	Cb	Tension Flange		Compr Flange	
		kip-ft	ft	ft		fb	Fb	fb	Fb
Center	PreCmp+	16.8	15.0	10.0	1.00	1.75	30.00	1.75	25.01
	Max +	477.7	15.0	---	---				
	Mmax/Seff					32.76	33.00	---	---
	Mconst/Sx+Mpost/Seff					33.35	45.00	---	---
Controlling		477.7	15.0	---	---	32.76	33.00	---	---

fc (ksi) = 0.91 Fc = 1.35

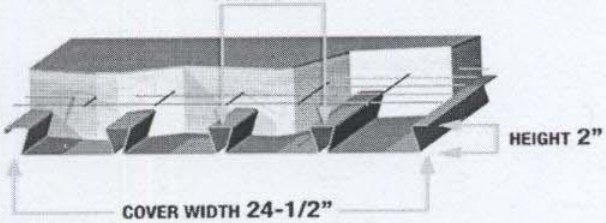
REACTIONS (kips):

Non-composite Deck Selection

Metal Dek Group
a unit of CSi

VERSA-DEK® S

2" high x 6-1/8" pitch x 24-1/2" wide



SECTION PROPERTIES fy = 40 ksi

GAGE	t (in)	Ip (in^4)	In (in^4)	Sp (in^3)	Sn (in^3)
22	0.0295	0.4027	0.3266	0.2895	0.2692
20	0.0358	0.4918	0.4251	0.3620	0.3354
18	0.0474	0.6578	0.6166	0.4852	0.4616
16	0.0598	0.8372	0.8185	0.6192	0.6000

115 PCF LIGHTWEIGHT CONCRETE

h	4"				4.25"				4.5"				4.75"				5"				5.25"			
GAGE	22	20	18	16	22	20	18	16	22	20	18	16	22	20	18	16	22	20	18	16	22	20	18	16
Wc	35.2	35.2	35.2	35.2	37.6	37.6	37.6	37.6	40.0	40.0	40.0	40.0	42.4	42.4	42.4	42.4	44.8	44.8	44.8	44.8	47.2	47.2	47.2	47.2
Ac	39.7	39.7	39.7	39.7	42.1	42.1	42.1	42.1	44.4	44.4	44.4	44.4	46.8	46.8	46.8	46.8	49.2	49.2	49.2	49.2	51.5	51.5	51.5	51.5
Iav	4.6	5.0	5.6	6.2	5.5	5.9	6.6	7.3	6.4	6.9	7.7	8.5	7.4	8.0	8.9	9.8	8.5	9.2	10.2	11.3	9.7	10.5	11.7	12.9
Sb	1.48	1.75	2.24	2.75	1.61	1.91	2.44	2.99	1.74	2.07	2.65	3.25	1.87	2.23	2.86	3.50	2.01	2.39	3.07	3.77	2.15	2.56	3.29	4.03
St	30.5	32.5	35.4	38.0	34.0	36.1	39.3	42.1	37.6	40.0	43.5	46.5	41.4	44.0	47.9	51.2	45.4	48.2	52.5	56.1	49.5	52.6	57.3	61.2
L	MAXIMUM ALLOWABLE UNIFORM LIVE LOADS, (psf) - ASD/LRFD - NO STUDS ON BEAMS																							
9'-0"	227	301	338	373	245	354	397	400	263	389	400	400	281	400	400	400	300	400	400	400	318	400	400	400
	230	278	338	373	251	304	397	400	273	330	400	400	294	356	400	400	317	383	400	400	339	400	400	400
10'-0"	170	186	246	272	204	223	289	319	235	246	337	372	251	263	390	400	267	280	400	400	284	297	400	400
	181	219	246	272	198	240	289	319	215	261	337	372	232	282	370	400	250	303	399	400	268	325	400	400
11'-0"	119	131	185	204	145	158	217	240	173	189	254	279	204	222	253	323	237	253	274	371	253	268	291	400
	145	165	185	204	158	193	217	240	172	210	254	279	186	227	293	323	200	245	323	371	215	262	347	400
12'-0"	84	93	108	157	103	114	131	185	124	137	157	215	148	162	185	249	174	190	217	285	203	221	252	280
	117	127	142	157	128	149	167	185	139	171	195	215	151	186	226	249	163	200	260	285	175	214	285	326
13'-0"	59	66	78	124	74	82	95	108	90	99	115	130	108	119	137	154	128	141	162	181	150	165	188	211
	92	100	112	124	105	117	132	145	114	137	154	169	124	153	178	196	133	165	204	225	143	177	233	256
14'-0"	41	46	56	64	52	59	69	79	65	72	85	96	79	87	102	115	94	104	121	136	112	123	142	160
	74	80	90	99	86	94	105	116	94	110	123	135	102	127	142	157	110	137	163	180	118	148	187	205
15'-0"				46		41	49	57	46	52	62	71	57	64	75	86	69	77	90	103	83	92	107	121
				80		76	86	95	78	89	100	110	85	103	116	127	91	115	133	146	98	124	152	167
16'-0"								41			44	52	40	45	55	64	49	56	67	77	60	68	80	92
								78			82	91	70	85	95	105	76	97	110	120	82	104	125	137
17'-0"																46		40	49	57	43	49	59	69
																87		82	91	100	68	88	104	115
18'-0"																				41			43	51
																				85			88	97
19'-0"																								
20'-0"																								
	MAXIMUM UNSHORED CONSTRUCTION CLEAR SPANS																							
1span	6'-10"	7'-10"	9'-4"	10'-9"	6'-8"	7'-8"	9'-1"	10'-6"	6'-6"	7'-6"	8'-11"	10'-3"	6'-4"	7'-4"	8'-8"	10'-0"	6'-3"	7'-2"	8'-6"	9'-10"	6'-2"	7'-0"	8'-4"	9'-7"
2span	8'-7"	9'-7"	11'-2"	12'-7"	8'-5"	9'-4"	10'-11"	12'-4"	8'-3"	9'-2"	10'-9"	12'-2"	8'-1"	9'-0"	10'-6"	11'-11"	7'-11"	8'-10"	10'-4"	11'-9"	7'-10"	8'-8"	10'-2"	11'-6"
3span	8'-11"	9'-11"	11'-6"	13'-1"	8'-8"	9'-8"	11'-4"	12'-9"	8'-6"	9'-6"	11'-1"	12'-7"	8'-4"	9'-4"	10'-10"	12'-4"	8'-3"	9'-2"	10'-8"	12'-1"	8'-1"	9'-0"	10'-6"	11'-11"
cantilever	2'-8"	3'-2"	4'-0"	4'-10"	2'-7"	3'-1"	3'-11"	4'-9"	2'-7"	3'-1"	3'-11"	4'-8"	2'-7"	3'-0"	3'-10"	4'-7"	2'-6"	3'-0"	3'-9"	4'-6"	2'-6"	2'-11"	3'-9"	4'-6"
cy/100sf	1.13				1.21				1.29				1.37				1.44				1.52			

