TECHNICAL ASSIGNMENT II

STRUCTURAL STUDY OF ALTERNATE FLOOR SYSTEMS

329 INNOVATION BOULEVARD
STATE COLLEGE, PA

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OCTOBER 26TH, 2007
TECHNICAL ASSIGNMENT II

EXECUTIVE SUMMARY

In this report you will find the discussion of the existing floor system along with the discussion of four newly designed floor systems. The purpose of the report is to compare these five flooring systems and determine a system that may be worth more investigation. The following is a list of the four newly designed systems:

- Modified Composite Floor System
- Girder-Slab System
- One-Way Concrete Slab System
- Joist/Joist Girder System

The design involved the selection of floor systems, the size of bays (the typical bay size of the existing floor system was regularly used to comply with the open floor plan), and the sizing of the members. The calculations were completed with the assistance of RAM Structural System, the AISC Steel Manual, the CRSI handbook, the Vulcraft Joist handbook, and the Girder-Slab Design Guide. The design loads used were the same as discussed in Technical Assignment 1 and were found on the structural plans. The following chart includes a description of the four newly designed systems:

Floor System	Beam Size	Girder Size	Slab Constuction	Design Method
Modified Composite	W16x31	W24x62	3" NWC on 3" Deck	RAM Structaral System Hand Spot Check
Girder-Slab	N/A	DB 8x35	8" Hollow Core Plank	Gired-Slab Design Guide
One-Way Concrete Slab	18x24	32x24	6" NWC Slab w/ Reinf.	CRSI Handbook
Joist/Joist Girder	24K10	32KG10N14.3K	3" NWC on 3" Deck	RAM Structaral System Hand Spot Check

A comparison analysis was used to conclude which system to further investigate for 329 Innovation Boulevard. The comparisons included cost, weight, floor depth, and constructability. Other advantages and disadvantages are given. Research on each floor system was done to retrieve these advantages/disadvantages and RSMeans was utilized in the pricing of the floor system. This was all used to come to the conclusion that the joist/joist girder system has some clear advantages and is the most deserving of the four newly designed systems of further investigation. The other systems' disadvantages outweighed the advantages, and merit no further investigation.

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329 Innovation Boulevard has been completed in terms of the design phase, and is currently undergoing the construction phase. The structural system consists of wide flange steel beams, girders, and columns, with a composite flooring system. The floor system is composed of 3” galvanized 20 gauge steel decking and 3.25” light weight concrete with one layer of WWF. The wide flange beams and girders range from W10x12(s) to W27x84(s). The three flooring systems are typically the same, with some discrepancies with the second floor framing plan due to architectural aspects.

Below is the typical floor plan. The rectangular bays are roughly symmetrical throughout the building, except for around the elevator shaft located in the center of the building. The highlighted section is where all comparisons and modifications are taken from. It is framed by (2) W24x55 girders, (2) W18x35 and (2) W27x84 beams. The section has the dimensions of: 30’-0” x 33’-4”. These dimensions are quite consistent throughout the building, ranging from the given to 29’-11” x 33’-3”. The middle bay, however, is 24’-0” wide compared to the regular 30’-0” width. A more in-depth explanation of the typical bay is given later in the report.

Figure 1.1 Typical Floor Framing System

DESIGN LOADS (FROM STRUCT. DRAWINGS)

Live Loads

Corridors	100 PSF
Stairs	100 PSF
Public Areas	100 PSF
Mechanical/Electrical Rooms	175 PSF
Open Plan Office (80 PSF + 20 PSF Partitions)	100 PSF
Slabs-On-Grade (U.N.O.)	100 PSF
Slabs-On-Grade (Dock/Receiving)	200 PSF

Dead Loads

Partition Allowance	20 PSF
Lightweight Concrete Slab	115 PCF
Reinforced Concrete Slab	150 PCF
MEP	5 PSF
Metal Decking	2-3 PSF (Deck Catalog)
Joist/Beam Weight	Specific To Each Member

ALTERNATE FLOORING SYSTEMS

In addition to evaluating the current flooring system, an analysis and comparison of four alternate floor systems to the existing floor system will be given in the report. The four alternate systems will include the following:

- Modifying the current composite system – re-evaluating the current floor system may allow for lighter members and an overall lighter floor system.
- Girder-Slab System – the usage of a pre-stressed hollow core slab may yield a more economical and lighter floor system.
- One-Way Concrete Slab – includes concrete beams and girders, used to assess whether or not concrete is structurally/economically comparable to composite steel system.
- Joist and Joist-Girder System – pre-fabricated joist and joist-girders may defer economical and time management benefits.

Technical Assignment II required the usage of the following design references and software:

Design Guides:

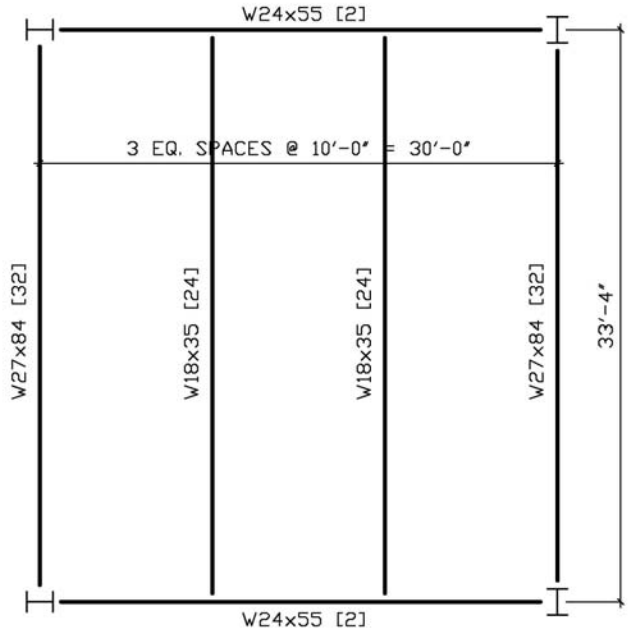
- **International Building Code 2006**
- **AISC Manual of Steel Construction -** LRFD Third Edition
- **CRSI Handbook 2002 Edition**
- **Girder Slab Design Guide v1.3** located at www.girder-slab.com
- **Vulcraft Joist Handbook**
- **2007 RSMeans -** Heavy Construction Cost Data

Design Software:

- **RAM Structural System**
  - Used to modify the existing floor system. The results and spot-checks may be found in the appendices.

The existing floor framing system typically consists of 30'-0" by 33'-4" bays. These bays are covered with 3.25" light weight concrete with one layer of 6x6W1.4xW1.4 WWF on 3" (20 Ga.) galvanized wide rib type composite steel deck. The total deck thickness comes to 6.25". The deck is continuous over a minimum of three spans. The number of welded 0.75" dia. by 5.5" long shear studs is given in brackets. By orienting the girders along the short dimension, a smaller member is able to be used, due to the fact that the tributary area will be smaller and subsequently, a smaller load.

NOTE: Comparisons found at the end of this section.



Advantages

Weight – the floor system is about 4.5^K, which is a light system. The weight of the building has an impact on design aspect (i.e. seismic) as explored in the previous technical assignment.

Thickness – the floor depth is about 33", which allows room for the MEP systems.

Steel Properties – highest strength to weight ration of any building material, 100% recyclable, dimensionally stable (expansion/ contraction minimal.)

Constructability (Benefits to Builder) – light weight compared to other materials, less scrap material (2% for steel compared to 20% for lumber), price stability.

Acoustical Aspects – the addition of concrete dampens the sound between floors.

Disadvantages

Wide Flange Interferences – MEP systems must be carefully coordinated with the structural plans so that web penetrations (if any) can be kept to a minimal.

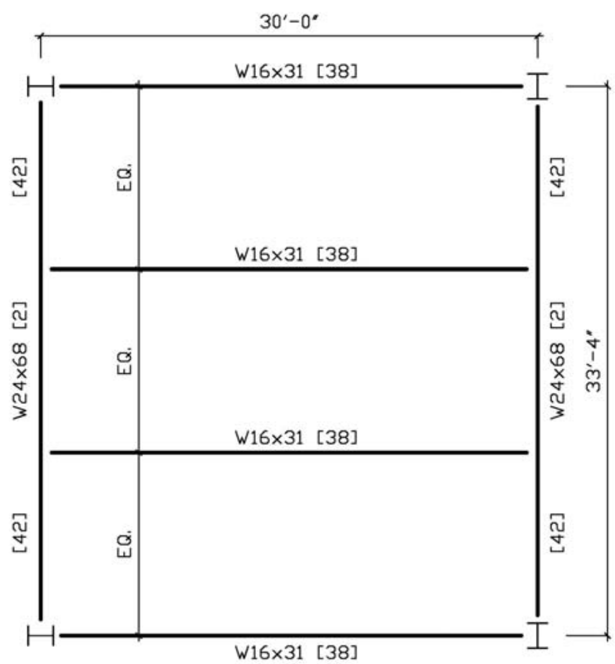
Composite Action – must rely on shear studs to induce proper composite action between steel and concrete.

