The Residences of Sherman Plaza
Evanston, IL

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Structural Technical Report 2
Pro-Con Structural Study of Alternate Floor Systems

Executive Summary

Several alternate floor framing systems can be used in place of Sherman Plaza's existing cast-in-place reinforced concrete system. This report evaluates and compares these floor systems in order to determine which could be considered for the final building redesign proposal. The systems analyzed in this report are:

1. Composite Steel System
2. Non-Composite Steel System
3. One-Way Pan Joist Concrete System
4. Hollow Core Plank System
5. Double Tee Beam System
6. Two-Way Concrete Slab System with Drop Panels
7. Concrete Waffle Slab System

Preliminary sizes for slabs and framing members were determined using different design aids, such as RAM Structural System, the CRSI Handbook and the PCI Handbook. These seven systems were then compared and contrasted by several different criteria. The comparison took into account the system's fire rating, susceptibility to vibration, weight, finish floor to ceiling section depth, constructability and cost. This criteria is not intended to be an exhaustive comparison but will be used to determine which systems should receive further investigation.

When each of the systems was used in the typical bay in Sherman Plaza, each was found to have a number of positive and negative aspects.

The steel systems were found to be the lightest and easiest systems to erect. The non-composite system is easier to erect than the composite system, because shear studs are

not needed. The disadvantages of the steel systems are that they have a large floor section depth and require additional fireproofing.

The double tee and hollow core plank systems are both precast systems, which make them very easy to construct. They are also the least expensive systems. A major downfall, however, is that they have the largest floor section depths. The hollow core plank system has a very high weight, and the double tee system needs additional fireproofing and vibration could be an issue.

The concrete waffle slab and one-way pan joist systems are both cast-in-place systems with relatively small ceiling to floor depths. These systems are harder to construct than the existing system however, since it is necessary to layout the pans to form the joists or waffle voids. Both these designs are more expensive. The waffle slab is even harder to design and therefore, the most expensive of the systems considered.

The two-way flat slab with drop panels has the same section depth as the existing system. It requires no additional fireproofing, and vibrations will be low. It is somewhat harder to construct than the existing system, however, and its weight is higher.

The purpose of the comparison of the floor framing systems is to determine which of the systems should be considered for further investigation. It was found that the steel systems, waffle slab, one-way pan joists, and two-way flat slab with drop panels should be continued as candidates for the building redesign. The double tee and hollow core plank systems, however, will not be considered due to their very large section depths, which can have a large impact on the costs and construction of the building.

Introduction

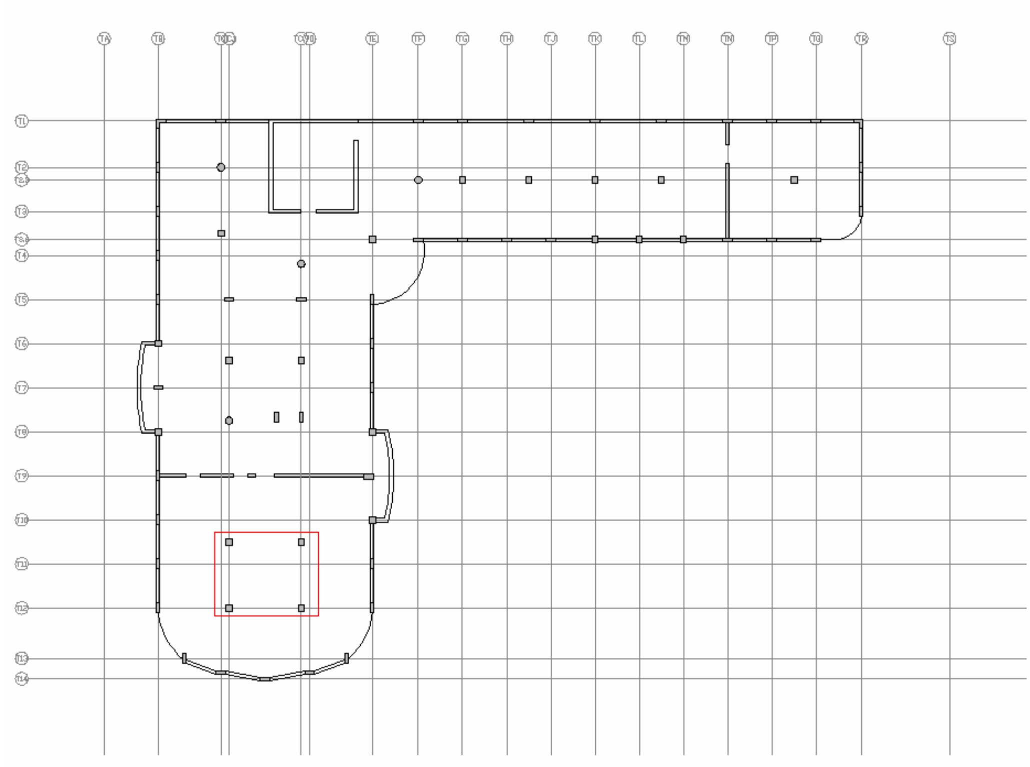
Sherman Plaza is a 25 story condominium building with a primary floor framing system of two-way cast-in-place reinforced concrete flat plates. This report provides a study and comparison of alternate floor systems. The report will consider two steel systems and several new concrete systems. A description of each system will be provided and preliminary sizes will be determined using design aids, such as RAM Structural System, the CRSI Handbook, and the PCI Handbook. After the evaluation, the systems will be compared and contrasted based on the adequacy of the system in relation to the building. The comparison will take into account factors, such as fire rating, durability, weight, cost, constructability, and other criteria. This report is intended to provide feasible alternatives to the existing floor framing system that could be used in the final redesign proposal of Sherman Plaza.

Existing Floor Framing System

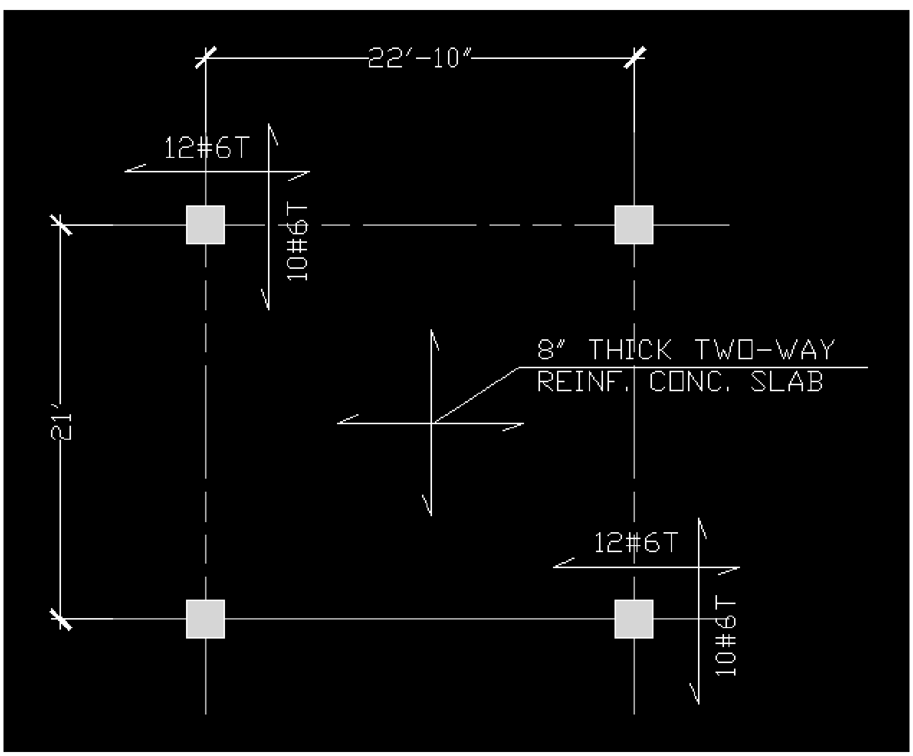
Sherman Plaza's primary floor system is composed of reinforced concrete two-way flat plates. The slab thickness of every floor is 8" with the exception of the first retail floor, which has a slab thickness of 9". From the first to the seventh floor, the column grid and layout of the structural elements changes due to the areas where the building steps back. The eighth floor, however, is constructed as a typical floor plan which is repeated for floors eight to twenty-two. The remaining levels have different column layouts, because they are penthouse levels.

On the typical floor, the columns are lined up along a grid, in general, but the spacing of the columns varies. Most bays are either approximately 14'x14' or 21'x21' square bays. For this comparison study, a typical bay from the eighth floor will be used for the analysis. The seven new floor systems will be analyzed for this bay, and the design outcomes will be compared. The typical bay is an interior bay with the dimensions: 21'-0" x 22'10". This bay is one of the larger bays in the building and will therefore produce a conservative design that can be used throughout the entire floor. The column layout for the building is limited by the architectural layout of the building. Columns are positioned between apartment units so that they will not be visible. Therefore, the column layout will not be changed when considering alternate floor systems.

The different bay sizes in the building causes the reinforcement size to change throughout the floor. In general, the slab reinforcing remains fairly constant from floor to floor, however. The slab is required to have a minimum of #6@12" top reinforcement at column strip intersections, #5@12" bottom reinforcement at middle strip intersections, and #5@12" top and bottom reinforcement at intersections of the column strip and middle strip. The typical bay has 12 #6 top bars in the north-south direction and 10 #6 top bars in the east-west direction.



Typical Floor Plan: Levels 8-22
(Typical bay is outlined in red.)



Typical Bay Used in Analysis and Comparison

Floor Loads

The floor loading for Sherman Plaza follows the provisions of ASCE 7-98.

Superimposed Dead Load:

- 15 psf, accounting for mechanical equipment, ceiling and floor finishes and other miscellaneous dead weight

Live Load:

- 40 psf for residential areas
- 20 psf extra for partitions
- 100 psf for corridors, kitchens, dining rooms, stairways and balconies
- **80 psf** approximated live load will be used as for the analysis of the typical floor
-

Total Superimposed Service Load = **95 psf**
Total Superimposed Factored Load = **146 psf**

Comparison Criteria

Each of the alternate floor systems and the existing system will be compared and contrasted by general criteria that will help to decide which system is ideal for the typical floor. The criteria considered in this report are:

1. Fire Rating
2. Weight of the System
3. Depth of the Structural Elements
4. Constructability of System
5. System Cost

Fire Rating
The fire rating for Sherman Plaza has been determined by the BOCA National Fire Protection Code of 1996. The floor construction assembly should have a 2 hour fire rating. A 4.5" concrete slab achieves the 2 hour fire rating, which makes the existing 8" slab more than adequate. If an alternate system does not meet the fire rating, additional design is required to meet the rating, such as applying fireproofing or using a fire resistant material in the ceiling or floor assembly.

Weight of the System
The calculations of the weight of the system will take into account all beams, girders, slab and deck in the typical bay. The weight of the structural elements in the existing system is due to the 8" reinforced concrete slab. Therefore, the distributed load over the typical bay is 100 psf. This weight will be compared with the distributed loads of the alternate systems. The weight of the system is not the most important consideration due to the building's foundation conditions, but it will still be taken into consideration in this report.

Depth of the Structural Elements
Since Sherman Plaza is a twenty-five story building, any addition to the ceiling to floor finish depth will have a great impact on the building. An increase in the structural elements will either increase the overall building height or decrease the floor to ceiling height of the apartments. The increase in overall building height would produce much higher building costs for elements such as exterior cladding, stairwells, elevators and mechanical equipment. A significant decrease in floor to ceiling height would take away from the luxurious atmosphere created in the condominiums. The depth of the existing floor system is 8", which leaves a large amount of space for mechanical ducts and floor and ceiling finishes. The 8" section depth will be compared with the depths of the other systems.

Constructability and Cost
Sherman Plaza is located in downtown Evanston, IL in a high traffic retail and residential area. It is therefore necessary that construction be finished in a reasonable amount of time. The speed of construction can be impacted by the time required to construct a floor assembly, the type of materials used, and the weight or amount of those materials. The existing flat plate system is relatively easy to construct and does not require any complex setup of forms. A precast system, however, would be easier to construct. The cost of the floor framing systems will also be taken into account.

Design Aids

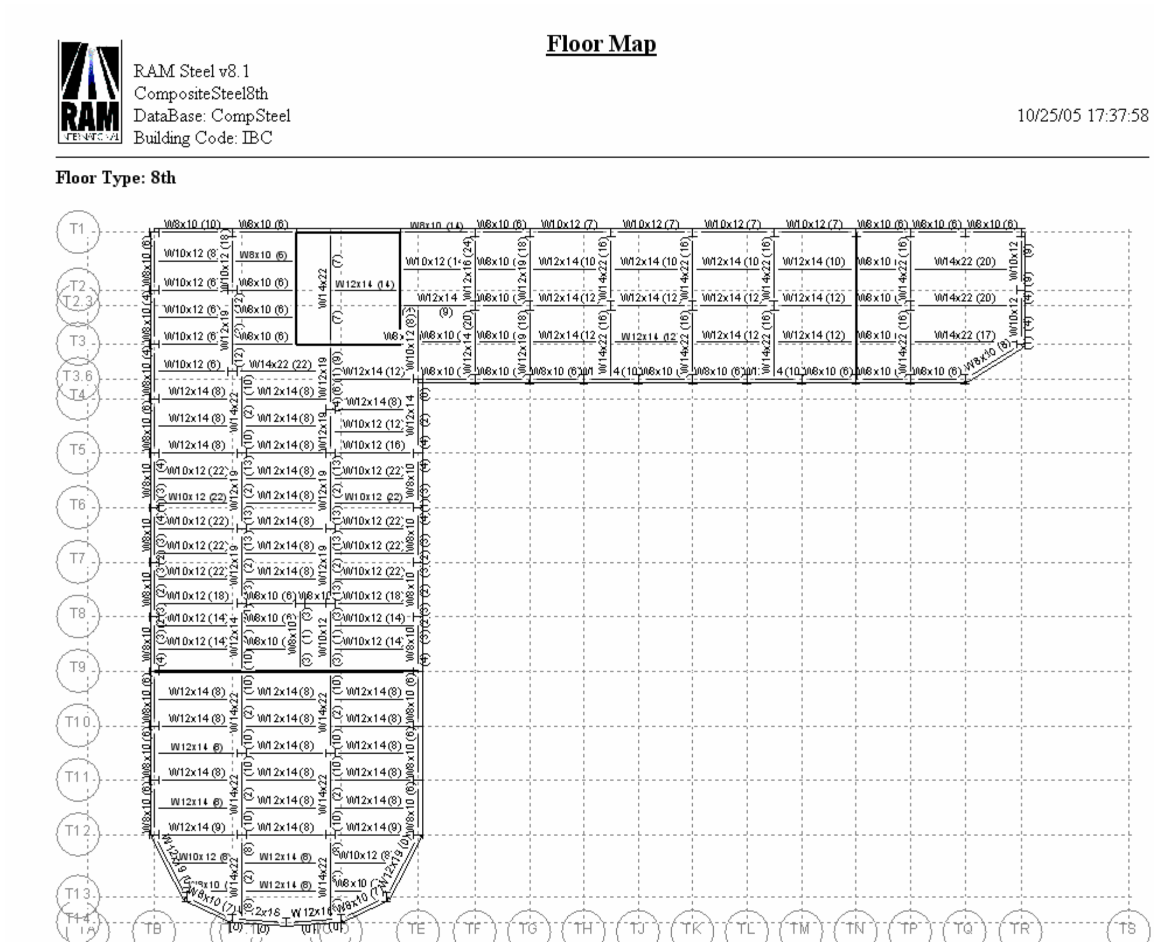
The alternate floor framing systems will be designed using the following methods:

