

CORTINA MULTI-USE BUILDING
Canyon Avenue & Howes Street
Ft. Collins, Colorado

Walls & Slab
Storage Rooms Under Sidewalls

STRUCTURAL CALCULATIONS
BY
RNF CONSULTANTS, INC.
Job No. 3374.0

10 November 2003



RNF CONSULTANTS
ron frickel

denver, colorado
consulting engineer

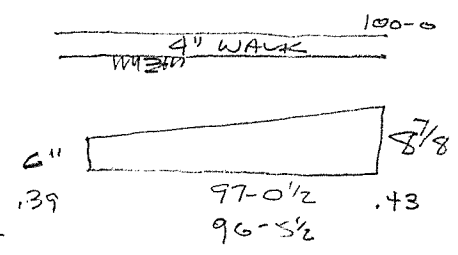
by _____ date 9/4/03 project STORAGE ROOM SLABS sheet no. 1 of _____
checked by _____ date _____ job no. _____

49 45

24D
120 X 2.25

4" SIDEWALK
2.25" SOIL @ 120 pcf
8 7/8" CONC

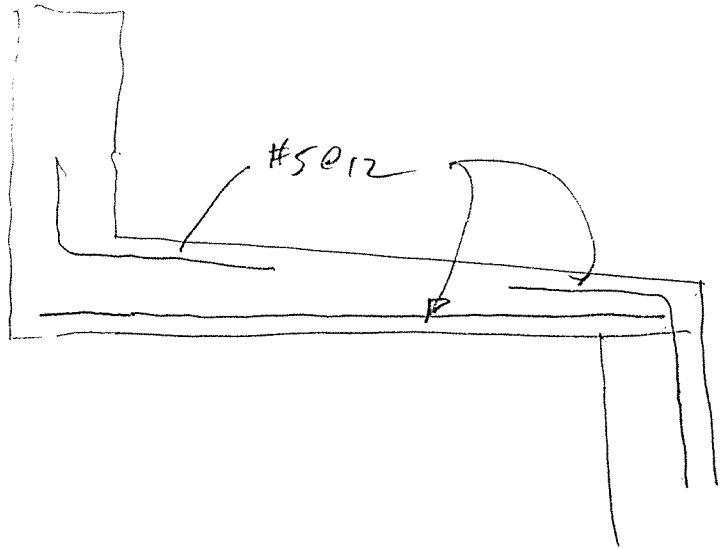
	50 pcf	50
	270	270
	111	75
DL	431 pcf	395 pcf
LL	250 pcf	250



MULTI-SPAN CONCRETE BEAM DESIGN

STOR SLAB OVER STORAGE ROOMS

GENERAL DATA		SLAB
		1
All Spans Simple Support ??	:	YES
Span Lengths	ft :	5.33
End Fixity:	:	Pin:Pin
Beam Width	in :	12.00
Beam Depth	in :	7.00
CALCULATED VALUES		-OK-
Left: Max Mu	k-ft :	0.0
Mn * Phi	k-ft :	4.7
Center:Max Mu	k-ft :	3.5
Mn * Phi	k-ft :	7.3
..Dist. to Mu	ft :	2.66
Right: Max Mu	k-ft :	0.0
Mn * Phi	k-ft :	3.9
Max Vu: Left	k :	2.68
Right	k :	2.63
Reactions:Left:Dead	k :	1.10
..(service) Live	k :	0.67
Total	k :	1.77
RightDead	k :	1.07
Live	k :	0.67
Total	k :	1.74
Max. Defl. @ Mid Span	in :	-0.010
X-Dist	ft :	2.66
BEAM DESIGN DATA		
f'c	psi :	4000
Fy	psi :	60000
Left: As-Top	in2 :	0.31
'd' to Bars	in :	7.00
Center: As-Bottom	in2 :	0.31
'd' to Bars	in :	5.50
Right: As-Top	in2 :	0.31
'd' to Bars	in :	4.00
APPLIED LOADS		
Use Live Load on This Span	?	Yes
Uniform.....DL	k/ft :	0.00
LL	k/ft :	0.25
Trapezoidal DL @ Left	k/ft :	0.43
DL @ Right	k/ft :	0.39
LL @ Left	k/ft :	
LL @ Right	k/ft :	
X-Left	ft :	0.00
X-Right	ft :	5.33