SEE COSTS LOCATED IN THE COMPARISON CHART ON PAGE 9

MODIFIED COMPOSITE FLOOR SYSTEM

The modified composite floor system consists of a role reversal of beams and girders. The typical bay size was maintained, but the beams now span 30’-0” rather than the original 33’-4”. The system produced beams with slightly smaller depths. However the girders are considerably heavier. Since the bay is almost square, similar results to the existing system are to be expected. The modification was attempted in an effort to lighten the system, causing positive efforts on design aspects. The beams are spaced at 11’-1$^{1}/_{3}$” and the girders span 33’-4”.

NOTE: Comparisons found at the end of this section.



Advantages

Weight – relatively similar to the existing system. The system produced a bay weight of 4.3^{K} compared to the 4.5^{K} of the existing bay.

Thickness – the floor depth is about 30”, which extends the floor to ceiling height (+3”). This may allow for some more flexibility with the MEP systems.

Disadvantages

Spacing – the irregular spacing of the beams makes for a tedious and time consuming process.

Composite Action – must rely on shear studs to induce proper composite action between steel and concrete.

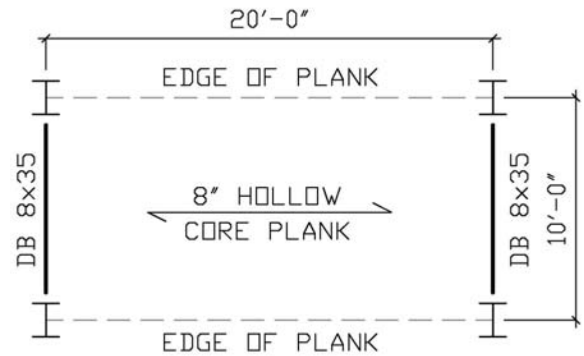
Architectural Aspects – there are certain areas on the floor plan (i.e. around the elevator shaft) where this orientation of beams and girders would be inefficient, and thus disrupting the symmetry of the bays.

SEE COSTS LOCATED IN THE COMPARISON CHART ON PAGE 9

GIRDER-SLAB SYSTEM

This combination of precast and composite steel was designed using the design guide and properties provided by Girder-Slab Technologies, LLC. The system required a smaller bay size. The size was reduced to a 20'-0" x 10'-0" bay. The composite girder, designated as DB 8x35, has a larger bottom flange which the slab rest upon, and provides a gap at the top where grout is placed to fill the pre-fabricated plank and create the composite action. The edges of the planks are also sealed with grout. The pre-cast slab is an 8" hollow-core plank, which can span up to 28'-0". D-Beams are typically 8" deep, but DB 9x's are available and provide the option of topping the plank with 2" of concrete. The figure to the right shows the components of the Slab-Girder system.

NOTE: Comparisons found at the end of this section.



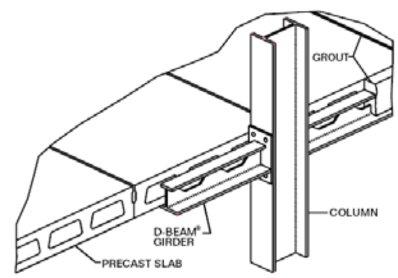


Figure 6.1

Advantages

Floor Depth – the entire floor system will be a mere 8" thick, which leaves a lot of options for the MEP systems. Ducts could easily run underneath the planks, or an air plenum could be installed above the floor.

Finishes – the underside of the planks are made for ceiling finishes.

Constructability – the slab easily sits on the bottom flange of the D-Beam, no formwork or scaffolding is required, assembled-in-place, pre-cast and slabs may be set in any type of weather.

Column Size – the new layout will cause the column size to decrease, which will have positive effects on pricing.

Disadvantages

New Layout – the new bay size (20'x10') introduces more columns. This not only adds cost, but it minimizes the effectiveness of an open floor plan, and may become a hindrance to architectural plans.

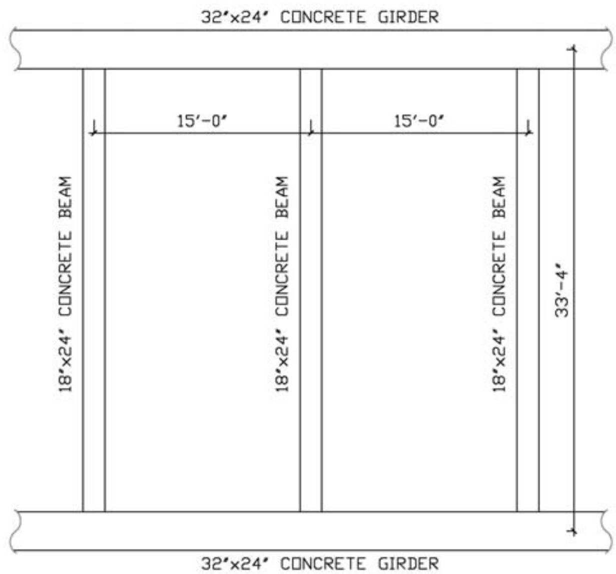
Lateral System – may become more difficult to achieve full moment connections with the D-Beam which could introduce more steel in the form of cross-bracing or shear walls throughout the building.

SEE COSTS LOCATED IN THE COMPARISON CHART ON PAGE 9

ONE-WAY CONCRETE SLAB SYSTEM

The one-way concrete slab system is comprised of (3) 18"x24" concrete beams and 32"x24" girders. They follow the same spacing as the typical bay, and are covered by a 6" reinforced concrete slab. The beams and girders contain reinforcing steel and are cast-in-place with normal weight concrete. The columns involved with the system will be much wider than the steel columns In the existing system, and contain a substantial amount of reinforcement.

NOTE: Comparisons found at the end of this section.



Advantages

Floor Depth – the total depth of the floor comes to 30", which is less than the 33" depth of the existing system. This may allow for more leeway with the MEP systems.

Fireproofing – no additional fire-proofing is required on concrete framing.

Increased Ductility – if designed/engineered/ constructed properly, concrete can experience increased ductility, which would be beneficial for seismic design.

Disadvantages

Constructability – the concrete must cure before the next floor level can be constructed which will expand the construction timetable.

Columns – the concrete columns will have a greater width than the steel columns in the existing system. This may affect interior room sizes and other architectural aspects.

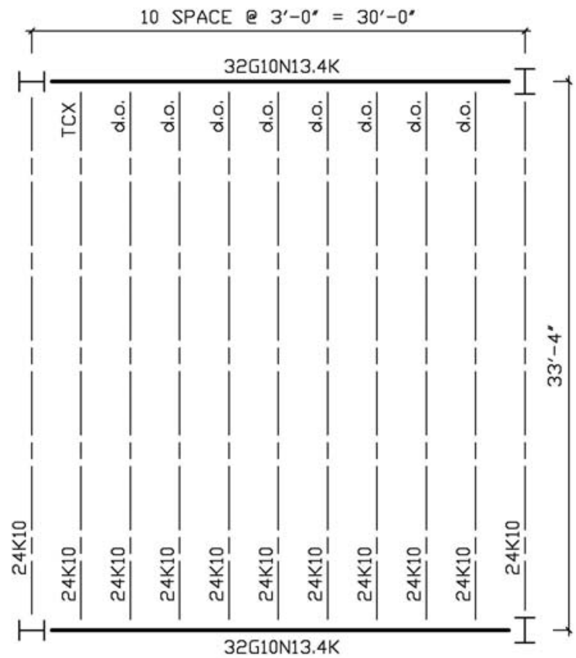
Weight – much heavier system, which will increase the base shear in seismic design.

SEE COSTS LOCATED IN THE COMPARISON CHART ON PAGE 9

JOIST/JOIST GIRDER SYSTEM

The joist/joist girder system was designed using RAM Structural System, and checked against the Vulcraft Corporation's joist catalog. The typical bay sized was used. The joists span 33'-4" and the girder spans 30'-0". The joists are spaced at 3'-0" on center. A composite slab is place on top of the joists, and is composed of 3" decking and 3" normal weight concrete. The plan on the right has designated some joist for the top chord being extended (TXC), but that is only for the exterior bays of the buildings.

NOTE: Comparisons found at the end of this section.



Advantages

Open Web – open web joists allows for flexibility with MEP systems.

Weight – steel joist are light weight and will cause the entire framing system to of equal or lesser weight than the existing.

Green Building – steel joists are recycled at a rate of 96%, and the usage of joists will help in acquiring LEED points if desired.

Disadvantages

Members – the number of members have increased from six (existing) to thirteen that is needed for the joist/joist girder system.

Fireproofing – open web joists are relatively difficult to fireproof. Additive measures must be taken to make the process easier.

Floor Depth – the joists and joist girders present a much deeper floor depth than the existing.