- Composite Steel System: using the RAM Structural System to create a model of the typical floor
- Non-Composite Steel System: using output from the RAM Structural System
- One-Way Concrete Pan Joist System: using an estimate from the Concrete Reinforcing Steel Institute (CRSI) Design Handbook, 9th Edition
- Hollow Core Plank System: using the Precast/Prestressed Concrete Institute (PCI) Design Handbook, 5th Edition
- Double Tee Beam System: using an estimate from the PCI Design Handbook
- Two-Way Concrete Slab System with Drop Panels: using the CRSI Design Handbook
- Concrete Waffle Slab System: using the CRSI Design Handbook

Floor Framing Systems Evaluation

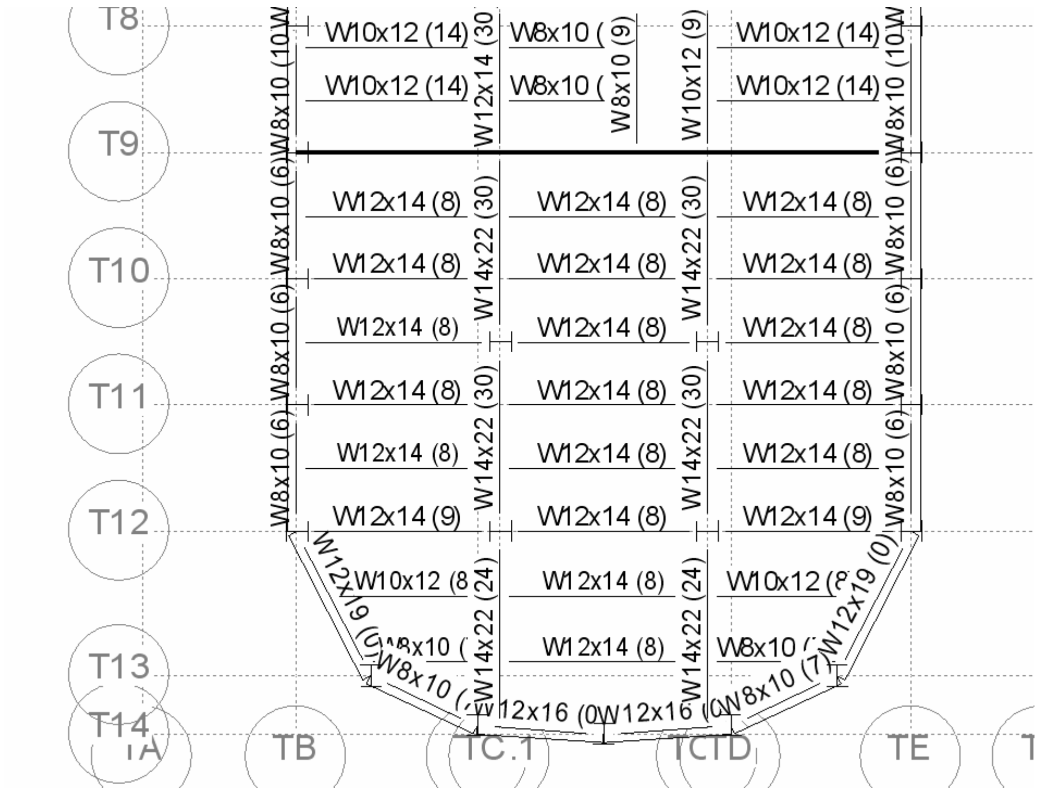
Composite Steel System

RAM Structural System was used to design and analyze the composite steel floor system. The eighth floor of the building was modeled using the original column locations from the existing design. Girders and beams were added between the columns. For the typical bay, the infill beams are spaced at 7'-0" on center.



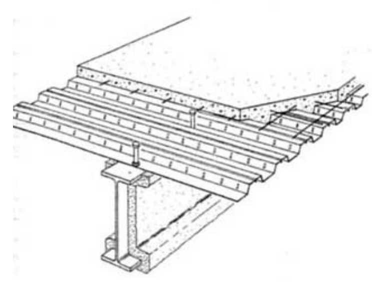
Eighth Floor Modeled in RAM Steel

For the composite design, a United Steel Deck, 22 gage, 2" Lok-Floor composite deck was chosen with 3" of concrete above the deck flutes, creating an overall concrete slab depth of 5". The studs are 4" long and ¾" in diameter. This deck allows for a uniform superimposed service live load of 365 psf which is well over the actual service live load of 80 psf. The maximum span for a three span section of the deck is 8.19' which is greater than the actual span, 7'-0".



Typical Floor Design in Composite Steel

The beams for the typical bay, designed by RAM Steel, are W12x14 with 8 studs, and the girders are W14x22 with 30 studs. This design results in a load of 2962.67 lbs. from the beams, girders and studs, assuming the studs are approximately 10 lbs. each. This load, when distributed across the typical bay, is 6.179 psf. The deck and slab add another 38 psf, which sums to a total distributed load of 44.179 psf over the entire bay. This weight is significantly less than the weight of the existing system.

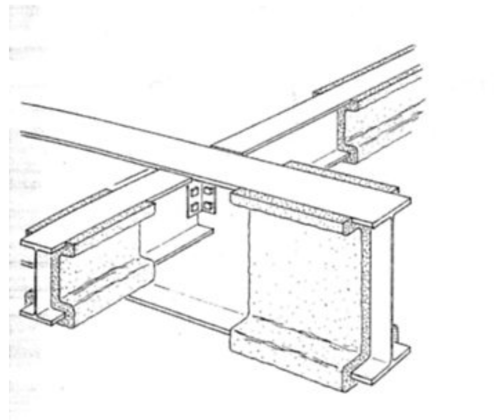


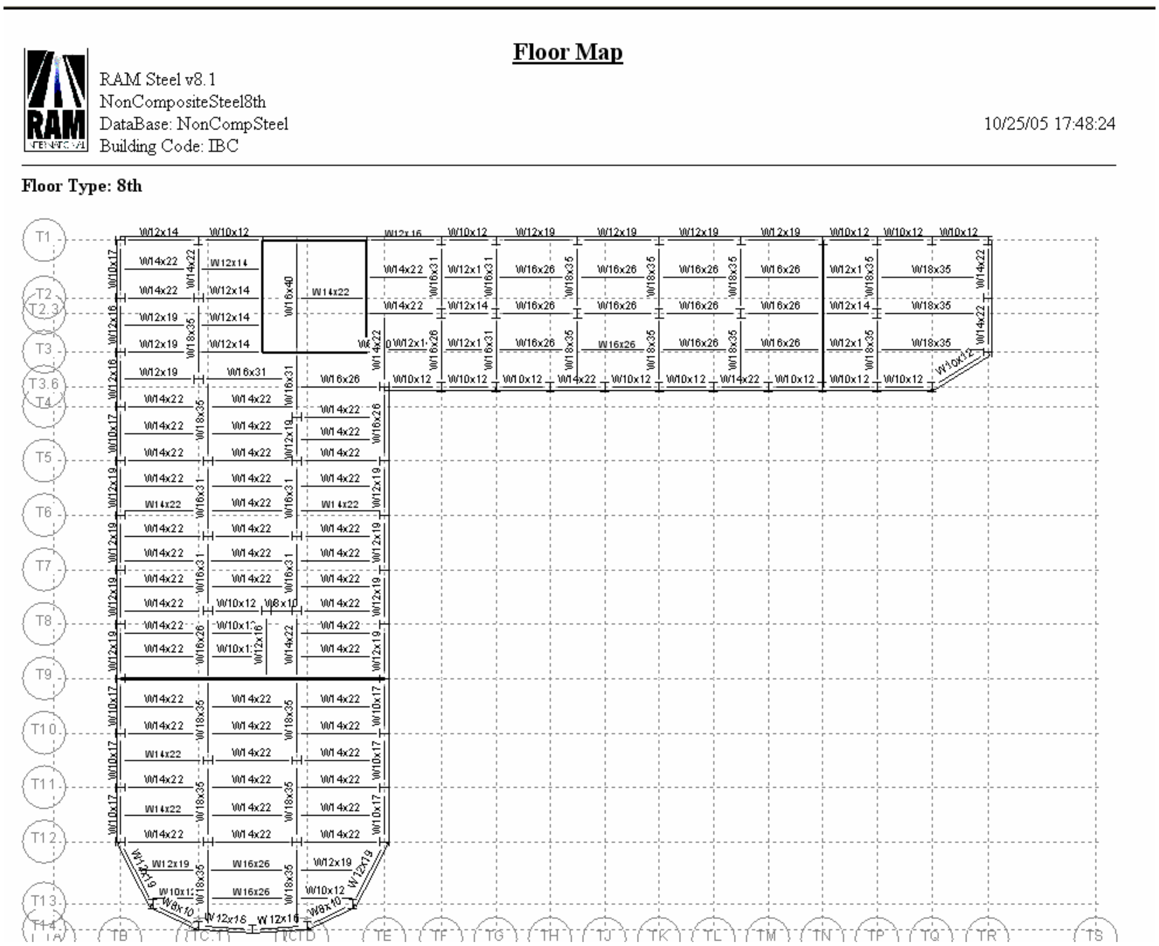
The depth of the composite steel floor system will be equal to the depth of the girder plus the 5” slab. Therefore, the overall depth is 18.7”, which is much greater than the depth of the existing system. The composite steel system will add an extra 10.7” to each floor of the building. This system will also require additional fireproofing to achieve an adequate fire rating. The 3” of concrete slab above the deck flutes will produce a fire rating of an hour and a half. Additional fireproofing is needed on both the slab and the steel elements of the building. Cementitious fireproofing on the steel will produce a 3 hour fire rating, or the steel could be encased in a fire-resistant material ceiling assembly.

Non-Composite Steel System

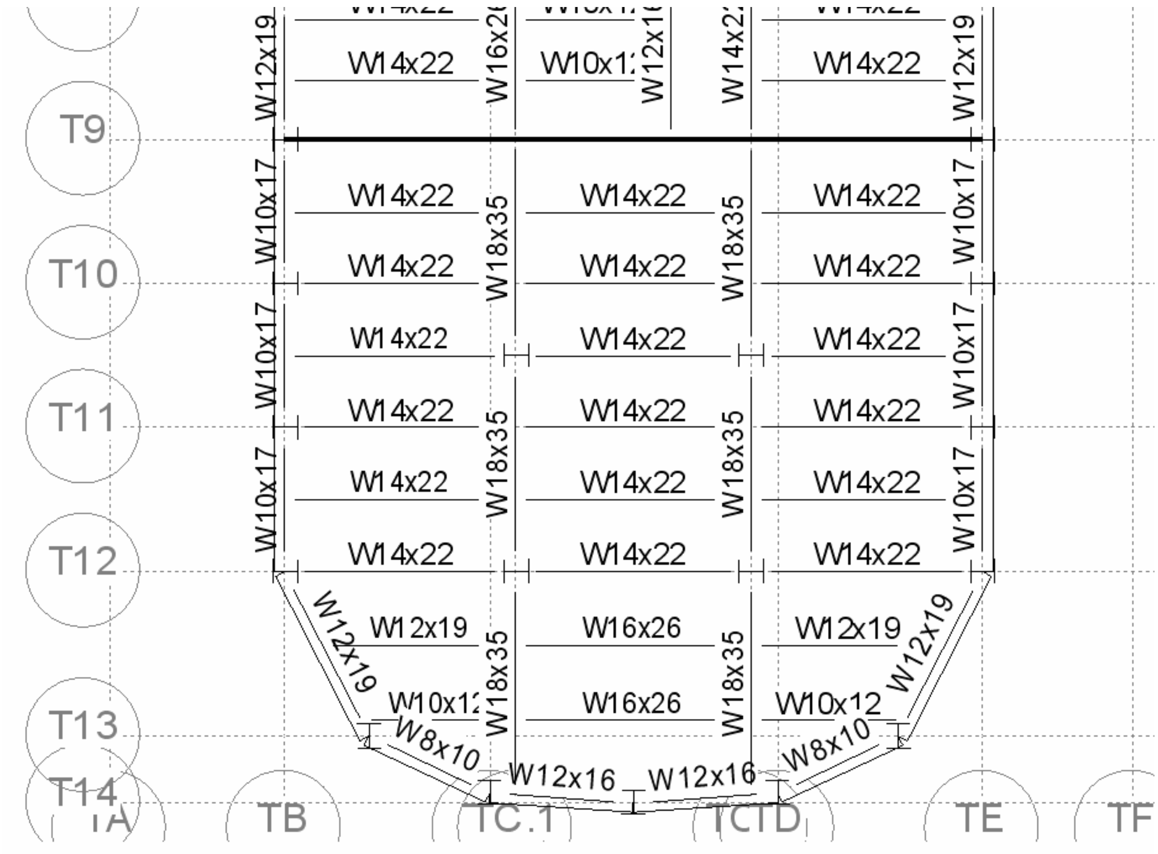
The non-composite steel floor system was also designed using RAM Steel. The same floor design and spacing was used as in the composite design but the beams and girders are changed to non-composite.

The deck was designed again using the United Steel Deck manual. The USD 22 gage 1.5" Lok-Floor was chosen with 2.5" concrete slab above the deck flutes, making an overall slab depth of 4". Lightweight concrete was used again. This deck allows for a uniform superimposed service live load of 195 psf which is well over the actual service live load of 80 psf. The maximum span for a three span section of the deck is 7.06' which is greater than the actual span, 7'-0".





Eighth Floor Modeled in RAM Steel



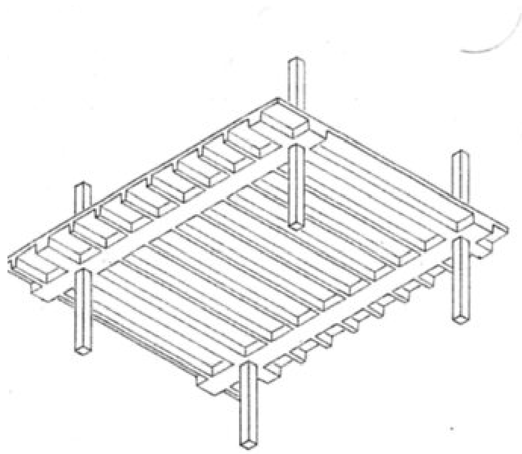
Typical Floor Designed in Non-Composite Steel

The beams in this design are W14x22 and the girders are W18x35. These sizes are significantly larger than those found in the composite design. The design results in a distributed load of 7.256 psf over the bay due to the steel and 31 psf due to the slab and deck. Therefore, the weight of this system over the typical bay is 38.256 psf, which is less than both the existing system and the composite steel design.

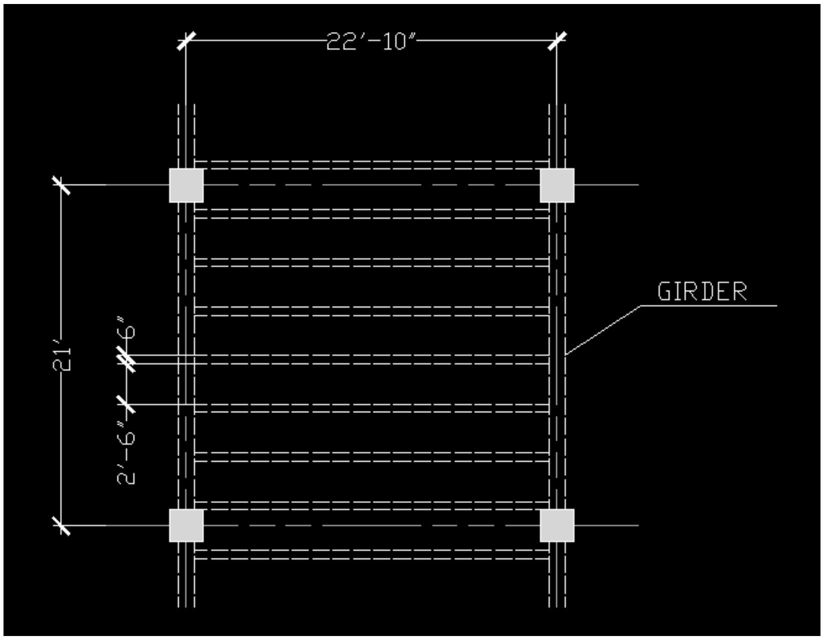
The depth of the non-composite steel floor system will equal the depth of the girder plus the 4” slab. The overall depth of the structural system is 21.7”, which is greater than the composite and existing systems. This depth is only 3” greater than the composite system but is 13.7” greater than the existing system. Also, similar to the composite system, extra fireproofing will be needed for this system. An advantage over the composite system is that the non-composite system is easier to construct, because it is not necessary to weld on the studs to create the composite action on the beams.

