Pearl Condominiums

9th & Arch Street
Philadelphia, PA

Technical Assignment #2

Structural Concepts / Structural Existing Conditions Report

October 29, 2007

Faculty Advisor:
Dr. Linda Hanagan

Joseph G. Lichman Jr. Structural Option

http://www.engr.psu.edu/ae/thesis/portfolios/2008/jgl138/

Table of Contents

Joseph G. Lichman Jr.

Executive Summary

The purpose of Technical Assignment #2 is to investigate alternative structural floor systems for the existing hollow core plank system used in the Pearl Condominiums. After the investigation of these systems, I will do a comparative analysis to see which of these solutions are viable based on numerous economic, construction and structural criteria.

Existing System:

The existing floor system is comprised of a 10" Precast Concrete Plank with a ¾" concrete thick topping. Theses planks are supported by 8" metal stud bearing walls.

Alternative Systems:

Four alternative systems were investigated as alternative for Pearl Condominiums:

1. Non-Composite Steel Framing
2. Composite Steel Framing
3. Two Way Slab with Drop Panels
4. Precast Beam with Hollow Core Planks

Conclusion:

After analyzing the four alternative systems it has been determined that the existing floor system was the correct choice for Pearl Condominiums. The precast floor planks work well for use in long spans and the metal stud bearing wall type is easy to construct and is also used to resist lateral forces.

During the analysis, the non-composite and the two way slab with the drop panel were found not to work as well in this situation as the other two possible alternative systems. This is the result from the high total depths and the time needed to construct each floor. The precast beams and hollow core planks work well as long as there is no restriction on overall depth. Also the precast concrete planks can span a greater length while having a shorter depth than a steel beam with a concrete slab. Overall the best system out of the alternative possibilities was the composite steel framing system. The formwork and shoring is minimal because of the metal floor deck. Also the ability for an open floor plan possibility is greater because of the limited reliance on load bearing walls. While these two alternatives performed well enough to be researched further, I feel that the current hollow core planks with metal stud bearing walls as the floor system of the building is the best solution for the structure.

Introduction

Pearl Condominiums is a mixed use development housing including 10 retail units on the ground floor and 90 condominium units on the upper floors. The gross floor area is 111,570 square feet and has 6 stories above grade. The start of construction was March 30, 2006 and the finish date is October 2007. The zoning is C-4 Commercial. Design considerations for the site included the site location existing above a SEPTA commuter rail tunnel.

In this report I will study the typical floors above the second level. On these levels the code required live load is 60 psf. This live load matches the engineer's choice for the project. The engineer also required a superimposed dead load of 25 psf accounting for partitions, MEP and flooring. This is a conservative dead load based on the code required for partitions is 12 psf. This results in 13 psf left for flooring and MEP, which usually can range from 3 to 8 psf depending on the type of flooring. These loads will be used in the analysis of the alternative systems throughout this report.

Structural Codes:

- Building Code
  Philadelphia Building Code 2003. The Philadelphia Building Code 2003 is an adoption of the IBC 2003 with city amendments.
- Structural Concrete
  ACI 318-02 Building Code Requirements for Structural Concrete
- Concrete Masonry
  ACI 530-02 Building Code Requirement for Masonry Structures
- Structural Steel
  American Institute of Steel Construction (AISC)
  LRFD Specification for Structural Steel Buildings – Latest Edition
- Structural Cold Formed Studs
  Specification for the Design of Cold Formed Structural Members

Existing Structural Systems

Foundations:

The primary support for the foundation is the use of drilled piers. The drilled pier option was performed, so the loads from the building would be transferred from the pier to the soil below the SEPTA commuter train tunnel. If a shallow foundation system was chosen, special precautions to not disturb the area around the tunnel would have been needed to be performed. The drilled piers range in size of diameter from 3'-0" to 3'-6" to 4'-0". They also range in depth depending on the rock elevations in the area as described in the geotechnical report.

To help distribute the load to the drilled piers the use of grade beams was employed. They range in width from 12" to 40" and in depth from 18" to 30". The slab on grade is 6" reinforced with 6x6 W2.9xW2.9 WWR over 6" crushed stone over 6 mil. Vapor retarder.

Columns \ Load Bearing Walls:

The columns used on the ends of the building are HSS tube columns sizes of 6"x6" and 8"x8" with varying thickness. Wide flange shapes are also used in select interior spaces ranging from W10X39, W10X49, W12X53, W12X120 and W30X90. The load bearing walls are comprised of 8" metal stud spaced at 16" and 12" on center.

Floor System:

The floor system for level 2 thru 6 is comprised of a 10" Precast Concrete Plank with a ¾" concrete thick topping. The concrete strength of the precast plank is f'c equals 5,000 psi. The plank has a maximum span of 34'-9".

Level two acts as a transfer level, which requires the use of wide flange beam (W36) to be implemented around the area near the Open Entry Drive on the first floor. These beams help to distribute the load from this area and down into the foundation.

Lateral Resisting System:

The Lateral System in the building is comprised of two types: concrete masonry unit shear walls and metal stud shear wall. The concrete masonry unit shear walls are used around the elevator and stairway towers. These walls range from thickness of 10" in the stair areas and 12" in the elevators. The strength of the concrete masonry units (f'm) range from 1500 psi to 2000psi and 3000psi depending on the area they are used in.

The metal stud shear walls are composed of 8" metal studs varying in thickness. The two heights of the studs are 13'-8" and 9'-0". Metal diagonal straps connected by #12 screws to the metal studs and 7/8" diameter anchor bolts connected through different boot types help to resist the lateral forces applied to the metal studs. The metal Studs are covered by gypsum wall board.

Alternative #1: Non-Composite Steel Framing

Designed Used: RAM

The First framing system considered was a non-composite steel framing system. This system consists of a 4” normal weight concrete slab placed on a 2” UF2X 20 Gauge Form Deck.(See A3) This metal deck spans 6’ across W12x14 joists which frame into W18x40 girders. (See A2 for framing plan)

Pros:

- Quick Erection Time
- Simplified erection process (Simple Connections)
- Reduced weight compared to concrete systems

Cons:

- Increase in depth from 10-3/4” to 21-7/8”
- Material cost increase because of increase in member depth, size and quantity
- Require additional fireproofing
- Increased lead time for steel compared to concrete

Alternative #2: Composite Steel Framing

Designed Used: RAM

The Second framing system considered was a composite steel framing system. This system consists of a 6” normal weight concrete slab placed on a 3” LOK-Floor 20 Gauge Form Deck. (See A5) This metal deck spans 6’ across W8x10 joists which frame into W14x22 girders. (See A4 for framing plan) The composite action is facilitated by ¾”Ø shear studs with length 4.5 in.

Pros:

- Added flexural resistance from the use of shear studs
- Depth of steel beams reduced compared to non-composite
- Vibration action with this system is reduced

Cons:

- Increase in depth from 10-3/4” to 19-3/4”
- Require additional fireproofing
- Increased lead time for steel compared to concrete
- With this system larger spans require the beam to be cambered or increase the depth

Alternative #3: Two Way Slab with Drop Panels

Designed Used: CRSI Handbook

The Third framing system considered was a two way slab with drop panels. This system has a span of 33' which requires a depth of 12" for the slab between drop panels. The edge panel drop panel size is 11.33 ft and a depth of 11 in. The edge panel column to support this two way system is 17"x17". (See A-6)

Pros:

- No added requirement for fireproofing
- Short lead time for concrete
- Vibration action with this system is minimal

Cons:

- Increase in depth from 10-3/4" to 23" at drop panel and 12" between drop panels
- Larger walls thickness to hide increase in column size from 8" stud to 12" for concrete column
- Increase in system weight, increase seismic shear force
- Required amount of formwork and shorting increased

Alternative #4: Precast Beams and Hollow Core Planks

Designed Used: PCI Handbook Sixth Edition

The Fourth framing system considered was a combination of precast beams and hollow core planks. This system is composed of precast columns, L-shape and inverted t-shape beams, and hollow core planks. Hollow core planks span 17' which requires a minimum depth of 6" with a 2" concrete topping. To make the planks compatible floor height with the beams, the planks need to be thickness of 10" and a 2" topping cover. (See A7)

The two types of beams that are used in this alternative system are the L-shape and inverted T-shape. (See A8&9 for dimensions) The purpose of this system was to compare the use of hollow core planks bearing on stud walls and precast beams.