SEE COSTS LOCATED IN THE COMPARISON CHART ON PAGE 9

COMPARISONS

Floor Framing System	Cost (per SF)	Advantages	Disadvantages	Design Method
Existing: Composite Steel	$17.10	Light weight system 33" floor depth Constructability	Composite action req'd Wide flange interferences	N/A
Modified Composite Steel	$13.50	Light weight system 30" floor depth Constructability Cost	Irregular member spacing Composite action req'd	RAM Structural System Hand Spot Check
Girder-Slab	$19.60	8" floor depth Finishes Constructability	More columns req'd Lateral system aspects Cost	Girder-Slab Design Guide
One-Way Concrete Slab	$21.60	30" floor depth No added fireproofing req'd Increased ductility	Constructability Increased column width Increased weight Cost	CRSI Handbook
Joist/Joist Girder	$9.75	Open Web Light weight system Green building aspects Cost	Increased number of members Fireproofing difficult Increased floor depth	RAM Structural System Hand Spot Check

CONCLUSION

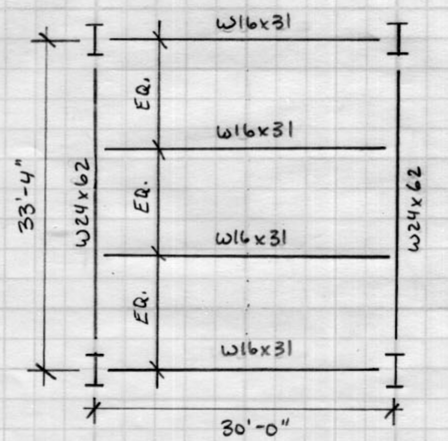
The joist/joist girdersystem with the composite concrete slab seems to be the most encouraging system of the five flooring systems. The criteria for this conclusion included: floor depth, weight, cost and constructability. The girder-slab system was the only system that had a clear advantage over the others with respect to floor depth, and the joist girder had a slightly larger floor depth (approx. 36 in.). The joist/joist girder system has a clear advantage in cost and is a very light weight system. The open web joist will allow for easier handling of MEP systems and are able to span long distances. The long spans will comply with the open floor plan that the building provides. However, as is the case with all systems, there are disadvantages and they include vibrations, increased number of members, difficultly fireproofing the system, and the increased floor depth as noted before.

APPENDICES

A.1 MODIFIED COMPOSITE FLOOR SYSTEM CALCS.

MODIFIED COMPOSITE SYSTEM

* SYSTEM RE-DESIGNED IN RAM STEEL, THE FOLLOWING IS A SPOT CHECK ANALYSIS OF THAT SYSTEM.



SPACING: 11'-1 1/3"
f'_c = 4,000 PSI
f_y = 60,000 PSI
l_n = 30'-0"

LOADS:

DEAD:

LWC SLAB = (3.25/12)(115 PCF)	=	31.15 PSF
STEEL DECKING		2.5 PSF
PARTITION ALLOWANCE		20.0 PSF
MEP		5.0 PSF
		58.65 PSF

LIVE: OPEN PLAN OFFICE 100 PSF

W_u = 1.2(58.65 PSF) + 1.6(100 PSF) = 230.4 PSF (11.11') = 2.56 KLF ← TRIB WIDTH

$M_u = w_u l^2/8$ = 2.56 KLF $(30')^2/8$ = 288'k

$V_u = w_u l/2$ = 2.56(30)/2 = 38.4k

ASSUME a = 2 in.

$Y_2 = Y_{CON} - a/2$ = 6.25 − 2/2 = 5.25

TABLE 5-14:

W16x31: Y_1 = 0.00, Q_n = 457k, M_n = 427'k

$$b \le \begin{cases} 2L/8 = 2(30')/8 = 7.5' \leftarrow \text{CONTROLS} \\ \text{SPACING} = 11.11' \end{cases}$$

b = 90"

$a_{REQ} = \Sigma Q_n / 0.85 f'_c b$ = 457/(0.85)(4)(90) = 1.49"

Y_2 = 6.25 − 1.49/2 = 5.5"

W16x36 VALUES: $\Phi_b M_n$ = 435'k > 288'k ∴ RAM VALUES ARE OK

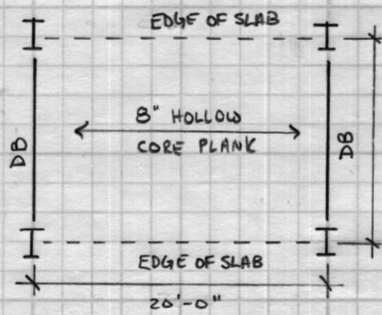
GIRDER-SLAB SYSTEM

LOADING:

DEAD: PARTITION ALLOWANCE = 20 PSF
MEP = 5 PSF
PLANK DEAD LOAD = 60 PSF
85 PSF

LIVE: OPEN PLAN OFFICE = 100 PSF

BAY LAYOUT:



PROPERTIES:

PLANK f'_c = 5 KSI
GROUT f'_c = 4 KSI
DB SPAN = 20'-0"
8" HOLLOW CORE SPAN = 20'-0"

CHANGED TO 10'-0"

ALLOWABLE $\Delta_{LL} = L/360 = 20'(12''/ft)/360 = 0.67''$

INITIAL LOAD (PRECOMPOSITE):

$M_{DL} = (20')(0.06\ KSF)(20')^2/8 = 60'^k$ TRY DB 8x40 $(66'^k > 60'^k)$

$\Delta_{DL} = 5(20')(0.06\ KSF)(20')^4(1728\ in^3/ft^3)/(384)(122\ in^4)(29{,}000\ KSI)$
$= 1.22''$

DB 8x40 PROPERTIES:

STEEL SECTION	TRANSFORMED SECTION
I_s = 122 in.^{4}	I_t = 289 in.^{4}
S_t = 26.5 in.^{3}	S_t = 67.2 in.^{3}
S_b = 36.1 in.^{3}	S_b = 67.9 in.^{3}
M_{SCAP} = 66$'^k$	b = 3.5"
t_w = 0.340"	

TOTAL LOAD (COMPOSITE)

$M_{SUP} = (20')(0.025 + 0.1\ KSF)(20')^2/8 = 125'^k$

$M_{TL} = 60'^k + 125'^k = 185'^k$

$S_{REQ} = (185'^k)(12''/ft)/(0.6)(50\ KSI) = 74\ in^3 < 67.2\ in^3$

* DECREASE THE SPAN OF DB TO 10'-0" (IN AN ATTEMPT TO KEEP BAYS SYM.)
- COMPUTATIONS ON FOLLOWING PAGES.

ALLOWABLE Δ_{LL} = L/360 = 10' (12"/ft) / 360 = 0.33"

INITIAL LOAD (PRECOMPOSITE)

M_{DL} = (20')(0.06 KSF)(10')²/8 = 15 'k TRY DB 8 x 35, I_s = 102 in⁴

Δ_{DL} = (5)(20')(0.06 KSF)(10')⁴ (1728 in³/ft³)/(384)(102)(29,000 KSI)

= 0.09"

DB 8 x 35 PROPERTIES:

STEEL SECTION	TRANSFORMED SECTION
I_s = 102 in⁴	I_t = 279 in⁴
S_t = 19.7 in³	S_t = 63.5 in³
S_b = 36.5 in³	S_b = 67.1 in³
M_{SCAP} = 49 'k	b = 3"
t_w = 0.340"	

TOTAL LOAD (COMPOSITE)

M_{SUP} = (20')(0.125 KSF)(10')²/8 = 31.25 'k

M_{TL} = 15'k + 31.25'k = 46.25'k

S_{REQ} = (46.25'k)(12"/ft) / (0.6)(50 KSI) = 18.5 in³ < 63.5 in³ OK

Δ_{SUP} = (5)(20')(0.125 KSF)(10')⁴ (1728) / (384)(279)(29,000)

= 0.07" < 0.09" OK

CHECK SUPERIMPOSED COMPRESSIVE STRESS IN CONCRETE

N VALUE = 29,000 KSI / 57,000 (4,000 PSI)^½ = 8.04 ∴ S_{TC} = 8.04(63.5) = 510.5 in³

f_c = (46.25'k)(12"/ft) / 510.5 in³ = 1.09 KSI

F_c = (0.45)(4 KSI) = 1.8 KSI > 1.09 KSI OK

CHECK BOTTOM FLANGE TENSION STRESS (TOTAL LOAD)

f_b = [(46.25'k)(12"/ft)/36.5 in³] + [(46.25'k)(12"/ft)/67.1 in³]

= 15.2 + 8.3 = 23.5 KSI

F_b = 0.9 (50 KSI) = 45 KSI > 23.5 KSI OK

CHECK SHEAR

TOTAL LOAD = 185 PSF

w = (0.185 KSF)(20') = 3.7 KLF

R = 3.7 KLF (10')/2 = 18.5k

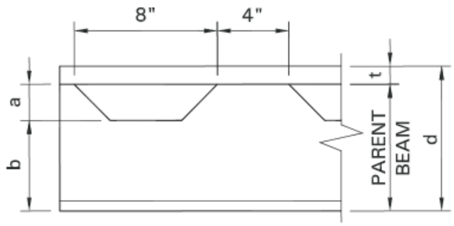
f_v = (18.5k)/0.340(3) = 18.14 KSI

F_v = 0.4 (50 KSI) = 20 KSI

20 KSI > 18.14 KSI OK

∴ DB 8 x 35 IS OK FOR SPANNING 10'-0"
AND PLANK SPANNING 20'-0"