One-Way Concrete Pan Joist System

The one-way concrete pan joist system was designed using the Concrete Reinforcing Steel Institute (CRSI) Handbook. The system spans the 22'-10" direction, and two pan joist systems were considered. First, a system with 20" forms and 6" ribs was considered. The span was approximated to be 23', and the allowable factored load was 155 psf, which is greater than the maximum load of 146 psf. This system had a total depth of 13" and weighed 67 psf. The second system considered was a 30" form and 6" rib system. This system is also 13" in depth and weighs 61 psf. The capacity is 182 psf for a 23'-0" span. Since the second system is lighter and requires fewer pans, which therefore takes less time in construction, the second system is more ideal than the first. The second system will be considered in the overall comparison of the floor systems.

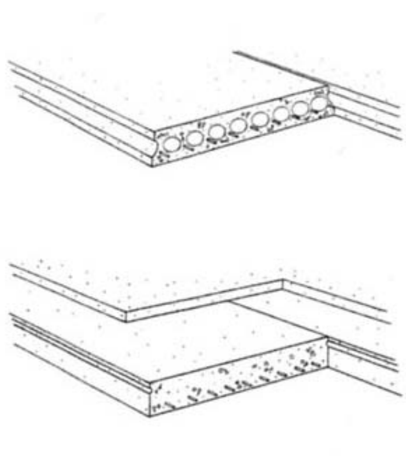


The pan joist system uses top bars of #5 spaced at 12" on center and bottom bars #5 and #6. This system has 10" deep ribs and a top slab of 3". The 13" depth increases the floor to ceiling section by 5". This 3" slab produces a fire rating of one a half hours. Therefore, additional fireproofing is necessary for this system to achieve the two hour rating. Time and constructability should also be taken into account when choosing this system. The setup for the pans takes much more time and makes construction harder than it would be for the flat plate existing system. Vibration could also be a concern with this system, because the slab is only 3" thick. The existing 8" slab will produce less vibration.

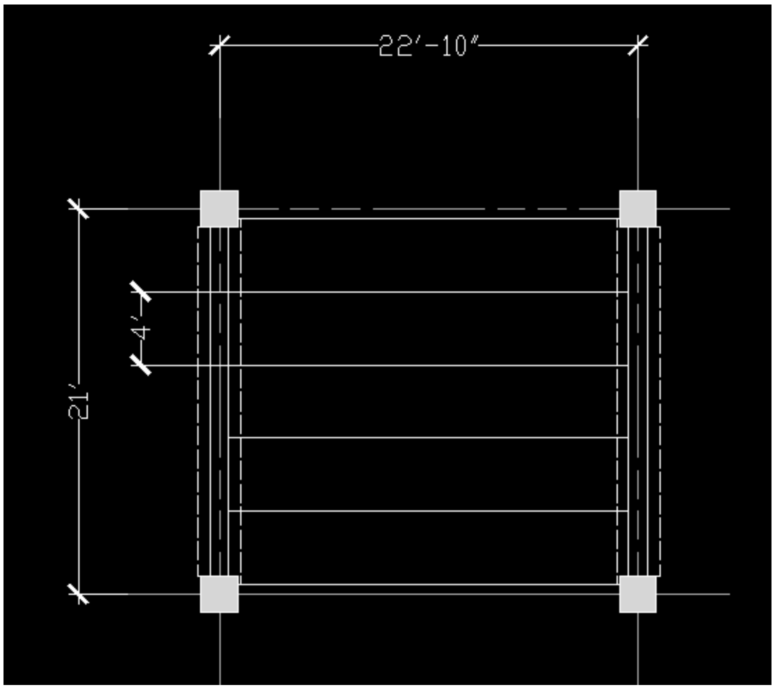


Hollow Core Plank System

Two hollow core plank systems were designed using the Precast/Prestressed Concrete Institute (PCI) Handbook. The first system considered is a 6” plank with a 2” concrete topping. This system weighs 74 psf. The second system is an 8” plank with a 2” topping, which weighs 81 psf. The first system will be considered in the design comparison, because it weighs less and has a smaller depth than the second system.



The hollow core planks will rest on girders that span the 21’ direction. For this floor system, an inverted tee beam will used as the girder to minimize the floor section depth. The hollow core planks can rest on the seat made by the tee section. The girder was also designed using the PCI Design Handbook. It was found that a 28IT24 tee beam with 11 ½” diameter reinforcement bars was necessary. The girder must hold the superimposed service load of 95 psf plus the 74 psf dead load of the planks. The total distributed load over the girder is 3859 plf, and the allowable load is 4925 plf.



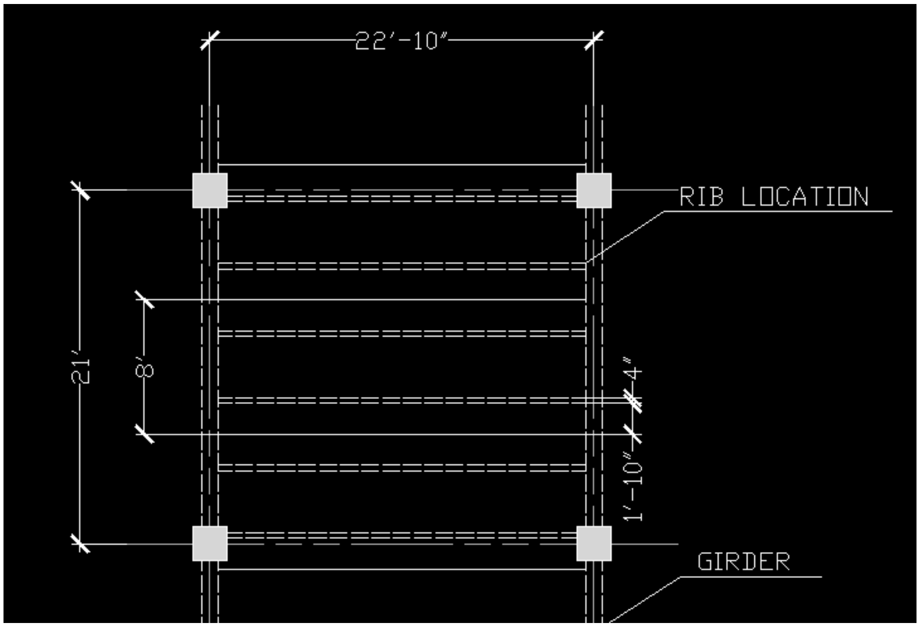
The planks will span 22’-10”, which is approximated at 23’ for the design. The plank chosen was a 4HC6+2 with a 96-S strand layout which has a capacity of 123 psf service load. The 8” depth provides the necessary fire rating, but more investigation is necessary to determine if extra fireproofing is needed for the hollows of the planks. The system, however, is relatively easy to construct because the planks are precast and ready to place in the building.

The depth of the hollow core plank system will be the depth of the inverted tee girder, which is 24”. This depth is three times the size of the existing system’s depth. The overall weight of the system is also larger than the weight of the existing system. The planks weigh 74 psf and the girders contribute an additional 43.8 psf. The total weight of the system is 117.8 psf.

Double Tee Beam System

The double tee beam system was also designed using the PCI Handbook. Again, the 22'-10" span was used, and it was determined that an 8LDT12+2 with a 68-S strand layout was necessary. This system is composed of lightweight concrete with a 2" normal weight topping. The double tees are 8' in length and 12" in depth with the 2" topping. The capacity is a 99 psf service load.

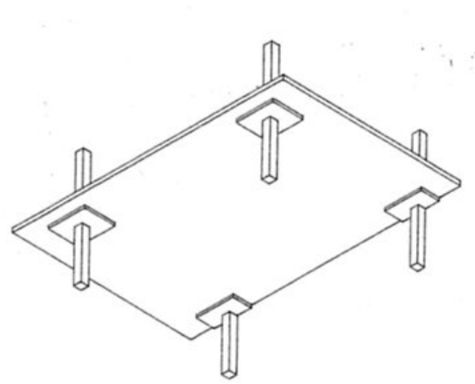
The double tee beams rest on a rectangular girder that was designed using the PCI Handbook. The girder is a 12RB24 with 10 ½" diameter reinforcement bars. The girder must support the 95 psf service load and the 54 psf double tee dead load. The girder will support an allowable load of 4558 plf, which is greater than the actual load of 3402 plf.



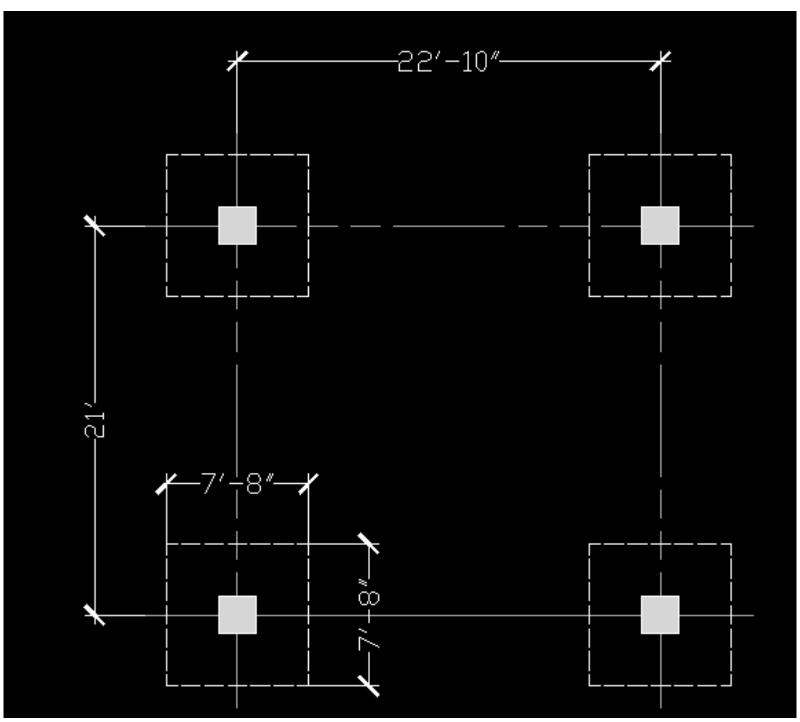
The overall depth of the system is equal to the depth of the girder, 24", plus the depth of the double tee beams,14". For this design, the overall depth is 38", which is much greater than the existing system depth. The weight of the system is calculated by adding the 54 psf of the double tees to the 26.3 psf of the girders. The total system weight of 80.3 psf is less than the existing weight. The 2" of normal weight concrete and 2" of lightweight concrete does not quite provide enough fire rating, so additional fireproofing is needed. This system, like the hollow core plank, will be easy to construct.

Two-Way Flat Slab with Drop Panels System

The two-way flat slab system with drop panels was designed with the CRSI Handbook. The bay was designed for the longer span of 22'-10". It was determined that a square drop panel of 6.5" depth and 7.67' width was necessary. For the column strip, 13 #5 bars on top and 11 #5 bars on bottom are needed. The middle strip receives 13 #4 bars on top and 11 #4 bars on bottom. The capacity of this system is 200 psf superimposed factored load. This design is overly conservative because the CRSI Handbook designs the flat slab in increments of 100 psf. Less reinforcement would probably be needed if the slab were designed for the 146 psf factored load.

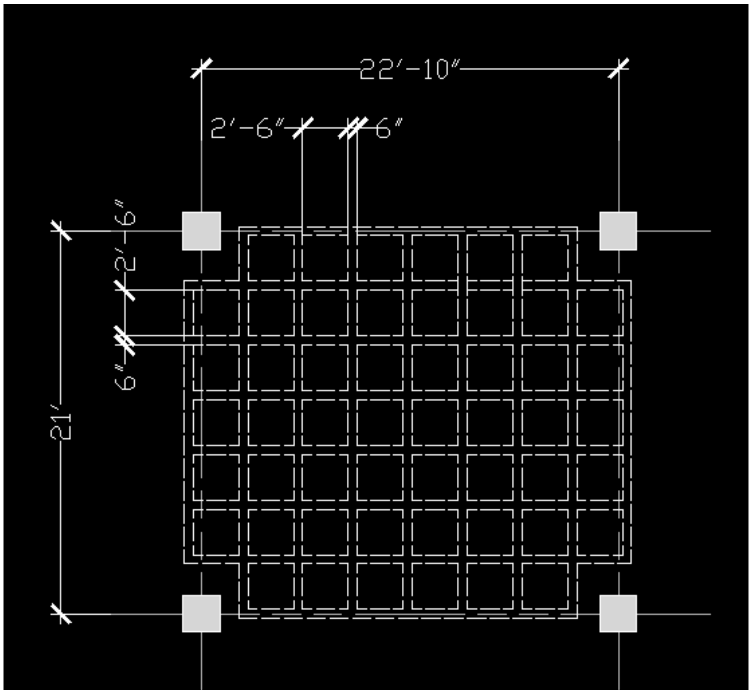


The total slab depth between drop panels is 8" which is equal to the existing system. The drop panels add 6.5", but for this system, mechanical equipment can be run through the middle section of the slab where the drop panels won't interfere. Therefore, the depth of this system can be taken as 8". The additional drop panels do increase the weight of the system to greater than the existing system. The total steel in the system weighs 2.36 psf, and the total weight is 112.33 psf. The drop panels also provide an extra difficulty in the construction of the system. The 8" slab provides more than enough fire protection. The flat slab with drop panels also provides a great resistance to vibrations.



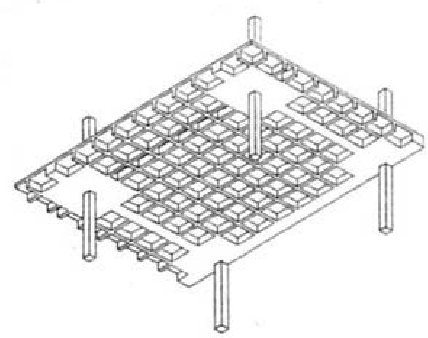
Concrete Waffle Slab System

The CRSI Handbook was used to design the concrete waffle slab system. After



consideration of two systems with different void lengths, the 30"x30" void system was chosen. The ribs between voids are 6", and the rib depth is 8". There is a 3" slab on top, making a total depth of 11". Since the typical bay is not completely square, it was necessary to approximate the dimensions as 24'-0"x24'-0". This will produce a more conservative design. The factored superimposed allowable load is 150 psf.

The system was designed to have 2 #5 bars in the bottom of the rib in the



column strip and 18 #5 bars in the top. The middle strip needs #4 longs bars in the bottom and 7 #5 bars in the top. This reinforcement produces a steel weight of 2.05 psf which is added to the 71 psf of the waffle slab for a total weight of 73.05 psf. This system would be one of the most hard to construct and will take a long amount of time to layout the pans to create the waffle. In addition, extra fireproofing is needed for the 3" slab depth.

