



CIVIL ENGINEERING CONSULTANTS

1805 WATERS ROAD

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October 28, 2019

Attn: Kevin Stallings
Dreams and Designs Building
1100 NE Delta School Rd
Lee's Summit, MO 64064

RE: MD2 Designs Plan DD-7139 (Choplin)
R.E.O. Project #19-003-32
4712 NE Gateway Dr
Lee's Summit, MO
Permit #PRRES20191501

Dear Mr. Stallings,

We are providing herewith an alternate beam specification in lieu of a center support column in the garage between the overhead doors in the above referenced plan. It is acceptable to support the side to side W12"x35# beam with a front to back beam of the same size and weight (W12"x35#). Each end of the beam shall be supported by a 3.5" schedule 40 steel column or 3"x3"x1/8" square tube steel column.

At the connection between the new support beam and the existing beam, provide 1/4 inch fillet welds all around. At each end of the new support beam to support columns provide 1/4 inch fillet weld all around or bolt per specification in approved plan.

Calculations and a markup sketch for reference are provided herewith. If there are any questions regarding this modification, please contact our Offices.

Very Truly Yours,

R.E.O. ENGINEERING, P.C.

By: , President
Aaron D. Obermiller, P.E.



Project: 19-003-15

Location: ALTERNATE SUPPORT BEAM

Multi-Loaded Multi-Span Beam

[2015 International Building Code(AISC 14th Ed ASD)]

A992-50 W12x35 x 24.0 FT

Section Adequate By: 32.7%

Controlling Factor: Moment



StruCalc 9.0

New Beam

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DEFLECTIONS

Center

Live Load 0.41 IN L/698

Dead Load 0.35 in

Total Load 0.76 IN L/379

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

A

B

Live Load 3428 lb 3428 lb

Dead Load 3039 lb 3039 lb

Total Load 6467 lb 6467 lb

Bearing Length 0.82 in 0.82 in

BEAM DATA

Center

Span Length 24 ft

Unbraced Length-Top 12 ft

Unbraced Length-Bottom 24 ft

STEEL PROPERTIES

W12x35 - A992-50

Properties:

Yield Stress: $F_y = 50$ ksi

Modulus of Elasticity: $E = 29000$ ksi

Depth: $d = 12.5$ in

Web Thickness: $t_w = 0.3$ in

Flange Width: $b_f = 6.56$ in

Flange Thickness: $t_f = 0.52$ in

Distance to Web Toe of Fillet: $k = 0.82$ in

Moment of Inertia About X-X Axis: $I_x = 285$ in⁴

Section Modulus About X-X Axis: $S_x = 45.6$ in³

Plastic Section Modulus About X-X Axis: $Z_x = 51.2$ in³

Design Properties per AISC 14th Edition Steel Manual:

Flange Buckling Ratio: $FBR = 6.31$

Allowable Flange Buckling Ratio: $AFBR = 9.15$

Web Buckling Ratio: $WBR = 36.2$

Allowable Web Buckling Ratio: $AWBR = 90.55$

Controlling Unbraced Length: $L_b = 12$ ft

Limiting Unbraced Length -

for lateral-torsional buckling: $L_p = 5.44$ ft

for Eqn. F2-2: $L_r = 16.65$ ft

Nominal Flexural Strength w/ safety factor: $M_n = 99590$ ft-lb

Controlling Equation: $F2-2$

Web height to thickness ratio: $h/t_w = 36.2$

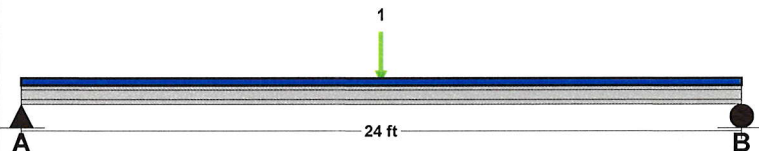
Limiting height to thickness ratio for eqn. G2-2: h/t_w -limit = 53.95

Cv Factor: $C_v = 1$

Controlling Equation: $G2-2$

Nominal Shear Strength w/ safety factor: $V_n = 75000$ lb

LOADING DIAGRAM



UNIFORM LOADS

Center

Uniform Live Load 0 plf

Uniform Dead Load 0 plf

Beam Self Weight 35 plf

Total Uniform Load 35 plf

POINT LOADS - CENTER SPAN

Load Number One * Two *

Live Load 3465 lb 3390 lb

Dead Load 2647 lb 2590 lb

Location 12 ft 12 ft

* Load obtained from Load Tracker. See Summary Report for details.