Pros:

- No added requirement for fireproofing
- Vibration action with this system is minimal
- Open floor plans with use of precast beams compared to stud bearing walls
- Minimal formwork and shorting

Cons:

- Longer lead time than typical concrete construction
- Precast concrete beams (24") are deeper than required for steel construction (11-7/8")
- Increase in weight, which will increase in seismic shear force

Comparison & Conclusion

Criteria	Hollow Core Planks\Metal Stud Wall	Non-Composite	Composite	Two Way Slab W\ Drop Panel	Precast Beams\ Hollow Core Planks
Cost/SF	18.12	20.30	21.65	18.50	22.35
Slab Depth	10-3/4”	4”	6”	12”	12”
Total Depth	10-3/4”	21-7/8”	19-3/4”	23”	24”
Added Fire Protection	Yes	Yes	Yes	No	No
Vibration Issue	Average	Average	Average	Above Average	Above Average
Long Lead Time	Yes	Yes	Yes	No	Yes
Form Work	No	No	No	Yes	No
Construction Difficulty	Easy	Easy	Medium	Medium-Hard	Easy
Fast Erection Time	No	Yes	Yes	No	Yes
Foundation Impact	-	Yes*	Yes*	Yes	Yes
Lateral System Effect	-	Yes	Yes	Yes	Yes
Viable Solution	-	No	Yes	No	Yes

* With steel construction, the building weight has the possibility for a reduced building weight

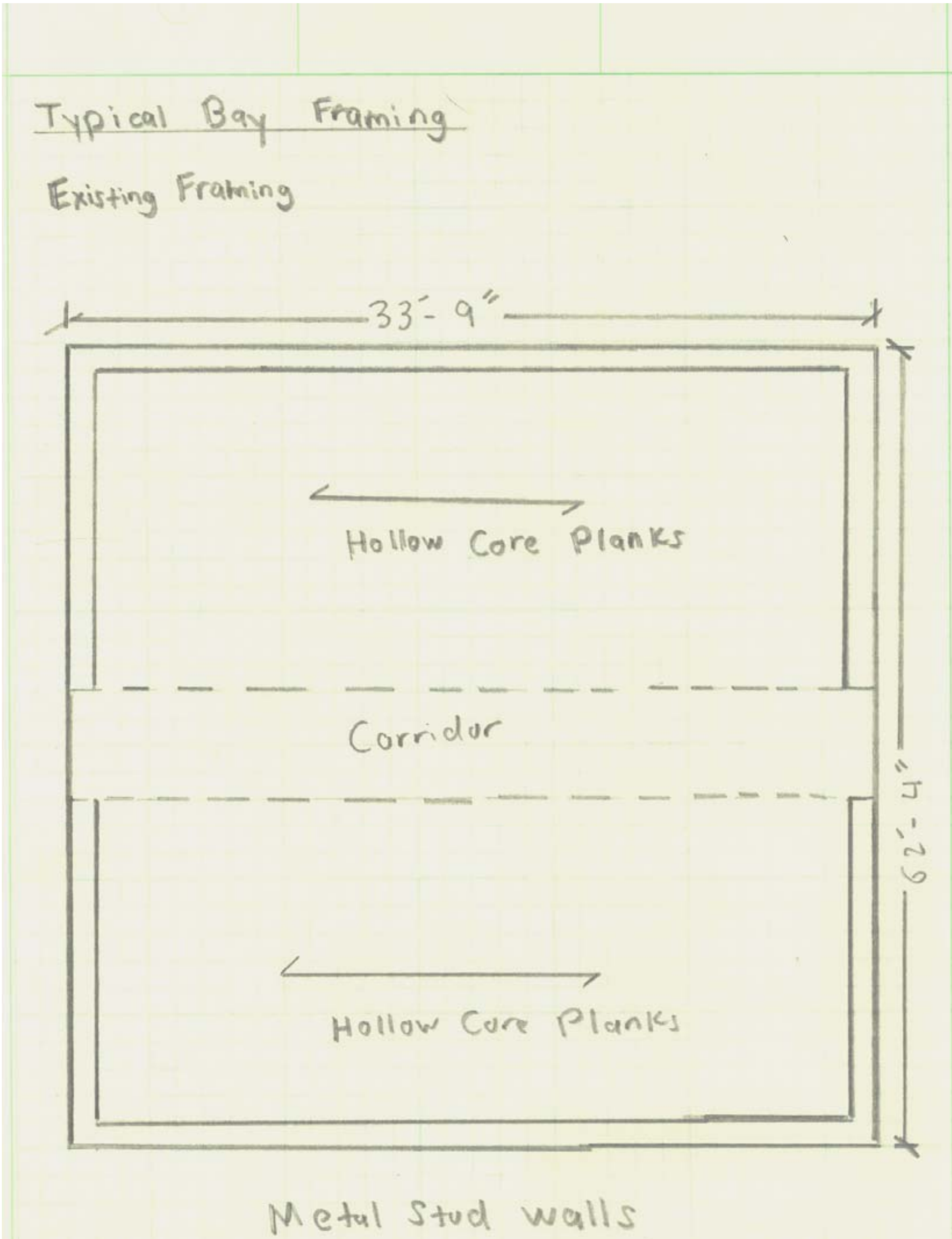
Conclusion:

After analyzing the four alternative systems it was clear that the existing floor system was the correct choice for Pearl Condominiums. The precast floor planks work well for use in long spans and the metal stud bearing wall type is easy to construct and is also used to resist lateral forces.