Floor Framing Systems Comparison

System	*Depth*	*Weight*	*Cost per S.F.*		
			Mat.	*Inst.*	*Total*
Existing	8”	100 psf	5.85	7.35	13.20
Composite Steel	18.7”	44.2 psf	10	4.94	14.94
Non-Composite Steel	21.7”	38.3 psf	10.2	4.18	14.38
One Way Pan Joists	13”	61 psf	6.45	9.15	15.60
Hollow Core Plank	24”	117.8 psf	6.85	3.48	10.33
Double Tee Beams	38”	80.3 psf	7.35	2.87	10.22
Two-Way with Drop Panels	8”	112.3 psf	6.05	7.80	13.85
Waffle Slab	11”	73.1 psf	9.4	9.15	18.55

System	*Pros*	*Cons*	*Further Consideration?*
Existing	• Adequate fire rating • Least floor to ceiling depth • Relatively easy construction • Low vibrations	• High weight	Yes
Composite Steel	• Low weight • Relatively easy construction	• Needs additional fireproofing • Large floor section depth	Yes
Non-Composite Steel	• Easy construction • Low weight	• Needs additional fireproofing • Large floor section depth	Yes
One-Way Pan Joists	• Low weight • Relatively easy construction • Relatively small section depth	• Needs additional fireproofing • Possible high vibrations • Somewhat expensive	Yes
Hollow Core Plank	• Easy construction • Inexpensive	• Large floor section depth • High weight	No
Double Tee Beams	• Easy construction • Most inexpensive design	• Large floor section depth • Needs additional fireproofing • Possible high vibrations	No
Two-Way with Drop Panels	• Adequate fire rating • Low floor section depth • Relatively easy construction • Low vibrations	• Highest weight	Yes
Waffle Slab	• Small floor section depth	• Difficult construction • Needs additional fireproofing • Most expensive design	Yes

Conclusion

Several alternate floor framing systems were considered as an alternative to the existing two-way cast-in-place reinforced concrete flat plate system of Sherman Plaza. The seven systems that were analyzed in this report were:

1. Composite Steel System
2. Non-Composite Steel System
3. One-Way Pan Joist Concrete System
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5. Double Tee Beam System
6. Two-Way Concrete Slab System with Drop Panels
7. Concrete Waffle Slab System

Each of the systems were found to work for the typical bay, but the systems had positive and negative aspects that make them a good choice or not for this building.

The steel systems were found to be the lightest and easiest systems to erect. The non-composite system is easier to erect than the composite system, because shear studs are not needed. The disadvantages of the steel systems are that they have a large floor section depth and require additional fireproofing. Both of these systems could use further investigation to determine if they could be used in the building redesign.

The double tee and hollow core plank systems are both precast systems, which make them very easy to construct. They are also the least expensive systems. A major downfall, however, is that they have the largest floor section depths. The hollow core plank system has a very high weight, and the double tee system needs additional fireproofing and vibration could be an issue. Since the floor section of these systems is three times or more the depth of the existing system, they will not be considered for further investigation. The increased depth can have a major impact on the building.

The concrete waffle slab and one-way pan joist systems are both cast-in-place systems with relatively small ceiling to floor depths. These systems are harder to construct than the existing system however, since it is necessary to layout the pans to form the joists or waffle voids. Both these designs are more expensive. The waffle slab is even harder to design and therefore, the most expensive of the systems considered. Despite the high costs, however, both these systems will be continued as candidates in the building redesign.

The two-way flat slab with drop panels has the same section depth as the existing system. It requires no additional fireproofing, and vibrations will be low. It is somewhat harder to construct than the existing system, however, and its weight is higher. It will also be considered for further investigation.

STANDARD ONE-WAY JOISTS (1) MULTIPLE SPANS — 30" Forms + 5" Rib @ 35" c.-c. (2) — FACTORED USABLE SUPERIMPOSED LOAD (PSF) — f'_c = 4,000 psi, f_y = 60,000 psi

10" Deep Rib + 3.0" Top Slab = 13.0" Total Depth

TOP BARS — Size @	#4 12	#4 12	#4 11.5	#4 9	#5 11.5	End Span Defl. Coeff. (3)	#4 12	#4 12	#4 11	#4 8	#5 10	Int. Span Defl. Coeff. (3)
BOTTOM BARS — # #	#3 #4	#4 #4	#4 #5	#5 #5	#5 #6		#3 #3	#3 #4	#4 #4	#4 #5	#5 #5	
Steel (psf)	.50	.60	.72	.89	1.08		.56	.63	.77	1.00	1.25	
CLEAR SPAN	END SPAN						INTERIOR SPAN					
17'-0"	131 / 0	192 / 0	264* / 0	274* / 338	282* / 417*	.978	139 / 0	227 / 0	305* / 316	315* / 422	322* / 521*	.602
18'-0"	106 / 0	162 / 0	227 / 0	249* / 293	255* / 368	1.229	115 / 0	194 / 0	273 / 0	288* / 367	293* / 463	.756
19'-0"	68 / 0	137 / 0	155 / 0	227* / 254	232* / 322	1.525	95 / 0	166 / 0	237 / 0	265* / 321	269* / 407	.939
20'-0"	72 / 0	116 / 0	168 / 0	207* / 222	212* / 282	1.873	78 / 0	142 / 0	206 / 0	244* / 282	248* / 360	1.153
21'-0"	58 / 0	98 / 0	145 / 0	190* / 193	194* / 248	2.276	63 / 0	121 / 0	179 / 0	225* / 248	229* / 318	1.401
22'-0"	45 / 0	62 / 0	125 / 0	169 / 0	179* / 219	2.742	50 / 0	103 / 0	156 / 0	209* / 219	212* / 283	1.687
23'-0"		66 / 0	107 / 0	148 / 0	165* / 193	3.276		87 / 0	136 / 0	193 / 0	196* / 252	2.016
24'-0"		56 / 0	92 / 0	129 / 0	152* / 171	3.684		73 / 0	118 / 0	171 / 0	183* / 225	2.390
25'-0"		45 / 0	78 / 0	112 / 0	141* / 151	4.572		61 / 0	102 / 0	151 / 0	170* / 201	2.814
26'-0"			66 / 0	98 / 0	131* / 134	5.349		50 / 0	88 / 0	134 / 0	159* / 179	3.292
27'-0"			56 / 0	85 / 0	118 / 0	6.221		41 / 0	76 / 0	118 / 0	149* / 160	3.828
28'-0"			46 / 0	73 / 0	104 / 0	7.195			65 / 0	104 / 0	139* / 143	4.428
29'-0"				63 / 0	91 / 0	8.279			55 / 0	91 / 0	128 / 0	5.095
30'-0"				53 / 0	80 / 0	9.481			46 / 0	80 / 0	114 / 0	5.835

(1) For gross section properties, see Table 8-1.
(2) First load is for standard square joist ends; second load is for special tapered joist ends.
(3) Computation of deflection is not required above horizonal line (thickness ≥ $\ell_n/18.5$ for end spans, $\ell_n/21$ for interior spans).
(4) Exclusive of bridging joists and tapered ends.
*Controlled by shear capacity. +Capacity at elastic deflection = $\ell_n/360$.

PROPERTIES FOR DESIGN (CONCRETE .39 CF/SF) (4)

NEGATIVE MOMENT											
STEEL AREA (SQ. IN.)	.58	.58	.61	.78	.94		.58	.58	.64	.88	1.09
STEEL % (UNIFORM)	.83	.83	.87	1.11	1.35		.83	.83	.91	1.25	1.55
(TAPERED)	.45	.45	.47	.60	.74		.45	.45	.49	.68	.85
EFF. DEPTH, IN.	11.8	11.8	11.8	11.8	11.7		11.8	11.8	11.8	11.8	11.7
−ICR/IGR	.191	.191	.197	.237	.268		.191	.191	.204	.258	.296
POSITIVE MOMENT											
STEEL AREA (SQ. IN.)	.31	.40	.51	.62	.75		.22	.31	.40	.51	.62
STEEL %	.08	.10	.12	.15	.18		.05	.08	.10	.12	.15
EFF. DEPTH, IN.	11.8	11.8	11.7	11.7	11.6		11.8	11.8	11.8	11.7	11.7
+ICR/IGR	.145	.184	.227	.270	.317		.106	.145	.184	.227	.270

STANDARD ONE-WAY JOISTS (1) MULTIPLE SPANS — 30" Forms + 6" Rib @ 36" c.-c. (2) — FACTORED USABLE SUPERIMPOSED LOAD (PSF) — f'_c = 4,000 psi, f_y = 60,000 psi

10" Deep Rib + 3.0" Top Slab = 13.0" Total Depth

TOP BARS — Size @	#4 12	#4 12	#4 9.5	#5 12	#5 10	End Span Defl. Coeff. (3)	#4 12	#4 11.5	#4 8.5	#4 7	#5 8.5	Int. Span Defl. Coeff. (3)
BOTTOM BARS — # #	#4 #4	#4 #5	#5 #5	#5 #6	#6 #6		#3 #4	#4 #4	#4 #5	#5 #5	#5 #6	
Steel (psf)	.58	.69	.86	1.05	1.25		.63	.74	.95	1.18	1.46	
CLEAR SPAN	END SPAN						INTERIOR SPAN					
17'-0"	180 / 0	251 / 0	309* / 322	317* / 404	328* / 478*	1.006	215 / 0	301 / 0	358* / 404	365* / 508	374* / 570*	.619
18'-0"	151 / 0	214 / 0	278 / 0	288* / 351	297* / 425	1.264	182 / 0	259 / 0	328* / 351	334* / 444	342* / 525*	.778
19'-0"	127 / 0	184 / 0	241 / 0	263* / 306	271* / 373	1.569	155 / 0	224 / 0	301* / 306	307* / 390	314* / 481*	.966
20'-0"	106 / 0	157 / 0	209 / 0	241* / 268	248* / 328	1.926	131 / 0	194 / 0	268 / 0	284* / 343	289* / 429	1.185
21'-0"	88 / 0	135 / 0	182 / 0	221* / 235	228* / 290	2.342	111 / 0	168 / 0	235 / 0	263* / 303	267* / 381	1.441
22'-0"	73 / 0	115 / 0	158 / 0	204* / 207	210* / 256	2.820	94 / 0	145 / 0	207 / 0	244* / 269	248* / 340	1.736
23'-0"	59 / 0	98 / 0	137 / 0	182 / 0	194* / 227	3.369	78 / 0	126 / 0	182 / 0	227* / 239	231* / 303	2.073
24'-0"	48 / 0	83 / 0	119 / 0	160 / 0	180* / 202	3.995	65 / 0	108 / 0	160 / 0	212* / 0	215* / 272	2.458
25'-0"		70 / 0	103 / 0	141 / 0	167* / 179	4.703	53 / 0	93 / 0	141 / 0	189 / 0	201* / 244	2.894
26'-0"		58 / 0	89 / 0	124 / 0	156* / 159	5.502	43 / 0	80 / 0	123 / 0	168 / 0	188* / 219	3.386
27'-0"		48 / 0	76 / 0	108 / 0	141 / 0	6.398	68 / 0	108 / 0	150 / 0	176* / 197		3.938
28'-0"			65 / 0	95 / 0	125 / 0	7.400		57 / 0	95 / 0	133 / 0	166* / 177	4.554
29'-0"			54 / 0	82 / 0	111 / 0	8.516		47 / 0	82 / 0	118 / 0	156* / 159	5.240
30'-0"			45 / 0	71 / 0	98 / 0	9.752			71 / 0	105 / 0	143 / 0	6.001

(1) For gross section properties, see Table 8-1.
(2) First load is for standard square joist ends; second load is for special tapered joist ends.
(3) Computation of deflection is not required above horizonal line (thickness ≥ $\ell_n/18.5$ for end spans, $\ell_n/21$ for interior spans).
(4) Exclusive of bridging joists and tapered ends.
*Controlled by shear capacity. +Capacity at elastic deflection = $\ell_n/360$.

PROPERTIES FOR DESIGN (CONCRETE .41 CF/SF) (4)

NEGATIVE MOMENT											
STEEL AREA (SQ. IN.)	.60	.60	.76	.93	1.12		.60	.63	.85	1.03	1.31
STEEL % (UNIFORM)	.73	.73	.92	1.14	1.37		.73	.76	1.03	1.25	1.61
(TAPERED)	.43	.43	.54	.66	.80		.43	.44	.60	.73	.94
EFF. DEPTH, IN.	11.8	11.8	11.8	11.7	11.7		11.8	11.8	11.8	11.8	11.7
−ICR/IGR	.179	.179	.214	.246	.280		.179	.185	.232	.268	.314
POSITIVE MOMENT											
STEEL AREA (SQ. IN.)	.40	.51	.62	.75	.88		.31	.40	.51	.62	.75
STEEL %	.09	.12	.15	.18	.21		.07	.09	.12	.15	.18
EFF. DEPTH, IN.	11.8	11.7	11.7	11.6	11.6		11.8	11.8	11.7	11.7	11.6
+ICR/IGR	.162	.200	.239	.280	.323		.128	.162	.200	.239	.280

STANDARD ONE-WAY JOISTS (1) MULTIPLE SPANS

20" Forms + 5" Rib @ 25" c.-c. (2) — FACTORED USABLE SUPERIMPOSED LOAD (PSF)

f'_c = 4,000 psi
f_y = 60,000 psi

10" Deep Rib + 3.0" Top Slab = 13.0" Total Depth

TOP BARS Size @	# 4 10	# 4 8	# 5 10	# 6 11.5	# 6 9.5	End Span Defl. Coeff. (3)	# 3 10	# 4 12	# 4 9	# 5 10		Int. Span Defl. Coeff. (3)
BOTTOM BARS # #	# 4 # 4	# 4 # 5	# 5 # 5	# 5 # 6	# 6 # 6		# 3 # 4	# 4 # 4	# 4 # 5	# 5 # 5		
Steel (psf)	.80	1.01	1.25	1.52	1.83		.82	1.08	1.39	1.78		
CLEAR SPAN	END SPAN						INTERIOR SPAN					
18'-0"	246	336	365*	375*	390*	.876	291	401	419*	428*		.540
	0	0	427	531	569*		0	0	532	639*		
19'-0"	211	292	334*	343*	356*	1.090	251	350	386*	394*		.671
	0	0	374	466	521*		0	0	468	586		
20'-0"	182	254	307*	315*	326*	1.338	217	307	358*	364*		.823
	0	0	328	412	479*		0	0	413	520		
21'-0"	156	222	284*	290*	300*	1.626	188	270	332*	338*		1.001
	0	0	269	365	442		0	0	366	463		
22'-0"	134	194	255	268*	277*	1.959	163	237	309*	314*		1.205
	0	0	0	324	394		0	0	325	413		
23'-0"	114	169	225	249*	257*	2.340	141	209	289*	293*		1.440
	0	0	0	268	353		0	0	0	370		
24'-0"	97	148	199	232*	239*	2.774	122	184	258	274*		1.707
	0	0	0	257	316		0	0	0	332		
25'-0"	82	129	176	216*	222*	3.266	105	162	230	257*		2.010
	0	0	0	230	284		0	0	0	299		
26'-0"	69	112	156	202*	208*	3.821	90	143	206	241*		2.351
	0	0	0	205	256		0	0	0	269		
27'-0"	57	97	137	183	194*	4.443	77	126	184	227*		2.734
	0	0	0	0	230		0	0	0	243		
28'-0"	46	84	121	164	182*	5.139	65	110	164	213*		3.163
	0	0	0	0	207		0	0	0	219		
29'-0"		72	107	146	171*	5.914	54	97	147	198		3.639
		0	0	0	187		0	0	0	0		
30'-0"		61	93	131	160*	6.772	44	84	131	179		4.168
		0	0	0	169		0	0	0	0		
31'-0"		51	82	116	141+	7.722		73	117	161		4.752
		0	0	0	152			0	0	0		

(1) For gross section properties, see Table 8-1.
(2) First load is for standard square joist ends; second load is for special tapered joist ends.
(3) Computation of deflection is not required above horizonal line (thickness ≥ $\ell_n/18.5$ for end spans, $\ell_n/21$ for interior spans).
(4) Exclusive of bridging joists and tapered ends.
*Controlled by shear capacity. +Capacity at elastic deflection = $\ell_n/360$.