(continued on next page....)

by _____ date _____ project CORONA sheet no. 3 of _____
checked by _____ date _____ STORAGE ROOMS job no. _____

TOP OF OPNGS IN WALL

STONE = 807

CONC = $150(3.08) = 462$

1.269 k/ft

SLAB DL

1.10

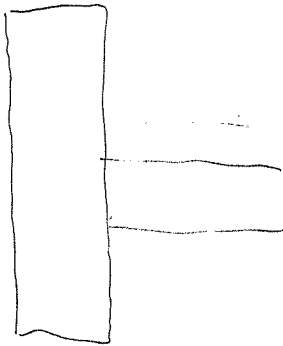
2.269

LL

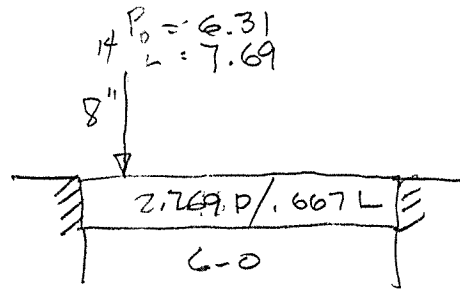
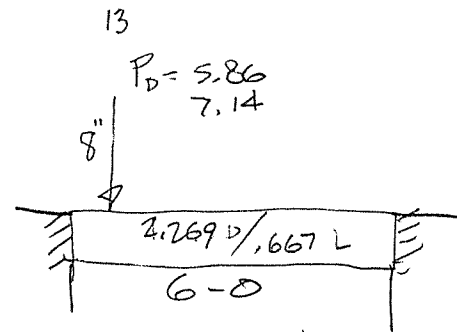
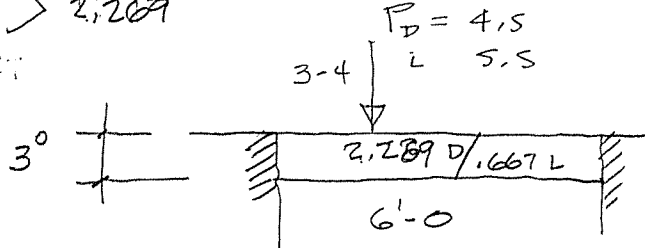
$.667 \text{ k/ft}$

$10^k \times \frac{78}{173} = 4.50$

$\frac{3-10\frac{1}{2}}{10\frac{1}{2}}$
 $-4 \frac{2-2\frac{1}{2}}{10\frac{1}{2}}$
 $= 5\frac{1}{2}$
 $= 1$



$d = 26'' - (1\frac{1}{2} + .5) = 24''$



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 Scope:
 Job #: 3374.0
 Designer: RNF
 Misc:
 Date: 09/04/03

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CONCRETE BEAM DESIGN

STOR BM WALL BM ABOVE STOR RM DOOR OPNCS
 W/E of line 6.6

BEAM DATA		DESIGN DATA		LOAD FACTORS USED	
Beam Span	= 6.00 ft	f'c	= 3500 psi	ACI 9-1 & 9-2 DL	= 1.40
Beam Depth	= 26.00 in	Fy	= 60000 psi	ACI 9-1 & 9-2 LL	= 1.70
Beam Width	= 8.00 in	Seismic Zone	= 1	ACI 9-1 & 9-2 ST	= 1.70
'T' Flange Thickness	= 0.00 in	Live Load not combined w/ Short Term	 Seismic = ST	* 1.10
Beam is Rectangular		End Fixity	: Fix:Fix	ACI 9-2 Group Factor	= 0.75
Web Spacing	= n/a	Concrete Weight	= 145.0 pcf	ACI 9-3 Dead Load Fact	= 0.90
Beam Wt. Auto Added to Loads		Stirrup Area	= 0.220 in ²	ACI 9-3 Short Term	= 1.30
Effective Slab Width	= 8.00 in			UBC 2625(c)4 "1.4" Factor	= 1.40
				UBC 2625(c)4 "0.9" Factor	= 0.90