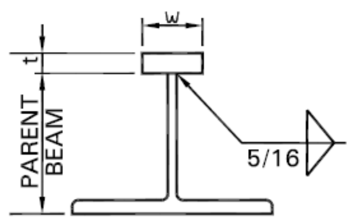
D-BEAM® DIMENSIONS TABLE



Designation	Web Included		Depth	Web	Parent Beam			Top Bar
	Weight	AVG AREA	d	Thickness t_w	Size	a	b	w x t
	lb./ft.	In.^{2}	In.	In.		In.	In.	In. x In.
DB 8 x 35	34.7	10.2	8	.340	W10 x 49	4	3	3 x 1
DB 8 x 37	36.7	10.8	8	.345	W12 x 53	2	5	3 x 1
DB 8 x 40	39.8	11.7	8	.340	W10 x 49	3	3.5	3 x 1.5
DB 8 x 42	41.8	12.3	8	.345	W12 x 53	1	5.5	3 x 1.5
DB 9 x 41	40.7	11.9	9.645	.375	W14 x 61	3.375	5.25	3 x 1
DB 9 x 46	45.8	13.4	9.645	.375	W14 x 61	2.375	5.75	3 x 1.5

D-BEAM® PROPERTIES TABLE

Designation	Steel Only Web Ignored						Transformed Section Web Ignored				
	Ix	C bot	C top	S bot	S top	Allowable Moment Fy=50 KSI f_b= 0.6Fy	Ix	C bot	C top	S bot	S top
	In.^{4}	In.	In.	In.^{3}	In.^{3}	kft	In.^{4}	In.	In.	In.^{3}	In.^{3}
DB 8 x 35	102	2.80	5.20	36.5	19.7	49	279	4.16	4.40	67.1	63.5
DB 8 x 37	103	2.76	5.24	37.3	19.7	49	282	4.16	4.42	67.7	63.8
DB 8 x 40	122	3.39	4.61	36.1	26.5	66	289	4.26	4.30	67.9	67.2
DB 8 x 42	123	3.35	4.65	36.9	26.5	66	291	4.26	4.32	68.4	67.5
DB 9 x 41	159	3.12	6.51	51.0	24.4	61	332	4.27	5.35	77.7	62.1
DB 9 x 46	195	3.84	5.79	50.8	33.7	84	356	4.43	5.20	80.6	68.6



ONE-WAY SLAB ANALYSIS

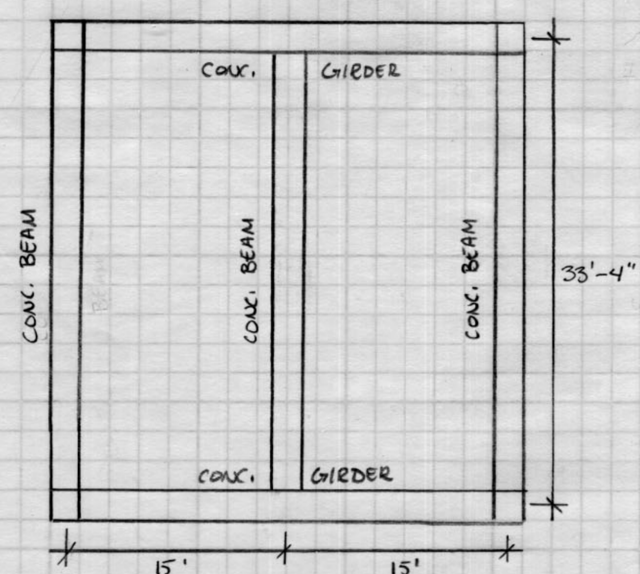
LOADS:

DEAD: PARTITION ALLOWANCE: 20 PSF
MEP 5 PSF
25 PSF

LIVE: OPEN PLAN OFFICE: 100 PSF

$w_u = 1.4(25\ PSF) + 1.7(100\ PSF) = 205\ PSF$ ~> DUE TO CRSI 2002 VALUES

INITIAL DESIGN OF SLAB SYSTEM:



$l_n = 33.33'$

INITIAL SIZES:
BEAMS: 14"x22"
GIRDERS: 20"x26"

SLAB THICKNESS: 7"
(TABLE 7.6 CRSI)

WEIGHT OF SLAB:
$7"/12"/ft\,(150\ PCF)(15')$
$= 1312.5\ PLF$

WEIGHT OF BEAM:
$(14")(22")(150\ PCF)/144$
$= 320.83\ PLF$

BEAM SIZE:

$w_{SDL} = 25\ PSF(15') = 375\ PLF$
$w_{LL} = 100\ PSF(15') = 1500\ PLF$

$w_u = 1.4(1312.5 + 320.83 + 375) + 1.7(1500)$
$= 5.4\ KLF$

LET $l_n = 34'$ FOR CRSI TABLES

∴ USE 18x24 w/ (2)#11 @ BOTTOM, (4)#14 @ TOP, TRANSVERSE REINF. = (17)#4 @ 10" O.C.
LOAD = 5.5 KLF > 5.4 KLF

WEIGHT OF BEAM = $(18)(24)(150)/144 = 450\ PLF$
$w_u = 1.4(1312.5 + 450 + 375) + 1.7(1500) = 5.5\ KLF = 5.5\ KLF$ ∴ 18x24 OK

ONE-WAY SLAB ANALYSIS

GIRDER SIZE: $l_n = 30'$

$P_u = w_u l/2 = 5.5\text{ KLF}(33.33')/2 = 91.7^k$

GIRDER WT = $(26" \times 20")(150\text{ PCF})/(144) = 541.7\text{ PLF}\ (1.4) = 758.3\text{ PLF}$

$M_u = P_u \cdot l_n/2 = 91.7^k(30')/2 = 1375'^k$

$M_u = w_u l^2/8 = 1300'^k = w_u(30')^2/8 \quad \therefore w_u = 11.6\text{ KLF}$

TOTAL LOADING: 13.8 KLF + 0.76 KLF = 14.5 KLF

$\therefore$ TRY 32x24 w/ $l_n = 32'$

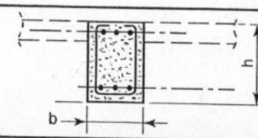
GIRDER WT = $(32)(24)(150)/144 = 800\text{ PLF}\ (1.4) = 1120\text{ PLF}$

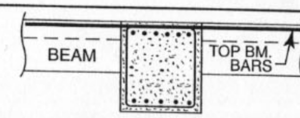
TOTAL LOADING = 13.8 KLF + 1.12 KLF = 14.9 KLF < 15.8 KLF $\therefore$ OK

$\therefore$ USE 32x24 w/ (2) #14 @ BOTTOM, (6) #14 @ TOP, TRANSVERSE REINF.: (32) #5 @ 6" O.C.

$f'_c = 4{,}000$ psi
$f_y = 60{,}000$ psi

RECTANGULAR BEAMS, INTERIOR SPANS





TOTAL CAPACITY $U = 1.4D + 1.7L$ (3)