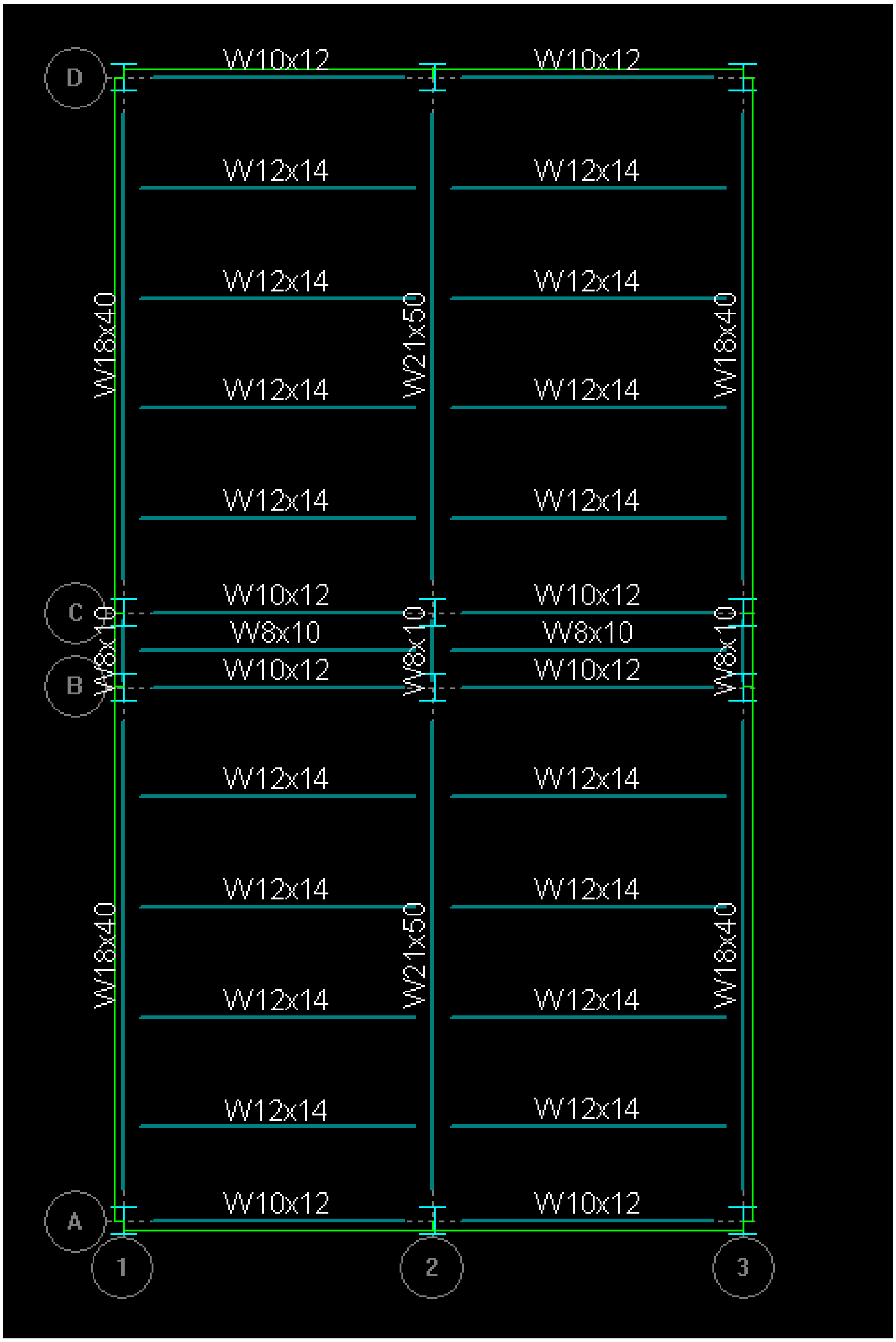
From the four alternatives, the best system from my analysis was the Composite steel framing. One of the main reason was the overall depth out of the four was the least. Even though the cost per square foot is the second largest, the overall weight will be less and the ability for open floor plans will be increased. This is possible because of the implementation of a column grid instead of metal stud load bearing walls.

Appendix

Typical Bay Framing



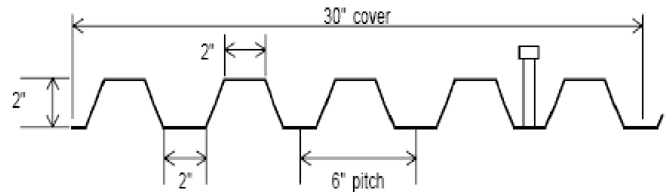
Alternative #1: Non-Composite Steel Framing



USD - UF2X Metal Form Deck

SECTION PROPERTIES						ASD			LRFD		
Metal Thickness		Wt.	I_p	S_p	S_n	V	R_1	R_2	ϕV	ϕR_1	ϕR_2
Gage	Inches	(psf)	(in.⁴)	(in.³)	(in.3)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)	(lbs)
24	0.0239	1.50	0.232	0.192	0.200	2360	360	836	3223	532	1156
22	0.0295	2.00	0.300	0.252	0.263	4205	528	1484	5477	736	1992
20	0.0358	2.00	0.379	0.325	0.339	6062	728	2224	8067	1004	3064
18	0.0474	3.00	0.523	0.468	0.485	8796	1204	3948	11182	1648	5388

UF2X



The bottom flange can accept a ¾" shear stud.

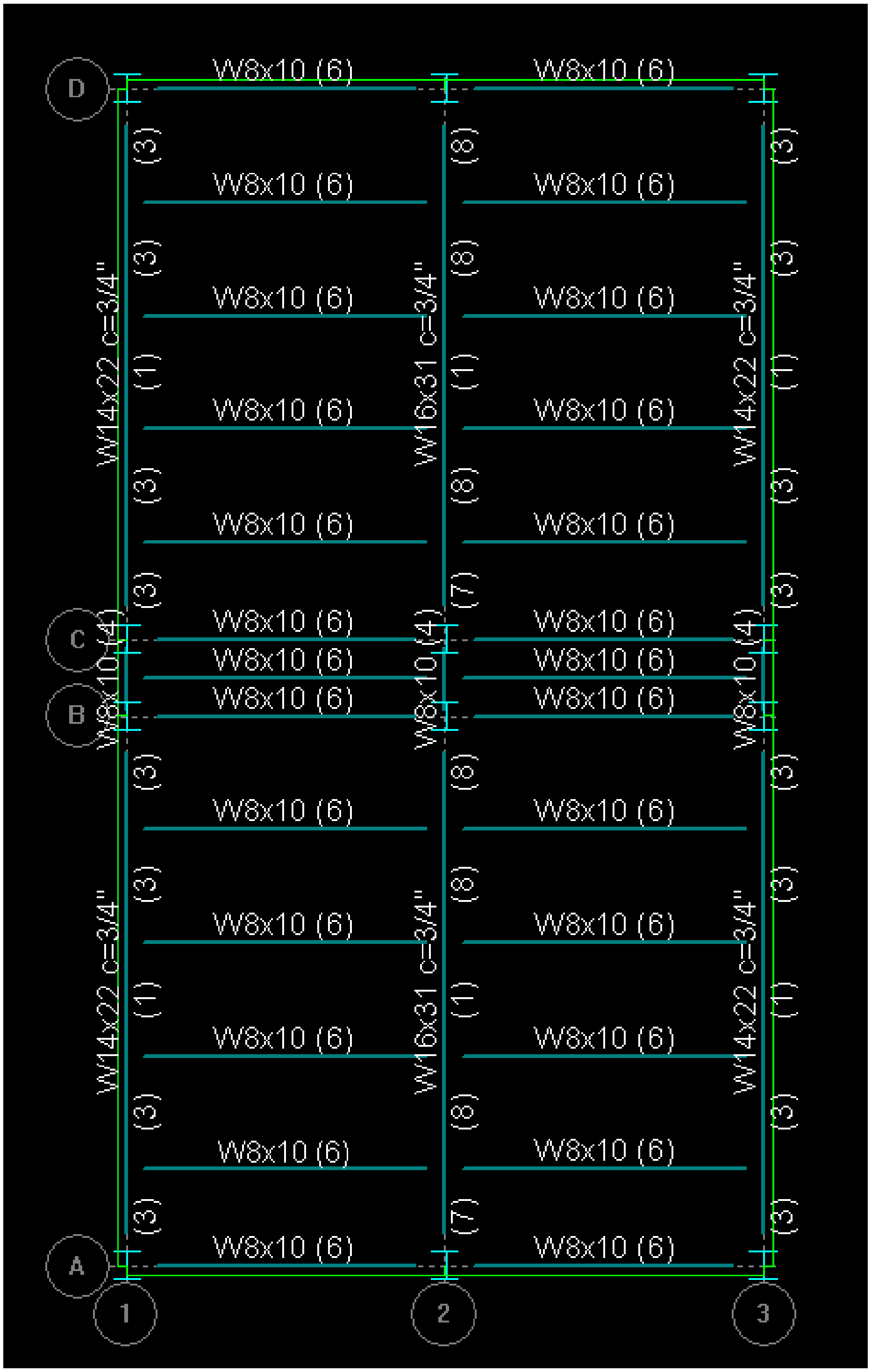
approx. scale: 1½" = 1'0"