9'-0" ↑ clear span
227 ← maximum allowable live load (psf) based on ASD composite design
230 ← maximum allowable live load (psf) based on LRFD composite design

- **t** Design thickness of deck
- **Ip** Moment of inertia of deck for positive bending
- **In** Moment of inertia of deck for negative bending
- **Sp** Section modulus of deck for positive bending
- **Sn** Section modulus of deck for negative bending
- **fy** 40 ksi
- **f'c** 3000 psi
- **h** Total height of concrete slab
- **Wc** Weight of concrete (neglecting deflection)
- **Ac** Effective area of concrete available to resist shear
- **Iav** Average moment of inertia of cracked & uncracked section
- **Sb** Cracked section modulus for positive bending
- **St** Cracked section modulus for negative bending
- **L** Span length; clear distance of deck between supports

Interior bearing of 5" in the above tables. If welded wire fabric is not supplied per ACI requirements (0.00075*Ac), reduce loads by 10%. The section property table is based on AISI's Cold-Formed Steel Design Manual, 2001 Edition. The live loads and unshored construction clear spans are based on the Steel Deck Institute's Composite Deck Design Handbook, March 1997 and Design Manual, Pub. No. 30, and ASCE's Standard for the Structural Design of Composite Slabs. Maximum Unshored Construction Clear Spans are based on ASD design. The loads in these tables are based on a Simple Span Design Analysis.

Rev: 01/27/05

115 PCF LIGHTWEIGHT CONCRETE TABLE

Non-composite Beam Design

Gravity Beam Design

RAM Steel v11.0
DataBase: noncomposite
Building Code: IBC

12/22/08 05:46:02
Steel Code: ASD 9th Ed.

Floor Type: typ **Beam Number = 105**

SPAN INFORMATION (ft): **I-End (90.00,106.00)** **J-End (120.00,106.00)**

Beam Size (Optimum) = W8X10 Fy = 50.0 ksi
Total Beam Length (ft) = 30.00

LINE LOADS (k/ft):

Load	Dist	DL	LL	Red%	Type
1	0.000	0.010	0.000	---	NonR
	30.000	0.010	0.000		

SHEAR: Max V (DL+LL) = 0.15 kips fv = 0.11 ksi Fv = 20.00 ksi

MOMENTS:

Span	Cond	Moment	@	Lb	Cb	Tension Flange		Compr Flange	
		kip-ft	ft	ft		fb	Fb	fb	Fb
Center	Max +	1.1	15.0	30.0	1.00	1.74	30.00	1.74	3.41
Controlling		1.1	15.0	30.0	1.00	---	---	1.74	3.41

REACTIONS (kips):

	Left	**Right**
DL reaction	0.15	0.15
Max +total reaction	0.15	0.15

DEFLECTIONS:

Dead load (in)	at	15.00 ft	=	-0.206	L/D =	1752
Live load (in)	at	15.00 ft	=	0.000		
Net Total load (in)	at	15.00 ft	=	-0.206	L/D =	1752

Non-composite Girder Design

Gravity Beam Design

RAM Steel v11.0
DataBase: noncomposite
Building Code: IBC

12/22/08 05:46:02
Steel Code: ASD 9th Ed.

Floor Type: typ **Beam Number = 23**

SPAN INFORMATION (ft): **I-End (120.00,86.00)** **J-End (120.00,116.00)**

Beam Size (Optimum) = W24X76 Fy = 50.0 ksi
Total Beam Length (ft) = 30.00

POINT LOADS (kips):

Dist	DL	RedLL	Red%	NonRLL	StorLL	Red%	RoofLL	Red%
10.000	0.15							
10.000	0.15							
20.000	0.15							
20.000	0.15							

LINE LOADS (k/ft):

Load	Dist	DL	LL	Red%	Type
1	0.000	2.670	2.400	39.6%	Red
	30.000	2.670	2.400		
2	0.000	0.076	0.000	---	NonR
	30.000	0.076	0.000		

SHEAR: Max V (DL+LL) = 63.22 kips fv = 6.01 ksi Fv = 20.00 ksi

MOMENTS:

Span	Cond	Moment	@	Lb	Cb	Tension Flange		Compr Flange	
		kip-ft	ft	ft		fb	Fb	fb	Fb
Center	Max +	474.9	15.0	0.0	1.00	32.38	33.00	32.38	33.00
Controlling		474.9	15.0	0.0	1.00	32.38	33.00	---	---

REACTIONS (kips):

	Left	**Right**
DL reaction	41.49	41.49
Max +LL reaction	21.73	21.73
Max +total reaction	63.22	63.22

DEFLECTIONS:

Dead load (in)	at	15.00 ft	=	-0.830	L/D =	434
Live load (in)	at	15.00 ft	=	-0.433	L/D =	830
Net Total load (in)	at	15.00 ft	=	-1.264	L/D =	285

Hollow Core Plank Specifications

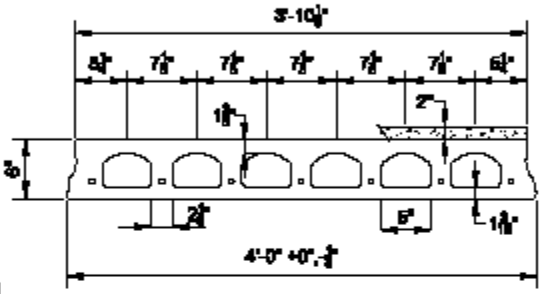
Prestressed Concrete
6"x4'-0" Hollow Core Plank