REBAR LAYOUT		APPLIED LOADS	
Bars @ Center of Beam....		Uniform Dead Load =	2.29 k/ft from 0.00 -> 6.00 ft
2 - # 6 @ d= 24.0 in		Uniform Live Load =	0.67 k/ft from 0.00 -> 6.00 ft
2 - # 6 @ d= 2.0 in		Point Load: Dead Load =	6.31 k, Live Load = 7.69 k, @ 0.67 ft
Bars @ Left End....			
2 - # 6 @ d= 24.0 in			
2 - # 6 @ d= 2.0 in			
Bars @ Right End....			
2 - # 6 @ d= 24.0 in			
2 - # 6 @ d= 2.0 in			

90.6 > 25.4 OK

		SUMMARY		
		ACI Equations...		
		9-1	9-2	9-3
Mn*Phi : Center	= 90.6 k-ft	Mu : Center = 7.8	4.2	4.2 k-ft
Mn*Phi : Left	= 90.6 k-ft	Mu : Left = -25.5	-11.4	-11.4 k-ft
Mn*Phi : Right	= 90.6 k-ft	Mu : Right = -15.4	-8.3	-8.3 k-ft
Vn*Phi: Left	= 19.3 k	Vu : Left = 3.1	2.0	2.0 k
Vn*Phi: Right	= 19.3 k	Vu : Right = 4.6	2.4	2.4 k

		Reactions		Deflections			
		Left	Right	Upward		Downward	
DL+[Bm Wt]	= 13.59 k		7.71 k	0.000 in at 0.00 ft		-0.000 in at 2.92 ft	
DL+LL+[Bm Wt]	= 23.01 k		9.98 k	0.000 in at 0.00 ft		-0.001 in at 2.88 ft	
DL+LL+ST+[Bm Wt]	= 13.59 k		7.71 k	0.000 in at 0.00 ft		-0.000 in at 2.92 ft	

SHEAR STIRRUP REQUIREMENTS

Region	=	0.0ft	1.0ft	2.0ft	3.0ft	4.0ft	5.0ft	6.0ft
Stirrup Spacing	=	Not Reqd	Not Reqd	Not Reqd	Not Reqd	Not Reqd	Not Reqd	Not Reqd
Max Vu in Region	=	3.10 k	3.10 k	3.10 k	3.10 k	4.62 k	4.62 k	4.62 k

