Daniel Tjondro
CEE 467 Final Project

Code to Hand Calculation Comparisons

I compared my hand calculations to my app’s calculations and all the numbers and member selections matched up. I have examples from each of the four member types: compression members, tension members, bending members and connections, each using both LRFD and ASD. The hand calculation scans come first, followed up by the corresponding results of the app.

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Hand Calc Comparisons

1. Tension Members

A. Select a double-angle tension member for use as a web member in a truss using LRFD and determine the maximum area reduction that would be permitted for holes and shear lag

Given: $P_D = 67.5$ kips, $P_L = 202.5$ kips, use equal leg angles of A36 steel.

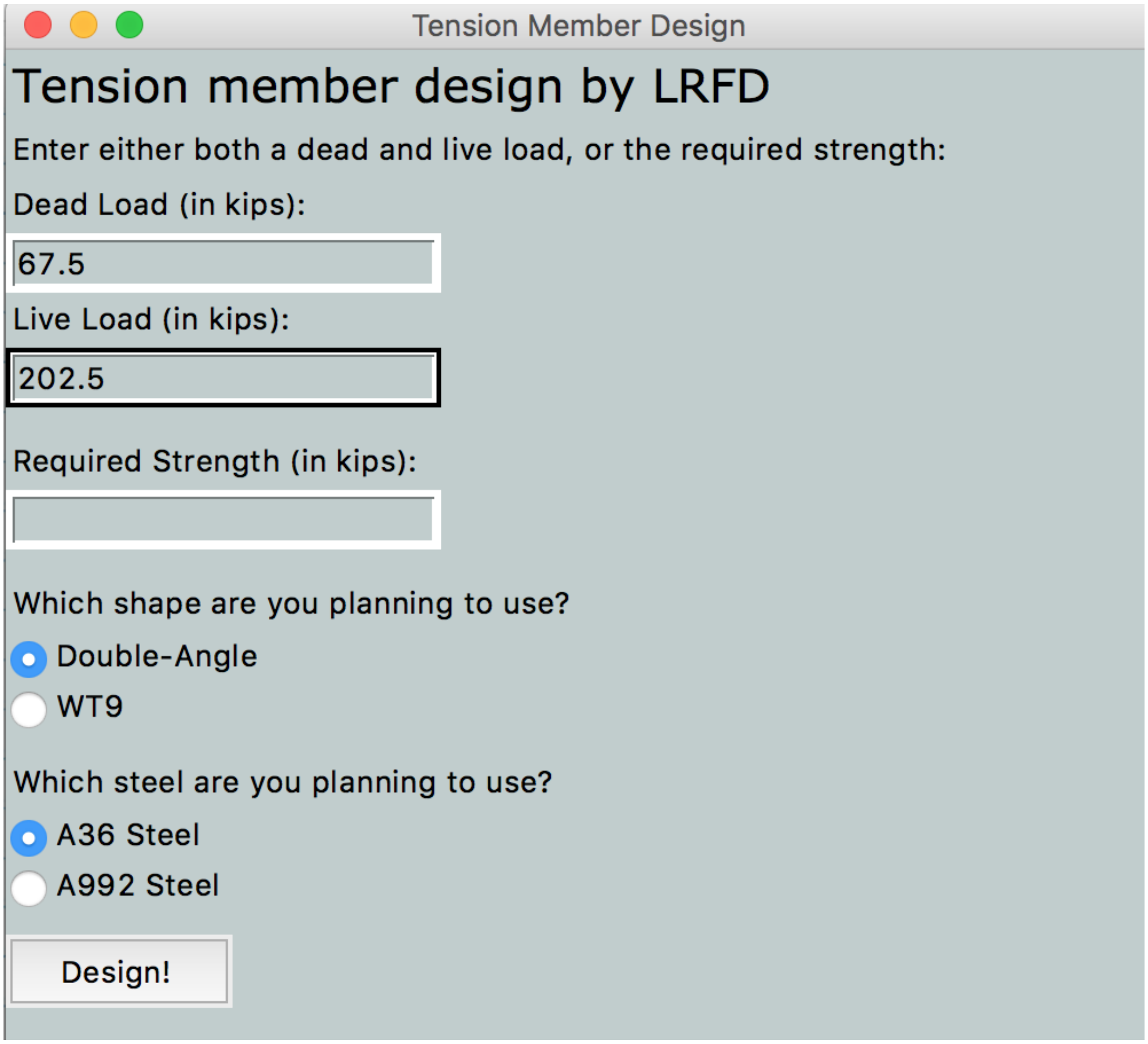
$$P_u = 1.2P_D + 1.6P_L$$
$$= 1.2(67.5\text{kips}) + 1.6(202.5\text{kips})$$
$$= 405\text{kips}$$

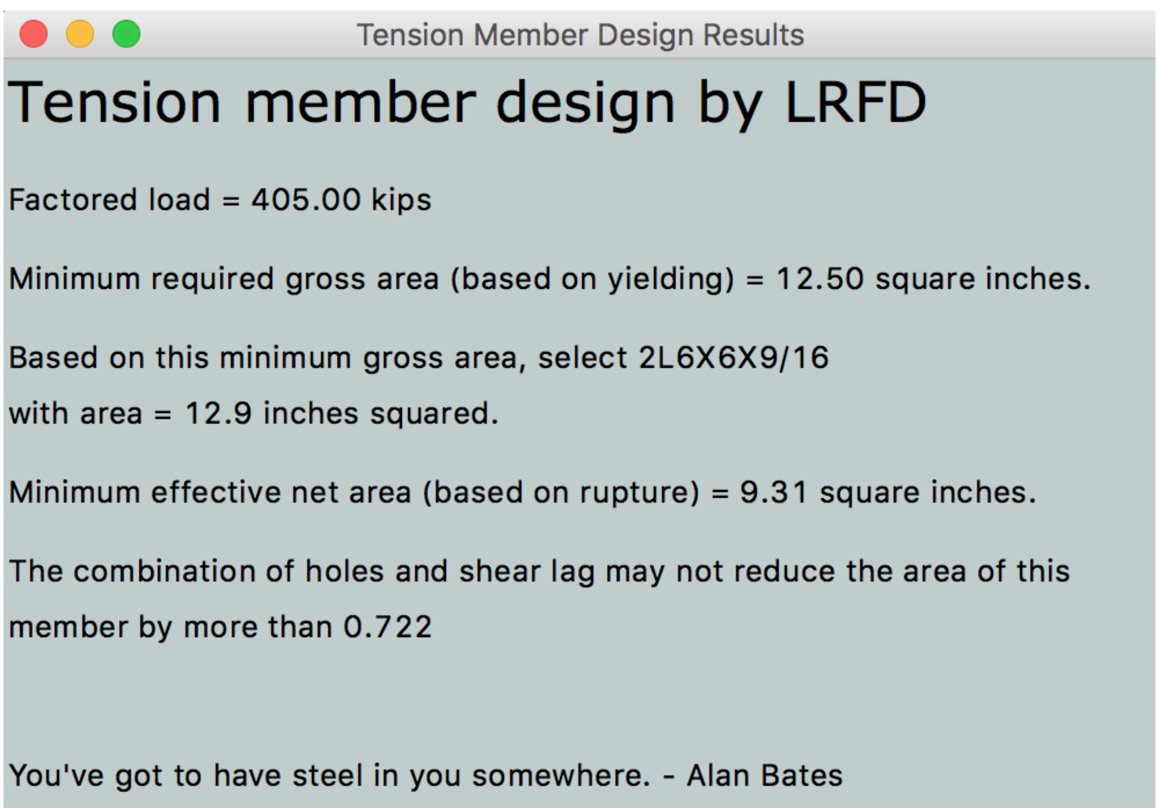
$$A_{g,min} = P_u / \phi F_y$$
$$= 405\text{kips} / (.90)(36\text{ksi})$$
$$= 12.5\text{in}^2$$

Based on that, from the manual, choose $2L6\times6\times9/16$ with $A_g = 12.9\text{in}^2$

$$A_{e,min} = P_u / \phi F_u$$
$$= 405\text{kips} / (.75)(58\text{ksi})$$
$$= 9.31\text{in}^2$$

$$A_e / A_g = 9.31\text{in}^2 / 12.9\text{in}^2$$
$$= 0.722$$


Tension Member Design
Tension member design by LRFD
Enter either both a dead and live load, or the required strength:
Dead Load (in kips):
67.5
Live Load (in kips):
202.5
Required Strength (in kips):
Which shape are you planning to use?
Double-Angle
WT9
Which steel are you planning to use?
A36 Steel
A992 Steel
Design!