PROPERTIES FOR DESIGN (CONCRETE .44 CF/SF) (4)

NEGATIVE MOMENT STEEL AREA (SQ. IN.)	.50	.63	.77	.96	1.16		.50	.65	.86	1.10		
STEEL % (UNIFORM)	.71	.89	1.11	1.38	1.67		.71	.92	1.23	1.59		
(TAPERED)	.45	.53	.66	.83	1.00		.43	.55	.74	.95		
EFF. DEPTH, IN.	11.8	11.8	11.7	11.6	11.6		11.8	11.7	11.7	11.6		
-ICR/IGR	.169	.224	.259	.298	.340		.189	.227	.280	.328		
POSITIVE MOMENT STEEL AREA (SQ. IN.)	.40	.51	.62	.75	.88		.31	.40	.51	.62		
STEEL %	.14	.17	.21	.26	.30		.11	.14	.17	.21		
EFF. DEPTH, IN.	11.8	11.7	11.7	11.6	11.6		11.8	11.8	11.7	11.7		
+ICR/IGR	.198	.244	.290	.339	.369		.157	.198	.244	.290		

STANDARD ONE-WAY JOISTS (1) MULTIPLE SPANS

20" Forms + 6" Rib @ 26" c.-c. (2) — FACTORED USABLE SUPERIMPOSED LOAD (PSF)

f'_c = 4,000 psi
f_y = 60,000 psi

10" Deep Rib + 3.0" Top Slab = 13.0" Total Depth

TOP BARS Size @	# 4 11	# 4 8.5	# 4 7	# 5 8.5	# 6 10.5	End Span Defl. Coeff. (3)	# 4 10	# 4 8	# 5 9.5	# 6 11	# 6 9	Int. Span Defl. Coeff. (3)
BOTTOM BARS # #	# 4 # 4	# 4 # 5	# 5 # 5	# 5 # 6	# 6 # 6		# 3 # 4	# 4 # 4	# 4 # 5	# 5 # 5	# 5 # 6	
Steel (psf)	.76	.97	1.19	1.46	1.73		.81	1.04	1.33	1.66	2.00	
CLEAR SPAN	END SPAN						INTERIOR SPAN					
18'-0"	229	316	403	420*	427*	.913	272	378	470*	476*	487*	.562
	0	0	0	503	601*		0	0	504	631	691*	
19'-0"	196	273	352	385*	391*	1.133	234	329	434*	439*	449*	.697
	0	0	0	441	532		0	0	442	557	640*	
20'-0"	167	237	308	355*	359*	1.391	201	287	389	407*	416*	.856
	0	0	0	389	471		0	0	0	493	596*	
21'-0"	142	206	270	328*	332*	1.691	174	252	344	378*	386*	1.041
	0	0	0	343	418		0	0	0	438	544	
22'-0"	121	179	237	304	308*	2.037	149	220	305	352*	360*	1.254
	0	0	0	0	372		0	0	0	390	487	
23'-0"	102	155	209	270	286*	2.433	128	193	270	329*	336*	1.497
	0	0	0	0	332		0	0	0	349	437	
24'-0"	86	134	184	240	266*	2.885	110	170	240	309*	315*	1.775
	0	0	0	0	297		0	0	0	312	393	
25'-0"	71	116	162	213	249*	3.397	93	149	214	280	295*	2.090
	0	0	0	0	266		0	0	0	0	355	
26'-0"	59	100	142	190	233*	3.974	79	130	190	251	278*	2.445
	0	0	0	0	238		0	0	0	0	321	
27'-0"	47	86	125	169	214	4.621	66	113	169	226	261*	2.844
	0	0	0	0	0		0	0	0	0	290	
28'-0"		73	109	150	192	5.345	55	98	150	203	247*	3.289
		0	0	0	0		0	0	0	0	263	
29'-0"		61	95	133	172	6.150	44	85	134	183	233*	3.785
		0	0	0	0		0	0	0	0	238	
30'-0"		51	82	118	155	7.043		73	118	164	216	4.334
		0	0	0	0			0	0	0	0	
31'-0"		41	71	104	138	8.030		62	105	148	196	4.942
		0	0	0	0			0	0	0	0	

(1) For gross section properties, see Table 8-1.
(2) First load is for standard square joist ends; second load is for special tapered joist ends.
(3) Computation of deflection is not required above horizonal line (thickness ≥ $\ell_n/18.5$ for end spans, $\ell_n/21$ for interior spans).
(4) Exclusive of bridging joists and tapered ends.
*Controlled by shear capacity. +Capacity at elastic deflection = $\ell_n/360$.

PROPERTIES FOR DESIGN (CONCRETE .47 CF/SF) (4)

NEGATIVE MOMENT STEEL AREA (SQ. IN.)	.47	.61	.74	.95	1.09		.52	.65	.85	1.04	1.27
STEEL % (UNIFORM)	.58	.75	.91	1.16	1.34		.63	.79	1.04	1.28	1.57
(TAPERED)	.37	.47	.58	.74	.85		.40	.50	.66	.82	1.00
EFF. DEPTH, IN.	11.8	11.8	11.8	11.7	11.6		11.8	11.8	11.7	11.6	11.6
-ICR/IGR	.165	.203	.235	.278	.304		.178	.212	.256	.294	.338
POSITIVE MOMENT STEEL AREA (SQ. IN.)	.40	.51	.62	.75	.88		.31	.40	.51	.62	.75
STEEL %	.13	.17	.20	.25	.29		.10	.13	.17	.20	.25
EFF. DEPTH, IN.	11.8	11.7	11.7	11.6	11.6		11.8	11.8	11.7	11.7	11.6
+ICR/IGR	.176	.216	.257	.301	.345		.139	.176	.216	.257	.301

Strand Pattern Designation

76–S

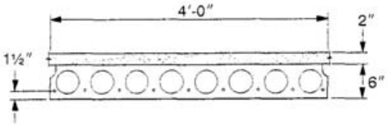
- S = straight
- Diameter of strand in 16ths
- No. of strand (7)

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.

HOLLOW-CORE

4′-0″ x 6″
Normal Weight Concrete



f'_c = 5,000 psi
f'_{ci} = 3,500 psi

Section Properties

		Untopped	Topped
A	=	187 in^2	—
I	=	763 in^4	1,640 in^4
y_b	=	3.00 in.	4.14 in.
y_t	=	3.00 in.	3.86 in.
S_b	=	254 in^3	396 in^3
S_t	=	254 in^3	425 in^3
b_w	=	16.00 in.	16.00 in.
wt	=	195 plf	295 plf
		49 psf	74 psf
V/S	=	1.73 in.	

Key
306 — Safe superimposed service load, psf
0.2 — Estimated camber at erection, in.
0.2 — Estimated long-time camber, in.

4HC6

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

Strand Designation Code	Span, ft																		
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
66-S	306	257	217	184	157	135	116	100	87	75	65	56	48	42	36	30			
	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0	−0.1	−0.2	−0.4			
	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.0	−0.2	−0.3	−0.5	−0.7	−1.0			
76-S	358	301	254	217	186	160	139	121	105	92	80	70	61	53	47	40	35		
	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.0	−0.1	−0.3		
	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.0	−0.1	−0.3	−0.5	−0.7	−1.0		
96-S		384	326	279	240	208	182	159	140	123	109	97	86	76	67	60	53	46	41
		0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.1	0.0	−0.1
		0.4	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.2	0.1	−0.1	−0.4	−0.6	−0.9
87-S			383	331	286	249	218	192	169	150	133	119	106	95	84	76	68	60	54
			0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.6	0.5	0.4	0.3
			0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.5	0.4	0.2	0.0	−0.3
97-S				364	317	277	243	214	189	168	150	134	120	107	96	87	78	70	62
				0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	0.9	0.9	0.8	0.8	0.7
				0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.0	1.0	0.9	0.8	0.6	0.4	0.2

4HC6+2

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

Strand Designation Code	Span, ft																
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
66-S	305	258	220	188	162	139	119	97	78	62	47	35					
	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0	−0.1					
	0.2	0.2	0.2	0.1	0.1	0.0	−0.1	−0.2	−0.3	−0.5	−0.7	−0.9					
76-S	358	304	260	224	194	168	146	122	101	82	66	52	39				
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.0				
	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.0	−0.2	−0.3	−0.5	−0.7	−0.9				
96-S		390	336	291	253	221	194	170	146	123	104	87	72	58	46	35	
		0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.3	0.3	0.1	0.0	
		0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.1	−0.1	−0.3	−0.5	−0.7	−1.0	−1.4	
87-S			398	346	302	265	234	206	182	158	136	117	100	85	71	59	47
			0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.6	0.5	0.4	0.3
			0.5	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.2	0.1	−0.1	−0.3	−0.5	−0.8	−1.2
97-S				382	335	294	260	231	205	181	157	137	119	102	88	75	63
				0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.7
				0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.4	0.2	0.0	−0.2	−0.5	−0.8

Strength based on strain compatibility; bottom tension limited to $6\sqrt{f'_c}$; see pages 2-2 – 2-6 for explanation.

Strand Pattern Designation

76-S

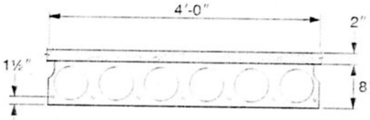
- S = straight
- Diameter of strand in 16ths
- No. of strand (7)

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.

HOLLOW-CORE

4′-0″ x 8″
Normal Weight Concrete



f'_c = 5,000 psi
f'_{ci} = 3,500 psi

Section Properties

	Untopped	Topped
A =	215 in^2	—
I =	1,666 in^4	3,071 in^4
y_b =	4.00 in.	5.29 in.
y_t =	4.00 in.	4.71 in.
S_b =	416 in^3	580 in^3
S_t =	416 in^3	652 in^3
b_w =	12.00 in.	12.00 in.
wt =	224 plf	324 plf
	56 psf	81 psf
V/S =	1.92 in.	

Key

335 — Safe superimposed service load, psf
0.2 — Estimated camber at erection, in.
0.3 — Estimated long-time camber, in.

4HC8

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

No Topping

Strand Designation Code	Span, ft																						
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
66-S	335	286	246	213	185	162	141	124	109	96	85	75	66	58	50	44	38	33					
	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.0	0.0	−0.1	−0.2					
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0	−0.1	−0.2	−0.3	−0.5	−0.7					
76-S	375	337	291	252	220	193	170	150	133	118	105	93	83	73	65	58	51	45	39	34			
	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0	−0.1	−0.2			
	0.3	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	−0.6	−0.8			
58-S	372	342	317	296	275	255	225	200	179	160	143	128	115	104	93	84	76	68	61	55	49	44	39
	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.0	−0.1
	0.4	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.4	0.3	0.2	0.0	−0.2	−0.4	−0.6	−0.9
68-S		351	326	302	284	266	250	236	218	196	176	159	143	130	117	107	97	88	80	72	65	59	54
		0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4
		0.6	0.6	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.7	0.6	0.4	0.2	0.0	−0.2
78-S		360	335	311	290	272	256	242	229	215	205	188	170	154	141	128	117	106	97	89	81	74	67
		0.5	0.6	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	0.9	0.9
		0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.1	1.0	0.9	0.7	0.5

4HC8+2

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

2″ Normal Weight Topping

Strand Designation Code	Span, ft																						
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
66-S	309	267	231	201	175	153	133	117	102	89	77	67	55	44	33								
	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.0	0.0	−0.1								
	0.2	0.2	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								
76-S		316	275	241	211	185	163	144	127	112	99	87	74	62	50	40	31						
		0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.0	−0.1						
		0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.0	−0.1	−0.2	−0.4	−0.5	−0.7	−0.9	−1.2						
58-S			352	317	279	248	220	196	174	156	139	124	111	98	84	71	60	50	40	32			
			0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.0			
			0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.3	0.3	0.2	0.1	−0.1	−0.2	−0.4	−0.6	−0.9	−1.2	−1.5			
68-S				337	316	297	268	239	215	193	173	156	141	127	114	100	87	75	64	54	45	36	
				0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.2	
				0.6	0.6	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.3	0.2	0.0	−0.2	−0.4	−0.6	−0.9	−1.2	−1.6	
78-S				346	325	306	286	271	252	227	205	186	168	152	138	124	111	98	86	76	66	56	47
				0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.0	0.9	0.9	0.7	0.6
				0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.6	0.5	0.3	0.1	−0.1	−0.3	−0.6	−0.9	−1.3

Strength based on strain compatibility; bottom tension limited to $6\sqrt{f'_c}$; see pages 2-2–2-6 for explanation.

Strand Pattern Designation

68-D1

- 6 — No. of strand (6)
- 8 — Diameter of strand in 16ths
- D — S = straight D = depressed
- 1 — No. of depression points

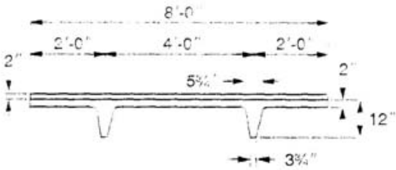
Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load. Long-time cambers include superimposed dead load but do not include live load.

Key

186 — Safe superimposed service load, psf
0.2 — Estimated camber at erection, in.
0.3 — Estimated long-time camber, in.

DOUBLE TEE

8'-0" x 12"
Lightweight Concrete



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

Section Properties

		Untopped	Topped
A	=	287 in²	—
I	=	2,37[illegible] in⁴	4,819 in⁴
y_b	=	9.13 in.	10.82 in.
y_t	=	2.87 in.	3.18 in.
S_b	=	315 in³	445 in³
S_t	=	1,001 in³	1,515 in³
wt	=	229 plf	429 plf
		29 psf	54 psf
V/S	=	1.22 in.	