Controlling Moment:

75072 ft-lb

12.0 Ft from left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s) 2

Controlling Shear:

6466 lb

At left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s)

Comparisons with required sections:

Req'd

Provided

Moment of Inertia (deflection): 180.41 in⁴ 285 in⁴

Moment: 75072 ft-lb 99590 ft-lb

Shear: 6466 lb 75000 lb



Project: 19-003-15

Location: ALT SUPPORT BEAM COL

Column

[2015 International Building Code(AISC 14th Ed ASD)]

HSS 3 x 3 x 1/8 x 8.0 FT /ASTM A500-GR.B-46

Section Adequate By: 90.9%



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New col.

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VERTICAL REACTIONS

Live Load: Vert-LL-Rxn = 3428 lb
Dead Load: Vert-DL-Rxn = 3077 lb
Total Load: Vert-TL-Rxn = 6505 lb

COLUMN DATA

Total Column Length: 8 ft
Unbraced Length (X-Axis) Lx: 0 ft
Unbraced Length (Y-Axis) Ly: 0 ft
Column End Condition-K (e): 1

COLUMN PROPERTIES

HSS 3 x 3 x 1/8 - Square

Steel Yield Strength: $F_y = 46$ ksi
Modulus of Elasticity: $E = 29000$ ksi
Column Section: $d_x = 3$ in $d_y = 3$ in
Column Wall Thickness: $t = 0.116$ in
Area: $A = 1.3$ in²
Moment of Inertia (deflection): $I_x = 1.78$ in⁴ $I_y = 1.78$ in⁴
Section Modulus: $S_x = 1.19$ in³ $S_y = 1.19$ in³
Plastic Section Modulus: $Z_x = 1.4$ in³ $Z_y = 1.4$ in³
Rad. of Gyration: $r_x = 1.17$ in $r_y = 1.17$ in

Column Compression Calculations:

KL/r Ratio: $KL_x/r_x = 0$ $KL_y/r_y = 0$

Controlling Direction for Compr. Calcs: (Y-Y Axis)

Flexural Buckling Stress: $F_{cr} = 46$ ksi

Controlling Equation F7-1

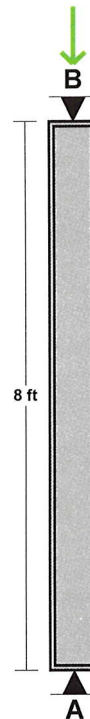
Nominal Compressive Strength: $P_c = 36$ kip

Combined Stress Calculations:

H1-1b Controls : 0.09

Controlling Combined Stress Factor: 0.09

LOADING DIAGRAM



AXIAL LOADING

Live Load: $PL = 3428$ lb *
Dead Load: $PD = 3039$ lb *
Column Self Weight: $CSW = 38$ lb
Total Axial Load: $PT = 6505$ lb

* Load obtained from Load Tracker. See Summary Report for details.



Project: 19-003-15

Location: MAIN A1

Multi-Loaded Multi-Span Beam

[2015 International Building Code(AISC 14th Ed ASD)]

A992-50 W12x35 x 19.25 FT

Section Adequate By: 305.5%

Controlling Factor: Deflection



StruCalc 9.0

Exstg. Beam

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DEFLECTIONS

Center

Live Load 0.13 IN L/1717

Dead Load 0.10 in

Total Load 0.24 IN L/973

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

A

B

Live Load 3465 lb 3465 lb

Dead Load 2647 lb 2647 lb

Total Load 6112 lb 6112 lb

Bearing Length 0.82 in 0.82 in

BEAM DATA

Center

Span Length 19.25 ft

Unbraced Length-Top 0 ft

Unbraced Length-Bottom 19.25 ft

STEEL PROPERTIES

W12x35 - A992-50

Properties:

Yield Stress:	Fy =	50 ksi
Modulus of Elasticity:	E =	29000 ksi
Depth:	d =	12.5 in
Web Thickness:	tw =	0.3 in
Flange Width:	bf =	6.56 in
Flange Thickness:	tf =	0.52 in
Distance to Web Toe of Fillet:	k =	0.82 in
Moment of Inertia About X-X Axis:	Ix =	285 in ⁴
Section Modulus About X-X Axis:	Sx =	45.6 in ³
Plastic Section Modulus About X-X Axis:	Zx =	51.2 in ³

Design Properties per AISC 14th Edition Steel Manual:

Flange Buckling Ratio:	FBR =	6.31
Allowable Flange Buckling Ratio:	AFBR =	9.15
Web Buckling Ratio:	WBR =	36.2
Allowable Web Buckling Ratio:	AWBR =	90.55
Controlling Unbraced Length:	Lb =	0 ft
Limiting Unbraced Length - for lateral-torsional buckling:	Lp =	5.44 ft
Nominal Flexural Strength w/ safety factor:	Mn =	127745 ft-lb
Controlling Equation:	F2-1	
Web height to thickness ratio:	h/tw =	36.2
Limiting height to thickness ratio for eqn. G2-2:	h/tw-limit =	53.95
Cv Factor:	Cv =	1
Controlling Equation:	G2-2	
Nominal Shear Strength w/ safety factor:	Vn =	75000 lb