Tension Member Design Results
Tension member design by LRFD
Factored load = 405.00 kips
Minimum required gross area (based on yielding) = 12.50 square inches.
Based on this minimum gross area, select 2L6X6X9/16
with area = 12.9 inches squared.
Minimum effective net area (based on rupture) = 9.31 square inches.
The combination of holes and shear lag may not reduce the area of this
member by more than 0.722
You've got to have steel in you somewhere. - Alan Bates

B. Using the same givens, design using ASD

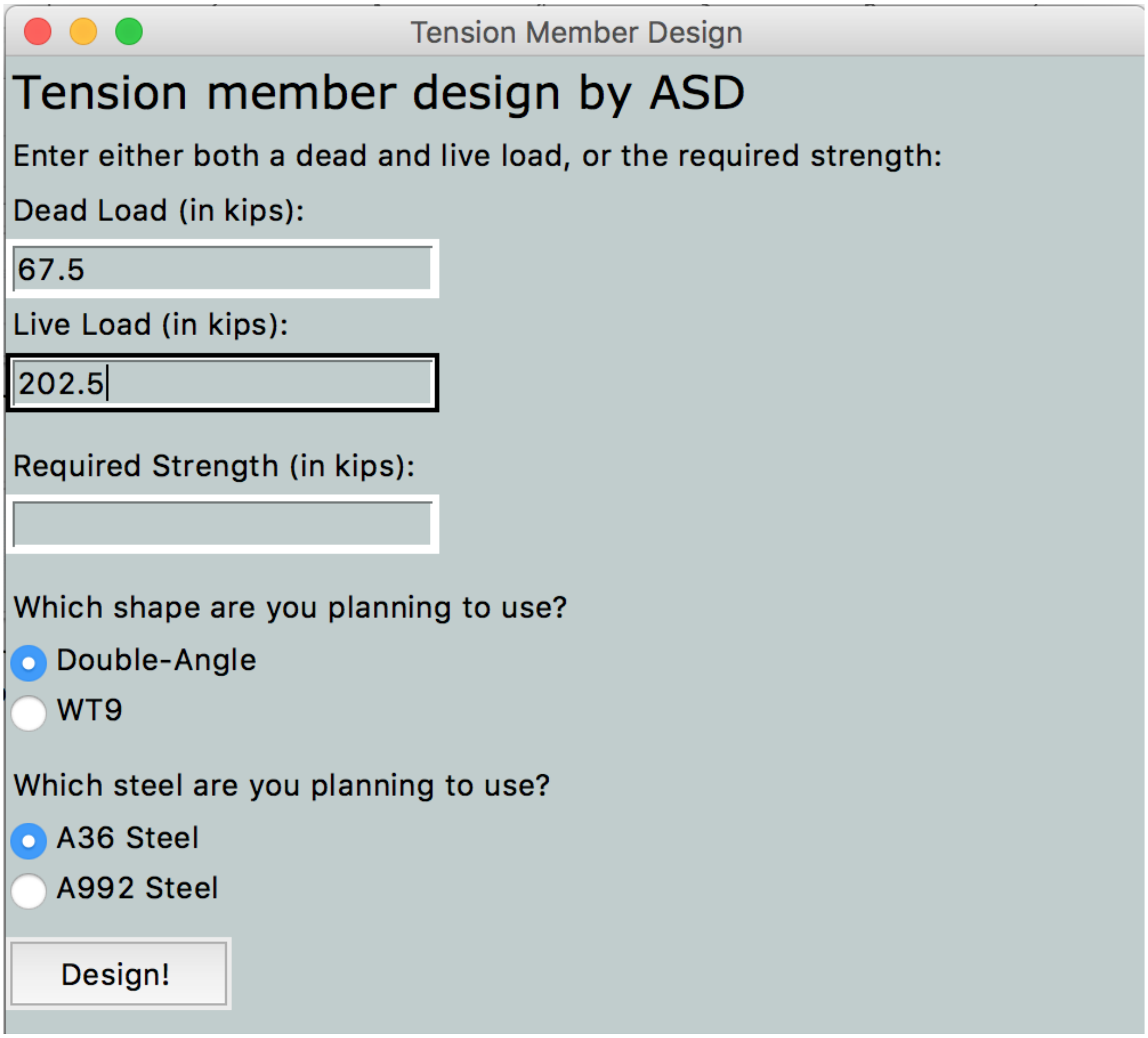
$P_a = P_D + P_L$
$= 67.5 \text{ kips} + 202.5 \text{ kips}$
$= 270 \text{ kips}$

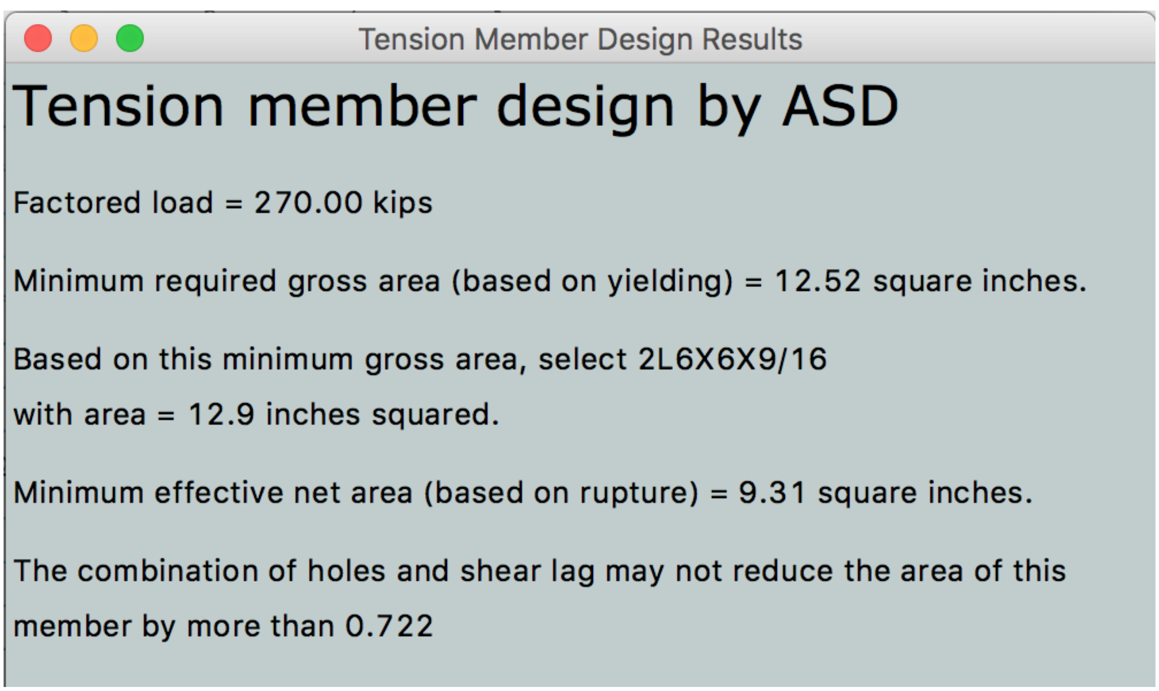
$A_{g,min} = P_a / (F_y / \Omega)$
$= 270 \text{ kips} / (36 \text{ ksi} / 1.67)$
$= 12.5 \text{ in}^2$