ADD'L DEFLECTION DATA


ADD'L DEFLECTION DATA		SECTION ANALYSIS				
Neutral Axis	= 5.37 in	Evaluate Moment Capacity:				
I : Gross	= 11717.3 in ⁴	X : Neutral Axis	=	Center	Left	Right
I : Cracked	= 3125.5 in ⁴	a = beta * x	=	2.27 in	2.27 in	2.27 in
E : Elastic Modulus	= 3372.2 ksi	Compression in Concrete	=	1.93 in	1.93 in	1.93 in
Fr : 7.5*(fc)^.5	= 443.7 psi	Sum [Steel comp. forces]	=	46.0 k	46.0 k	46.0 k
Z:Cracking	= 90.7 ksi	Tension in Reinforcing	=	6.6 k	6.6 k	6.6 k
Mcr: Cracking	= 33.3 k-ft	For Evaluation of Max. As For Ductile Failure....				
Ms:Max DL+LL	= 16.9 k-ft	X-Balanced	=	-52.8 k	-52.8 k	-52.8 k
R1 = (Ms:DL+LL)/Mcr	= 1.972	Xmax = Xbal * 0.75	=			
Ms:Max DL+LL+ST	= 10.8 k-ft	a-max = beta*Xbal	=	14.20 in	14.20 in	14.20 in
R2 = (Ms:DL+LL+ST)/Mcr	= 3.077	Compression in Concrete	=	10.65 in	10.65 in	10.65 in
I:eff... Ms(DL+LL)	= 11717.3 in ⁴	Sum [Steel comp. forces]	=	12.07 in	12.07 in	12.07 in
I:eff... Ms(DL+LL+ST)	= 11717.3 in ⁴	Total Compressive Force	=	215.5 k	215.5 k	215.5 k
		As Max. = Tot Force / fy	=	50.2 k	50.2 k	50.2 k
			=	265.7 k	265.7 k	265.7 k
			=	4.43 in ²	4.43 in ²	4.43 in ²

MAX SHEAR CONDITION

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Misc:
Date: 09/04/03

CONCRETE BEAM DESIGN

STOR BM WALL BM ABOVE STOR ROOM DOOR OPENINGS - W. of 

BEAM DATA		DESIGN DATA		LOAD FACTORS USED	
Beam Span	= 6.00 ft	f'c	= 3500 psi	ACI 9-1 & 9-2 DL	= 1.40
Beam Depth	= 26.00 in	Fy	= 60000 psi	ACI 9-1 & 9-2 LL	= 1.70
Beam Width	= 8.00 in	Seismic Zone	= 1	ACI 9-1 & 9-2 ST	= 1.70
'T' Flange Thickness	= 0.00 in	Live Load not combined w/ Short Term	 Seismic = ST	* 1.10
Beam is Rectangular		End Fixity	: Fix:Fix	ACI 9-2 Group Factor	= 0.75
Web Spacing	= n/a	Concrete Weight	= 145.0 pcf	ACI 9-3 Dead Load Fact	= 0.90
Beam Wt. Auto Added to Loads		Stirrup Area	= 0.220 in ²	ACI 9-3 Short Term	= 1.30
Effective Slab Width	= 8.00 in			UBC 2625(c)4 "1.4" Factor	= 1.40
				UBC 2625(c)4 "0.9" Factor	= 0.90

REBAR LAYOUT		APPLIED LOADS	
Bars @ Center of Beam....		Uniform Dead Load =	2.29 k/ft from 0.00 -> 6.00 ft
2 - # 6 @ d= 24.0 in		Uniform Live Load =	0.67 k/ft from 0.00 -> 6.00 ft
2 - # 6 @ d= 2.0 in		Point Load: Dead Load =	4.50 k, Live Load = 5.50 k, @ 3.33 ft
Bars @ Left End....			
2 - # 6 @ d= 24.0 in			
2 - # 6 @ d= 2.0 in			
Bars @ Right End....			
2 - # 6 @ d= 24.0 in			
2 - # 6 @ d= 2.0 in			

$\phi_{DL} > \phi_{LS} \text{ OK}$

		SUMMARY		
		ACI Equations...		
		9-1	9-2	9-3
Mn*Phi : Center	= 90.6 k-ft	Mu : Center = 18.1	7.2	7.2 k-ft
Mn*Phi : Left	= 90.6 k-ft	Mu : Left = -24.2	-11.0	-11.0 k-ft
Mn*Phi : Right	= 90.6 k-ft	Mu : Right = -26.8	-11.8	-11.8 k-ft

Vn*Phi: Left	= 41.8 k	Vu : Left	= 10.4	4.2	4.2 k
Vn*Phi: Right	= 41.8 k	Vu : Right	= 13.0	4.9	4.9 k