STEM h (in.)	STEM b (in.)	BARS(1) BOTTOM ℓ_n + 12 in.	BARS(1) BOTTOM 0.875 ℓ_n	Layers (2)	TOP	SPAN, ℓ_n = 32 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	$A\ell$ sq. in.	STEEL WGT lb.	SPAN, ℓ_n = 34 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	$A\ell$ sq. in.	STEEL WGT lb.	SPAN, ℓ_n = 36 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	$A\ell$ sq. in.	STEEL WGT lb.	SPAN, ℓ_n = 38 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	$A\ell$ sq. in.	STEEL WGT lb.	$+\phi M_n$ / $-\phi M_n$ (6) ft-kip	DEFL (C) (7) × 10^{-9} in.
24	12	2# 8		1	2# 9	1.9	123H	6	-	369	1.7	123H	6	-	388	1.5	123H	6	-	408	1.4	123H	6	-	428	144	399
				1			274E	23	1.0	606		293E	23	1.0	494		303E	23	1.0	519		313E	23	1.0	544	179	
		2# 9		1	2#11	2.8	153H	6	-	510	2.5	153H	6	-	538	2.2	153H	6	-	566	2.0	163H	6	-	598	179	407
				1			274E	23	1.0	736		294E	23	1.0	785		304E	23	1.0	823		314E	23	1.0	861	266	
		2#11		1	2#14	3.9	164H	6	-	800	3.4	174H	6	-	849	3.1	183H	6	-	831	2.8	183H	6	-	873	266	332
				1			274E	23	1.0	962		294E	23	1.0	1025		304E	23	1.0	1077		314E	23	1.0	1129	361	
		2#11		1	4#10	4.0	164H	6	-	841	3.6	174H	6	-	893	3.2	184H	6	-	945	2.8	183H	6	-	922	266	339
				2			474B	23	1.0	1214		294E	23	1.0	1068		304E	23	1.0	1123		314E	23	1.0	1177	373	
	14	2# 8		1	3# 8	2.3	123H	7	-	396	2.0	123H	7	-	417	1.8	123H	7	-	439	1.6	123H	7	-	460	145	354
				1			244F	30	1.1	611		254F	30	1.1	644		274F	30	1.1	687		284F	29	1.1	719	213	
		2#10		1	3#10	3.5	153H	7	-	620	3.1	153H	7	-	655	2.8	163H	7	-	693	2.5	163H	7	-	728	225	340
				1			244F	30	1.1	824		254F	30	1.1	869		274F	30	1.1	925		284F	29	1.1	971	325	
		2#11		1	3#11	4.2	164H	7	-	817	3.7	164H	7	-	860	3.3	173H	7	-	845	2.9	183H	7	-	892	271	306
				1			245F	30	1.1	1125		255F	30	1.1	1185		275F	30	1.1	1264		285F	29	1.1	1324	386	
		2#10	1#10	1	3#14	5.1	174H	7	-	1011	4.5	174H	7	-	1066	4.0	184H	7	-	1128	3.6	194H	7	-	1190	325	256
				1			245F	30	1.1	1311		255F	30	1.1	1383		275F	30	1.1	1474		285F	29	1.1	1546	513	
	16	2# 9		1	3# 9	2.9	133H	9	-	497	2.5	133H	9	-	524	2.3	133H	9	-	551	2.0	133H	9	-	578	182	320
				1			244F	37	1.3	717		264F	37	1.2	767		274F	37	1.2	806		284F	36	1.2	845	267	
		2#10		1	3#10	3.5	143H	9	-	618	3.1	153H	9	-	657	2.8	153H	9	-	691	2.5	153H	9	-	726	228	314
				1			244F	37	1.2	835		264F	37	1.2	892		274F	37	1.2	938		284F	36	1.2	984	330	
		2#10	1#10	1	4#11	5.2	164H	9	-	971	4.6	174H	9	-	1031	4.1	174H	9	-	1083	3.7	184H	9	-	1143	330	249
				1			245F	37	1.2	1291		265F	37	1.2	1381		275F	37	1.2	1452		285F	36	1.2	1522	501	
		2#14		1	3#14	5.7	175H	9	-	1216	5.0	174H	9	-	1194	4.5	184H	9	-	1263	4.0	194H	9	-	1333	378	235
				1			245F	37	1.2	1445		265F	37	1.2	1544		275F	37	1.2	1624		285F	36	1.2	1704	529	
	18	2# 8	1# 8	1	3# 9	2.9	123H	11	-	510	2.6	123H	11	-	538	2.3	123H	11	-	566	2.1	123H	11	-	595	216	266
				1			284E	45	1.4	792		294E	45	1.4	832		314E	44	1.4	884		323E	44	1.4	735	269	
		2# 9	1# 9	1	3#11	4.2	153H	11	-	711	3.7	153H	11	-	751	3.3	153H	11	-	791	3.0	163H	11	-	835	269	271
				1			225G	45	1.4	1074		235G	44	1.4	1134		245G	44	1.4	1193		255G	44	1.4	1253	400	
		2#11	1#11	1	3#14	5.8	164H	11	-	1102	5.2	174H	11	-	1170	4.6	184H	11	-	1238	4.1	184H	11	-	1298	400	221
				1			325D	45	1.4	1591		345D	44	1.4	1690		245G	44	1.3	1555		255G	44	1.3	1634	542	
		2#11	1#11	1	4#14	6.3	175H	11	-	1359	5.5	174H	11	-	1343	4.9	184H	11	-	1422	4.4	194H	11	-	1500	400	199
				1			325D	45	1.4	1754		345D	44	1.4	1863		365D	44	1.3	1972		255G	44	1.3	1828	678	

(1) See "Recommended Bar Details", Fig. 12-1. For girders, use tabulated beam depth — 2 inches (b — 2").
(2) In "Layers" column, first line is number of layers for bottom bars, second line is for number of layers for top bars.
(3) For superimposed factored load capacity, deduct 1.4 x stem weight.
(4) Total capacities tabulated causing deflection in excess of $\ell_n/360$ are designated thus: * — $\ell_n/360$ < deflection < $\ell_n/240$
X — $\ell_n/240$ < deflection < $\ell_n/180$
Y — deflection > $\ell_n/180$

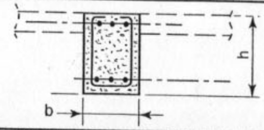
(5) For each beam design, first line is for open stirrups, secondline is for closed ties. See Fig. 12-4. At free ends, use stirrups tabulated for "Interior Spans". For b > 24 in., provide 4 legs (two stirrups) of size and spacing tabulated. For stirrup nomenclature, see page 12-13.

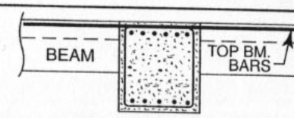
Other notation:
N/A — STIRRUPS ARE NOT REQUIRED
** — MAXIMUM SPACING IS LESS THAN 3 INCHES. NOT RECOMMENDED
*** — SHEAR STRESS IS GREATER THAN $10\sqrt{f'_c}$
**** — TORSION STRESS EXCEEDS ALLOWABLE

(6) $+\phi M_n$ and $-\phi M_n$ are design moment strength capacities for rectangular section b × h.
(7) Midspan elastic deflection (in.) = C x (w/1.6) x ℓ_n^4, where w = tabulated load (k/ft.), ℓ_n in ft.
"Average service load" is taken as w/1.6.

$f'_c = 4{,}000$ psi
$f_y = 60{,}000$ psi

RECTANGULAR BEAMS, INTERIOR SPANS





TOTAL CAPACITY $U = 1.4D + 1.7L$ (3)

STEM h in.	STEM b in.	BARS (1) BOTTOM ℓ_n + 12 in.	BOTTOM 0.875 ℓ_n	Layers (2)	TOP	SPAN ℓ_n = 32 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	Aℓ sq. in.	STEEL WGT lb.	SPAN ℓ_n = 34 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	Aℓ sq. in.	STEEL WGT lb.	SPAN ℓ_n = 36 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	Aℓ sq. in.	STEEL WGT lb.	SPAN ℓ_n = 38 ft LOAD (4) k/ft	STIR. TIES (5)	ϕT_n ft-kips	Aℓ sq. in.	STEEL WGT lb.	$+\phi M_n$ / $-\phi M_n$ (6) ft-kip	DEFL (C) (7) $\times 10^{-9}$ in.
24	12	2# 8		1	2# 9	1.9	123H	6	-	369	1.7	123H	6	-	388	1.5	123H	6	-	408	1.4	123H	6	-	428	144	399
				1			274E	23	1.0	606		293E	23	1.0	494		303E	23	1.0	519		313E	23	1.0	544	179	
		2# 9		1	2#11	2.8	153H	6	-	510	2.5	153H	6	-	538	2.2	153H	6	-	566	2.0	163H	6	-	598	179	407
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		2#11		1	4#10	4.0	164H	6	-	841	3.6	174H	6	-	893	3.2	184H	6	-	945	2.8	183H	6	-	922	266	339
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		2#10		1	3#10	3.5	153H	7	-	620	3.1	153H	7	-	655	2.8	163H	7	-	693	2.5	163H	7	-	728	225	340
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		2#11		1	3#11	4.2	164H	7	-	817	3.7	164H	7	-	860	3.3	173H	7	-	845	2.9	183H	7	-	892	271	306
				1			245F	30	1.1	1125		255F	30	1.1	1185		275F	30	1.1	1264		285F	29	1.1	1324	386	
		2#10	1#10	1	3#14	5.1	174H	7	-	1011	4.5	174H	7	-	1066	4.0	184H	7	-	1128	3.6	194H	7	-	1190	325	256
				1			245F	30	1.1	1311		255F	30	1.1	1383		275F	30	1.1	1474		285F	29	1.1	1546	513	
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				1			244F	37	1.3	717		264F	37	1.2	767		274F	37	1.2	806		284F	36	1.2	845	267	
		2#10		1	3#10	3.5	143H	9	-	618	3.1	153H	9	-	657	2.8	153H	9	-	691	2.5	153H	9	-	726	228	314
				1			244F	37	1.2	835		264F	37	1.2	892		274F	37	1.2	938		284F	36	1.2	984	330	
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				1			245F	37	1.2	1291		265F	37	1.2	1381		275F	37	1.2	1452		285F	36	1.2	1522	501	
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				1			284E	45	1.4	792		294E	45	1.4	832		314E	44	1.4	884		323E	44	1.4	735	269	
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				1			225G	45	1.4	1074		235G	44	1.4	1134		245G	44	1.4	1193		255G	44	1.4	1253	400	
		2#11	1#11	1	3#14	5.8	164H	11	-	1102	5.2	174H	11	-	1170	4.6	184H	11	-	1238	4.1	184H	11	-	1298	400	221
				1			325D	45	1.4	1591		345D	44	1.4	1690		245G	44	1.3	1555		255G	44	1.3	1634	542	
		2#11	1#11	1	4#14	6.3	175H	11	-	1359	5.5	174H	11	-	1343	4.9	184H	11	-	1422	4.4	194H	11	-	1500	400	199
				1			325D	45	1.4	1754		345D	44	1.4	1863		365D	44	1.3	1972		255G	44	1.3	1828	678	

(1) See "Recommended Bar Details", Fig. 12-1. For girders, use tabulated beam depth — 2 inches (b — 2").
(2) In "Layers" column, first line is number of layers for bottom bars, second line is for number of layers for top bars.
(3) For superimposed factored load capacity, deduct 1.4 x stem weight.
(4) Total capacities tabulated causing deflection in excess of $\ell_n/360$ are designated thus: * — $\ell_n/360$ < deflection < $\ell_n/240$
X — $\ell_n/240$ < deflection < $\ell_n/180$
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(5) For each beam design, first line is for open stirrups, secondline is for closed ties. See Fig. 12-4. At free ends, use stirrups tabulated for "Interior Spans". For b > 24 in., provide 4 legs (two stirrups) of size and spacing tabulated. For stirrup nomenclature, see page 12-13.