Based on this, from the manual, choose 2L6×6×9/16 with $A_g = 12.9 \text{ in}^2$

$A_{e,min} = P_a / (F_u / \Omega)$
$= 270 \text{ kips} / (58 \text{ ksi} / 2)$
$= 9.31 \text{ in}^2$

$A_e / A_g = 9.31 \text{ in}^2 / 12.9 \text{ in}^2$
$= .722$


Tension Member Design
Tension member design by ASD
Enter either both a dead and live load, or the required strength:
Dead Load (in kips):
67.5
Live Load (in kips):
202.5
Required Strength (in kips):
Which shape are you planning to use?
Double-Angle
WT9
Which steel are you planning to use?
A36 Steel
A992 Steel
Design!


Tension Member Design Results
Tension member design by ASD
Factored load = 270.00 kips
Minimum required gross area (based on yielding) = 12.52 square inches.
Based on this minimum gross area, select 2L6X6X9/16
with area = 12.9 inches squared.
Minimum effective net area (based on rupture) = 9.31 square inches.
The combination of holes and shear lag may not reduce the area of this
member by more than 0.722

C. Select a WT9 for use as a tension member by LRFD

Given : $P_u = 818$ kips, use A992 steel

$A_{g,min} = P_u / \Phi F_y$
$= 818\text{kips} / (.90)(50\text{ksi})$
$= 18.2\text{in}^2$

Based on this, from the manual, choose WT9 × 65 with $A_g = 19.2\text{in}^2$

$A_{e,min} = P_u / \Phi F_u$
$= 818\text{kips} / (.75)(65\text{ksi})$
$= 16.8\text{in}^2$

$A_e / A_g = .875$

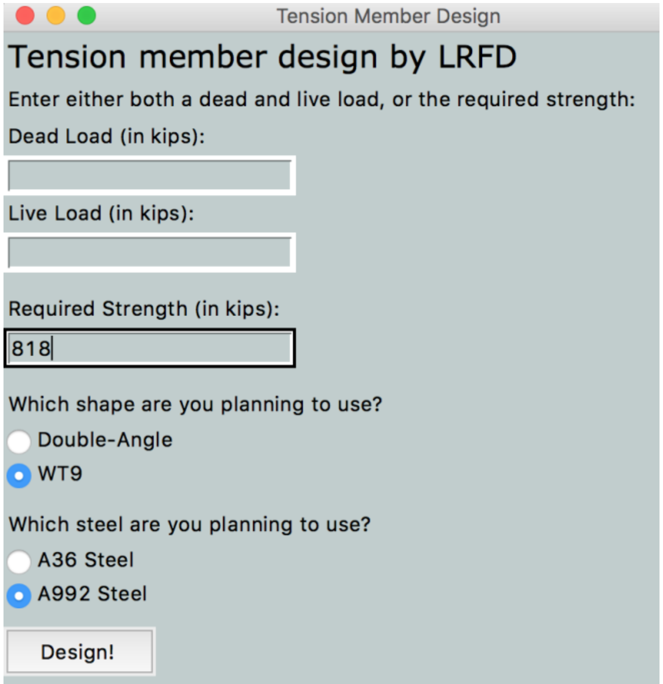
D. Use ASD with $P_a = 545$ kips

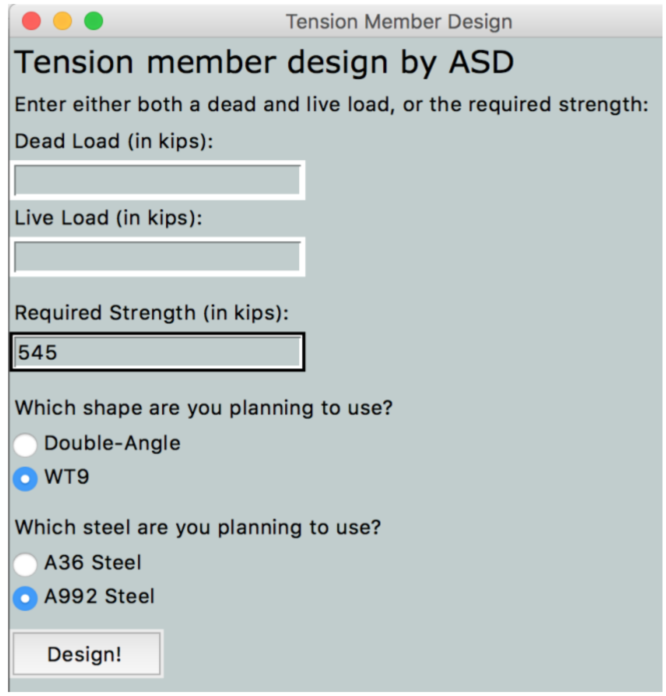
$A_{g,min} = P_a / (F_y / \Omega)$
$= 545\text{kips} / (50\text{ksi} / 1.67)$
$= 18.2\text{in}^2$

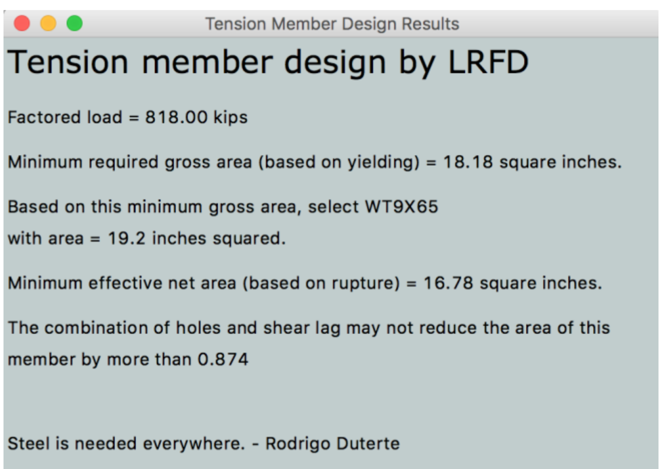
Based on this, from the manual, choose WT9 × 65 with $A_g = 19.2\text{in}^2$

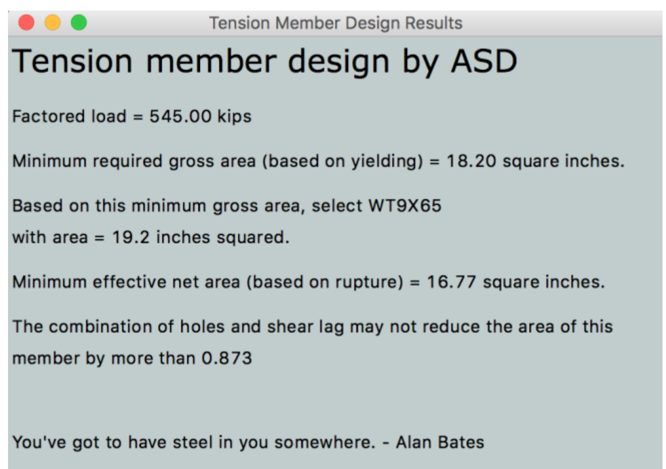
$A_{e,min} = P_a / (F_u / \Omega)$
$= 545\text{kips} / (65\text{ksi} / 2)$
$= 16.8\text{in}^2$

$A_e / A_g = 16.8\text{in}^2 / 19.2\text{in}^2 = .875$


Tension Member Design
Tension member design by LRFD
Enter either both a dead and live load, or the required strength:
Dead Load (in kips):
Live Load (in kips):
Required Strength (in kips):
818
Which shape are you planning to use?
Double-Angle
WT9
Which steel are you planning to use?
A36 Steel
A992 Steel
Design!