8LDT12

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

Strand Pattern	e_e, in. e_c, in.	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
28-S	7.13 7.13	186 0.2 0.3	144 0.3 0.4	116 0.4 0.5	89 0.5 0.6	68 0.5 0.6	53 0.6 0.7	41 0.6 0.7	31 0.6 0.6								
48-S	5.13 5.13			195 0.6 0.8	153 0.7 0.9	120 0.8 1.1	95 1.0 1.2	77 1.1 1.3	62 1.2 1.3	50 1.3 1.4	41 1.3 1.3	33 1.3 1.2					
68-S	3.13 3.13				169 0.6 0.8	133 0.8 1.0	106 0.9 1.1	86 1.0 1.1	70 1.0 1.1	57 1.1 1.1	47 1.1 1.0	39 1.1 0.8	32 1.0 0.5				
68-D1	3.13 6.63											72 2.6 2.9	61 2.8 2.9	52 3.0 2.9	45 3.1 2.7	38 3.2 2.4	33 3.2 2.1

8LDT12+2

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

Strand Pattern	e_e, in. e_c, in.	12	14	16	18	20	22	24	26	28	30	32	34	36	38
28-S	7.13 7.13	207 0.2 0.2	157 0.3 0.3	123 0.4 0.4	91 0.5 0.4	66 0.5 0.4	47 0.6 0.3	33 0.6 0.2							
48-S	5.13 5.13				175 0.7 0.7	134 0.8 0.8	103 1.0 0.8	80 1.1 0.7	62 1.2 0.6	48 1.3 0.5	36 1.3 0.2				
68-S	3.13 3.13					162 0.8 0.7	126 0.9 0.7	99 1.0 0.6	79 1.0 0.5	62 1.1 0.3	47 1.1 0.1				
68-D1	3.13 6.63											72 2.6 1.3	59 2.8 1.0	46 3.0 0.6	33 3.1 0.0

Strength based on strain compatibility; bottom tension limited to $12\sqrt{f'_c}$; see pages 2-2–2-6 for explanation.
Shaded values require release strengths higher than 3500 psi.

f'_c = 4,000 psi
Grade 60 Bars

FLAT SLAB SYSTEM

SQUARE EDGE PANEL — With Drop Panels — No Beams

SPAN ($\ell_1 = \ell_2$) (ft)	Factored Superimposed Load (psf)	Square Drop Panel Depth (in.)	Square Drop Panel Width (ft)	Square Column[3] Size (in.)	Square Column γ_f	Reinforcing Bars (E. W.) Column Strip[1] Top Ext. +	Column Strip Bottom	Column Strip 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 = 8 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS														
21	100	3.50	7.00	12	0.705	11-#4 1	9-#5	15-#4	9-#4	11-#4	1.92	66.0	132.0	177.8
21	200	5.00	7.00	14	0.630	11-#4 1	9-#6	12-#5	13-#4	11-#4	2.40	90.8	181.6	244.4
21	300	5.00	7.00	16	0.727	12-#4 3	9-#7	15-#5	16-#4	9-#5	2.99	115.3	230.6	310.4
21	400	6.50	7.00	18	0.628	12-#4 2	20-#5	16-#5	13-#5	8-#6	3.51	139.1	278.2	374.5
21	500	6.50	8.40	20	0.740	15-#4 4	19-#6	14-#6	9-#7	13-#5	4.55	164.0	354.6	441.4
22	100	3.50	7.33	12	0.792	11-#4 4	16-#4	12-#5	11-#4	11-#4	2.02	76.3	152.5	205.3
22	200	5.00	7.33	14	0.714	11-#4 3	15-#5	14-#5	10-#5	13-#4	2.57	105.0	210.0	282.7
22	300	6.50	7.33	16	0.630	12-#4 2	19-#5	11-#6	19-#4	16-#4	3.17	133.7	267.4	359.9
22	400	6.50	8.80	19	0.736	14-#4 5	10-#8	14-#6	15-#5	19-#4	3.96	160.6	321.2	432.4
23	100	5.00	7.67	12	0.728	12-#4 3	12-#5	12-#5	12-#4	12-#4	2.10	87.8	175.6	236.4
23	200	6.50	7.67	15	0.631	12-#4 1	17-#5	14-#5	11-#5	14-#4	2.71	120.4	240.9	324.3
23	300	6.50	7.67	17	0.721	14-#4 4	22-#5	18-#5	22-#4	12-#5	3.45	152.5	305.0	410.6
23	400	8.00	9.20	19	0.664	15-#4 3	15-#7	14-#6	10-#7	22-#4	4.41	185.3	370.7	499.0
24	100	5.00	8.00	12	0.769	13-#4 3	21-#4	13-#5	9-#5	13-#4	2.25	100.1	200.3	269.6
24	200	6.50	8.00	15	0.704	13-#4 4	14-#6	16-#5	9-#6	16-#4	3.05	137.6	275.1	370.4
24	300	8.00	8.00	17	0.636	14-#4 3	11-#8	18-#5	9-#7	10-#6	4.00	174.6	349.2	470.1
24	400	8.00	9.60	20	0.688	17-#4 3	17-#7	12-#7	20-#5	9-#7	4.62	211.2	422.4	568.6

SQUARE INTERIOR PANEL — With Drop Panels[2] — No Beams

Factored Superimposed Load (psf)	Square Column[3] 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 = 8 in. = TOTAL SLAB DEPTH BETWEEN DROP PANELS							
100	12	14-#4	10-#4	11-#4	10-#4	1.85	0.699
200	17	11-#5	13-#4	11-#4	10-#4	2.14	0.713
300	19	14-#5	16-#4	8-#5	11-#4	2.56	0.713
400	21	15-#5	13-#5	10-#5	13-#4	3.08	0.727
500	21	18-#5	9-#7	12-#5	8-#6	3.93	0.753
100	12	16-#4	11-#4	11-#4	10-#4	1.88	0.699
200	17	19-#4	15-#4	12-#4	10-#4	2.21	0.713
300	19	14-#5	19-#4	10-#5	13-#4	2.77	0.727
400	22	12-#6	15-#5	12-#5	10-#5	3.37	0.753
100	12	16-#4	13-#4	12-#4	10-#4	1.90	0.713
200	17	13-#5	11-#5	13-#4	11-#4	2.36	0.727
300	20	16-#5	14-#5	11-#5	14-#4	2.98	0.727
400	22	18-#5	10-#7	20-#4	12-#5	3.76	0.773
100	12	12-#5	14-#4	13-#4	11-#4	2.03	0.713
200	17	15-#5	13-#5	10-#5	13-#4	2.65	0.727
300	20	12-#6	9-#7	19-#4	16-#4	3.36	0.741
400	22	20-#5	20-#5	23-#4	13-#5	3.89	0.773

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

WAFFLE FLAT SLAB SYSTEM 19″ X 19″ Voids: 5″ Ribs @ 24″

f'_c = 4,000 psi
Grade 60 Bars

SQUARE EDGE PANELS

Total Depth = 11 in. Rib Depth = 8 in. Total Slab Depth = 3 in.

Span (c. to c. columns) $\ell_1 = \ell_2$ (ft)	Factored Superimposed Load (psf)	(1) Steel (psf)	Square Edge Column $c_1 = c_2$ (in.)	γ_f	(2) Stirrups	Column Strip Top Edge No.-size +	Column Strip Bottom No. Ribs	Column Strip Bottom Bars per Rib	Column Strip Top Interior No.-size	Middle Strip Bottom No. Ribs	Middle Strip Bottom Long Bars	Middle Strip Bottom Short Bars	Middle Strip Top Interior No.-size	−M Edge (ft-k)	+M Bot. (ft-k)	−M Int. (ft-k)
[illegible]	50	2.26	12	0.855		18-#5+0	5	2-#4	18-#5	7	#4	#4	7-#5	67	135	181
	100	2.39	12 *	0.889		18-#5+0	5	2-#5	18-#5	7	#4	#4	7-#5	88	182	237
	150	2.51	12 *	0.926		18-#5+1	5	1-#5 and 1-#6	18-#5	7	#4	#4	7-#5	109	251	292
	200	2.96	13 *	0.629		18-#5+0	5	1-#6 and 1-#7	21-#5	7	#4	#5	7-#5	129	315	347
	300	3.73	13 *	0.623	3 S 1 1	18-#5+0	5	1-#7 and 1-#8	19-#6	7	#5	#5	9-#5	166	417	446
[illegible]	50	2.32	13	0.583		19-#5+0	6	1-#4 and 1-#5	19-#5	7	#4	#4	8-#5	86	173	233
	100	2.40	13 *	0.911		19-#5+2	6	2-#5	19-#5	7	#4	#4	8-#5	113	227	303
	150	2.35	14 *	0.936		19-#5+4	6	2-#6	22-#5	7	#4	#5	8-#5	138	315	373
	200	3.31	17 *	0.624		19-#5+2	6	1-#6 and 1-#7	26-#5	7	#5	#5	8-#5	163	393	439
[illegible]	50	2.50	14 *	0.581		21-#5+1	6	2-#5	21-#5	8	#4	#4	8-#5	107	215	289
	100	2.55	14 *	0.931		21-#5+4	6	1-#5 and 1-#6	22-#5	8	#4	#4	8-#5	140	280	377
	150	3.14	17 *	0.624		21-#5+0	6	1-#6 and 1-#7	20-#6	8	#4	#5	9-#5	171	378	461
	200	3.45	23	0.619		21-#5+2	6	2-#7	23-#6	8	#4	#5	10-#5	198	414	533
[illegible]	50	2.50	15 *	0.893		22-#5+2	6	1-#5 and 1-#6	22-#5	9	#4	#4	9-#5	132	263	354
	100	2.77	16 *	0.934		22-#5+6	6	2-#6	28-#5	9	#4	#4	9-#5	171	343	461
	150	3.37	23 *	0.619		22-#5+1	6	2-#7	24-#6	9	#4	#5	11-#5	207	417	556

SQUARE INTERIOR PANELS

Total Depth = 11 in. Rib Depth = 8 in. Total Slab Depth = 3 in.

(1) Steel (psf)	Square Interior Column $c_1 = c_2$ (in.)	(2) Stirrups	Column Strip Bottom No. Ribs	Column Strip Bottom Bars per Rib	Column Strip Top Interior No.-size	Middle Strip Bottom No. Ribs	Middle Strip Bottom Long Bars	Middle Strip Bottom Short Bars	Middle Strip Top Interior No.-size
2.23	12		5	2-#4	18-#5	7	#4	#4	7-#5
2.23	12		5	2-#4	18-#5	7	#4	#4	7-#5
2.35	12 *	3 S 4 1	5	1-#4 and 1-#5	18-#5	7	#4	#4	7-#5
2.53	12 *	3 S 4 1	5	2-#5	19-#5	7	#4	#4	7-#5
3.21	14 *	3 S 4 2	5	2-#6	18-#6	7	#4	#4	8-#5
2.23	13		6	2-#4	19-#5	7	#4	#4	8-#5
2.23	13		6	2-#4	19-#5	7	#4	#4	8-#5
2.52	13 *	3 S 4 1	6	2-#5	20-#5	7	#4	#4	8-#5
2.94	13 *	3 S 4 1	6	1-#5 and 1-#6	18-#6	7	#4	#4	8-#5
2.23	14		6	2-#4	21-#5	8	#4	#4	8-#5
2.35	14 *	3 S 4 1	6	1-#4 and 1-#5	21-#5	8	#4	#4	8-#5
2.81	14 *	3 S 4 1	6	1-#5 and 1-#6	26-#5	8	#4	#4	8-#5
3.13	17 *	3 S 4 2	6	1-#5 and 1-#6	22-#6	8	#4	#4	10-#5
2.33	15		6	1-#4 and 1-#5	22-#5	9	#4	#4	9-#5
2.60	15 *	3 S 4 1	6	2-#5	26-#5	9	#4	#4	9-#5
3.06	16 *	3 S 4 2	6	1-#5 and 1-#6	23-#6	9	#4	#4	10-#5

See the notes on Page 11-19

WAFFLE FLAT SLAB SYSTEM 30″ X 30″ Voids: 6″ Ribs @ 36″

f'_c = 4,000 psi
Grade 60 Bars

SQUARE EDGE PANELS

Total Depth = 11 in. Rib Depth = 8 in. Total Slab Depth = 3 in.

Span $\ell_1 = \ell_2$ (ft)	Factored Superimposed Load (psf)	(1) Steel (psf)	Square Edge Column $c_1 = c_2$ (in.)	γ_f	(2) Stirrups	Column Strip Top Edge No.-size +	Column Strip Bottom No. Ribs	Column Strip Bottom Bars per Rib	Column Strip Top Interior No.-size	Middle Strip Bottom No. Ribs	Middle Strip Bottom Long Bars	Middle Strip Bottom Short Bars	Middle Strip Top Interior No.-size	−M Edge (ft-k)	+M Bot. (ft-k)	−M Int. (ft-k)
[illegible]	50	1.35	12	0.654		11-#5+0	3	2-#4	11-#5	2	#4	#4	4-#5	15	29	40
	100	1.35	12	0.675		11-#5+0	3	2-#4	11-#5	2	#4	#4	4-#5	20	42	53
	150	1.33	12	0.698		11-#5+0	3	2-#4	11-#5	2	#4	#4	4-#5	24	57	65
	200	1.33	12	0.717		11-#5+0	3	2-#4	11-#5	2	#4	#4	4-#5	29	72	78
	300	1.33	12	0.760		11-#5+0	3	1-#4 and 1-#5	11-#5	2	#4	#5	4-#5	39	102	104
	400	1.31	12	0.803		11-#5+0	3	1-#5 and 1-#6	11-#5	2	#5	#6	4-#5	48	130	130
[illegible]	50	1.50	12	0.732		13-#5+0	3	2-#4	13-#5	3	#4	#4	5-#5	26	51	69
	100	1.50	12	0.755		13-#5+0	3	2-#4	13-#5	3	#4	#4	5-#5	34	73	92
	150	1.52	12	0.781		13-#5+0	3	1-#4 and 1-#5	13-#5	3	#4	#4	5-#5	43	100	115
	200	2.03	12	0.807		13-#5+0	3	2-#5	13-#5	3	#4	#4	5-#5	51	127	138
	300	2.34	12	0.836		13-#5+0	3	2-#6	13-#5	3	#5	#5	5-#5	68	179	183
	400	2.75	12*	0.912	3 S 4 1	13-#5+0	3	2-#7	13-#5	3	#5	#6	5-#5	85	229	229
[illegible]	50	1.94	12	0.792		15-#5+0	4	2-#4	15-#5	3	#4	#4	6-#5	43	85	115
	100	1.90	12	0.822		15-#5+0	4	1-#4 and 1-#5	15-#5	3	#4	#4	6-#5	56	121	151
	150	2.03	12	0.855		15-#5+0	4	2-#5	15-#5	3	#5	#5	6-#5	70	165	188
	200	2.36	12	0.830		15-#5+1	4	2-#6	15-#5	3	#5	#6	6-#5	84	208	225
	300	2.91	12*	0.630		15-#5+1	4	2-#7	17-#5	3	#6	#7	6-#5	111	292	298
	400	3.73	16*	0.625		15-#5+0	4	2-#8	15-#6	3	#7	#8	7-#5	135	362	364
[illegible]	50	1.92	12	0.548		18-#5+0	4	1-#4 and 1-#5	18-#5	4	#4	#4	7-#5	63	127	171
	100	2.11	12*	0.852		18-#5+0	4	1-#5 and 1-#6	18-#5	4	#4	#5	7-#5	84	180	226
	150	2.40	12*	0.915		18-#5+0	4	1-#6 and 1-#7	18-#5	4	#5	#5	7-#5	105	247	282
	200	2.80	13*	0.629		18-#5+0	4	2-#7	20-#5	4	#6	#6	7-#5	125	310	336
	300	3.72	13*	0.623		18-#5+1	4	1-#8 and 1-#9	26-#5	4	#6	#7	9-#5	162	412	435
[illegible]	50	2.00	13	0.870		20-#5+0	4	1-#5 and 1-#6	20-#5	5	#4	#4	8-#5	90	180	242
	100	2.29	13*	0.914		20-#5+1	4	1-#6 and 1-#7	20-#5	5	#4	#5	8-#5	119	246	321
	150	2.85	15*	0.930		20-#5+4	4	1-#7 and 1-#8	24-#5	5	#5	#6	8-#5	148	339	398
	200	3.51	15*	0.623		20-#5+1	4	1-#8 and 1-#9	20-#6	5	#6	#6	9-#5	175	426	472
[illegible]	50	2.12	15	0.879		22-#5+1	5	1-#5 and 1-#6	22-#5	5	#4	#5	9-#5	125	249	336
	100	2.62	16*	0.923		22-#5+5	5	1-#6 and 1-#7	26-#5	5	#5	#6	9-#5	164	329	443
	150	3.30	22*	0.921		22-#5+8	5	1-#7 and 1-#8	23-#6	5	#6	#6	11-#5	201	437	541

SQUARE INTERIOR PANELS

Total Depth = 11 in. Rib Depth = 8 in. Total Slab Depth = 3 in.