UNIFORM TOTAL LOAD / Load that Produces l/180 Deflection, psf

	Gage	Span Condition	Span 6'0"	6'6"	7'0"	7'6"	8'0"	8'6"	9'0"	9'6"	10'0"
ASD	24	Single	128 / 94	109 / 74	94 / 59	82 / 48	72 / 40	64 / 33	57 / 28	51 / 24	46 / 20
ASD	24	Double	130 / 226	111 / 178	96 / 143	84 / 116	74 / 96	66 / 80	59 / 67	53 / 57	48 / 49
ASD	24	Triple	162 / 177	138 / 139	120 / 112	105 / 91	92 / 75	82 / 62	73 / 52	66 / 45	59 / 38
ASD	22	Single	168 / 122	143 / 96	123 / 77	108 / 62	94 / 51	84 / 43	75 / 36	67 / 31	60 / 26
ASD	22	Double	173 / 293	148 / 230	128 / 184	111 / 150	98 / 123	87 / 103	78 / 87	70 / 74	63 / 63
ASD	22	Triple	215 / 229	184 / 180	159 / 144	139 / 117	122 / 97	108 / 81	97 / 68	87 / 58	78 / 49
ASD	20	Single	217 / 154	185 / 121	159 / 97	139 / 79	122 / 65	108 / 54	96 / 46	86 / 39	78 / 33
ASD	20	Double	224 / 370	191 / 291	165 / 233	144 / 189	126 / 156	112 / 130	100 / 110	90 / 93	81 / 80
ASD	20	Triple	279 / 289	238 / 228	205 / 182	179 / 148	158 / 122	140 / 102	125 / 86	112 / 73	101 / 63
ASD	18	Single	312 / 212	266 / 167	229 / 133	200 / 109	176 / 89	155 / 75	139 / 63	124 / 53	112 / 46
ASD	18	Double	320 / 510	273 / 401	236 / 321	206 / 261	181 / 215	160 / 179	143 / 151	128 / 129	116 / 110
ASD	18	Triple	399 / 399	340 / 314	294 / 252	256 / 204	226 / 168	200 / 140	179 / 118	160 / 101	145 / 86
LRFD	24	Single	177 / 94	164 / 74	149 / 59	130 / 48	114 / 40	101 / 33	90 / 28	81 / 24	73 / 20
LRFD	24	Double	154 / 226	142 / 178	132 / 143	123 / 116	116 / 96	104 / 80	93 / 67	83 / 57	75 / 49
LRFD	24	Triple	175 / 177	162 / 139	150 / 112	140 / 91	131 / 75	124 / 62	115 / 52	103 / 45	94 / 38
LRFD	22	Single	245 / 122	226 / 96	195 / 77	170 / 62	150 / 51	133 / 43	118 / 36	106 / 31	96 / 26
LRFD	22	Double	266 / 293	233 / 230	201 / 184	176 / 150	155 / 123	137 / 103	122 / 87	110 / 74	99 / 63
LRFD	22	Triple	302 / 229	279 / 180	250 / 144	218 / 117	192 / 97	171 / 81	152 / 68	137 / 58	124 / 49
LRFD	20	Single	335 / 154	292 / 121	252 / 97	220 / 79	193 / 65	171 / 54	152 / 46	137 / 39	124 / 33
LRFD	20	Double	353 / 370	301 / 291	260 / 233	227 / 189	200 / 156	177 / 130	158 / 110	142 / 93	128 / 80
LRFD	20	Triple	418 / 289	375 / 228	324 / 182	283 / 148	249 / 122	221 / 102	197 / 86	177 / 73	160 / 63
LRFD	18	Single	494 / 212	421 / 167	363 / 133	316 / 109	278 / 89	246 / 75	220 / 63	197 / 53	178 / 46
LRFD	18	Double	505 / 510	431 / 401	372 / 321	325 / 261	286 / 215	253 / 179	226 / 151	203 / 129	183 / 110
LRFD	18	Triple	627 / 399	536 / 314	463 / 252	404 / 204	356 / 168	316 / 140	282 / 118	253 / 101	229 / 86

Joseph G. Lichman Jr.

Alternative #2: Composite Steel Framing



USD – 3” LOK-Floor Deck

3 x 12" DECK F_y = 33ksi f'_c = 3 ksi 145 pcf concrete

LRFD

Gage	Slab Depth	φMn in.k	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50	15.00
			L, Uniform Live Loads, psf *												
22 gage	5.50	52.80	235	205	180	160	145	130	115	105	95	85	75	65	60
22 gage	6.00	59.89	265	235	205	185	165	145	130	120	105	95	85	75	70
22 gage	6.50	66.97	300	265	230	205	185	165	145	130	120	105	95	85	75
22 gage	7.00	74.05	330	290	255	230	205	180	165	145	130	120	105	95	85
22 gage	7.50	81.13	360	320	280	250	225	200	180	160	145	130	115	105	95
22 gage	8.00	88.22	395	345	305	275	245	220	195	175	155	140	125	115	105
22 gage	8.25	91.76	400	360	320	285	255	225	205	180	165	145	135	120	105
22 gage	8.50	95.30	400	375	330	295	265	235	210	190	170	155	140	125	110
20 gage	5.50	62.81	285	250	225	200	180	160	145	130	115	105	95	85	80
20 gage	6.00	71.37	325	285	255	225	205	185	165	150	135	120	110	100	90
20 gage	6.50	79.92	365	320	285	255	230	205	185	165	150	135	125	110	100
20 gage	7.00	88.48	400	355	315	285	255	225	205	185	165	150	135	125	110
20 gage	7.50	97.03	400	390	350	310	280	250	225	205	185	165	150	135	125
20 gage	8.00	105.59	400	400	380	340	305	270	245	220	200	180	165	150	135
20 gage	8.25	109.87	400	400	395	350	315	285	255	230	210	190	170	155	140
20 gage	8.50	114.15	400	400	400	365	330	295	265	240	215	195	180	160	145
19 gage	5.50	72.04	335	295	260	235	210	190	170	155	140	125	115	105	95
19 gage	6.00	82.00	380	335	300	265	240	215	195	175	160	145	130	120	110
19 gage	6.50	91.95	400	375	335	300	270	245	220	200	180	165	150	135	125
19 gage	7.00	101.91	400	400	375	335	300	270	245	220	200	180	165	150	135
19 gage	7.50	111.87	400	400	400	365	330	295	270	240	220	200	180	165	150
19 gage	8.00	121.83	400	400	400	400	360	325	290	265	240	220	200	180	165
19 gage	8.25	126.81	400	400	400	400	375	335	305	275	250	225	205	190	170
19 gage	8.50	131.78	400	400	400	400	390	350	315	285	260	235	215	195	180
18 gage	5.50	80.96	380	335	300	270	240	215	195	180	160	145	135	120	110
18 gage	6.00	92.32	400	385	340	305	275	250	225	205	185	170	155	140	130
18 gage	6.50	103.68	400	400	385	345	310	280	255	230	210	190	175	160	145
18 gage	7.00	115.04	400	400	400	385	345	310	280	255	230	210	195	175	160
18 gage	7.50	126.40	400	400	400	400	380	340	310	280	255	235	210	195	180
18 gage	8.00	137.76	400	400	400	400	400	375	340	305	280	255	230	210	195
18 gage	8.25	143.44	400	400	400	400	400	390	350	320	290	265	240	220	200

☐ 1 STUD/FT.