Tension Member Design
Tension member design by ASD
Enter either both a dead and live load, or the required strength:
Dead Load (in kips):
Live Load (in kips):
Required Strength (in kips):
545
Which shape are you planning to use?
Double-Angle
WT9
Which steel are you planning to use?
A36 Steel
A992 Steel
Design!


Tension Member Design Results
Tension member design by LRFD
Factored load = 818.00 kips
Minimum required gross area (based on yielding) = 18.18 square inches.
Based on this minimum gross area, select WT9X65
with area = 19.2 inches squared.
Minimum effective net area (based on rupture) = 16.78 square inches.
The combination of holes and shear lag may not reduce the area of this
member by more than 0.874
Steel is needed everywhere. - Rodrigo Duterte


Tension Member Design Results
Tension member design by ASD
Factored load = 545.00 kips
Minimum required gross area (based on yielding) = 18.20 square inches.
Based on this minimum gross area, select WT9X65
with area = 19.2 inches squared.
Minimum effective net area (based on rupture) = 16.77 square inches.
The combination of holes and shear lag may not reduce the area of this
member by more than 0.873
You've got to have steel in you somewhere. - Alan Bates

2. Compression Members

A. Determine the least weight section to carry $P_D = 56$ kips, $P_L = 172$ kips, $P_W = 176$ kips. Use A992 steel, LRFD

$$P_u = \max \begin{cases} 1.4P_D = 1.4(56\text{ kips}) = 78.4\text{ kips} \\ 1.2P_D + 1.6P_L = 1.2(56\text{ kips}) + 1.6(172\text{ kips}) = 342.4\text{ kips} \\ 1.2P_D + 0.5P_L + P_W = 1.2(56\text{ kips}) + 0.5(172) + 176 = 329.2 \\ 0.9P_D + P_W = 0.9(56\text{ kips}) + 176\text{ kips} = 226.4\text{ kips} \end{cases}$$

$P_u = 342.4$ kips

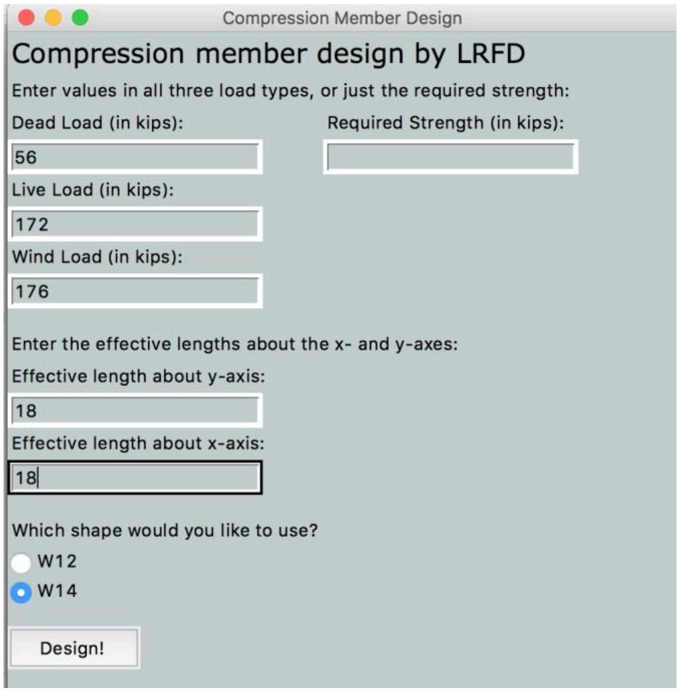
Enter manual with $L_c = 18$ft and select the least-weight shape → W14×61 with $\phi P_n = 456$ kips

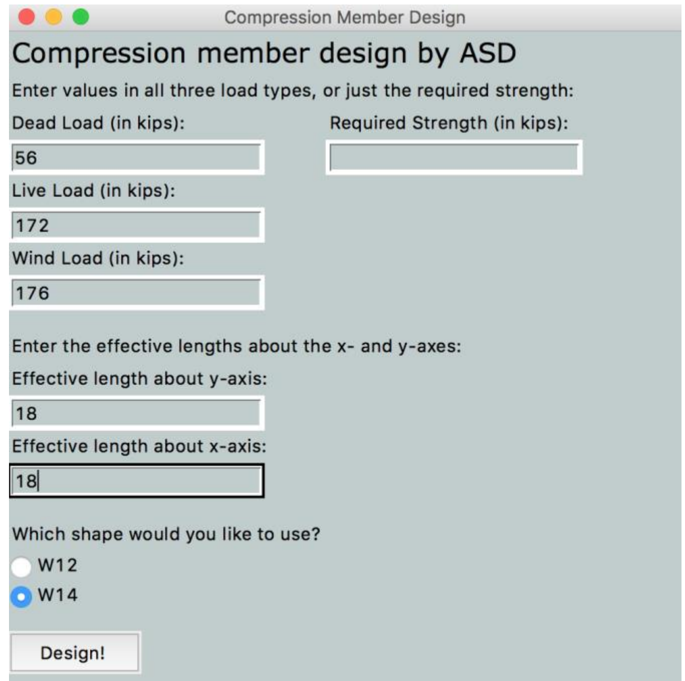
B. Use ASD

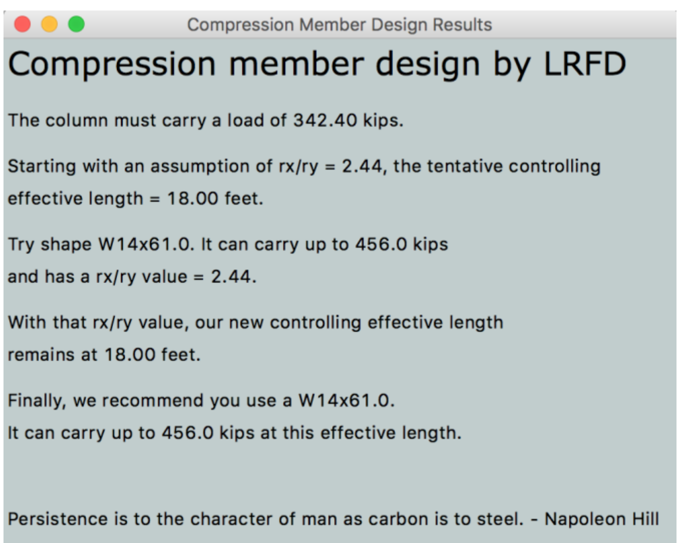
$$P_a = \max \begin{cases} P_D = 56\text{ kips} \\ P_D + P_L = 56\text{ kips} + 172\text{ kips} = 228\text{ kips} \\ P_D + 0.6P_W = 56\text{ kips} + 0.6(176\text{ kips}) = 161.6\text{ kips} \\ P_D + 0.75P_L + .75(.6)P_W = 264.2\text{ kips} \end{cases}$$