Other notation: N/A — STIRRUPS ARE NOT REQUIRED
** — MAXIMUM SPACING IS LESS THAN 3 INCHES. NOT RECOMMENDED
*** — SHEAR STRESS IS GREATER THAN $10\sqrt{f'_c}$
**** — TORSION STRESS EXCEEDS ALLOWABLE

(6) $+\phi M_n$ and $-\phi M_n$ are design moment strength capacities for rectangular section b × h.
(7) Midspan elastic deflection (in.) = C x (w/1.6) x ℓ_n^4, where w = tabulated load (k/ft.), ℓ_n in ft.
"Average service load" is taken as w/1.6.

SOLID ONE-WAY SLABS—SINGLE SPAN

f'_c = 3,000 psi — Grade 60 Bars — Bottom Steel for + M_u — $\rho \approx 0.0050$

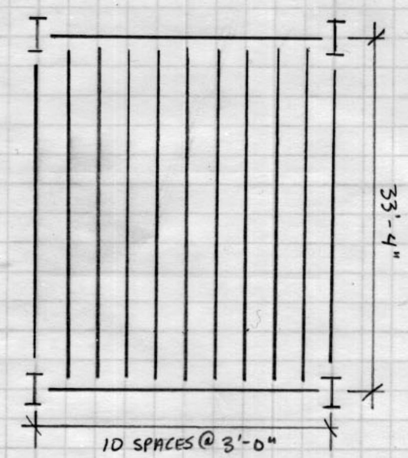
Thickness (in.)	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
Bottom Bars Spacing (in.)	#4 12	#4 11	#4 10	#4 9	#5 12	#5 11	#5 10	#5 10	#5 9	#6 12	#6 11	#6 10	#6 10
Top Bars Spacing (in.)	#3 12	#3 12	#3 12	#4 12	#4 12	#4 12	#4 12	#4 12	#4 12	#4 12	#4 12	#4 12	#4 12
T-S Bars Spacing (in.)	#3 15	#3 13	#3 12	#3 11	#4 18	#4 17	#4 15	#4 14	#4 13	#4 13	#4 12	#5 18	#5 17
Areas of Steel (in.^{2}/ft) Bottom	.200	.218	.240	.267	.310	.338	.372	.372	.413	.440	.480	.528	.528
Slab Wt. (psf)	50	56	63	69	75	81	88	94	100	106	113	119	125
CLEAR SPAN	FACTORED USABLE SUPERIMPOSED LOAD (psf)												
6′-0″	490	638	814										
6′-6″	407	532	681	866									
7′-0″	341	448	575	733	949								
7′-6″	288	380	489	626	814	991							
8′-0″	245	324	419	538	702	857							
8′-6″	209	278	361	466	610	746	909	993					
9′-0″	179	240	313	405	533	653	797	872					
9′-6″	153	207	272	354	467	575	703	769	936				
10′-0″	131	179	236	310	411	508	622	681	831	951			
10′-6″	113	155	206	272	363	450	553	605	741	848			
11′-0″	96	134	180	239	322	400	493	540	663	760	899		
11′-6″	82	116	157	210	285	356	440	483	594	683	809	962	
12′-0″	70	100	137	185	253	318	394	433	534	615	730	870	927
12′-6″	59	86	119	163	225	284	354	388	482	555	660	789	841
13′-0″	49	74	104	144	200	254	318	349	435	502	598	716	764
13′-6″	40	63	90	126	178	227	286	314	393	454	543	652	696
14′-0″		53	77	110	158	203	257	283	355	412	494	595	635
14′-6″		44	66	96	140	182	231	255	322	374	450	543	580
15′-0″			56	84	124	162	208	229	292	340	410	497	530
15′-6″			47	72	110	145	187	206	264	309	374	454	486
16′-0″				62	96	129	168	185	239	281	341	416	445
16′-6″				52	84	114	150	167	217	255	311	381	408
17′-0″				44	73	101	134	149	196	232	284	350	374
17′-6″					63	89	120	133	177	210	259	320	343
18′-0″					54	78	107	119	160	190	236	294	315
18′-6″					46	68	94	105	144	172	215	269	289
19′-0″						58	83	93	129	156	196	247	264
19′-6″						50	73	82	115	140	178	226	242
20′-0″						41	63	71	103	126	161	206	222

Note: See Fig. 7-1 for reinforcing bar details.

STEEL JOIST SYSTEM

* JOIST AND JOIST GIRDER SYSTEM WAS CREATED USING RAM STEEL, THE FOLLOWING IS A SPOT-CHECK ANALYSIS OF IT:

VULCRAFT JOIST DESIGN MANUAL WAS USED TO SIZE JOISTS.



FROM RAM STEEL:

JOISTS = 24K10
JOIST GIRDERS = xxG10N13.4K

LENGTH = 33.33'

LOADS:

DEAD:

LWC SLAB	=	31.15 PSF
STEEL DECKING	=	2.5 PSF
PARTITIONS	=	20.0 PSF
MEP	=	5.0 PSF
		58.65 PSF

LIVE: OPEN PLAN OFFICE = 100 PSF

K-SERIES JOISTS:

$W_u = 1.2D + 1.6L = 1.2(58.65) + 1.6(100) = 230.4\ PSF\,(3') = 691.2\ PLF$

$W_{sji} \geq W_u/(0.9)(1.65) = 691.2/(0.9)(1.65) = 465.5\ PLF$

USE SPAN = 34'-0"
VULCRAFT GIVES THE FOLLOWING VALUES:

	DEAD LOAD		LIVE LOAD	
22K10:	458 PLF < 465.5 PLF	NO	280 PLF < 300 PLF	NO
22K11:	516 PLF > 465.5 PLF	YES	314 PLF > 300 PLF	YES
→ 24K10:	502 PLF > 465.5 PLF	YES	337 PLF > 300 PLF	YES
24K12:	516 PLF > 465.5 PLF	YES	344 PLF > 300 PLF	YES

DEFLECTION LIVE LOAD: $\Delta_{LL} \leq L/360$

∴ RAM MODEL CORRECTLY SIZED JOISTS.

JOIST GIRDER DESIGN:

GIRDER SPAN = 30'-0"
TOTAL LOAD = 58.65 + 100 = 158.65 PSF

NUMBER OF ACTUAL JOIST SPACES, N = 10
LOAD = 3'(158.65 PSF) = 476 PLF
P = 30'(476 PLF)/1000 = 14.3 K

DEPTH OF GIRDER: VULCRAFT DOES NOT SPECIFY A JOIST GIRDER THAT SPANS 30' AND HAS 10N, SO I USED THE VALUES FOR 30' SPAN AND 8N @ 3.75'.
DEPTH = 32"

DESIGNATION: 32G10N14.3K
RAM DESIGNATION: xxG10N13.4K

∴ RAM DESIGNATION OK

LOADS VARY DUE TO THE FACT RAM STEEL USES LIVE LOAD REDUCTION; HOWEVER, THEY ARE VERY SIMILAR.