Controlling Moment:

29413 ft-lb

9.62 Ft from left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s) 2

Controlling Shear:

6112 lb

At left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s)

Comparisons with required sections:

Req'd

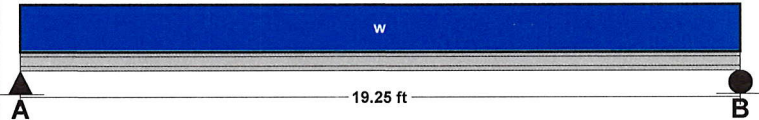
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Moment of Inertia (deflection): 70.28 in⁴ 285 in⁴

Moment: 29413 ft-lb 127745 ft-lb

Shear: 6112 lb 75000 lb

LOADING DIAGRAM



UNIFORM LOADS

Center

Uniform Live Load 360 plf

Uniform Dead Load 240 plf

Beam Self Weight 35 plf

Total Uniform Load 635 plf



Project: 19-003-15

Location: MAIN A2

Multi-Loaded Multi-Span Beam

[2015 International Building Code(AISC 14th Ed ASD)]

A992-50 W12x35 x 18.833 FT

Section Adequate By: 333.1%

Controlling Factor: Deflection



StruCalc 9.0

Exstg. Beam

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DEFLECTIONS

Center

Live Load 0.12 IN L/1833

Dead Load 0.09 in

Total Load 0.22 IN L/1039

Live Load Deflection Criteria: L/360 Total Load Deflection Criteria: L/240

REACTIONS

A

B

Live Load 3390 lb 3390 lb

Dead Load 2590 lb 2590 lb

Total Load 5980 lb 5980 lb

Bearing Length 0.82 in 0.82 in

BEAM DATA

Center

Span Length 18.83 ft

Unbraced Length-Top 0 ft

Unbraced Length-Bottom 18.83 ft

STEEL PROPERTIES

W12x35 - A992-50

Properties:

Yield Stress:	Fy =	50 ksi
Modulus of Elasticity:	E =	29000 ksi
Depth:	d =	12.5 in
Web Thickness:	tw =	0.3 in
Flange Width:	bf =	6.56 in
Flange Thickness:	tf =	0.52 in
Distance to Web Toe of Fillet:	k =	0.82 in
Moment of Inertia About X-X Axis:	Ix =	285 in ⁴
Section Modulus About X-X Axis:	Sx =	45.6 in ³
Plastic Section Modulus About X-X Axis:	Zx =	51.2 in ³

Design Properties per AISC 14th Edition Steel Manual:

Flange Buckling Ratio:	FBR =	6.31
Allowable Flange Buckling Ratio:	AFBR =	9.15
Web Buckling Ratio:	WBR =	36.2
Allowable Web Buckling Ratio:	AWBR =	90.55
Controlling Unbraced Length:	Lb =	0 ft
Limiting Unbraced Length - for lateral-torsional buckling:	Lp =	5.44 ft
Nominal Flexural Strength w/ safety factor:	Mn =	127745 ft-lb
Controlling Equation:	F2-1	
Web height to thickness ratio:	h/tw =	36.2
Limiting height to thickness ratio for eqn. G2-2:	h/tw-limit =	53.95
Cv Factor:	Cv =	1
Controlling Equation:	G2-2	
Nominal Shear Strength w/ safety factor:	Vn =	75000 lb

Controlling Moment:

28154 ft-lb

9.42 Ft from left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s) 2

Controlling Shear:

5980 lb

At left support of span 2 (Center Span)

Created by combining all dead loads and live loads on span(s)

Comparisons with required sections:

Req'd

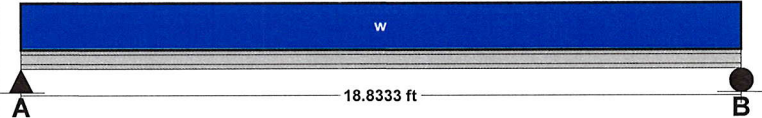
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Moment of Inertia (deflection): 65.81 in⁴ 285 in⁴

Moment: 28154 ft-lb 127745 ft-lb

Shear: 5980 lb 75000 lb

LOADING DIAGRAM



UNIFORM LOADS

Center

Uniform Live Load 360 plf

Uniform Dead Load 240 plf

Beam Self Weight 35 plf

Total Uniform Load 635 plf