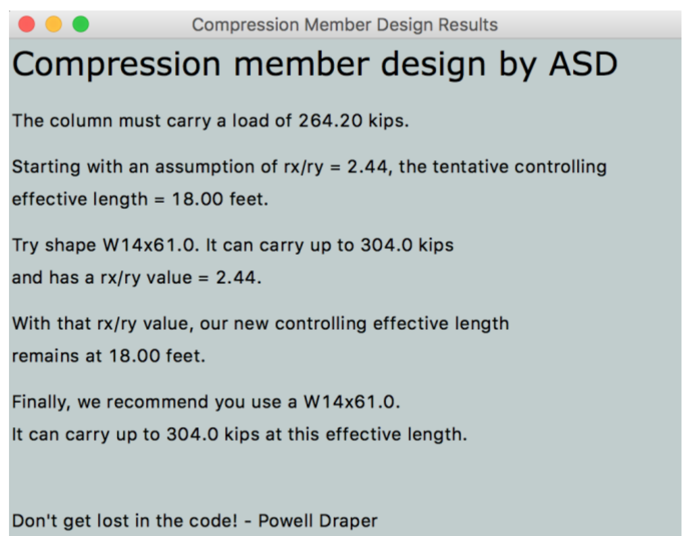
$P_a = 264.2$ kips

Enter manual and choose W14×61 with $P_n/\Omega = 304$ kips


Compression Member Design
Compression member design by LRFD
Enter values in all three load types, or just the required strength:
Dead Load (in kips):
56
Required Strength (in kips):
Live Load (in kips):
172
Wind Load (in kips):
176
Enter the effective lengths about the x- and y-axes:
Effective length about y-axis:
18
Effective length about x-axis:
18
Which shape would you like to use?
W12
W14
Design!


Compression Member Design
Compression member design by ASD
Enter values in all three load types, or just the required strength:
Dead Load (in kips):
56
Required Strength (in kips):
Live Load (in kips):
172
Wind Load (in kips):
176
Enter the effective lengths about the x- and y-axes:
Effective length about y-axis:
18
Effective length about x-axis:
18
Which shape would you like to use?
W12
W14
Design!


Compression Member Design Results
Compression member design by LRFD
The column must carry a load of 342.40 kips.
Starting with an assumption of rx/ry = 2.44, the tentative controlling
effective length = 18.00 feet.
Try shape W14x61.0. It can carry up to 456.0 kips
and has a rx/ry value = 2.44.
With that rx/ry value, our new controlling effective length
remains at 18.00 feet.
Finally, we recommend you use a W14x61.0.
It can carry up to 456.0 kips at this effective length.
Persistence is to the character of man as carbon is to steel. - Napoleon Hill


Compression Member Design Results
Compression member design by ASD
The column must carry a load of 264.20 kips.
Starting with an assumption of rx/ry = 2.44, the tentative controlling
effective length = 18.00 feet.
Try shape W14x61.0. It can carry up to 304.0 kips
and has a rx/ry value = 2.44.
With that rx/ry value, our new controlling effective length
remains at 18.00 feet.
Finally, we recommend you use a W14x61.0.
It can carry up to 304.0 kips at this effective length.
Don't get lost in the code! - Powell Draper

C. Determine the least-weight section to carry 342 kips with $L_{cy} = 10$ ft and $L_{cx} = 30$ft (LRFD)

$$(L_c)_{eff} = \frac{L_{cx}}{(r_x/r_y)} = \frac{30\text{ft}}{2.44} = 12.3\text{ft}$$ using a guess for r_x/r_y

Since 12.3 ft > 10 ft, enter table with $L_c = 12.3$ft

Try W14×43 which has $r_x/r_y = 3.08$

$$(L_c)_{eff} = \frac{30\text{ft}}{3.08} = 9.74\text{ ft}$$

Since 10 ft > 9.74 ft, enter table with $L_c = 9.74$ft

choose W14×43 with $\Phi P_n = 422$ kips

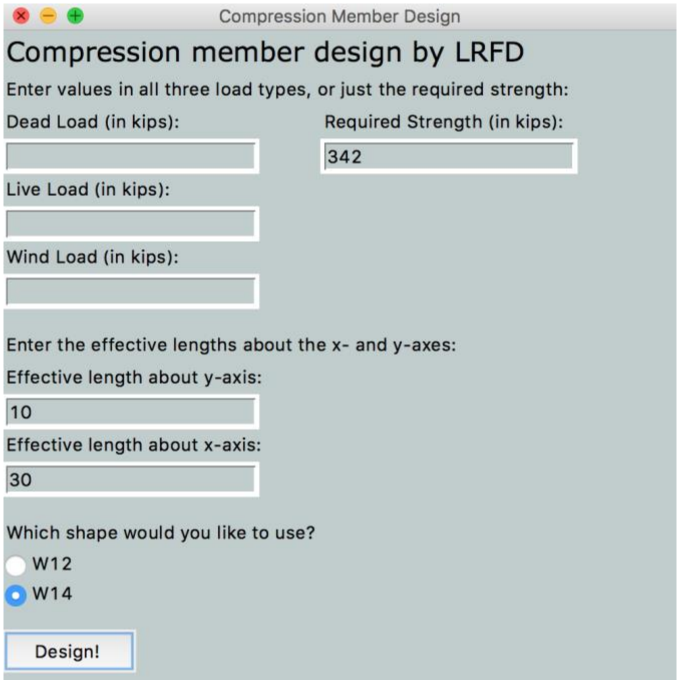
D. Use ASD, $P_a = 264$ kips

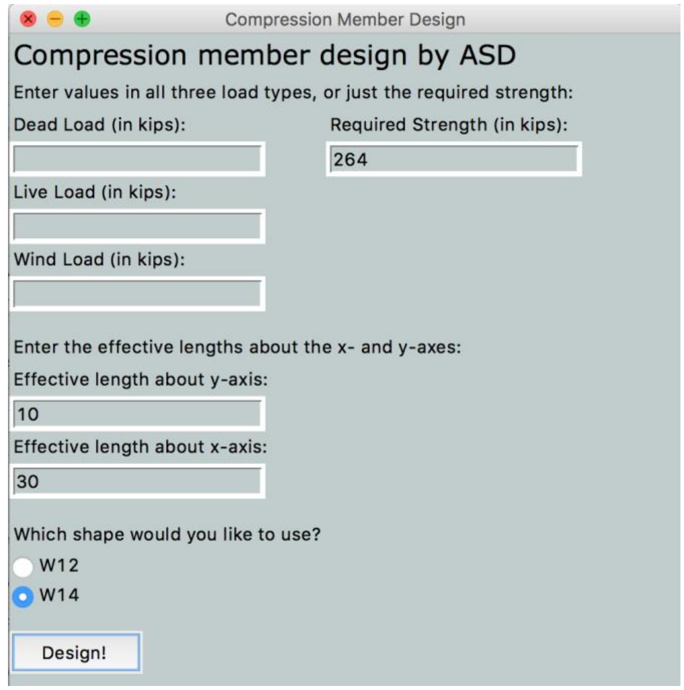
$$(L_c)_{eff} = \frac{30\text{ft}}{3.06} = 9.80\text{ ft}$$ using a guess for r_x/r_y