TOTAL WEIGHT OF JOIST SYSTEM:

JOISTS:	13.1 PLF / 3'	=	4.37 PSF
JOIST GIRDER:	61.0 PLF / 30'	=	2.03 PSF
			6.40 PSF

STANDARD LOAD TABLE/OPEN WEB STEEL JOISTS, K-SERIES
Based on a Maximum Allowable Tensile Stress of 30 ksi

Joist Designation	18K3	18K4	18K5	18K6	18K7	18K9	18K10	20K3	20K4	20K5	20K6	20K7	20K9	20K10	22K4	22K5	22K6	22K7	22K9	22K10	22K11
Depth (In.)	18	18	18	18	18	18	18	20	20	20	20	20	20	20	22	22	22	22	22	22	22
Approx. Wt. (lbs./ft.)	6.6	7.2	7.7	8.5	9	10.2	11.7	6.7	7.6	8.2	8.9	9.3	10.8	12.2	8	8.8	9.2	9.7	11.3	12.6	13.8
Span (ft.) ↓																					
18	550 550	550 550	550 550	550 550	550 550	550 550	550 550														
19	514 494	550 523	550 523	550 523	550 523	550 523	550 523														
20	463 423	550 490	550 490	550 490	550 490	550 490	550 490	517 517	550 550	550 550	550 550	550 550	550 550	550 550							
21	420 364	506 426	550 460	550 460	550 460	550 460	550 460	468 453	550 520	550 520	550 520	550 520	550 520	550 520							
22	382 316	460 370	518 414	550 438	550 438	550 438	550 438	426 393	514 461	550 490	550 490	550 490	550 490	550 490	550 548	550 548	550 548	550 548	550 548	550 548	550 548
23	349 276	420 323	473 362	516 393	550 418	550 418	550 418	389 344	469 402	529 451	550 468	550 468	550 468	550 468	518 491	550 518	550 518	550 518	550 518	550 518	550 518
24	320 242	385 284	434 318	473 345	526 382	550 396	550 396	357 302	430 353	485 396	528 430	550 448	550 448	550 448	475 431	536 483	550 495	550 495	550 495	550 495	550 495
25	294 214	355 250	400 281	435 305	485 337	550 377	550 377	329 266	396 312	446 350	486 380	541 421	550 426	550 426	438 381	493 427	537 464	550 474	550 474	550 474	550 474
26	272 190	328 222	369 249	402 271	448 299	538 354	550 361	304 236	366 277	412 310	449 337	500 373	550 405	550 405	404 338	455 379	496 411	550 454	550 454	550 454	550 454
27	252 169	303 198	342 222	372 241	415 267	498 315	550 347	281 211	339 247	382 277	416 301	463 333	550 389	550 389	374 301	422 337	459 367	512 406	550 432	550 432	550 432
28	234 151	282 177	318 199	346 216	385 239	463 282	548 331	261 189	315 221	355 248	386 269	430 298	517 353	550 375	348 270	392 302	427 328	475 364	550 413	550 413	550 413
29	218 136	263 159	296 179	322 194	359 215	431 254	511 298	243 170	293 199	330 223	360 242	401 268	482 317	550 359	324 242	365 272	398 295	443 327	532 387	550 399	550 399
30	203 123	245 144	276 161	301 175	335 194	402 229	477 269	227 153	274 179	308 201	336 218	374 242	450 286	533 336	302 219	341 245	371 266	413 295	497 349	550 385	550 385
31	190 111	229 130	258 146	281 158	313 175	376 207	446 243	212 138	256 162	289 182	314 198	350 219	421 259	499 304	283 198	319 222	347 241	387 267	465 316	550 369	550 369
32	178 101	215 118	242 132	264 144	294 159	353 188	418 221	199 126	240 147	271 165	295 179	328 199	395 235	468 276	265 180	299 201	326 219	363 242	436 287	517 337	549 355
33	168 92	202 108	228 121	248 131	276 145	332 171	393 201	187 114	226 134	254 150	277 163	309 181	371 214	440 251	249 164	281 183	306 199	341 221	410 261	486 307	532 334
34	158 84	190 98	214 110	233 120	260 132	312 156	370 184	176 105	212 122	239 137	261 149	290 165	349 195	414 229	235 149	265 167	288 182	321 202	386 239	458 280	516 314
35	149 77	179 90	202 101	220 110	245 121	294 143	349 168	166 96	200 112	226 126	246 137	274 151	329 179	390 210	221 137	249 153	272 167	303 185	364 219	432 257	494 292
36	141 70	169 82	191 92	208 101	232 111	278 132	330 154	157 88	189 103	213 115	232 125	259 139	311 164	369 193	209 126	236 141	257 153	286 169	344 201	408 236	467 269
37								148 81	179 95	202 106	220 115	245 128	294 151	349 178	198 116	223 130	243 141	271 156	325 185	386 217	442 247
38								141 74	170 87	191 98	208 106	232 118	279 139	331 164	187 107	211 119	230 130	256 144	308 170	366 200	419 228
39								133 69	161 81	181 90	198 98	220 109	265 129	314 151	178 98	200 110	218 120	243 133	292 157	347 185	397 211
40								127 64	153 75	172 84	188 91	209 101	251 119	298 140	169 91	190 102	207 111	231 123	278 146	330 171	377 195
41															161 85	181 95	197 103	220 114	264 135	314 159	359 181
42															153 79	173 88	188 96	209 106	252 126	299 148	342 168
43															146 73	165 82	179 89	200 99	240 117	285 138	326 157
44															139 68	157 76	171 83	191 92	229 109	272 128	311 146

STANDARD LOAD TABLE/OPEN WEB STEEL JOISTS, K-SERIES
Based on a Maximum Allowable Tensile Stress of 30 ksi

Joist Designation	24K4	24K5	24K6	24K7	24K8	24K9	24K10	24K12	26K5	26K6	26K7	26K8	26K9	26K10	26K12
Depth (in.)	24	24	24	24	24	24	24	24	26	26	26	26	26	26	26
Approx. Wt. (lbs./ft.)	8.4	9.3	9.7	10.1	11.5	12.0	13.1	16.0	9.8	10.6	10.9	12.1	12.2	13.8	16.6
Span (ft.) ↓															
24	520 516	550 544	550 544	550 544	550 544	550 544	550 544	550 544							
25	479 456	540 511	550 520	550 520	550 520	550 520	550 520	550 520							
26	442 405	499 453	543 493	550 499	550 499	550 499	550 499	550 499	542 535	550 541	550 541	550 541	550 541	550 541	550 541
27	410 361	462 404	503 439	550 479	550 479	550 479	550 479	550 479	502 477	547 519	550 522	550 522	550 522	550 522	550 522
28	381 323	429 362	467 393	521 436	550 456	550 456	550 456	550 456	466 427	508 464	550 501	550 501	550 501	550 501	550 501
29	354 290	400 325	435 354	485 392	536 429	550 436	550 436	550 436	434 384	473 417	527 463	550 479	550 479	550 479	550 479
30	331 262	373 293	406 319	453 353	500 387	544 419	550 422	550 422	405 346	441 377	492 417	544 457	550 459	550 459	550 459
31	310 237	349 266	380 289	424 320	468 350	510 379	550 410	550 410	379 314	413 341	460 378	509 413	550 444	550 444	550 444
32	290 215	327 241	357 262	397 290	439 318	478 344	549 393	549 393	356 285	387 309	432 343	477 375	519 407	549 431	549 431
33	273 196	308 220	335 239	373 265	413 289	449 313	532 368	532 368	334 259	364 282	406 312	448 342	488 370	532 404	532 404
34	257 179	290 201	315 218	351 242	388 264	423 286	502 337	516 344	315 237	343 257	382 285	422 312	459 338	516 378	516 378
35	242 164	273 184	297 200	331 221	366 242	399 262	473 308	501 324	297 217	323 236	360 261	398 286	433 310	501 356	501 356
36	229 150	258 169	281 183	313 203	346 222	377 241	447 283	487 306	280 199	305 216	340 240	376 263	409 284	486 334	487 334
37	216 138	244 155	266 169	296 187	327 205	356 222	423 260	474 290	265 183	289 199	322 221	356 242	387 262	460 308	474 315
38	205 128	231 143	252 156	281 172	310 189	338 204	401 240	461 275	251 169	274 184	305 204	337 223	367 241	436 284	461 299
39	195 118	219 132	239 144	266 159	294 174	320 189	380 222	449 261	238 156	260 170	289 188	320 206	348 223	413 262	449 283
40	185 109	208 122	227 133	253 148	280 161	304 175	361 206	438 247	227 145	247 157	275 174	304 191	331 207	393 243	438 269
41	176 101	198 114	216 124	241 137	266 150	290 162	344 191	427 235	215 134	235 146	262 162	289 177	315 192	374 225	427 256
42	168 94	189 106	206 115	229 127	253 139	276 151	327 177	417 224	205 125	224 136	249 150	275 164	300 178	356 210	417 244
43	160 88	180 98	196 107	219 118	242 130	263 140	312 165	406 213	196 116	213 126	238 140	263 153	286 166	339 195	407 232
44	153 82	172 92	187 100	209 110	231 121	251 131	298 154	387 199	187 108	204 118	227 131	251 143	273 155	324 182	398 222
45	146 76	164 86	179 93	199 103	220 113	240 122	285 144	370 185	179 101	194 110	217 122	240 133	261 145	310 170	389 212
46	139 71	157 80	171 87	191 97	211 106	230 114	272 135	354 174	171 95	186 103	207 114	229 125	250 135	296 159	380 203
47	133 67	150 75	164 82	183 90	202 99	220 107	261 126	339 163	164 89	178 96	199 107	219 117	239 127	284 149	369 192
48	128 63	144 70	157 77	175 85	194 93	211 101	250 118	325 153	157 83	171 90	190 100	210 110	229 119	272 140	353 180
49									150 78	164 85	183 94	202 103	220 112	261 131	339 169
50									144 73	157 80	175 89	194 97	211 105	250 124	325 159
51									139 69	151 75	168 83	186 91	203 99	241 116	313 150
52									133 65	145 71	162 79	179 86	195 93	231 110	301 142