☐ NO STUDS

* The **Uniform Live Loads** are based on the LRFD equation $\phi M_n = (1.6L + 1.2D)l^2/8$. Although there are other load combinations that may require investigation, this will control most of the time. The equation assumes there is no negative bending reinforcement over the beams and therefore each composite slab is a single span. Two sets of values are shown; ϕM_{nf} is used to calculate the uniform load when the full required number of studs is present; ϕM_{no} is used to calculate the load when no studs are present. A straight line interpolation can be done if the average number of

Alternative #3: Two Way Slab with Drop Panels

f'_c = 4,000 psi
Grade 60 Bars

FLAT SLAB SYSTEM
SQUARE EDGE PANEL With Drop Panels
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)
h = 12 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS														
30	100	7.00	10.00	12	0.808	14-#5 3	12-#7	16-#6	15-#5	13-#5	3.10	257.4	514.8	693.0
30	200	9.00	10.00	16	0.707	14-#5 3	15-#7	18-#6	10-#7	11-#6	3.65	329.4	658.8	886.8
30	300	9.00	10.00	19	0.763	15-#5 5	12-#9	22-#6	12-#7	19-#5	4.62	401.5	803.1	1081.0
30	400	11.00	10.00	21	0.661	16-#5 3	17-#8	14-#8	11-#8	12-#7	5.27	473.2	946.3	1273.9
30	500	11.00	12.00	24	0.766	19-#5 6	13-#10	16-#8	13-#8	11-#8	6.20	545.2	1090.4	1467.9
31	100	9.00	10.33	12	0.729	14-#5 2	13-#7	16-#6	16-#5	14-#5	3.12	285.7	571.4	769.2
31	200	9.00	10.33	16	0.766	14-#5 5	13-#8	15-#7	11-#7	13-#6	3.96	364.7	729.3	981.8
31	300	11.00	10.33	19	0.683	15-#5 4	13-#9	16-#7	18-#6	15-#6	4.76	444.4	888.7	1196.4
31	400	11.00	10.33	22	0.749	18-#5 6	19-#8	15-#8	16-#7	18-#6	5.68	522.9	1045.8	1407.8
31	500	11.00	12.40	27	0.755	15-#6 4	18-#9	14-#9	12-#9	12-#8	6.78	599.3	1198.5	1613.4
32	100	9.00	10.67	12	0.794	15-#5 5	11-#8	17-#6	13-#6	15-#5	3.33	314.9	629.9	847.9
32	200	11.00	10.67	16	0.640	15-#5 2	12-#9	15-#7	13-#7	19-#5	4.27	403.4	806.8	1086.1
32	300	11.00	10.67	19	0.757	17-#5 6	18-#8	18-#7	12-#8	13-#7	5.16	490.7	981.3	1321.0
32	400	11.00	12.80	25	0.729	20-#5 5	14-#10	16-#8	11-#9	12-#8	6.21	575.3	1150.7	1549.0
32	500	11.00	12.80	30	0.718	16-#6 4	16-#10	15-#9	13-#9	13-#8	7.14	651.1	1302.2	1752.9
33	100	11.00	11.00	12	0.678	15-#5 1	16-#7	17-#6	14-#6	12-#6	3.44	347.3	694.7	935.1
33	200	11.00	11.00	16	0.743	15-#5 5	13-#9	16-#7	18-#6	15-#6	4.45	443.7	887.5	1194.7
33	300	11.00	11.00	21	0.747	19-#5 5	13-#10	15-#8	22-#6	11-#8	5.55	537.1	1074.2	1446.0
33	400	11.00	13.20	28	0.721	22-#5 6	15-#10	18-#8	12-#9	16-#7	6.55	628.5	1257.0	1692.2
33	500	11.00	13.20	33	0.680	17-#6 3	17-#10	16-#9	11-#10	14-#8	7.47	705.8	1411.6	1900.3
34	100	11.00	11.33	12	0.752	16-#5 4	14-#8	19-#6	12-#7	13-#6	3.74	380.6	761.2	1024.7
34	200	11.00	11.33	17	0.767	17-#5 6	14-#9	18-#7	12-#8	13-#7	4.83	485.4	970.8	1306.8
34	300	11.00	11.33	24	0.699	20-#5 4	17-#9	17-#8	14-#8	12-#8	5.88	584.8	1169.6	1574.5
34	400	11.00	13.60	30	0.700	17-#6 3	17-#10	19-#8	13-#9	14-#8	7.00	681.2	1362.3	1833.9
35	100	11.00	11.67	12	0.795	16-#5 6	12-#9	16-#7	13-#7	14-#6	3.95	415.9	831.9	1119.8
35	200	11.00	11.67	19	0.752	18-#5 6	19-#8	16-#8	16-#7	18-#6	4.98	528.2	1056.4	1422.1
35	300	11.00	11.67	26	0.715	22-#5 6	15-#10	18-#8	12-#9	22-#6	6.24	636.9	1273.8	1714.8
35	400	11.00	14.00	33	0.706	18-#6 5	18-#10	17-#9	14-#9	12-#9	7.34	734.7	1469.4	1978.1
36	100	11.00	12.00	14	0.767	16-#5 6	13-#9	22-#6	14-#7	12-#7	4.17	451.1	902.3	1214.6
36	200	11.00	12.00	21	0.760	20-#5 7	17-#9	16-#8	14-#8	12-#8	5.45	573.5	1147.0	1544.0
36	300	11.00	12.00	29	0.704	17-#6 5	17-#10	16-#9	13-#9	14-#8	6.66	686.8	1373.6	1849.1
36	400	11.00	14.40	36	0.660	27-#5 5	19-#10	18-#9	19-#8	13-#9	7.67	793.0	1586.1	2135.1

SQUARE INTERIOR PANEL
With Drop Panel(2)
No Beams

SPAN (ft)	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 = 12 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS								
30	100	12	15-#6	15-#5	13-#5	13-#5	2.82	1.065
30	200	19	23-#5	19-#5	15-#5	13-#5	3.16	1.083
30	300	22	15-#7	17-#6	10-#7	15-#5	4.02	1.083
30	400	25	16-#7	11-#8	11-#7	18-#5	4.59	1.102
30	500	27	14-#8	13-#8	10-#8	11-#7	5.31	1.147
31	100	12	20-#5	12-#6	13-#5	13-#5	2.78	1.083
31	200	19	26-#5	11-#7	16-#5	14-#5	3.41	1.083
31	300	23	15-#7	18-#6	14-#6	12-#6	4.10	1.102
31	400	25	14-#8	16-#7	13-#7	14-#6	4.98	1.102
31	500	27	16-#8	12-#9	11-#8	13-#7	5.93	1.147
32	100	12	16-#6	18-#5	14-#5	14-#5	2.90	1.083
32	200	19	26-#5	17-#6	13-#6	15-#5	3.57	1.102
32	300	23	22-#6	15-#7	12-#7	13-#6	4.43	1.102
32	400	26	15-#8	11-#9	11-#8	12-#7	5.37	1.147
32	500	30	17-#8	13-#9	12-#8	18-#6	6.12	1.147
33	100	12	16-#6	14-#6	11-#6	14-#5	2.97	1.102
33	200	19	15-#7	18-#6	14-#6	12-#6	3.82	1.102
33	300	23	18-#7	22-#6	13-#7	11-#7	4.71	1.102
33	400	26	17-#8	12-#9	12-#8	13-#7	5.74	1.147
33	500	33	15-#9	11-#1	13-#8	11-#8	6.52	1.147
34	100	12	18-#6	22-#5	12-#6	15-#5	3.16	1.102
34	200	19	22-#6	15-#7	12-#7	13-#6	4.13	1.102
34	300	23	16-#8	14-#8	14-#7	12-#7	5.15	1.102
34	400	29	18-#8	14-#9	22-#6	14-#7	6.07	1.147
35	100	12	19-#6	17-#6	13-#6	16-#5	3.32	1.102
35	200	19	18-#7	22-#6	13-#7	20-#5	4.31	1.102
35	300	23	17-#8	20-#7	12-#8	13-#7	5.43	1.102
35	400	32	16-#9	18-#8	14-#8	12-#8	6.42	1.147
36	100	12	16-#7	14-#7	20-#5	17-#5	3.58	1.102
36	200	19	37-#5	14-#8	14-#7	12-#7	4.71	1.102
36	300	25	18-#8	17-#8	22-#6	14-#7	5.68	1.102
36	400	34	17-#9	13-#10	12-#9	22-#6	6.84	1.147

NOTES: (1) 50 percent of these bars may be place in the middle third of column strip. (2) Drop panels same size as for edge panels. (3) Same column size above and below slab.