2 Hour Fire Resistance Rating With 2" Topping

PHYSICAL PROPERTIES
Composite Section

A_c = 253 in.^{2}	Precast b_w = 16.13 in.
I_c = 1519 in.^{4}	Precast S_{bc} = 370 in.^{3}
Y_{bc} = 4.10 in.	Topping S_{tc} = 551 in.^{3}
Y_{tc} = 1.90 in.	Precast S_{bp} = 799 in.^{3}
Y_{ct} = 3.90 in.	Precast Wt. = 195 PLF
	Precast Wt. = 48.75 PSF

DESIGN DATA



1. Precast Strength @ 28 days = 6000 PSI
2. Precast Strength @ release = 3500 PSI
3. Precast Density = 150 PCF
4. Strand = 1/2"Ø 270K Lo-Relaxation.
5. Strand Height = 1.75 In.
6. Ultimate moment capacity (when fully developed)...
   - 4-1/2"Ø, 270K = 67.4 k-ft at 60% jacking force
   - 6-1/2"Ø, 270K = 92.6 k-ft at 60% jacking force
   - 7-1/2"Ø, 270K = 95.3 k-ft at 60% jacking force
7. Maximum bottom tensile stress is $10\sqrt{f'c}$ = 775 PSI
8. All superimposed load is treated as live load in the strength analysis of flexure and shear.
9. Flexural strength capacity is based on stress/strain strand relationships.
10. Deflection limits were not considered when determining allowable loads in this table.
11. Topping Strength @ 28 days = 3000 PSI. Topping Weight = 25 PSF.
12. These tables are based upon the topping having a uniform 2" thickness over the entire span. A lesser thickness might occur if camber is not taken into account during design, thus reducing the load capacity.
13. Load values to the left of the solid line are controlled by ultimate shear strength.
14. Load values to the right are controlled by ultimate flexural strength or fire endurance limits.
15. Load values may be different for IBC 2000 & ACI 318-99. Load tables are available upon request.
16. Camber is inherent in all prestressed hollow core slabs and is a function of the amount of eccentric prestressing force needed to carry the superimposed design loads along with a number of other variables. Because prediction of camber is based on empirical formulas it is at best an estimate, with the actual camber usually higher than calculated values.

SAFE SUPERIMPOSED SERVICE LOADS — **IBC 2006 & ACI 318-05 (1.2 D + 1.6 L)**

Strand Pattern		SPAN (FEET)																		
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
4 - 1/2"ø	LOAD (PSF)	349	317	290	266	227	197	174	149	127	108	92	78	66	55					
6- 1/2"ø	LOAD (PSF)	534	478	437	377	334	292	259	237	215	188	165	142	122	104	88	73	61	49	39
7 - 1/2"ø	LOAD (PSF)	541	492	461	415	364	331	293	274	242	214	190	167	144	124	107	91	77	64	53

NITTERHOUSE
CONCRETE PRODUCTS
2955 Molly Pitcher Hwy. South, Box N
Chambersburg, PA 17202-9203
717-267-4505 Fax 717-267-4518

This table is for simple span and uniform loads. Design data for any of these span-load conditions is available on request. Individual designs may be furnished to satisfy unusual conditions of heavy loads, concentrated loads, cantilevers, flange or stem openings and narrow widths. The allowable loads shown in this table reflect a 2 Hour & 0 Minute fire resistance rating.