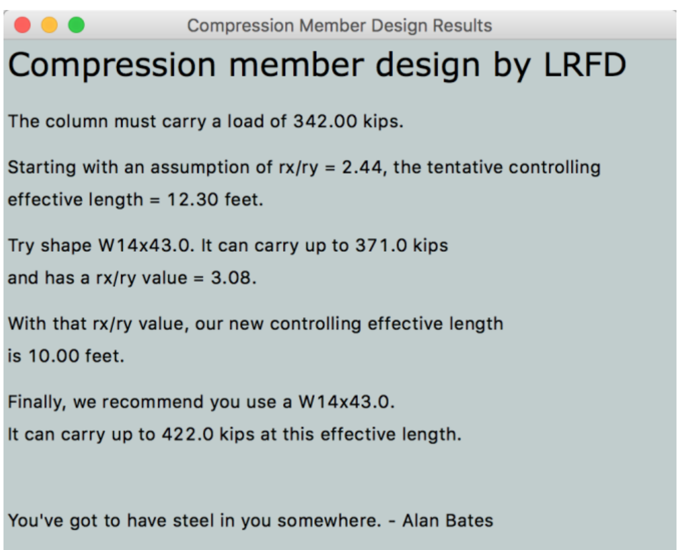
Since 9.8 ft < 10ft, enter table with $L_c = 10$ft

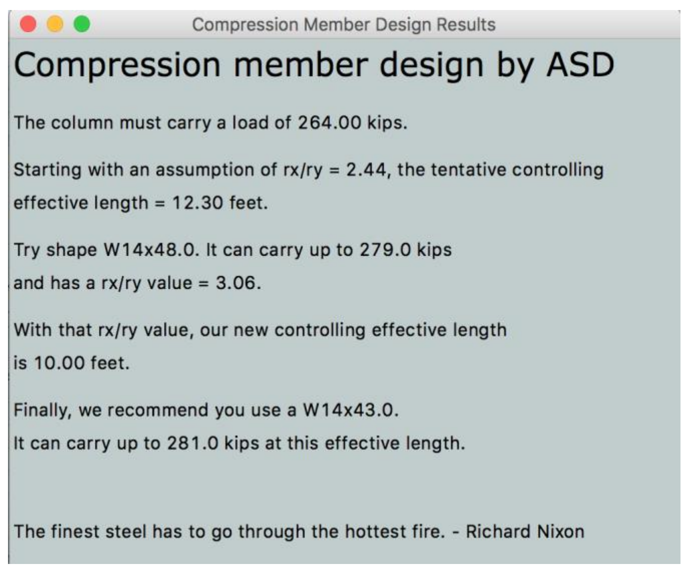
Try W14×43 with $P_n/\Omega = 281$ kips and $r_x/r_y = 3.08$

10ft is still controlling length → W14×43


Compression Member Design
Compression member design by LRFD
Enter values in all three load types, or just the required strength:
Dead Load (in kips):
Required Strength (in kips):
342
Live Load (in kips):
Wind Load (in kips):
Enter the effective lengths about the x- and y-axes:
Effective length about y-axis:
10
Effective length about x-axis:
30
Which shape would you like to use?
W12
W14
Design!


Compression Member Design
Compression member design by ASD
Enter values in all three load types, or just the required strength:
Dead Load (in kips):
Required Strength (in kips):
264
Live Load (in kips):
Wind Load (in kips):
Enter the effective lengths about the x- and y-axes:
Effective length about y-axis:
10
Effective length about x-axis:
30
Which shape would you like to use?
W12
W14
Design!


Compression Member Design Results
Compression member design by LRFD
The column must carry a load of 342.00 kips.
Starting with an assumption of rx/ry = 2.44, the tentative controlling
effective length = 12.30 feet.
Try shape W14x43.0. It can carry up to 371.0 kips
and has a rx/ry value = 3.08.
With that rx/ry value, our new controlling effective length
is 10.00 feet.
Finally, we recommend you use a W14x43.0.
It can carry up to 422.0 kips at this effective length.
You've got to have steel in you somewhere. - Alan Bates


Compression Member Design Results
Compression member design by ASD
The column must carry a load of 264.00 kips.
Starting with an assumption of rx/ry = 2.44, the tentative controlling
effective length = 12.30 feet.
Try shape W14x48.0. It can carry up to 279.0 kips
and has a rx/ry value = 3.06.
With that rx/ry value, our new controlling effective length
is 10.00 feet.
Finally, we recommend you use a W14x43.0.
It can carry up to 281.0 kips at this effective length.
The finest steel has to go through the hottest fire. - Richard Nixon

3. Bending Members

A. Select the least-weight wide flange member by LRFD with span = 20ft, loading = P_D = 8.0kips @ midspan and P_L = 24.0kips @ midspan. Use A992 steel and assume full lateral support and a compact section.

$$P_U = 1.2P_D + 1.6P_L$$
$$= 1.2(8\text{kips}) + 1.6(24\text{kips})$$
$$= 48\text{ kips}$$

$$M_U = \tfrac{1}{4}P_U L$$
$$= .25(48\text{kips})(20\text{ft})$$
$$= 240\text{kip}\cdot\text{ft}$$

$$Z_{req} = M_U / \Phi F_y$$
$$= (240\text{kip}\cdot\text{ft}) / (.90 \times 50\text{ksi})$$
$$= 64\text{in}^3$$

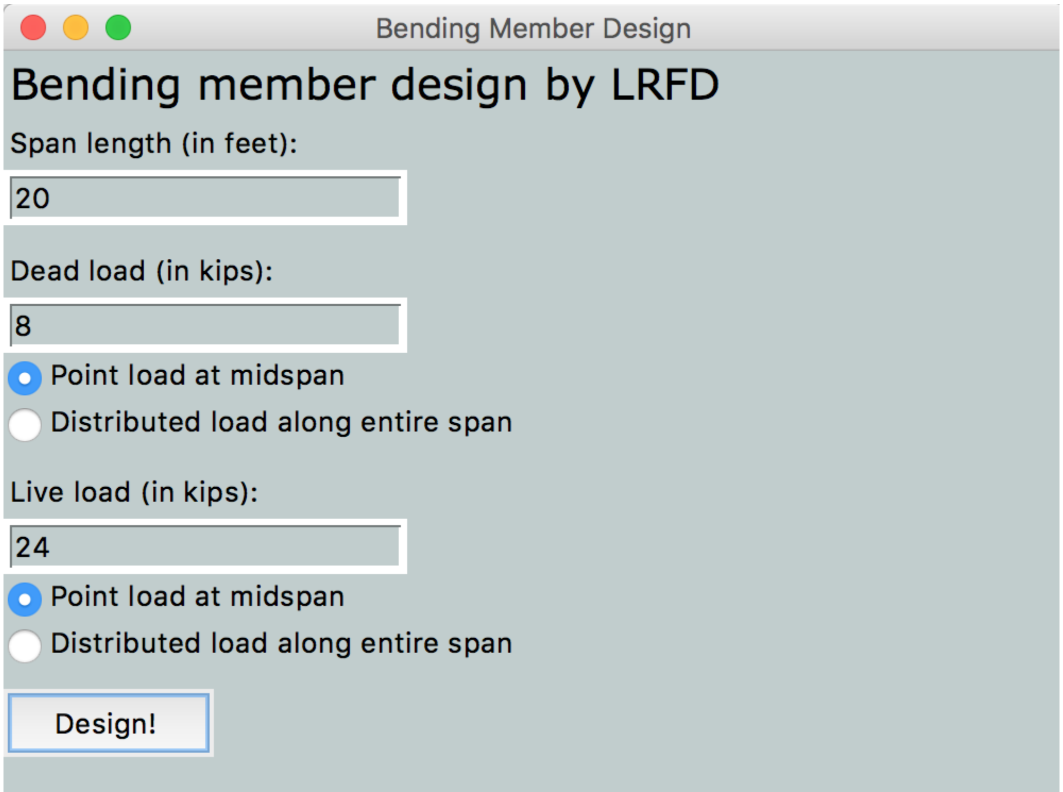
Select W18 × 35 with $Z = 66.5\text{in}^3$