CONCRETE REINFORCING STEEL INSTITUTE

10-31

Alternative #4: Precast Beams and Hollow Core Planks

Hollow Core Planks

Strand Pattern Designation
48-S

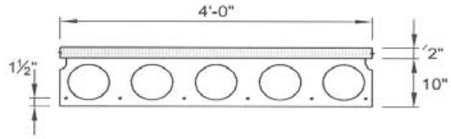
- S = straight
- Diameter of strand in 16ths
- No. of Strand (4)

Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load. Long-time cambers include superimposed dead load but do not include live load.

Capacity of sections of other configurations are similar. For precise values, see local hollow-core manufacturer.

Key
258 – Safe superimposed service load, psf
0.3 – Estimated camber at erection, in.
0.4 – Estimated long-time camber, in.

HOLLOW-CORE
4'-0" x 10"
Normal Weight Concrete



f'_c = 5,000 psi
f_{pu} = 270,000 psi

Section Properties

	Untopped	Topped
A =	259 in.^{2}	355 in.^{2}
I =	3,223 in.^{4}	5,328 in.^{4}
y_b =	5.00 in.	6.34 in.
y_t =	5.00 in.	5.66 in.
S_b =	645 in.^{3}	840 in.^{3}
S_t =	645 in.^{3}	941 in.^{3}
wt =	270 plf	370 plf
DL =	68 psf	93 psf
V/S =	2.23 in.	

4HC10

Table of safe superimposed service load (psf) and cambers (in.) — **No Topping**

Strand Designation Code	Span, ft																										
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
48-S	258	234	209	187	168	151	136	123	111	100	90	82	74	66	60	54	48	43	38	34	30	26					
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0	−0.1	−0.2	−0.3	−0.4	−0.6	−0.7	−0.9					
	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.2	0.1	0.0	−0.1	−0.2	−0.3	−0.5	−0.7	−0.8	−1.1	−1.3	−1.3	−1.9					
58-S	267	249	237	223	211	197	179	162	148	134	122	112	102	93	85	77	70	64	58	53	48	43	39	35	30	26	
	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.0	−0.1	−0.3	−0.4	−0.6	−0.7	−0.9	−1.2	
	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.3	0.2	0.1	0.0	−0.1	−0.3	−0.5	−0.7	−1.0	−1.2	−1.5	−1.8	−2.2	−2.6	
68-S	273	255	243	229	217	206	196	187	176	162	153	141	129	118	109	100	92	84	78	71	65	60	54	49	44	39	34
	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.3	0.2	0.1	−0.1	−0.2	−0.4	−0.6	−0.8
	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.2	0.1	−0.1	−0.3	−0.6	−0.8	−1.1	−1.4	−1.8	−2.2
78-S	282	264	249	235	223	212	202	193	185	174	165	153	144	136	129	119	113	104	96	89	82	76	69	63	57	52	47
	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.1	0.0	−0.2
	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.8	0.6	0.5	0.3	0.1	−0.1	−0.4	−0.7	−1.0	−1.3
88-S	288	270	255	241	229	218	208	199	188	180	174	165	153	145	135	128	122	115	106	101	96	91	84	77	71	65	59
	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.5	0.3
	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.5	1.5	1.4	1.4	1.4	1.3	1.2	1.2	1.0	0.9	0.7	0.6	0.3	0.1	−0.2	−0.5

4HC10 + 2

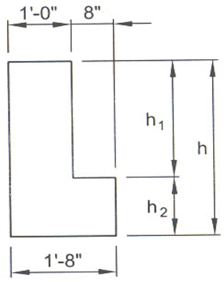
Table of safe superimposed service load (psf) and camber (in.) — **2 in. Normal Weight Topping**

Strand Designation Code	Span, ft																										
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
48-S	308	287	256	228	204	183	165	148	133	119	107	96	86	74	63	52	43	34	26								
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0	−0.1	−0.2	−0.3	−0.4								
	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0	−0.1	−0.2	−0.3	−0.4	−0.6	−0.8	−1.0	−1.2	−1.4	−1.7								
58-S	317	298	282	267	252	237	219	198	180	163	148	134	120	105	92	80	69	59	50	41	33	26					
	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.0	−0.1	−0.3	−0.4					
	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.0	−0.1	−0.2	−0.4	−0.5	−0.7	−0.9	−1.2	−1.5	−1.8	−2.1					
68-S	326	307	291	273	258	246	234	222	212	202	188	171	153	137	122	108	96	84	74	64	55	46	38	31			
	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.3	0.2	0.1	−0.1	−0.2			
	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.2	0.0	−0.1	−0.3	−0.5	−0.7	−0.9	−1.2	−1.5	−1.8	−2.2			
78-S	335	313	297	279	267	252	240	228	218	208	196	189	181	165	150	135	122	109	97	86	76	67	58	50	42	35	28
	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.6	0.5	0.4	0.3	0.1	0.0	−0.2
	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.2	0.0	−0.2	−0.4	−0.6	−0.9	−1.2	−1.6	−1.9	−2.3	−2.8
88-S	344	322	306	288	273	258	246	234	221	211	202	195	184	178	172	158	144	130	118	107	96	87	77	68	60	52	44
	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.5	0.3
	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.7	0.6	0.4	0.3	0.1	−0.1	−0.3	−0.6	−0.9	−1.3	−1.6	−2.0

Strength is based on strain compatibility; bottom tension is limited to $7.5\sqrt{f'_c}$; see pages 2–7 through 2–10 for explanation.

L-Shape Precast Beam

L-BEAMS



f'_c = 5,000 psi
f_{pu} = 270,000 psi
½ in. diameter
low-relaxation strand

Normal Weight Concrete

Designation	h in.	h_1/h_2 in./in.	A in.^{2}	I in.^{4}	y_b in.	S_b in.^{3}	S_t in.^{3}	wt plf
20LB20	20	12/8	304	10,160	8.74	1,163	902	317
20LB24	24	12/12	384	17,568	10.50	1,673	1,301	400
20LB28	28	16/12	432	27,883	12.22	2,282	1,767	450
20LB32	32	20/12	480	41,600	14.00	2,971	2,311	500
20LB36	36	24/12	528	59,119	15.82	3,737	2,930	550
20LB40	40	24/16	608	81,282	17.47	4,653	3,608	633
20LB44	44	28/16	656	108,107	19.27	5,610	4,372	683
20LB48	48	32/16	704	140,133	21.09	6,645	5,208	733
20LB52	52	36/16	752	177,752	22.94	7,749	6,117	783
20LB56	56	40/16	800	221,355	24.80	8,926	7,095	833
20LB60	60	44/16	848	271,332	26.68	10,170	8,143	883

1. Check local area for availability of other sizes.
2. Safe loads shown include 50% superimposed dead load and 50% live load. 800 psi top tension has been allowed, therefore, additional top reinforcement is required.
3. Safe loads can be significantly increased by use of structural composite topping.