11/03/06

6F2.0T

Hollow Core Plank Calculations

W= 1.2(99+48.75 psf) + 1.6*80 = 305.3 psf

w = 305.3 psf * 15 ft. = 4.58 klf

$M_u = 4.58*(30)^2/8 = 515$ ft.-kips

$V_u = 4.58*30/2 = 68.7$ kips

$I_{required} = 360*4.58*(30*12)^2/(384*29000) = 6907$ in^4

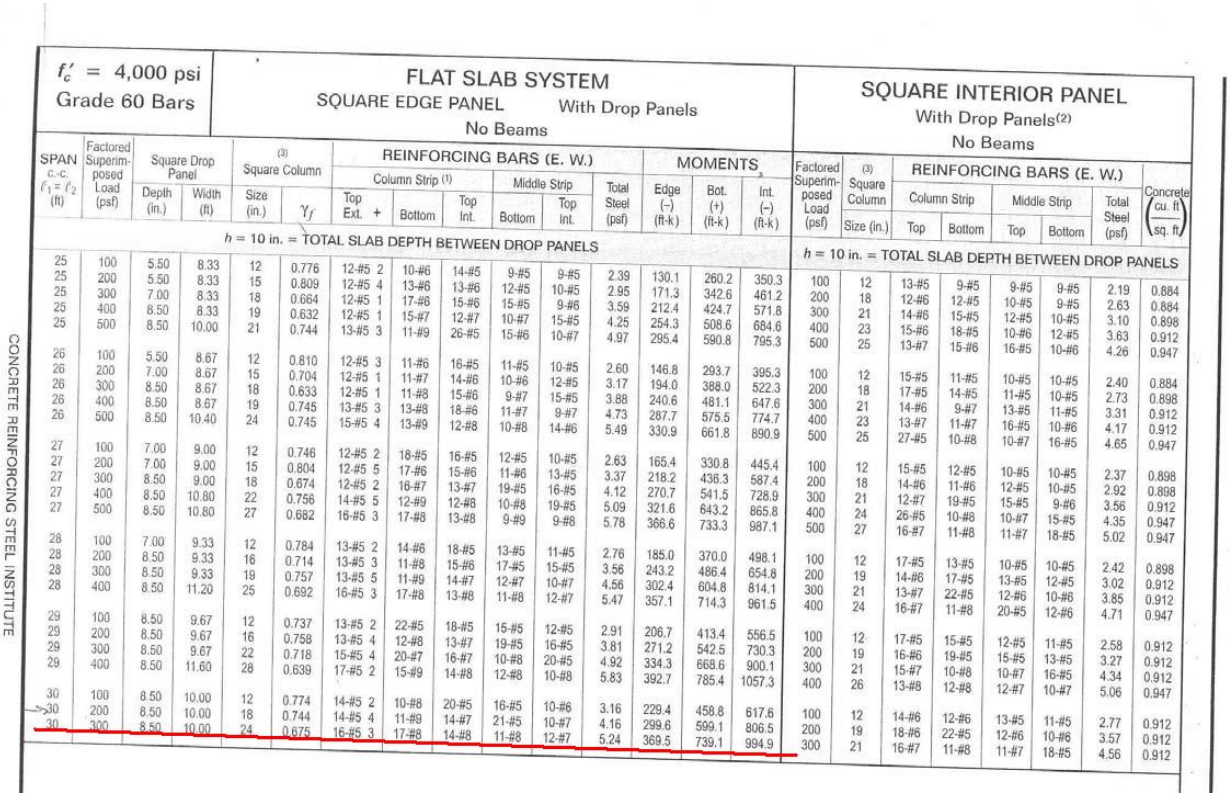
Try W24x229 to optimize floor thickness

w= 4.58+1.2*.229 = 4.85

$Mu = 4.85*30^2/8 = 546$ ft-kips < 1760 ft-kips , OK

Vu = 4.85*30/2 = 73 kips < 674 kips , OK

CRSI Handbook



f'_c = 4,000 psi
Grade 60 Bars

FLAT SLAB SYSTEM
SQUARE EDGE PANEL With Drop Panels
No Beams

SQUARE INTERIOR PANEL
With Drop Panels(2)
No Beams

SPAN c.-c. $\ell_1 = \ell_2$ (ft)	Factored Superimposed Load (psf)	Square Drop Panel Depth (in.)	Square Drop Panel Width (ft)	(3) Square Column Size (in.)	(3) Square Column γ_f	REINFORCING BARS (E. W.) Column Strip (1) Top Ext. +	Column Strip (1) Bottom	Column Strip (1) Top Int.	Middle Strip Bottom	Middle Strip Top Int.	Total Steel (psf)	MOMENTS Edge (−) (ft-k)	MOMENTS Bot. (+) (ft-k)	MOMENTS Int. (−) (ft-k)	Factored Superimposed Load (psf)	(3) Square Column Size (in.)	REINFORCING BARS (E. W.) Column Strip Top	Column Strip Bottom	Middle Strip Top	Middle Strip Bottom	Total Steel (psf)	Concrete (cu. ft / sq. ft)
h = 10 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS															h = 10 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS							
25	100	5.50	8.33	12	0.776	12-#5 2	10-#6	14-#5	9-#5	9-#5	2.39	130.1	260.2	350.3	100	12	13-#5	9-#5	9-#5	9-#5	2.19	0.884
25	200	5.50	8.33	15	0.809	12-#5 4	13-#6	13-#6	12-#5	10-#5	2.95	171.3	342.6	461.2	200	18	12-#6	12-#5	10-#5	9-#5	2.63	0.884
25	300	7.00	8.33	18	0.664	12-#5 1	17-#6	15-#6	15-#5	9-#6	3.59	212.4	424.7	571.8	300	21	14-#6	15-#5	12-#5	10-#5	3.10	0.898
25	400	8.50	8.33	19	0.632	12-#5 1	15-#7	12-#7	10-#7	15-#5	4.25	254.3	508.6	684.6	400	23	15-#6	18-#5	10-#6	12-#5	3.63	0.912
25	500	8.50	10.00	21	0.744	13-#5 3	11-#9	26-#5	15-#6	10-#7	4.97	295.4	590.8	795.3	500	25	13-#7	15-#6	16-#5	10-#6	4.26	0.947
26	100	5.50	8.67	12	0.810	12-#5 3	11-#6	16-#5	11-#5	10-#5	2.60	146.8	293.7	395.3								
26	200	7.00	8.67	15	0.704	12-#5 1	11-#7	14-#6	10-#6	12-#5	3.17	194.0	388.0	522.3	100	12	15-#5	11-#5	10-#5	10-#5	2.40	0.884
26	300	8.50	8.67	18	0.633	12-#5 1	11-#8	15-#6	9-#7	15-#5	3.88	240.6	481.1	647.6	200	18	17-#5	14-#5	11-#5	10-#5	2.73	0.898
26	400	8.50	8.67	19	0.745	13-#5 3	13-#8	18-#6	11-#7	9-#7	4.73	287.7	575.5	774.7	300	21	14-#6	9-#7	13-#5	11-#5	3.31	0.912
26	500	8.50	10.40	24	0.745	15-#5 4	13-#9	12-#8	10-#8	14-#6	5.49	330.9	661.8	890.9	400	23	13-#7	11-#7	16-#5	10-#6	4.17	0.912
															500	25	27-#5	10-#8	10-#7	16-#5	4.65	0.947
27	100	7.00	9.00	12	0.746	12-#5 2	18-#5	16-#5	12-#5	10-#5	2.63	165.4	330.8	445.4								
27	200	7.00	9.00	15	0.804	12-#5 5	17-#6	15-#6	11-#6	13-#5	3.37	218.2	436.3	587.4	100	12	15-#5	12-#5	10-#5	10-#5	2.37	0.898
27	300	8.50	9.00	18	0.674	12-#5 2	16-#7	13-#7	19-#5	16-#5	4.12	270.7	541.5	728.9	200	18	14-#6	11-#6	12-#5	10-#5	2.92	0.898
27	400	8.50	10.80	22	0.756	14-#5 5	12-#9	12-#8	10-#8	19-#5	5.09	321.6	643.2	865.8	300	21	12-#7	19-#5	15-#5	9-#6	3.56	0.912
27	500	8.50	10.80	27	0.682	16-#5 3	17-#8	13-#8	9-#9	9-#8	5.78	366.6	733.3	987.1	400	24	26-#5	10-#8	10-#7	15-#5	4.35	0.947
															500	27	16-#7	11-#8	11-#7	18-#5	5.02	0.947
28	100	7.00	9.33	12	0.784	13-#5 2	14-#6	18-#5	13-#5	11-#5	2.76	185.0	370.0	498.1								
28	200	8.50	9.33	16	0.714	13-#5 3	11-#8	15-#6	17-#5	15-#5	3.56	243.2	486.4	654.8	100	12	17-#5	13-#5	10-#5	10-#5	2.42	0.898
28	300	8.50	9.33	19	0.757	13-#5 5	11-#9	14-#7	12-#7	10-#7	4.56	302.4	604.8	814.1	200	19	14-#6	17-#5	13-#5	12-#5	3.02	0.912
28	400	8.50	11.20	25	0.692	16-#5 3	17-#8	13-#8	11-#8	12-#7	5.47	357.1	714.3	961.5	300	21	13-#7	22-#5	12-#6	10-#6	3.85	0.912
															400	24	16-#7	11-#8	20-#5	12-#6	4.71	0.947
29	100	8.50	9.67	12	0.737	13-#5 2	22-#5	18-#5	15-#5	12-#5	2.91	206.7	413.4	556.5								
29	200	8.50	9.67	16	0.758	13-#5 4	12-#8	13-#7	19-#5	16-#5	3.81	271.2	542.5	730.3	100	12	17-#5	15-#5	12-#5	11-#5	2.58	0.912
29	300	8.50	9.67	22	0.718	15-#5 4	20-#7	16-#7	10-#8	20-#5	4.92	334.3	668.6	900.1	200	19	16-#6	19-#5	15-#5	13-#5	3.27	0.912
29	400	8.50	11.60	28	0.639	17-#5 2	15-#9	14-#8	12-#8	10-#8	5.83	392.7	785.4	1057.3	300	21	15-#7	10-#8	10-#7	16-#5	4.34	0.912
															400	26	13-#8	12-#8	12-#7	10-#7	5.06	0.947
30	100	8.50	10.00	12	0.774	14-#5 2	10-#8	20-#5	16-#5	10-#6	3.16	229.4	458.8	617.6								
30	200	8.50	10.00	18	0.744	14-#5 4	11-#9	14-#7	21-#5	10-#7	4.16	299.6	599.1	806.5	100	12	14-#6	12-#6	13-#5	11-#5	2.77	0.912
30	300	8.50	10.00	24	0.675	16-#5 3	17-#8	14-#8	11-#8	12-#7	5.24	369.5	739.1	994.9	200	19	18-#6	22-#5	12-#6	10-#6	3.57	0.912
															300	21	16-#7	11-#8	11-#7	18-#5	4.56	0.912