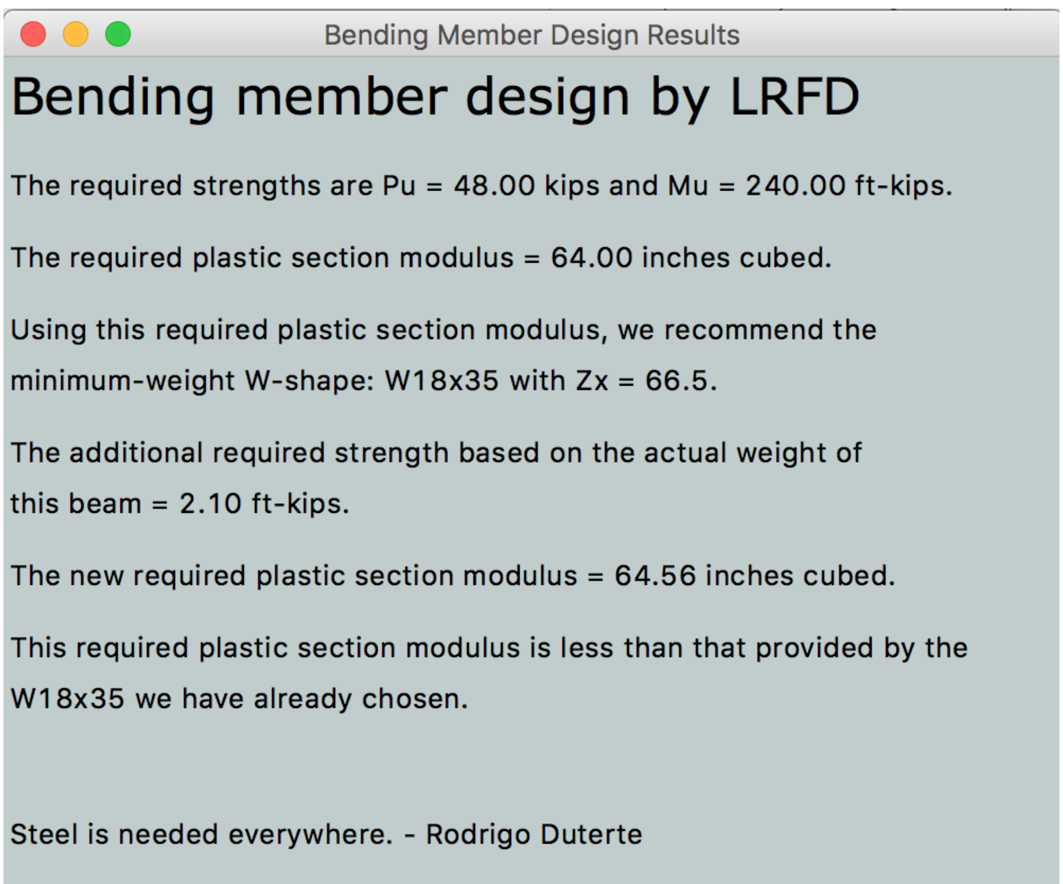
$$M_{u,self} = 1.2\left(\frac{.035(20)^2}{8}\right) = 2.10\text{ ft}\cdot\text{kips}$$

$$M_U = 240 + 2.10 = 242.10\text{kip}\cdot\text{ft}$$

$$\text{New } Z_{req} = M_U / \Phi F_y$$
$$= (242.10) / (.90 \times 50)$$
$$= 64.5\text{in}^3$$

W18 × 35 ✓ since $66.5\text{in}^3 > 64.5\text{in}^3$


Bending Member Design
Bending member design by LRFD
Span length (in feet):
20
Dead load (in kips):
8
Point load at midspan
Distributed load along entire span
Live load (in kips):
24
Point load at midspan
Distributed load along entire span
Design!


Bending Member Design Results
Bending member design by LRFD
The required strengths are Pu = 48.00 kips and Mu = 240.00 ft-kips.
The required plastic section modulus = 64.00 inches cubed.
Using this required plastic section modulus, we recommend the minimum-weight W-shape: W18x35 with Zx = 66.5.
The additional required strength based on the actual weight of this beam = 2.10 ft-kips.
The new required plastic section modulus = 64.56 inches cubed.
This required plastic section modulus is less than that provided by the W18x35 we have already chosen.
Steel is needed everywhere. - Rodrigo Duterte

B. Use ASD

$P_a = P_D + P_L$
$= 8\text{ kips} + 24\text{ kips}$
$= 32\text{ kips}$

$M_a = .25 P_a L$
$= .25(32\text{ kips})(20\text{ ft})$
$= 160\text{ ft}\cdot\text{kips}$

$Z_{req} = M_a / (F_y/\Omega)$
$= (160\text{ ft}\cdot\text{kips}) / (50\text{ ksi}/1.67)$
$= 64.0\text{ in}^3$

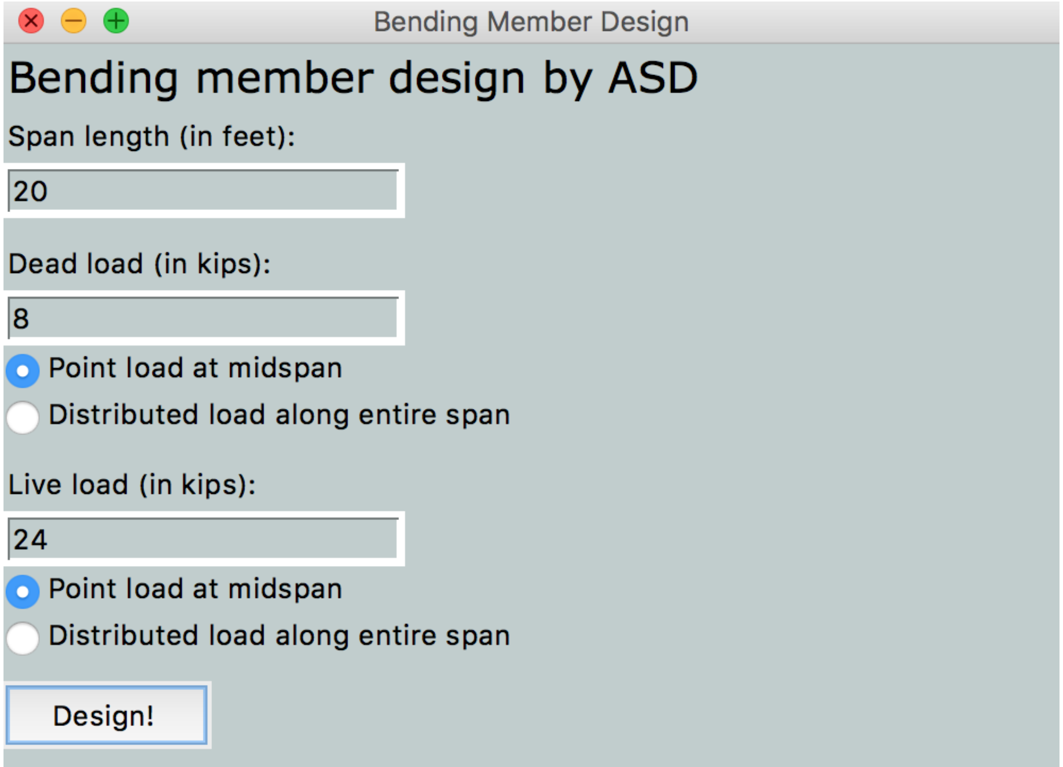
Select W18×35 with $Z = 66.5\text{ in}^3$