Key
6566 – Safe superimposed service load, plf.
0.3 – Estimated camber at erection, in.
0.1 – Estimated long-time camber, in.

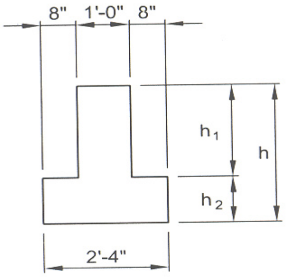
Table of safe superimposed service load (plf) and cambers (in.)

Desig-nation	No. Strand	y_s(end) in. y_s(center) in.	Span, ft: 16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
20LB20	98-S	2.44 2.44	6566 0.3 0.1	5131 0.4 0.2	4105 0.5 0.2	3345 0.6 0.2	2768 0.7 0.2	2318 0.8 0.2	1961 0.9 0.3	1674 1.0 0.3	1438 1.0 0.3	1243 1.1 0.3	1079 1.2 0.2							
20LB24	108-S	2.80 2.80	9577 0.3 0.1	7495 0.3 0.1	6006 0.4 0.1	4904 0.5 0.1	4066 0.5 0.1	3414 0.6 0.2	2896 0.7 0.2	2479 0.8 0.2	2137 0.9 0.2	1854 0.9 0.2	1617 1.0 0.1	1416 1.0 0.1	1244 1.1 0.1	1097 1.1 0.0	969 1.2 0.0			
20LB28	128-S	3.33 3.33			8228 0.4 0.1	6733 0.4 0.1	5596 0.5 0.2	4711 0.6 0.2	4009 0.6 0.2	3443 0.7 0.2	2979 0.8 0.2	2595 0.9 0.2	2273 0.9 0.2	2000 1.0 0.2	1768 1.1 0.2	1567 1.1 0.2	1394 1.2 0.1	1243 1.2 0.1	1110 1.2 0.0	992 1.3 0.0
20LB32	148-S	3.71 3.71				8942 0.4 0.1	7446 0.5 0.2	6281 0.5 0.2	5356 0.6 0.2	4611 0.7 0.2	4001 0.7 0.2	3495 0.8 0.2	3071 0.9 0.3	2712 1.0 0.3	2406 1.0 0.3	2143 1.1 0.2	1914 1.2 0.2	1715 1.2 0.2	1540 1.3 0.2	1386 1.3 0.1
20LB36	168-S	4.25 4.25					9457 0.4 0.2	7988 0.5 0.2	6823 0.5 0.2	5883 0.6 0.2	5113 0.7 0.2	4476 0.8 0.3	3941 0.8 0.3	3489 0.9 0.3	3103 1.0 0.3	2771 1.1 0.3	2483 1.1 0.3	2231 1.2 0.3	2011 1.2 0.3	1816 1.3 0.2
20LB40	188-S	4.89 4.89						9812 0.4 0.2	8386 0.5 0.2	7235 0.6 0.2	6293 0.6 0.2	5513 0.7 0.2	4858 0.8 0.2	4305 0.8 0.3	3832 0.9 0.3	3425 1.0 0.3	3073 1.0 0.3	2765 1.1 0.3	2495 1.1 0.3	2257 1.2 0.3
20LB44	198-S	5.05 5.05								8959 0.5 0.2	7803 0.6 0.2	6845 0.6 0.2	6042 0.7 0.2	5363 0.8 0.2	4783 0.8 0.2	4284 0.9 0.2	3851 0.9 0.2	3474 1.0 0.2	3143 1.1 0.2	2850 1.1 0.2
20LB48	218-S	5.81 5.81									9226 0.5 0.2	8100 0.6 0.2	7158 0.6 0.2	6360 0.7 0.2	5678 0.8 0.2	5092 0.8 0.2	4584 0.9 0.3	4140 0.9 0.3	3751 1.0 0.3	3408 1.1 0.3
20LB52	238-S	6.17 6.17										9634 0.6 0.2	8521 0.6 0.2	7578 0.7 0.2	6774 0.7 0.3	6082 0.8 0.3	5482 0.9 0.3	4958 0.9 0.3	4499 1.0 0.3	4094 1.0 0.3
20LB56	258-S	6.64 6.64											9954 0.6 0.2	8860 0.7 0.2	7927 0.7 0.3	7124 0.8 0.3	6427 0.8 0.3	5820 0.9 0.3	5287 1.0 0.3	4816 1.0 0.3
20LB60	278-S	7.33 7.33													9089 0.7 0.3	8173 0.7 0.3	7380 0.8 0.3	6688 0.9 0.3	6080 0.9 0.3	5544 1.0 0.3

Inverted T-Shape Precast Beam

INVERTED TEE BEAMS

Normal Weight Concrete



f'_c = 5,000 psi
f_{pu} = 270,000 psi
½ in. diameter
low-relaxation strand

Section Properties

Designation	h in.	h_1/h_2 in./in.	A $in.^2$	I $in.^4$	y_b in.	S_b $in.^3$	S_t $in.^3$	wt plf
28IT20	20	12/8	368	11,688	7.91	1,478	967	383
28IT24	24	12/12	480	20,275	9.60	2,112	1,408	500
28IT28	28	16/12	528	32,076	11.09	2,892	1,897	550
28IT32	32	20/12	576	47,872	12.67	3,778	2,477	600
28IT36	36	24/12	624	68,101	14.31	4,759	3,140	650
28IT40	40	24/16	736	93,503	15.83	5,907	3,869	767
28IT44	44	28/16	784	124,437	17.43	7,139	4,683	817
28IT48	48	32/16	832	161,424	19.08	8,460	5,582	867
28IT52	52	36/16	880	204,884	20.76	9,869	6,558	917
28IT56	56	40/16	928	255,229	22.48	11,354	7,614	967
28IT60	60	44/16	976	312,866	24.23	12,912	8,747	1,017

1. Check local area for availability of other sizes.
2. Safe loads shown include 50% superimposed dead load and 50% live load. 800 psi top tension has been allowed, therefore, additional top reinforcement is required.
3. Safe loads can be significantly increased by use of structural composite topping.

Key
6511 – Safe superimposed service load, plf.
0.2 – Estimated camber at erection, in.
0.1 – Estimated long-time camber, in.

Table of safe superimposed service load (plf) and cambers (in.)