(1) Steel (psf)	Square Interior Column $c_1 = c_2$ (in.)	(2) Stirrups	Column Strip Bottom No. Ribs	Column Strip Bottom Bars per Rib	Column Strip Top Interior No.-size	Middle Strip Bottom No. Ribs	Middle Strip Bottom Long Bars	Middle Strip Bottom Short Bars	Middle Strip Top Interior No.-size
1.85	12		3	2-#4	11-#5	2	#4	#4	4-#5
1.85	12		3	2-#4	11-#5	2	#4	#4	4-#5
1.85	12		3	2-#4	11-#5	2	#4	#4	4-#5
1.85	12		3	2-#4	11-#5	2	#4	#4	4-#5
1.85	12		3	2-#4	11-#5	2	#4	#4	4-#5
2.03	12	3 S 4 1	3	1-#4 and 1-#5	11-#5	2	#4	#5	4-#5
1.84	12		3	2-#4	13-#5	3	#4	#4	5-#5
1.84	12		3	2-#4	13-#5	3	#4	#4	5-#5
1.84	12		3	2-#4	13-#5	3	#4	#4	5-#5
1.95	12		3	1-#4 and 1-#5	13-#5	3	#4	#4	5-#5
2.05	12	3 S 4 1	3	2-#5	13-#5	3	#4	#4	5-#5
2.40	12*	3 S 4 1	3	2-#6	13-#5	3	#4	#5	5-#5
1.82	12		4	2-#4	15-#5	3	#4	#4	6-#5
1.82	12		4	2-#4	15-#5	3	#4	#4	6-#5
1.82	12		4	2-#4	15-#5	3	#4	#4	6-#5
2.01	12		4	1-#4 and 1-#5	15-#5	3	#4	#5	6-#5
2.49	12*	3 S 4 1	4	1-#5 and 1-#6	16-#5	3	#5	#6	6-#5
3.19	13*	3 S 4 1	4	1-#6 and 1-#7	14-#6	3	#6	#6	7-#5
1.86	12		4	2-#4	18-#5	4	#4	#4	7-#5
1.95	12		4	1-#4 and 1-#5	18-#5	4	#4	#4	7-#5
2.05	12*	3 S 4 1	4	2-#5	18-#5	4	#4	#4	7-#5
2.36	12*	3 S 4 1	4	2-#6	18-#5	4	#4	#5	7-#5
3.24	14*	3 S 4 1	4	2-#7	17-#6	4	#5	#6	8-#5
1.94	13		4	1-#4 and 1-#5	20-#5	5	#4	#4	8-#5
2.02	13	3 S 4 1	4	2-#5	20-#5	5	#4	#4	8-#5
2.42	13*	3 S 4 1	4	2-#6	22-#5	5	#4	#5	8-#5
3.10	13*	3 S 4 1	4	2-#7	19-#6	5	#5	#5	9-#5
1.94	15		5	1-#4 and 1-#5	22-#5	5	#4	#4	9-#5
2.31	15*	3 S 4 1	5	1-#5 and 1-#6	24-#5	5	#4	#5	9-#5
3.02	15*	3 S 4 1	5	1-#6 and 1-#7	22-#6	5	#5	#5	10-#5

NOTES: * Factored shear stress for the column size so designated is greater than $4\sqrt{f'_c}$ but less than $6\sqrt{f'_c}$. Shear reinforcement, structural steel shearheads, or shear caps must be provided with columns indicated.

(1) Average reinforcing steel weight (psf) includes twice the flexural reinforcement tabulated (tabulated reinforcement placed in each direction). Shrinkage and temperature reinforcement, integrity reinforcement, and shear reinforcement are not included.

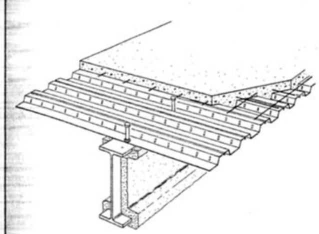
(2) The notation 3 S 4 1 for the stirrups: the first character "3" is the bar size, i.e. #3; the "S" stands for "stirrup"; and the "4" is the spacing of the stirrups in inches. The last character indicates the length over which stirrups are required in each joist rib; the "1" denotes the length from the face of the solid head to the first cross rib, i.e., a length of one module; a "2" indicates stirrups are required to the second cross rib from the face of the solid head, i.e., a length of two modules.

Appendix B: R.S. Means

B10 Superstructure

B1010 Floor Construction

SHELL B



Description: Table below lists costs ($/S.F.) for a floor system using composite steel beams with welded shear studs, composite steel deck, and light weight concrete slab reinforced with W.W.F. Price includes sprayed fiber fireproofing on steel beams.

Design and Pricing Assumptions:
Structural steel is A36, high strength bolted.
Composite steel deck varies from 22 gauge to 16 gauge, galvanized.
Shear Studs are 3/4".
W.W.F., 6 x 6 – W1.4 x W1.4 (10 x 10)
Concrete f'c = 3 KSI, lightweight.
Steel trowel finish and cure.
Fireproofing is sprayed fiber (non-asbestos).
Spandrels are assumed the same as interior beams and girders to allow for exterior wall loads and bracing or moment connections.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	INST.	TOTAL
SYSTEM B1010 256 2400					
20X25 BAY, 40 PSF S. LOAD, 5-1/2" SLAB, 17-1/2" TOTAL THICKNESS					
Structural steel	4.320	Lb.	4.23	1.47	5.70
Welded shear connectors 3/4" diameter 4-7/8" long	.163	Ea.	.09	.25	.34
Metal decking, non-cellular composite, galv. 3" deep, 22 gauge	1.050	S.F.	1.76	.75	2.51
Sheet metal edge closure form, 12", w/2 bends, 18 ga, galv	.045	L.F.	.15	.08	.23
Welded wire fabric rolls, 6 x 6 - W1.4 x W1.4 (10 x 10), 21 lb/csf	1.000	S.F.	.22	.29	.51
Concrete ready mix, light weight, 3,000 PSI	.333	C.F.	2		2
Place and vibrate concrete, elevated slab less than 6", pumped	.333	C.F.		.41	.41
Finishing floor, monolithic steel trowel finish for finish floor	1.000	S.F.		.70	.70
Curing with sprayed membrane curing compound	.010	C.S.F.	.06	.07	.13
Shores, erect and strip vertical to 10' high	.020	Ea.		.33	.33
Sprayed mineral fiber/cement for fireproof, 1" thick on beams	.483	S.F.	.22	.38	.60
TOTAL			8.73	4.73	13.46

B1010 256 Composite Beams, Deck & Slab

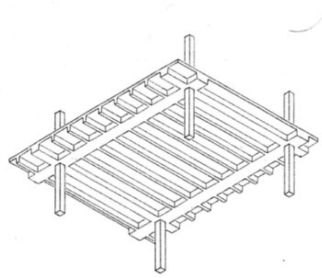
	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	SLAB THICKNESS (IN.)	TOTAL DEPTH (FT.-IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	INST.	TOTAL
2400	20x25	40	5-1/2	1 - 5-1/2	80	8.75	4.73	13.48
2500	RB1010 -100	75	5-1/2	1 - 9-1/2	115	9.10	4.73	13.83
2750		125	5-1/2	1 - 9-1/2	167	11.05	5.55	16.60
2900		200	6-1/4	1 - 11-1/2	251	12.40	6	18.40
3000	25x25	40	5-1/2	1 - 9-1/2	82	8.65	4.49	13.14
3100		75	5-1/2	1 - 11-1/2	118	9.60	4.56	14.16
3200		125	5-1/2	2 - 2-1/2	169	10	4.94	14.94
3300		200	6-1/4	2 - 6-1/4	252	13.45	5.80	19.25
3400	25x30	40	5-1/2	1 - 11-1/2	83	8.85	4.47	13.32
3600		75	5-1/2	1 - 11-1/2	119	9.50	4.52	14.02
3900		125	5-1/2	1 - 11-1/2	170	10.95	5.10	16.05
4000		200	6-1/4	2 - 6-1/4	252	13.50	5.80	19.30
4200	30x30	40	5-1/2	1 - 11-1/2	81	8.80	4.61	13.41
4400		75	5-1/2	2 - 2-1/2	116	9.50	4.83	14.33
4500		125	5-1/2	2 - 5-1/2	168	11.45	5.40	16.85
4700		200	6-1/4	2 - 9-1/4	252	13.65	6.25	19.90
4900	30x35	40	5-1/2	2 - 2-1/2	82	9.20	4.78	13.98
5100		75	5-1/2	2 - 5-1/2	117	10	4.88	14.88
5300		125	5-1/2	2 - 5-1/2	169	11.75	5.55	17.30
5500		200	6-1/4	2 - 9-1/4	254	13.75	6.30	20.05
5750	35x35	40	5-1/2	2 - 5-1/2	84	9.85	4.79	14.64
6000		75	5-1/2	2 - 5-1/2	121	11.20	5.15	16.35

B1010 Floor Construction

B1010 241 W Shape Beams & Girders

	BAY SIZE (FT.) BEAM X GIRD	SUPERIMPOSED LOAD (P.S.F.)	STEEL FRAMING DEPTH (IN.)	FIREPROOFING (S.F. PER S.F.)	TOTAL LOAD (P.S.F.)	COST PER S.F.		
						MAT.	INST.	TOTAL
3100		200	27	.855	275	11.35	3.63	14.98
3300	20x25	40	14	.608	50	4.20	1.84	6.04
3350		40	21	.751	90	5.85	2.50	8.35
3400		75	24	.793	125	7.20	3	10.20
3450		125	24	.846	175	8.60	3.60	12.20
3500		200	24	.947	256	10.80	3.55	14.35
3550	20x25	40	14	.72	50	4.84	2.13	6.97
3600		40	21	.802	90	5.85	2.53	8.38
3650		75	24	.924	125	7.50	3.17	10.67
3700		125	24	.964	175	9.05	3.83	12.88
3750		200	27	1.09	250	11.45	3.81	15.26
3800	25x20	40	12	.512	50	4.16	1.76	5.92
3850		40	16	.653	90	5.60	2.34	7.94
3900		75	18	.726	125	7.20	2.95	10.15
4000		125	21	.827	175	9	3.73	12.73
4100		200	24	.928	250	11	3.58	14.58
4200	25x20	40	12	.65	50	4.22	1.87	6.09
4300		40	18	.702	90	6.20	2.59	8.79
4400		75	21	.829	125	7.25	3.03	10.28
4500		125	24	.914	175	8.85	3.72	12.57
4600		200	24	1.015	250	10.85	3.60	14.45
4700	25x20	40	14	.769	50	4.47	2.03	6.50
4800		40	16	.938	90	6.70	2.91	9.61
4900		75	18	.969	125	8.10	3.41	11.51
5000		125	24	1.136	175	11.30	4.74	16.04
5100		200	24	1.239	250	14.60	4.77	19.37
5200	25x25	40	18	.486	50	4.53	1.87	6.40
5300		40	18	.592	96	6.75	2.71	9.46
5400		75	21	.668	131	8.15	3.24	11.39
5450		125	24	.738	191	10.75	4.29	15.04
5500		200	30	.861	272	12.50	3.95	16.45
5550	25x25	40	18	.597	50	4.39	1.90	6.29
5600		40	18	.704	90	7	2.86	9.86
5650		75	21	.777	125	8	3.25	11.25
5700		125	24	.865	175	10.20	4.18	14.38
5750		200	27	.96	250	12.35	3.97	16.32
5800	25x25	40	18	.71	50	4.84	2.13	6.97
5850		40	21	.767	90	7	2.91	9.91
5900		75	24	.887	125	8.45	3.48	11.93
5950		125	24	.972	175	10.65	4.40	15.05
6000		200	30	1.10	250	13	4.24	17.24
6050	25x30	40	24	.547	50	5.75	2.33	8.08
6100		40	24	.629	103	8.15	3.21	11.36
6150		75	30	.726	138	9.75	3.84	13.59
6200		125	30	.751	206	11.50	4.58	16.08
6250		200	33	.868	281	13.85	4.32	18.17
6300	25x30	40	21	.568	50	5.15	2.15	7.30
6350		40	21	.694	90	7	2.86	9.86
6400		75	24	.776	125	9	3.59	12.59
6450		125	30	.904	175	10.80	4.41	15.21
6500		200	33	1.008	263	12.95	4.17	17.12

B1010 Floor Construction



General: Combination of thin concrete slab and monolithic ribs at uniform spacing to reduce dead weight and increase rigidity. The ribs (or joists) are arranged parallel in one direction between supports.

Square end joists simplify forming. Tapered ends can increase span or provide for heavy load.

Costs for multiple span joists are provided in this section. Single span joist costs are not provided here.

Design and Pricing Assumptions:
Concrete f'c = 4 KSI, normal weight placed by concrete pump.
Reinforcement, fy = 60 KSI.
Forms, four use.
4-1/2" slab.
30" pans, sq. ends (except for shear req.).
6" rib thickness.
Distribution ribs as required.
Finish, steel trowel.
Curing, spray on membrane.
Based on 4 bay x 4 bay structure.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	INST.	TOTAL
SYSTEM B1010 226 2000					
15'X15' BAY, 40 PSF, S. LOAD 12" MIN. COLUMN					
Forms in place, floor slab with 30" metal pans, 4 use	.905	S.F.	2.70	4.51	7.21
Forms in place, exterior spandrel, 12" wide, 4 uses	.170	SFCA	.21	1.37	1.58
Forms in place, interior beam. 12" wide, 4 uses	.095	SFCA	.13	.63	.76
Edge forms, 7"-12" high on elevated slab, 4 uses	.010	L.F.	.01	.05	.06
Reinforcing in place, elevated slabs #4 to #7	.628	Lb.	.29	.22	.51
Concrete ready mix, regular weight, 4000 psi	.555	C.F.	1.90		1.90
Place and vibrate concrete, elevated slab, 6" to 10" pump	.555	C.F.		.57	.57
Finish floor, monolithic steel trowel finish for finish floor	1.000	S.F.		.70	.70
Cure with sprayed membrane curing compound	.010	S.F.	.06	.07	.13
TOTAL			5.30	8.12	13.42

B1010 226 Cast in Place Multispan Joist Slab

	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	MINIMUM COL. SIZE (IN.)	RIB DEPTH (IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	INST.	TOTAL
2000	15 x 15	40	12	8	115	5.30	8.15	13.45
2100	RB1010 -010	75	12	8	150	5.30	8.15	13.45
2200		125	12	8	200	5.45	8.25	13.70
2300		200	14	8	275	5.60	8.55	14.15
2600	15 x 20	40	12	8	115	5.40	8.15	13.55
2800	RB1010 -100	75	12	8	150	5.50	8.30	13.80
3000		125	14	8	200	5.70	8.75	14.45
3300		200	16	8	275	5.95	8.85	14.80
3600	20 x 20	40	12	10	120	5.50	8	13.50
3900		75	14	10	155	5.70	8.45	14.15
4000		125	16	10	205	5.80	8.60	14.40
4100		200	18	10	280	6.05	8.95	15
4300	20 x 25	40	12	10	120	5.50	8.05	13.55
4400		75	14	10	155	5.75	8.50	14.25
4500		125	16	10	205	6.05	8.95	15
4600		200	18	12	280	6.35	9.40	15.75
4700	25 x 25	40	12	12	125	5.55	7.85	13.40
4800		75	16	12	160	5.85	8.30	14.15
4900		125	18	12	210	6.45	9.15	15.60
5000		200	20	14	291	6.85	9.40	16.25

Important: See the Reference Section for critical supporting data - Reference Numbers and City Cost Indexes

B1010 Floor Construction

B1010 229 Precast Plank with No Topping

	SPAN (FT.)	SUPERIMPOSED LOAD (P.S.F.)	TOTAL DEPTH (IN.)	DEAD LOAD (P.S.F.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
1700	45	40	12	70	110	6.75	1.56	8.31