CONCRETE REINFORCING STEEL INSTITUTE

PCA Slab Design

```
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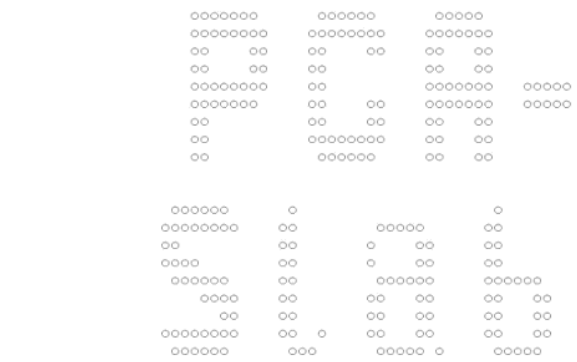

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                                pcaSlab v1.51 (TM)
                  A Computer Program Analysis, Design, and Investigation of
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================================================================================================
[1] INPUT ECHO
================================================================================================

General Information:
====================
   File name: C:\Documents and Settings\USER\My Documents\FlatPlate.slb
   Project: Flat Plate
   Frame:                                          Engineer:
   Code: ACI 318-02       Mode: Design             Reinforcement Database: ASTM A615
   Number of supports = 6
   Floor System: Two-Way

   Live load pattern ratio = 75%
   Minimum free edge for punching shear = 10 times slab thickness
   Deflections are based on cracked section properties.
   In negative moment regions, Ig and Mcr DO NOT include flange/slab contribution (if available)
   Compression reinforcement calculations NOT selected.

Material Properties:
====================
            Slabs|Beams       Columns
            ------------   ------------
   wc    =          150            150 lb/ft3
   f'c   =            4              4 ksi
   Ec    =       3834.3         3834.3 ksi
   fr    =      0.47434        0.47434 ksi

   fy    =           60 ksi, Bars are not epoxy-coated
   fyv   =           60 ksi
   Es    =        29000 ksi

Reinforcement Database:
===============
   Units: Db (in), Ab (in^2), Wb (lb/ft)
   Size       Db       Ab       Wb    Size       Db       Ab       Wb
   ---- -------- -------- --------    ---- -------- -------- --------
     #3     0.38     0.11     0.38      #4     0.50     0.20     0.67
     #5     0.63     0.31     1.04      #6     0.75     0.44     1.50
     #7     0.88     0.60     2.04      #8     1.00     0.79     2.67
     #9     1.13     1.00     3.40     #10     1.27     1.27     4.30
```

#11	1.41	1.56	5.31	#14	1.69	2.25	7.65
#18	2.26	4.00	13.60				

Span Data:

Slabs: L1, wL, wR (ft); t, Hmin (in)

Span	Loc	L1	t	wL	wR	Hmin	
1	Int	30.000	10.00	15.000	15.000	10.18	*b
2	Int	30.000	10.00	15.000	15.000	9.33	
3	Int	30.000	10.00	15.000	15.000	9.33	
4	Int	30.000	10.00	15.000	15.000	9.33	
5	Int	30.000	10.00	15.000	15.000	10.18	*b

NOTES:
*b- Slab thickness is less than minimum.

Support Data:

Columns: c1a, c2a, c1b, c2b (in); Ha, Hb (ft)

Supp	c1a	c2a	Ha	c1b	c2b	Hb	Red%	
1	24.00	24.00	16.000	24.00	24.00	19.000	100	*
2	24.00	24.00	16.000	24.00	24.00	19.000	100	
3	24.00	24.00	16.000	24.00	24.00	19.000	100	
4	24.00	24.00	16.000	24.00	24.00	19.000	100	
5	24.00	24.00	16.000	24.00	24.00	19.000	100	
6	24.00	24.00	16.000	24.00	24.00	19.000	100	*

* Do not check punching shear around this column.

Drop Panels: h (in); L1, L2, W1, W2 (ft)

Supp	h	L1	L2	W1	W2	
1	8.50	1.000	5.000	5.000	5.000	*a b d
2	8.50	5.000	5.000	5.000	5.000	*b
3	8.50	5.000	5.000	5.000	5.000	*b
4	8.50	5.000	5.000	5.000	5.000	*b
5	8.50	5.000	5.000	5.000	5.000	*b
6	8.50	5.000	1.000	5.000	5.000	*a b d

*a- Do not check punching shear around this drop panel.
*b- Standard drop.
*d- Excessive drop thickness will not be used for flexural design.