		Reactions		Deflections	
		Left	Right	Upward	Downward
DL+[Bm Wt]	= 9.38 k	10.12 k	10.12 k	0.000 in at 0.00 ft	-0.001 in at 3.08 ft
DL+LL+[Bm Wt]	= 13.67 k	15.32 k	15.32 k	0.000 in at 0.00 ft	-0.001 in at 3.08 ft
DL+LL+ST+[Bm Wt]	= 9.38 k	10.12 k	10.12 k	0.000 in at 0.00 ft	-0.001 in at 3.08 ft

SHEAR STIRRUP REQUIREMENTS

Region	= 0.0ft	1.0ft	2.0ft	3.0ft	4.0ft	5.0ft	6.0ft
Stirrup Spacing	= 12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in
Max Vu in Region	= 10.40 k	10.40 k	10.40 k	10.40 k	12.97 k	12.97 k	12.97 k

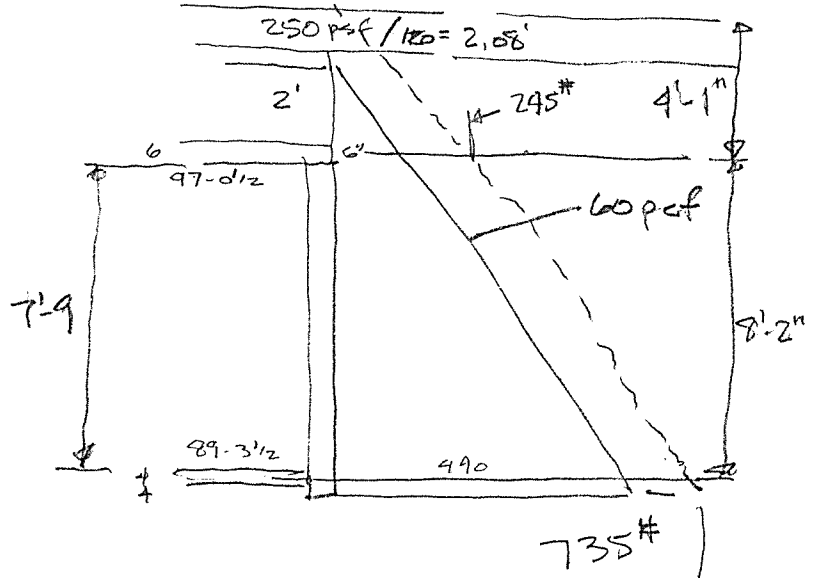
ADD'L DEFLECTION DATA SECTION ANALYSIS

ADD'L DEFLECTION DATA		SECTION ANALYSIS			
Neutral Axis	= 5.37 in	Evaluate Moment Capacity:	Center	Left	Right
I : Gross	= 11717.3 in ⁴	X : Neutral Axis	= 2.27 in	2.27 in	2.27 in
I : Cracked	= 3125.5 in ⁴	a = beta * x	= 1.93 in	1.93 in	1.93 in
E : Elastic Modulus	= 3372.2 ksi	Compression in Concrete	= 46.0 k	46.0 k	46.0 k
Fr : 7.5*(fc)^.5	= 443.7 psi	Sum [Steel comp. forces]	= 6.6 k	6.6 k	6.6 k
Z:Cracking	= 90.7 ksi	Tension in Reinforcing	= -52.8 k	-52.8 k	-52.8 k
Mcr: Cracking	= 33.3 k-ft	For Evaluation of Max. As For Ductile Failure....			
Ms:Max DL+LL	= 17.7 k-ft	X-Balanced	= 14.20 in	14.20 in	14.20 in
R1 = (Ms:DL+LL)/Mcr	= 1.881	Xmax = Xbal * 0.75	= 10.65 in	10.65 in	10.65 in
Ms:Max DL+LL+ST	= 11.2 k-ft	a-max = beta*Xbal	= 12.07 in	12.07 in	12.07 in
R2 = (Ms:DL+LL+ST)/Mcr	= 2.977	Compression in Concrete	= 215.5 k	215.5 k	215.5 k
I:eff... Ms(DL+LL)	= 11717.3 in ⁴	Sum [Steel comp. forces]	= 50.2 k	50.2 k	50.2 k
I:eff... Ms(DL+LL+ST)	= 11717.3 in ⁴	Total Compressive Force	= 265.7 k	265.7 k	265.7 k
		As Max.= Tot Force / fy	= 4.43 in ²	4.43 in ²	4.43 in ²

by RNF date _____ project CORTINA sheet no. 6 of _____
checked by _____ date _____ job no. _____