DESIGN GUIDE WEIGHT TABLE FOR JOIST GIRDERS
U. S. CUSTOMARY

Based on an allowable tensile stress of 30ksi

Girder Span (ft)	Joist Spaces (ft)	Girder Depth (in)	Joist Girder Weight – Pounds Per Linear Foot																				
			Load on Each Panel Point																				
			4K	5K	6K	7K	8K	9K	10K	11K	12K	14K	16K	18K	20K	25K	30K	35K	40K	50K	60K	70K	80K	100K
28	2N@ 14.00	24	29	29	29	29	29	29	29	30	31	31	33	34	37	39	42	49	57	65	77	91	103	129
		28	29	29	30	30	30	30	30	30	30	31	32	34	34	38	40	43	46	58	66	78	93	106
		32	30	30	30	30	30	30	30	30	30	31	32	33	34	37	39	40	44	52	60	68	76	95
	3N@ 9.33	24	16	16	16	16	16	18	21	22	23	26	29	33	36	44	54	61	70	91	105	124	133	174
		28	16	16	16	16	16	16	18	19	21	23	26	29	31	39	47	52	61	77	94	107	115	156
		32	16	16	16	16	17	17	17	18	19	24	24	27	29	36	42	47	54	70	80	97	110	131
	4N@ 7.00	24	16	16	17	19	21	24	27	28	31	35	39	45	50	62	74	91	101	121	143	165	190	244
		28	17	17	17	18	20	23	24	25	28	32	36	39	44	57	64	76	85	109	124	151	170	206
		32	16	16	16	18	19	20	21	22	24	27	31	37	39	46	54	62	74	88	108	126	149	185
	5N@ 5.6	24	16	17	19	22	24	28	31	33	35	41	47	55	62	78	92	105	114	152	176	215	244	
		28	16	16	17	20	21	26	28	29	32	35	40	47	52	64	80	94	104	134	156	186	213	260
		32	16	16	17	19	20	22	26	27	29	32	38	42	46	58	66	82	97	111	136	162	190	232
	6N@ 4.67	24	17	19	21	25	29	32	36	39	43	50	59	66	73	100	109	121	142	191	219	254	314	
		28	16	19	21	22	26	29	32	34	37	44	52	57	60	76	103	105	123	149	194	223	253	
		32	17	17	20	22	24	27	30	31	34	38	45	51	54	71	87	105	108	148	177	201	230	301
	7N@ 4.00	24	18	22	26	31	33	37	43	48	51	59	67	79	84	103	131	144	166	219	261			
		28	17	20	24	26	29	32	36	41	45	53	61	65	74	95	109	125	147	184	224	272	312	
		32	17	20	23	25	27	30	33	37	40	47	55	60	67	83	106	115	127	169	202	240	277	
	14N@ 2.00	24	33	43	51	59	66	79	84	102	103	121	143	155	173	221	281							
		28	30	38	45	53	61	70	75	82	88	106	114	137	149	198	235	274	332					
		32	28	33	40	47	54	63	72	76	79	100	113	118	132	172	206	244	284					
30	2N@ 15.00	24	29	29	29	29	29	29	30	30	31	32	33	35	37	40	46	53	60	72	85	102	103	139
		28	29	29	29	29	29	30	30	30	30	32	32	34	36	38	41	44	49	65	74	86	92	115
		32	30	30	30	30	30	30	30	30	30	31	32	33	34	37	40	41	45	55	66	75	89	106
		36	30	30	30	30	30	30	30	30	30	31	32	32	33	36	38	41	42	51	60	68	76	95
	3N@ 10.00	24	15	16	16	16	18	19	22	24	25	29	31	34	38	48	57	65	74	91	109	130	151	176
		28	16	16	16	16	16	17	20	21	24	25	28	31	33	43	50	58	67	79	94	108	126	156
		32	16	16	16	16	16	17	18	19	21	25	26	29	30	38	45	51	60	69	89	96	110	136
		36	16	17	17	17	17	17	17	18	20	24	26	27	30	34	42	46	55	70	80	92	99	122
	4N@ 7.5	24	16	16	17	20	24	26	27	30	32	37	42	47	54	66	78	99	104	140	161	183	210	265
		28	16	16	17	18	21	23	25	27	28	33	37	42	46	56	71	79	93	110	143	156	179	223
		32	16	16	16	18	19	20	21	23	27	29	32	36	41	50	60	69	76	104	112	146	149	202
		36	16	16	17	17	18	19	21	22	24	27	30	35	38	45	54	62	71	87	106	115	147	184
	5N@ 6.00	24	16	17	20	23	26	29	32	34	38	45	53	58	62	78	100	108	131	162	193	231	262	
		28	16	16	19	21	24	27	28	31	34	38	46	49	56	71	79	102	107	143	166	195	224	285
		32	16	16	17	19	21	25	26	28	31	36	39	44	50	64	73	85	104	118	147	177	198	248
		36	16	17	17	19	21	22	25	27	29	31	38	40	44	58	66	76	88	108	127	151	179	220
	6N@ 5.00	24	17	19	24	28	31	34	39	42	47	54	62	69	78	100	109	140	161	190	237	288		
		28	16	19	20	26	28	31	34	37	40	46	52	60	67	84	102	111	143	167	195	222	289	
		32	16	17	20	22	26	28	31	32	35	41	47	53	60	74	87	106	113	148	175	200	237	304
		36	17	18	19	21	24	28	28	30	33	38	44	49	55	67	79	90	108	129	154	180	206	275
	8N@ 3.75	24	21	25	31	36	41	47	50	58	62	73	83	100	102	131	162	188	216	255				
		28	20	23	29	32	37	40	44	49	53	61	72	81	86	111	144	147	175	224	281			
		32	19	22	26	30	32	36	41	45	50	57	65	75	82	105	114	147	159	204	242	308	343	
		36	19	21	24	28	30	35	38	39	43	53	59	69	74	89	111	118	152	185	218	256	314	
	15N@ 2.00	24	40	50	58	66	78	92	101	106	115	142	165	181	196	257	326							
		28	34	41	52	60	68	76	85	103	105	113	137	152	176	216	265	329						
		32	30	39	47	54	62	73	77	83	91	111	117	133	159	195	242	275	325					
		36	29	35	42	49	56	66	72	79	82	103	117	127	142	183	222	260	290					
32	3N@ 10.67	24	15	15	15	17	19	21	23	25	26	31	34	37	42	50	63	72	86	102	123	130	150	197
		28	16	16	16	16	17	19	21	22	24	27	29	32	35	44	51	64	67	87	105	114	132	173
		32	16	16	16	16	16	17	19	21	22	25	27	30	32	39	45	52	60	77	93	107	115	156
		36	16	16	17	17	17	17	18	19	21	25	25	28	30	37	44	51	54	69	79	97	110	131
	4N@ 8.00	24	16	16	18	22	24	26	29	31	34	40	45	53	58	69	89	99	107	139	161	187	222	273
		28	16	16	17	19	22	24	26	27	30	35	38	46	48	62	70	83	101	115	143	165	187	243
		32	17	17	17	18	20	24	25	25	28	32	36	39	46	56	65	73	85	109	124	151	172	203
		36	16	16	18	18	19	20	22	23	26	28	34	37	39	50	57	66	75	88	107	125	149	184
	5N@ 6.4	24	16	19	22	26	29	31	34	38	41	47	54	61	68	91	103	113	140	172	200	237	275	
		28	16	17	19	22	24	27	29	32	35	41	47	54	62	71	92	102	114	143	175	209	233	305
		32	16	16	18	20	22	26	27	30	33	36	42	47	55	64	80	94	103	133	156	187	203	258
		36	16	17	17	19	20	23	25	28	29	35	37	43	48	58	72	82	96	111	137	162	189	230
	6N@ 5.33	24	18	21	25	29	33	36	40	46	49	57	65	73	82	100	119	141	161	214	242	307		
		28	17	19	21	26	28	31	36	39	43	50	59	62	70	92	102	121	142	171	219	249	290	
		32	16	19	20	24	26	28	32	34	37	44	52	57	60	76	103	105	123	149	194	223	253	321
		36	17	17	20	21	25	27	30	32	35	39	46	51	57	74	87	105	108	148	176	200	229	299
	8N@ 4.00	24	23	28	33	39	42	50	57	58	65	77	91	100	108	140	162	188	216	282				
		28	21	26	28	33	37	42	48	51	59	67	75	85	101	111	143	167	192	241	292			
		32	20	23	27	30	34	38	42	46	52	61	69	76	86	109	125	149	176	207	258	304		
		36	19	22	26	29	32	36	39	43	46	54	62	74	76	97	116	129	152	195	241	277	316	
Bearing Depth																7 1/2 in.					10 in.			

Joist Girder weights between the heavy black and blue lines have 7 1/2 inch bearing depths.
Joist Girder weights to the right of the heavy blue line have 10 inch bearing depths. Check with Vulcraft for material availablity.