Boundary Conditions: Kz (kip/in); Kry (kip-in/rad)

Supp	Spring Kz	Spring Kry	Far End A	Far End B
1	0	0	Fixed	Fixed
2	0	0	Fixed	Fixed
3	0	0	Fixed	Fixed
4	0	0	Fixed	Fixed
5	0	0	Fixed	Fixed
6	0	0	Fixed	Fixed

Load Data:

Load Cases and Combinations:

Case	SELF	Dead	Live
Type	DEAD	DEAD	LIVE
U1	1.200	1.200	1.600

Span Loads:

Span	Case	Wa
Area Loads - Wa (lb/ft2):		
1	Dead	99
2	Dead	99
3	Dead	99
4	Dead	99
5	Dead	99
1	Live	80
2	Live	80
3	Live	80
4	Live	80
5	Live	80

Support Loads: --- NONE ---

Support Displacements: --- NONE ---

Reinforcement Criteria:

	Top bars Min	Top bars Max	Bottom bars Min	Bottom bars Max	Stirrups Min	Stirrups Max
Slabs and Ribs:						
Bar Size	#5	#8	#5	#8		
Bar spacing	1.00	18.00	1.00	18.00	in	

Reinf ratio	0.14	5.00	0.14	5.00	%
Cover	1.50		1.50		in

Beams:

Bar Size	#5	#8	#5	#8	#3	#5
Bar spacing	1.00	18.00	1.00	18.00	6.00	18.00 in
Reinf ratio	0.14	5.00	0.14	5.00	%	
Cover	1.50		1.50		in	

[2] DESIGN RESULTS

Top Reinforcement:

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Strip	Zone	Width	Mmax	Xmax	AsMin	AsMax	SpReq	AsReq	Bars
1	Column	Left	15.00	240.57	1.000	5.076	36.170	10.588	3.250	17-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	895.31	29.000	5.076	36.170	4.390	12.625	41-#5
	Middle	Left	15.00	-0.00	1.000	3.240	26.620	16.364	0.000	11-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	298.45	29.000	3.240	26.620	6.429	8.537	28-#5
2	Column	Left	15.00	767.05	1.000	5.076	36.170	4.390	10.721	41-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	620.88	29.000	5.076	36.170	6.000	8.593	30-#5
	Middle	Left	15.00	255.68	1.000	3.240	26.620	6.429	7.255	28-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	206.96	29.000	3.240	26.620	9.000	5.820	20-#5
3	Column	Left	15.00	653.76	1.000	5.076	36.170	6.000	9.068	30-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	653.76	29.000	5.076	36.170	6.000	9.068	30-#5
	Middle	Left	15.00	217.92	1.000	3.240	26.620	9.000	6.140	20-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	217.92	29.000	3.240	26.620	9.000	6.140	20-#5
4	Column	Left	15.00	620.88	1.000	5.076	36.170	6.000	8.593	30-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	767.05	29.000	5.076	36.170	4.390	10.721	41-#5
	Middle	Left	15.00	206.96	1.000	3.240	26.620	9.000	5.820	20-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	255.68	29.000	3.240	26.620	6.429	7.255	28-#5
5	Column	Left	15.00	895.31	1.000	5.076	36.170	4.390	12.625	41-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	240.57	29.000	5.076	36.170	10.588	3.250	17-#5
	Middle	Left	15.00	298.45	1.000	3.240	26.620	6.429	8.537	28-#5
		Middle	15.00	0.00	15.000	0.000	26.620	0.000	0.000	---
		Right	15.00	-0.00	29.000	3.240	26.620	16.364	0.000	11-#5

Top Bar Details:

Units: Length (ft)

Span	Strip	Left				Continuous		Right			
		Bars	Length	Bars	Length	Bars	Length	Bars	Length	Bars	Length
1	Column	17-#5	10.24	---		---		21-#5	11.25	20-#5	7.46
	Middle	11-#5	7.16	---		---		28-#5	11.25	---	
2	Column	21-#5	12.25	20-#5	6.88	---		17-#5	10.75	13-#5	6.60
	Middle	28-#5	12.25	---		---		20-#5	10.75	---	
3	Column	17-#5	10.50	13-#5	6.62	---		17-#5	10.50	13-#5	6.62
	Middle	20-#5	10.50	---		---		20-#5	10.50	---	
4	Column	17-#5	10.75	13-#5	6.60	---		21-#5	12.25	20-#5	6.88
	Middle	20-#5	10.75	---		---		28-#5	12.25	---	
5	Column	21-#5	11.25	20-#5	7.46	---		17-#5	10.24	---	
	Middle	28-#5	11.25	---		---		11-#5	7.16	---	

Bottom Reinforcement:

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Strip	Width	Mmax	Xmax	AsMin	AsMax	SpReq	AsReq	Bars
1	Column	15.00	305.60	12.250	3.240	26.620	6.207	8.753	29-#5

Middle	15.00	203.73	12.250	3.240	26.620	9.474	5.726	19-#5
2 Column	15.00	171.50	15.500	3.240	26.620	11.250	4.792	16-#5
Middle	15.00	114.33	15.500	3.240	26.620	16.364	3.163	11-#5
3 Column	15.00	196.27	15.000	3.240	26.620	10.000	5.509	18-#5
Middle	15.00	130.85	15.000	3.240	26.620	15.000	3.630	12-#5
4 Column	15.00	171.50	14.500	3.240	26.620	11.250	4.792	16-#5
Middle	15.00	114.33	14.500	3.240	26.620	16.364	3.163	11-#5
5 Column	15.00	305.60	17.750	3.240	26.620	6.207	8.753	29-#5
Middle	15.00	203.73	17.750	3.240	26.620	9.474	5.726	19-#5

Bottom Bar Details:

Units: Start (ft), Length (ft)

		Long Bars			Short Bars		
Span	Strip	Bars	Start	Length	Bars	Start	Length
1	Column	29-#5	0.00	30.00	---		
	Middle	11-#5	0.00	30.00	8-#5	4.50	21.00
2	Column	16-#5	0.00	30.00	---		
	Middle	11-#5	0.00	30.00	---		
3	Column	18-#5	0.00	30.00	---		
	Middle	11-#5	0.00	30.00	1-#5	4.50	21.00
4	Column	16-#5	0.00	30.00	---		
	Middle	11-#5	0.00	30.00	---		
5	Column	29-#5	0.00	30.00	---		
	Middle	11-#5	0.00	30.00	8-#5	4.50	21.00