Desig-nation	No. Strand	y_s(end) in. y_s(center) in.	Span, ft 16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
28IT20	98-S	2.44 2.44	6511 0.2 0.1	5076 0.3 0.1	4049 0.4 0.1	3289 0.4 0.1	2711 0.5 0.1	2262 0.5 0.1	1905 0.6 0.0	1617 0.7 0.0	1381 0.7 0.0	1186 0.7 0.0	1022 0.8 –0.1							
28IT24	188-S	2.73 2.73	9612 0.2 0.1	7504 0.3 0.1	5997 0.3 0.1	4882 0.4 0.1	4034 0.4 0.1	3374 0.5 0.1	2850 0.6 0.1	2427 0.6 0.1	2081 0.7 0.1	1795 0.7 0.1	1555 0.7 0.0	1351 0.8 0.0	1178 0.8 –0.1	1029 0.8 –0.2				
28IT28	138-S	3.08 3.08			8353 0.3 0.1	6822 0.3 0.1	5657 0.4 0.1	4750 0.5 0.1	4031 0.5 0.1	3451 0.6 0.1	2976 0.6 0.1	2582 0.7 0.1	2252 0.7 0.1	1973 0.8 0.1	1735 0.8 0.0	1530 0.8 0.0	1352 0.9 –0.1	1197 0.8 –0.2	1061 0.8 –0.2	
28IT32	158-S	3.47 3.47				9049 0.3 0.1	7521 0.4 0.1	5333 0.4 0.1	5389 0.5 0.1	4628 0.5 0.1	4006 0.6 0.1	3490 0.6 0.1	3057 0.7 0.1	2691 0.7 0.1	2379 0.8 0.1	2110 0.8 0.1	1876 0.9 0.0	1673 0.9 0.0	1495 0.9 0.0	1337 0.9 –0.1
28IT36	168-S	3.50 3.50					9832 0.3 0.1	8295 0.4 0.1	7075 0.4 0.1	6092 0.5 0.1	5287 0.5 0.1	4619 0.6 0.1	4060 0.6 0.1	3587 0.7 0.1	3183 0.7 0.1	2835 0.8 0.1	2534 0.8 0.0	2271 0.9 0.0	2040 0.9 0.0	1836 0.9 –0.1
28IT40	198-S	4.21 4.21							8638 0.4 0.1	7440 0.5 0.1	6460 0.5 0.1	5647 0.6 0.1	4966 0.6 0.1	4390 0.7 0.1	3898 0.7 0.1	3474 0.8 0.1	3107 0.8 0.1	2787 0.8 0.1	2506 0.9 0.1	2258 0.9 0.1
28IT44	208-S	4.40 4.40								9186 0.4 0.1	7989 0.5 0.1	6997 0.5 0.1	6165 0.6 0.1	5462 0.6 0.1	4861 0.7 0.1	4344 0.7 0.1	3896 0.7 0.1	3505 0.8 0.1	3162 0.8 0.1	2859 0.8 0.0
28IT48	228-S	4.55 4.55									9719 0.4 0.1	8525 0.5 0.1	7523 0.5 0.1	6676 0.6 0.1	5953 0.6 0.1	5330 0.7 0.1	4791 0.7 0.1	4320 0.8 0.1	3907 0.8 0.1	3542 0.9 0.1
28IT52	248-S	5.17 5.17										9987 0.5 0.1	8823 0.5 0.1	7838 0.6 0.1	6998 0.6 0.1	6274 0.6 0.1	5647 0.7 0.1	4100 0.7 0.1	4619 0.8 0.1	4196 0.8 0.1
28IT56	268-S	5.23 5.23												9307 0.5 0.2	8319 0.6 0.2	7469 0.6 0.2	6731 0.7 0.2	6088 0.7 0.2	5524 0.8 0.2	5026 0.8 0.2
28IT60	288-S	5.57 5.57													9645 0.6 0.2	8668 0.6 0.2	7820 0.7 0.2	7081 0.7 0.2	6432 0.8 0.2	5859 0.8 0.2

PCI Design Handbook/Sixth Edition 2–45

Sample Load Calculations

Sample Calculations

Loads

Superimposed Dead Load – 25psf

Live Load – 60 psf

$1.2D + 1.6L$

$1.2(25\text{psf}) + 1.6(60\text{psf}) = 126\text{psf}$

L-shape beam (plf)

$8.5' \times (126\text{psf}) \approx 1071\text{ plf}$

Inverted T-shape Beam plf

$2 \times 8.5' \times (126\text{psf}) = 2142\text{ plf}$

Precast Plank

10" thick @ 20' span

$w_u = 308\text{ psf} > 126\text{ psf}$

Deflections for Non-Composite Steel Framing

Beam Deflection Summary

RAM Steel v11.0
DataBase: Non Composite
Building Code: IBC

10/29/07 02:55:19
Steel Code: ASD 9th Ed.

STEEL BEAM DEFLECTION SUMMARY:

Floor Type: Third Floor

Noncomposite

Bm #	Beam Size	Dead in	Live in	NetTotal in	Camber in
9	W18X40	0.837	0.449	1.287	
10	W10X12	0.547	0.181	0.729	
98	W12X14	0.407	0.238	0.645	
97	W12X14	0.436	0.256	0.692	
96	W12X14	0.436	0.256	0.692	
95	W12X14	0.436	0.256	0.692	
64	W8X10	0.005	0.003	0.008	
14	W10X12	0.482	0.304	0.786	
66	W8X10	0.429	0.327	0.756	
8	W18X40	0.836	0.448	1.285	
15	W10X12	0.433	0.275	0.707	
94	W12X14	0.406	0.238	0.644	
93	W12X14	0.436	0.256	0.692	
92	W12X14	0.436	0.256	0.692	
91	W12X14	0.436	0.256	0.692	
2	W10X12	0.596	0.210	0.806	
17	W21X50	0.982	0.437	1.418	
11	W10X12	0.547	0.181	0.729	
102	W12X14	0.407	0.238	0.645	
101	W12X14	0.436	0.256	0.692	
100	W12X14	0.436	0.256	0.692	
99	W12X14	0.436	0.256	0.692	
6	W8X10	0.009	0.007	0.016	
13	W10X12	0.482	0.304	0.786	
65	W8X10	0.429	0.327	0.756	
3	W21X50	0.980	0.436	1.416	
16	W10X12	0.433	0.275	0.707	
90	W12X14	0.406	0.238	0.644	
89	W12X14	0.436	0.256	0.692	
88	W12X14	0.436	0.256	0.692	
87	W12X14	0.436	0.256	0.692	
1	W10X12	0.596	0.210	0.806	
12	W18X40	0.837	0.449	1.287	
5	W8X10	0.005	0.003	0.008	
4	W18X40	0.836	0.448	1.285	

Deflections for Composite Steel Framing

Beam Deflection Summary

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

10/29/07 07:01:08
Steel Code: ASD 9th Ed.

STEEL BEAM DEFLECTION SUMMARY:

Floor Type: Third Floor

Composite / Unshored

Bm #	Beam Size	Initial in	PostLive in	PostTotal in	NetTotal in	Camber in
9	W16X26	0.744	0.412	0.583	1.327	
10	W8X10	0.282	0.092	0.226	0.508	
98	W8X10	0.493	0.180	0.255	0.748	
97	W8X10	0.528	0.193	0.274	0.802	
96	W8X10	0.528	0.193	0.274	0.802	
95	W8X10	0.528	0.193	0.274	0.802	
64	W8X10	0.002	0.001	0.002	0.004	
14	W8X10	0.359	0.149	0.206	0.565	
66	W8X10	0.190	0.102	0.134	0.324	
8	W16X26	0.743	0.411	0.582	1.325	
15	W8X10	0.324	0.134	0.186	0.509	
94	W8X10	0.493	0.180	0.255	0.748	
93	W8X10	0.528	0.193	0.274	0.802	
92	W8X10	0.528	0.193	0.274	0.802	
91	W8X10	0.528	0.193	0.274	0.802	
2	W8X10	0.317	0.107	0.247	0.564	
17	W18X35	0.813	0.376	0.576	1.389	
11	W8X10	0.282	0.092	0.226	0.508	
102	W8X10	0.493	0.180	0.255	0.748	
101	W8X10	0.528	0.193	0.274	0.802	
100	W8X10	0.528	0.193	0.274	0.802	
99	W8X10	0.528	0.193	0.274	0.802	
6	W8X10	0.004	0.003	0.003	0.007	
13	W8X10	0.359	0.149	0.206	0.565	
65	W8X10	0.190	0.102	0.134	0.324	
3	W18X35	0.812	0.375	0.575	1.387	
16	W8X10	0.324	0.134	0.186	0.509	
90	W8X10	0.493	0.180	0.255	0.748	
89	W8X10	0.528	0.193	0.274	0.802	
88	W8X10	0.528	0.193	0.274	0.802	
87	W8X10	0.528	0.193	0.274	0.802	
1	W8X10	0.317	0.107	0.247	0.564	
12	W16X26	0.744	0.412	0.583	1.327	
5	W8X10	0.002	0.001	0.002	0.004	
4	W16X26	0.743	0.411	0.582	1.325	