STORAGE ROOM WALLS

$$d = 8" - (1\frac{1}{2} + \frac{1}{2}) = 6"$$



LATERAL LOAD IS ALL LIVE LOAD

WIND LOAD

FROM SURF DL = 1070 UL = 1,670

$$\frac{8'-2}{8} = 8.167$$

$$\begin{array}{r} \text{WALL } 100 \times 8.167 \\ \hline 8167 \\ \times 1.14 \\ \hline \end{array}$$

$$\times 1.7$$

$$w_u = 2,712 + 1,139 = 3,851$$

MAX SPAN 19'

$$M_u = \frac{19^2}{8} \times 3,851 = 1741\text{-k}$$

$$d = 96" - 2 = 94 \quad f = \frac{94^2 \times 8}{12000} = 5.89$$

$$K_u = 30 \quad a_u = 4.31$$

$$A_s = \frac{174}{94 \times 4.31} = 0.43 \text{ in}^2$$

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 Misc:
 Date: 11/09/03

SINGLE

WALL

MULTI-SPAN CONCRETE BEAM DESIGN

STOR WALL

GENERAL DATA 1

All Spans Simple Support ?? : YES
 Span Lengths ft : 8.17
 End Fixity: : Pin:Pin
 Beam Width in : 12.00
 Beam Depth in : 8.00

CALCULATED VALUES ReCheck!

Left: Max Mu k-ft : 0.0
 Mn * Phi k-ft : 5.2
 Center: Max Mu k-ft : 7.0
 Mn * Phi k-ft : 8.0
 ...Dist. to Mu ft : 4.41
 Right: Max Mu k-ft : -0.0
 Mn * Phi k-ft : 0.0
 Max Vu: Left k : 2.84
 Right k : 3.97
 Reactions: Left: Dead k : 0.00
 ..(service) Live k : 1.67
 Total k : 1.67
 Right: Dead k : 0.00
 Live k : 2.34
 Total k : 2.34
 Max. Defl. @ Mid Span in : -0.071
 X-Dist ft : 4.14

> 8 > T OK

4/1380 OK

BEAM DESIGN DATA

f'c psi : 3500
 Fy psi : 60000
 Left: As-Top in2 : 0.31
 'd' to Bars in : 4.00
 Center: As-Bottom in2 : 0.31
 'd' to Bars in : 6.00
 Right: As-Top in2 :
 'd' to Bars in : 4.00

#5 @ 12 VENT I.F.

APPLIED LOADS

Use Live Load on This Span ? Yes
 Trapezoidal DL @ Left k/ft :
 DL @ Right k/ft :
 LL @ Left k/ft : 0.25
 LL @ Right k/ft : 0.74
 X-Left ft : 0.00
 X-Right ft : 8.17

✓
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SINGLE

WALL

MULTI-SPAN CONCRETE BEAM DESIGN

STOR WALL

(.....continued)

SHEAR STIRRUPS		
Stirrup Av @ Section	in ² :	0.00
Spacing Req'd @ Left	in :	
" Req'd @ .2L	in :	
" Req'd @ .4L	in :	
" Req'd @ .6L	in :	
" Req'd @ .8L	in :	
Spacing Req'd @ Right	in :	
QUERY VALUES		
Location	ft :	2.67
Shear	k :	1.36
Moment	k-ft :	5.76
Deflection	in :	-0.06