Flexural Capacity:

Units: From, To (ft), As (in^2), PhiMn (k-ft)

Span	Strip	From	To	AsTop	AsBot	PhiMn-	PhiMn+
1	Column	0.000	1.000	5.27	8.99	-386.55	313.40
		1.000	5.000	5.27	8.99	-386.55	313.40
		5.000	9.240	5.27	8.99	-188.04	313.40
		9.240	10.240	0.00	8.99	0.00	313.40
		10.240	10.800	0.00	8.99	0.00	313.40
		10.800	15.000	0.00	8.99	0.00	313.40
		15.000	18.750	0.00	8.99	0.00	313.40
		18.750	19.200	0.00	8.99	0.00	313.40
		19.200	19.928	0.00	8.99	0.00	313.40
		19.928	22.540	6.51	8.99	-230.50	313.40
		22.540	23.718	6.51	8.99	-230.50	313.40
		23.718	25.000	12.71	8.99	-432.65	313.40
		25.000	29.000	12.71	8.99	-900.99	313.40
		29.000	30.000	12.71	8.99	-900.99	313.40
	Middle	0.000	1.000	3.41	3.41	-123.07	123.07
		1.000	4.500	3.41	3.41	-123.07	123.07
		4.500	5.653	3.41	3.41	-123.07	123.07
		5.653	6.161	3.41	5.89	-123.07	209.36
		6.161	7.161	0.00	5.89	0.00	209.36
		7.161	10.800	0.00	5.89	0.00	209.36
		10.800	15.000	0.00	5.89	0.00	209.36
		15.000	18.750	0.00	5.89	0.00	209.36
		18.750	19.200	0.00	5.89	0.00	209.36
		19.200	19.916	0.00	5.89	0.00	209.36
		19.916	24.347	8.68	5.89	-303.18	209.36
		24.347	25.500	8.68	3.41	-303.18	123.07
		25.500	29.000	8.68	3.41	-303.18	123.07
		29.000	30.000	8.68	3.41	-303.18	123.07
2	Column	0.000	1.000	12.71	4.96	-900.99	177.32
		1.000	5.000	12.71	4.96	-900.99	177.32
		5.000	5.878	12.71	4.96	-432.65	177.32
		5.878	6.878	6.51	4.96	-230.50	177.32
		6.878	10.800	6.51	4.96	-230.50	177.32
		10.800	11.250	6.51	4.96	-230.50	177.32
		11.250	12.250	0.00	4.96	0.00	177.32
		12.250	15.000	0.00	4.96	0.00	177.32
		15.000	19.200	0.00	4.96	0.00	177.32
		19.200	19.250	0.00	4.96	0.00	177.32
		19.250	20.346	0.00	4.96	0.00	177.32
		20.346	23.399	5.27	4.96	-188.04	177.32
		23.399	24.495	5.27	4.96	-188.04	177.32
		24.495	25.000	9.30	4.96	-323.57	177.32
		25.000	29.000	9.30	4.96	-669.75	177.32
		29.000	30.000	9.30	4.96	-669.75	177.32
	Middle	0.000	1.000	8.68	3.41	-303.18	123.07

	1.000	10.800	8.68	3.41	-303.18	123.07
	10.800	11.250	8.68	3.41	-303.18	123.07
	11.250	12.250	0.00	3.41	0.00	123.07
	12.250	15.000	0.00	3.41	0.00	123.07
	15.000	19.200	0.00	3.41	0.00	123.07
	19.200	19.250	0.00	3.41	0.00	123.07
	19.250	20.363	0.00	3.41	0.00	123.07
	20.363	29.000	6.20	3.41	-219.95	123.07
	29.000	30.000	6.20	3.41	-219.95	123.07
3 Column	0.000	1.000	9.30	5.58	-669.75	198.72
	1.000	5.000	9.30	5.58	-669.75	198.72
	5.000	5.461	9.30	5.58	-323.57	198.72
	5.461	6.618	5.27	5.58	-188.04	198.72
	6.618	9.344	5.27	5.58	-188.04	198.72
	9.344	10.500	0.00	5.58	0.00	198.72
	10.500	10.800	0.00	5.58	0.00	198.72
	10.800	15.000	0.00	5.58	0.00	198.72
	15.000	19.200	0.00	5.58	0.00	198.72
	19.200	19.500	0.00	5.58	0.00	198.72
	19.500	20.656	0.00	5.58	0.00	198.72
	20.656	23.382	5.27	5.58	-188.04	198.72
	23.382	24.539	5.27	5.58	-188.04	198.72
	24.539	25.000	9.30	5.58	-323.57	198.72
	25.000	29.000	9.30	5.58	-669.75	198.72
	29.000	30.000	9.30	5.58	-669.75	198.72
Middle	0.000	1.000	6.20	3.41	-219.95	123.07
	1.000	4.500	6.20	3.41	-219.95	123.07
	4.500	5.657	6.20	3.41	-219.95	123.07
	5.657	9.325	6.20	3.72	-219.95	134.01
	9.325	10.500	0.00	3.72	0.00	134.01
	10.500	10.800	0.00	3.72	0.00	134.01
	10.800	15.000	0.00	3.72	0.00	134.01
	15.000	19.200	0.00	3.72	0.00	134.01
	19.200	19.500	0.00	3.72	0.00	134.01
	19.500	20.675	0.00	3.72	0.00	134.01
	20.675	24.343	6.20	3.72	-219.95	134.01
	24.343	25.500	6.20	3.41	-219.95	123.07
	25.500	29.000	6.20	3.41	-219.95	123.07
	29.000	30.000	6.20	3.41	-219.95	123.07
4 Column	0.000	1.000	9.30	4.96	-669.75	177.32
	1.000	5.000	9.30	4.96	-669.75	177.32
	5.000	5.505	9.30	4.96	-323.57	177.32
	5.505	6.601	5.27	4.96	-188.04	177.32
	6.601	9.654	5.27	4.96	-188.04	177.32
	9.654	10.750	0.00	4.96	0.00	177.32
	10.750	10.800	0.00	4.96	0.00	177.32
	10.800	15.000	0.00	4.96	0.00	177.32
	15.000	17.750	0.00	4.96	0.00	177.32
	17.750	18.750	0.00	4.96	0.00	177.32
	18.750	19.200	6.51	4.96	-230.50	177.32
	19.200	23.122	6.51	4.96	-230.50	177.32
	23.122	24.122	6.51	4.96	-230.50	177.32
	24.122	25.000	12.71	4.96	-432.65	177.32
	25.000	29.000	12.71	4.96	-900.99	177.32
	29.000	30.000	12.71	4.96	-900.99	177.32
Middle	0.000	1.000	6.20	3.41	-219.95	123.07
	1.000	9.637	6.20	3.41	-219.95	123.07
	9.637	10.750	0.00	3.41	0.00	123.07
	10.750	10.800	0.00	3.41	0.00	123.07
	10.800	15.000	0.00	3.41	0.00	123.07
	15.000	17.750	0.00	3.41	0.00	123.07
	17.750	18.750	0.00	3.41	0.00	123.07
	18.750	19.200	8.68	3.41	-303.18	123.07
	19.200	29.000	8.68	3.41	-303.18	123.07
	29.000	30.000	8.68	3.41	-303.18	123.07
5 Column	0.000	1.000	12.71	8.99	-900.99	313.40
	1.000	5.000	12.71	8.99	-900.99	313.40
	5.000	6.282	12.71	8.99	-432.65	313.40
	6.282	7.460	6.51	8.99	-230.50	313.40
	7.460	10.072	6.51	8.99	-230.50	313.40
	10.072	10.800	0.00	8.99	0.00	313.40
	10.800	11.250	0.00	8.99	0.00	313.40
	11.250	15.000	0.00	8.99	0.00	313.40
	15.000	19.200	0.00	8.99	0.00	313.40
	19.200	19.760	0.00	8.99	0.00	313.40
	19.760	20.760	0.00	8.99	0.00	313.40
	20.760	25.000	5.27	8.99	-188.04	313.40
	25.000	29.000	5.27	8.99	-386.55	313.40
	29.000	30.000	5.27	8.99	-386.55	313.40
Middle	0.000	1.000	8.68	3.41	-303.18	123.07
	1.000	4.500	8.68	3.41	-303.18	123.07
	4.500	5.653	8.68	3.41	-303.18	123.07
	5.653	10.084	8.68	5.89	-303.18	209.36