B1010 230 Precast Plank with 2″ Concrete Topping

	SPAN (FT.)	SUPERIMPOSED LOAD (P.S.F.)	TOTAL DEPTH (IN.)	DEAD LOAD (P.S.F.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
2000	10	40	6	75	115	5.30	4.13	9.43
2100		75	8	75	150	6.30	3.76	10.06
2200		100	8	75	175	6.30	3.76	10.06
2500	15	40	8	75	115	6.30	3.76	10.06
2600		75	8	75	150	6.30	3.76	10.06
2700		100	8	75	175	6.30	3.76	10.06
2800	20	40	8	75	115	6.30	3.76	10.06
2900		75	8	75	150	6.30	3.76	10.06
3000		100	8	75	175	6.30	3.76	10.06
3100	25	40	8	75	115	6.30	3.76	10.06
3200		75	8	75	150	6.30	3.76	10.06
3300		100	10	80	180	6.85	3.48	10.33
3400	30	40	10	80	120	6.85	3.48	10.33
3500		75	10	80	155	6.85	3.48	10.33
3600		100	10	80	180	6.85	3.48	10.33
3700	35	40	12	95	135	6.75	3.26	10.01
3800		75	12	95	170	6.75	3.26	10.01
3900		100	14	95	195	7.60	3.09	10.69
4000	40	40	12	95	135	6.75	3.26	10.01
4500		75	14	95	170	7.60	3.09	10.69
5000	45	40	14	95	135	7.60	3.09	10.69

B1010 Floor Construction

B1010 234 Precast Double "T" Beams with No Topping

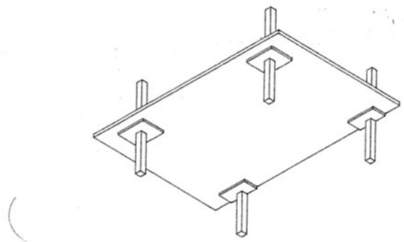
	SPAN (FT.)	SUPERIMPOSED LOAD (P.S.F.)	DBL. "T" SIZE D (IN.) W (FT.)	CONCRETE "T" TYPE	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
4300	50	30	20x8	Lt. Wt.	66	6.15	1.21	7.36
4400		40	20x8	Lt. Wt.	76	6.65	1.10	7.75
4500		50	20x8	Lt. Wt.	86	6.70	1.32	8.02
4600		75	20x8	Lt. Wt.	111	6.75	1.52	8.27
4700		100	20x8	Lt. Wt.	136	6.85	1.84	8.69
4800	60	30	24x8	Lt. Wt.	70	6.65	1.19	7.84
4900		40	32x10	Lt. Wt.	88	7.25	.82	8.07
5000		50	32x10	Lt. Wt.	98	7.30	1.01	8.31
5200		75	32x10	Lt. Wt.	123	7.35	1.16	8.51
5400		100	32x10	Lt. Wt.	148	7.40	1.42	8.82
5600	70	30	32x10	Lt. Wt.	78	7.25	.82	8.07
5750		40	32x10	Lt. Wt.	88	7.30	1.01	8.31
5900		50	32x10	Lt. Wt.	98	7.35	1.16	8.51
6000		75	32x10	Lt. Wt.	123	7.40	1.42	8.82
6100		100	32x10	Lt. Wt.	148	7.55	1.93	9.48
6200	80	30	32x10	Lt. Wt.	78	7.35	1.16	8.51
6300		40	32x10	Lt. Wt.	88	7.40	1.42	8.82
6400		50	32x10	Lt. Wt.	98	7.50	1.68	9.18

B1010 235 Precast Double "T" Beams With 2″ Topping

	SPAN (FT.)	SUPERIMPOSED LOAD (P.S.F.)	DBL. "T" SIZE D (IN.) W (FT.)	CONCRETE "T" TYPE	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
6700	30	30	18x8	Reg. Wt.	117	7.25	2.54	9.79
6750		40	18x8	Reg. Wt.	127	7.25	2.54	9.79
6800		50	18x8	Reg. Wt.	137	7.30	2.77	10.07
6900		75	18x8	Reg. Wt.	162	7.30	2.77	10.07
7000		100	18x8	Reg. Wt.	187	7.35	2.87	10.22
7100	40	30	18x8	Reg. Wt.	120	5.75	2.45	8.20
7200		40	20x8	Reg. Wt.	130	5.80	2.33	8.13
7300		50	20x8	Reg. Wt.	140	5.90	2.56	8.46
7400		75	20x8	Reg. Wt.	165	5.90	2.66	8.56
7500		100	20x8	Reg. Wt.	190	6	2.99	8.99
7550	50	30	24x8	Reg. Wt.	120	6.20	2.45	8.65
7600		40	24x8	Reg. Wt.	130	6.25	2.53	8.78
7750		50	24x8	Reg. Wt.	140	6.25	2.54	8.79
7800		75	24x8	Reg. Wt.	165	6.35	2.87	9.22
7900		100	32x10	Reg. Wt.	189	7.10	2.34	9.44
8000	60	30	32x10	Reg. Wt.	118	7	1.98	8.98
8100		40	32x10	Reg. Wt.	129	7.05	2.15	9.20
8200		50	32x10	Reg. Wt.	139	7.10	2.34	9.44
8300		75	32x10	Reg. Wt.	164	7.15	2.49	9.64
8350		100	32x10	Reg. Wt.	189	7.20	2.75	9.95
8400	70	30	32x10	Reg. Wt.	119	7.05	2.24	9.29
8450		40	32x10	Reg. Wt.	129	7.15	2.49	9.64
8500		50	32x10	Reg. Wt.	139	7.20	2.75	9.95
8550		75	32x10	Reg. Wt.	164	7.40	3.26	10.66
8600	80	30	32x10	Reg. Wt.	119	7.40	3.25	10.65
8800	50	30	20x8	Lt. Wt.	105	7.10	2.54	9.64
8850		40	24x8	Lt. Wt.	121	7.15	2.67	9.82
8900		50	24x8	Lt. Wt.	131	7.20	2.87	10.07
8950		75	24x8	Lt. Wt.	156	7.20	2.87	10.07
9000		100	24x8	Lt. Wt.	181	7.30	3.19	10.49

SHELL B

B1010 Floor Construction



General: Flat Slab: Solid uniform depth concrete two-way slabs with drop panels at columns and no column capitals.

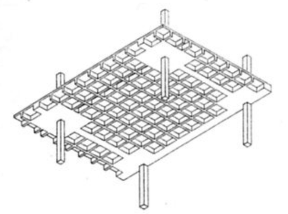
Design and Pricing Assumptions:
- Concrete f'c = 3 KSI, placed by concrete pump.
- Reinforcement, fy = 60 KSI.
- Forms, four use.
- Finish, steel trowel.
- Curing, spray on membrane.
- Based on 4 bay x 4 bay structure.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	INST.	TOTAL
SYSTEM B1010 222 1700					
15'X15' BAY 40 PSF S. LOAD, 12" MIN. COL. 6" SLAB, 1-1/2" DROP, 117 PSF					
Forms in place, flat slab with drop panels, to 15' high, 4 uses	.993	S.F.	1.58	4.55	6.13
Forms in place, exterior spandrel, 12" wide, 4 uses	.034	SFCA	.04	.27	.31
Reinforcing in place, elevated slabs #4 to #7	1.588	Lb.	.73	.56	1.29
Concrete ready mix, regular weight, 3000 psi	.513	C.F.	1.69		1.69
Place and vibrate concrete, elevated slab, 6" to 10" pump	.513	C.F.		.53	.53
Finish floor, monolithic steel trowel finish for finish floor	1.000	S.F.		.70	.70
Cure with sprayed membrane curing compound	.010	C.S.F.	.06	.07	.13
TOTAL			4.10	6.68	10.78

B1010 222 Cast in Place Flat Slab with Drop Panels

	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	MINIMUM COL. SIZE (IN.)	SLAB & DROP (IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	INST.	TOTAL
1700	15 x 15	40	12	6 - 1-1/2	117	4.10	6.65	10.75
1720	RB1010 -010	75	12	6 - 2-1/2	153	4.19	6.75	10.94
1760		125	14	6 - 3-1/2	205	4.38	6.90	11.28
1780		200	16	6 - 4-1/2	281	4.61	7.05	11.66
1840	15 x 20	40	12	6-1/2 - 2	124	4.37	6.80	11.17
1860	RB1010 -100	75	14	6-1/2 - 4	162	4.56	6.95	11.51
1880		125	16	6-1/2 - 5	213	4.84	7.10	11.94
1900		200	18	6-1/2 - 6	293	4.97	7.20	12.17
1960	20 x 20	40	12	7 - 3	132	4.59	6.90	11.49
1980		75	16	7 - 4	168	4.86	7.05	11.91
2000		125	18	7 - 6	221	5.40	7.30	12.70
2100		200	20	8 - 6-1/2	309	5.50	7.40	12.90
2300	20 x 25	40	12	8 - 5	147	5.10	7.15	12.25
2400		75	18	8 - 6-1/2	184	5.50	7.45	12.95
2600		125	20	8 - 8	236	6	7.75	13.75
2800		200	22	8-1/2 - 8-1/2	323	6.20	7.90	14.10
3200	25 x 25	40	12	8-1/2 - 5-1/2	154	5.35	7.25	12.60
3400		75	18	8-1/2 - 7	191	5.65	7.50	13.15
4000		125	20	8-1/2 - 8-1/2	243	6.05	7.80	13.85
4400		200	24	9 - 8-1/2	329	6.35	7.95	14.30
5000	25 x 30	40	14	9-1/2 - 7	168	5.80	7.50	13.30
5200		75	18	9-1/2 - 7	203	6.20	7.80	14
5600		125	22	9-1/2 - 8	256	6.50	8	14.50
5800		200	24	10 - 10	342	6.90	8.25	15.15
6400	30 x 30	40	14	10-1/2 - 7-1/2	182	6.30	7.75	14.05

B1010 Floor Construction



General: Waffle slabs are basically flat slabs with hollowed out domes on bottom side to reduce weight. Solid concrete heads at columns function as drops without increasing depth. The concrete ribs function as two-way right angle joist.

Joists are formed with standard sized domes. Thin slabs cover domes and are usually reinforced with welded wire fabric. Ribs have bottom steel and may have stirrups for shear.

Design and Pricing Assumptions:
Concrete f'c = 4 KSI, normal weight placed by concrete pump.
Reinforcement, fy = 60 KSI.
Forms, four use.
4-1/2" slab.
30" x 30" voids.
6" wide ribs.
(ribs @ 36" O.C.).
Rib depth filler beams as required.
Solid concrete heads at columns.
Finish, steel trowel.
Curing, spray on membrane.
Based on 4 bay x 4 bay structure.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	INST.	TOTAL
SYSTEM B1010 227 3900					
20X20' BAY, 40 PSF S. LOAD, 12" MIN. COLUMN					
Formwork, floor slab with 30" fiberglass domes, 4 uses	1.000	S.F.	4.94	5.95	10.89
Edge forms, 7"-12" high on elevated slab, 4 uses	.052	SFCA	.07	.26	.33
Forms in place, bulkhead for slab with keyway, 1 use, 3 piece	.010	L.F.	.02	.05	.07
Reinforcing in place, elevated slabs #4 to #7	1.580	Lb.	.73	.55	1.28
Welded wire fabric rolls, 6 x 6 - W4 x W4 (4 x 4) 58 lb./c.s.f	1.000	S.F.	.48	.37	.85
Concrete ready mix, regular weight, 4000 psi	.690	C.F.	2.36		2.36
Place and vibrate concrete, elevated slab, over 10", pump	.690	C.F.		.73	.73
Finish floor, monolithic steel trowel finish for finish floor	1.000	S.F.		.70	.70
Cure with sprayed membrane curing compound	.010	C.S.F.	.06	.07	.13
TOTAL			8.66	8.68	17.34

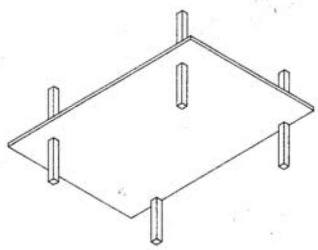
B1010 227 Cast in Place Waffle Slab

	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	MINIMUM COL. SIZE (IN.)	RIB DEPTH (IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	INST.	TOTAL
3900	20 x 20	40	12	8	144	8.65	8.70	17.35
4000	RB1010 -010	75	12	8	179	8.75	8.80	17.55
4100		125	16	8	229	8.90	8.90	17.80
4200		200	18	8	304	9.30	9.20	18.50
4400	20 x 25	40	12	8	146	8.80	8.75	17.55
4500	RB1010 -100	75	14	8	181	8.95	8.90	17.85
4600		125	16	8	231	9.10	9	18.10
4700		200	18	8	306	9.45	9.25	18.70
4900	25 x 25	40	12	10	150	8.95	8.85	17.80
5000		75	16	10	185	9.20	9	18.20
5300		125	18	10	235	9.40	9.15	18.55
5500		200	20	10	310	9.60	9.30	18.90
5700	25 x 30	40	14	10	154	9.10	8.90	18
5800		75	16	10	189	9.30	9.05	18.35
5900		125	18	10	239	9.50	9.20	18.70
6000		200	20	12	329	10.25	9.55	19.80
6400	30 x 30	40	14	12	169	9.55	9.05	18.60
6500		75	18	12	204	9.75	9.20	18.95
6600		125	20	12	254	9.85	9.30	19.15
6700		200	24	12	329	10.60	9.85	20.45

Important: See the Reference Section for critical supporting data - Reference Numbers and City Cost Indexes

B10 Superstructure

B1010 Floor Construction



General: Flat Plates: Solid uniform depth concrete two-way slab without drops or interior beams. Primary design limit is shear at columns.

Design and Pricing Assumptions:
Concrete f'c to 4 KSI, placed by concrete pump.
Reinforcement, fy = 60 KSI.
Forms, four use.
Finish, steel trowel.
Curing, spray on membrane.
Based on 4 bay x 4 bay structure.

System Components	QUANTITY	UNIT	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
SYSTEM B1010 223 2000					
15'X15' BAY 40 PSF S. LOAD, 12" MIN. COL.					
Forms in place, flat plate to 15' high, 4 uses	.992	S.F.	1.42	4.41	5.83
Edge forms to 6" high on elevated slab, 4 uses	.065	L.F.	.01	.21	.22
Reinforcing in place, elevated slabs #4 to #7	1.706	Lb.	.78	.60	1.38
Concrete ready mix, regular weight, 3000 psi	.459	C.F.	1.51		1.51
Place and vibrate concrete, elevated slab less than 6", pump	.459	C.F.		.57	.57
Finish floor, monolithic steel trowel finish for finish floor	1.000	S.F.		.70	.70
Cure with sprayed membrane curing compound	.010	C.S.F.	.06	.07	.13
TOTAL			3.78	6.56	10.34

B1010 223 Cast in Place Flat Plate

	BAY SIZE (FT.)	SUPERIMPOSED LOAD (P.S.F.)	MINIMUM COL. SIZE (IN.)	SLAB THICKNESS (IN.)	TOTAL LOAD (P.S.F.)	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
2000	15 x 15	40	12	5-1/2	109	3.78	6.60	10.38
2200	RB1010 -010	75	14	5-1/2	144	3.81	6.60	10.41
2400		125	20	5-1/2	194	3.95	6.65	10.60
2600		175	22	5-1/2	244	4.04	6.70	10.74
3000	15 x 20	40	14	7	127	4.35	6.65	11
3400	RB1010 -100	75	16	7-1/2	169	4.62	6.80	11.42
3600		125	22	8-1/2	231	5.05	6.95	12
3800		175	24	8-1/2	281	5.10	6.95	12.05
4200	20 x 20	40	16	7	127	4.36	6.65	11.01
4400		75	20	7-1/2	175	4.67	6.80	11.47
4600		125	24	8-1/2	231	5.10	6.95	12.05
5000		175	24	8-1/2	281	5.10	7	12.10
5600	20 x 25	40	18	8-1/2	146	5.05	6.95	12
6000		75	20	9	188	5.20	7.05	12.25
6400		125	26	9-1/2	244	5.60	7.25	12.85
6600		175	30	10	300	5.85	7.35	13.20
7000	25 x 25	40	20	9	152	5.20	7.05	12.25
7400		75	24	9-1/2	194	5.50	7.20	12.70
7600		125	30	10	250	5.85	7.35	13.20
8000								