10.084	10.800	0.00	5.89	0.00	209.36	
10.800	11.250	0.00	5.89	0.00	209.36	
11.250	15.000	0.00	5.89	0.00	209.36	
15.000	19.200	0.00	5.89	0.00	209.36	
19.200	22.839	0.00	5.89	0.00	209.36	
22.839	23.839	0.00	5.89	0.00	209.36	
23.839	24.347	3.41	5.89	-123.07	209.36	
24.347	25.500	3.41	3.41	-123.07	123.07	
25.500	29.000	3.41	3.41	-123.07	123.07	
29.000	30.000	3.41	3.41	-123.07	123.07	

Slab Shear Capacity:

Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu
1	360.00	8.19	1.000	279.62	196.87	28.32
2	360.00	8.19	1.000	279.62	169.72	1.68
3	360.00	8.19	1.000	279.62	162.76	1.68
4	360.00	8.19	1.000	279.62	169.72	28.32
5	360.00	8.19	1.000	279.62	196.87	1.68

Flexural Transfer of Negative Unbalanced Moment at Supports:

Units: Width (in), Munb (k-ft), As (in^2)

Supp	Width	GammaF*Munb	Comb	Pat	AsReq	AsProv	Additional Bars
1	--- Not checked ---						
2	79.50	191.35	U1	Odd	2.593	5.614	---
3	79.50	119.41	U1	Odd	1.607	4.107	---
4	79.50	119.41	U1	Odd	1.607	4.107	---
5	79.50	191.35	U1	Odd	2.593	5.614	---
6	--- Not checked ---						

Punching Shear Around Columns:

Units: Vu (kip), Munb (k-ft), vu (psi), Phi*vc (psi)

Supp	Vu	vu	Munb	Comb	Pat	GammaV	vu	Phi*vc
1	--- Not checked ---							
2	406.33	152.0	-198.16	U1	All	0.400	177.3	189.7
3	358.30	134.0	50.81	U1	All	0.400	140.5	189.7
4	358.30	134.0	-50.81	U1	All	0.400	140.5	189.7
5	406.33	152.0	198.16	U1	All	0.400	177.3	189.7
6	--- Not checked ---							

Punching Shear Around Drops:

Units: Vu (kip), vu (psi), Phi*vc (psi)

Supp	Vu	Comb	Pat	vu	Phi*vc
1	--- Not checked ---				
2	365.70	U1	All	89.3	124.5
3	317.67	U1	All	77.6	124.5
4	317.67	U1	All	77.6	124.5
5	365.70	U1	All	89.3	124.5
6	--- Not checked ---				

Maximum Deflections:

Units: Dz (in)

	Frame			Column Strip			Middle Strip		
Span	Dz(DEAD)	Dz(LIVE)	Dz(TOTAL)	Dz(DEAD)	Dz(LIVE)	Dz(TOTAL)	Dz(DEAD)	Dz(LIVE)	Dz(TOTAL)
1	-0.223	-0.124	-0.347	-0.329	-0.183	-0.512	-0.117	-0.065	-0.182
2	-0.077	-0.076	-0.153	-0.105	-0.102	-0.207	-0.050	-0.049	-0.100
3	-0.095	-0.091	-0.186	-0.128	-0.123	-0.252	-0.062	-0.059	-0.121
4	-0.077	-0.076	-0.153	-0.105	-0.102	-0.207	-0.050	-0.049	-0.100
5	-0.223	-0.124	-0.347	-0.329	-0.183	-0.512	-0.117	-0.065	-0.182

Material Takeoff:

Reinforcement in the Direction of Analysis

Top Bars:	5526.2	lb	<=>	36.84	lb/ft	<=> 1.228 lb/ft^2
Bottom Bars:	5472.6	lb	<=>	36.48	lb/ft	<=> 1.216 lb/ft^2
Stirrups:	0.0	lb	<=>	0.00	lb/ft	<=> 0.000 lb/ft^2
Total Steel:	10998.8	lb	<=>	73.33	lb/ft	<=> 2.444 lb/ft^2
Concrete:	4104.2	ft^3	<=>	27.36	ft^3/ft	<=> 0.912 ft^3/ft^2