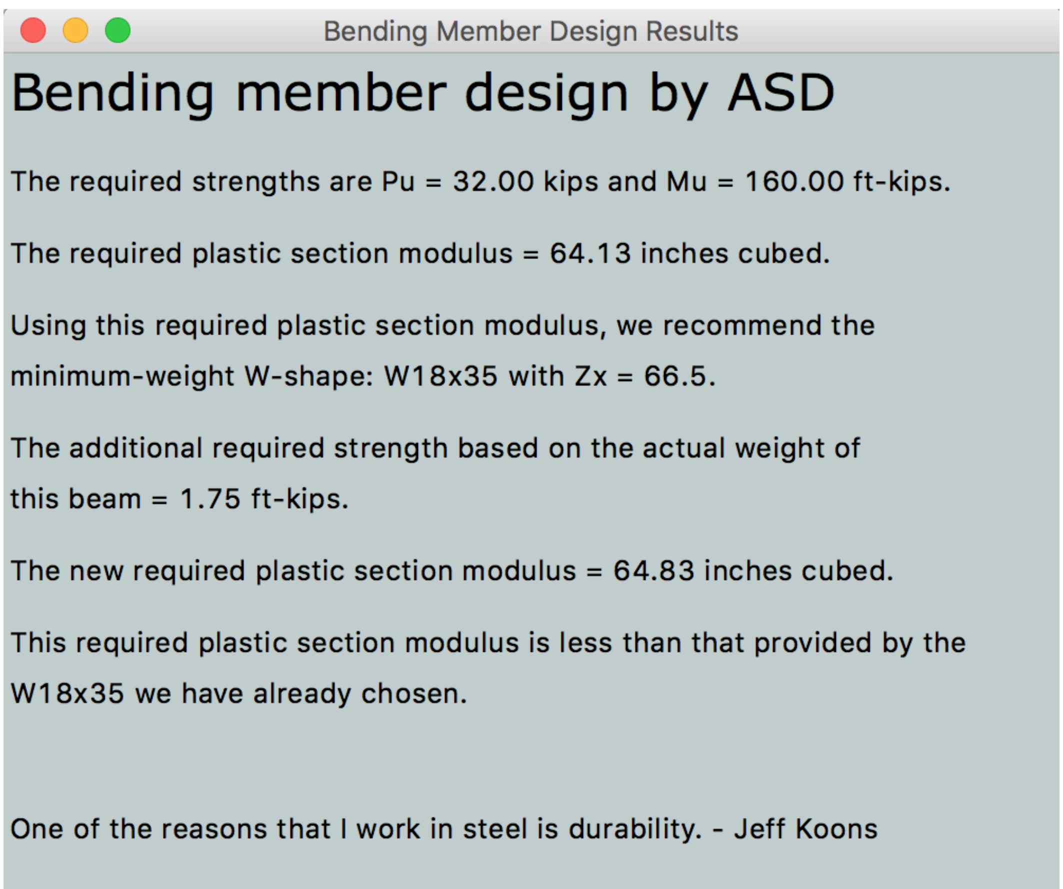
$M_{a,self} = \dfrac{.035(20)^2}{8} = 1.75\text{ kip}\cdot\text{ft}$

$M_a = 160 + 1.75$
$= 161.75\text{ kip}\cdot\text{ft}$

New $Z_{req} = M_a / (F_y/\Omega)$
$= 161.75\text{ kip}\cdot\text{ft} / (50\text{ ksi}/1.67)$
$= 64.8\text{ in}^3$

W18×35 ✓ since $66.5\text{ in}^3 > 64.8\text{ in}^3$


Bending Member Design
Bending member design by ASD
Span length (in feet):
20
Dead load (in kips):
8
Point load at midspan
Distributed load along entire span
Live load (in kips):
24
Point load at midspan
Distributed load along entire span
Design!


Bending Member Design Results
Bending member design by ASD
The required strengths are Pu = 32.00 kips and Mu = 160.00 ft-kips.
The required plastic section modulus = 64.13 inches cubed.
Using this required plastic section modulus, we recommend the minimum-weight W-shape: W18x35 with Zx = 66.5.
The additional required strength based on the actual weight of this beam = 1.75 ft-kips.
The new required plastic section modulus = 64.83 inches cubed.
This required plastic section modulus is less than that provided by the W18x35 we have already chosen.
One of the reasons that I work in steel is durability. - Jeff Koons

4. Connections

A. Determine the available bolt shear strength for a single 3/4 in. A325-N bolt

Bolt shank area = $A_b = .25\pi d^2$

$= .25\pi(0.75 in)^2$

$= .442 in^2$

For A325 bolt, $F_u = 120 ksi$

A325-N bolt, $F_{nv} = .45F_u$

$= .45(120 ksi)$

$= 54 ksi$

For shear, design strength $= \phi r_n$

$= 0.75(54 ksi)(.442 in^2)$

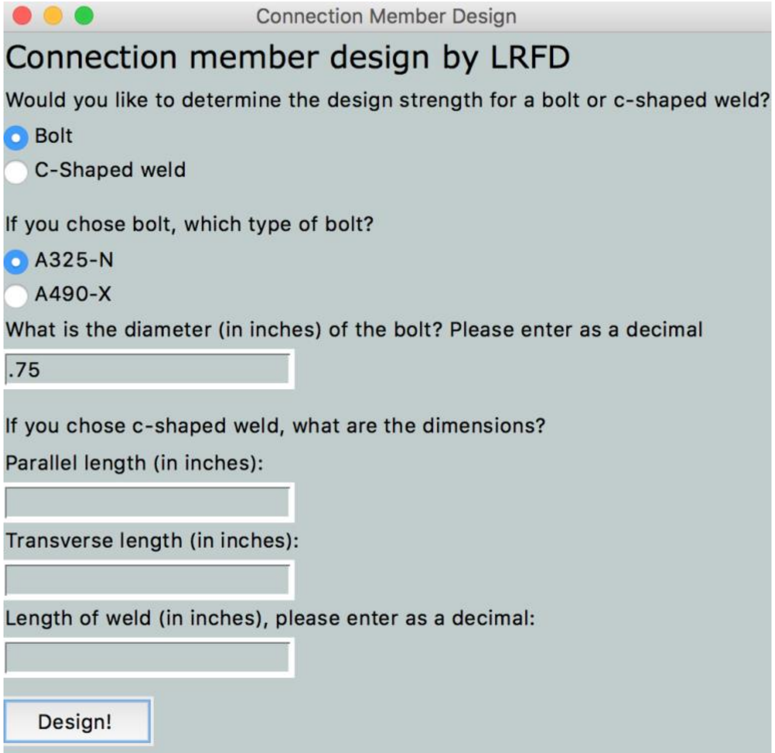
$= 17.9 kips$

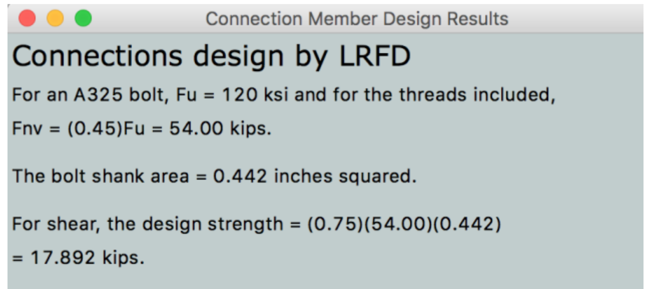
B. Use ASD

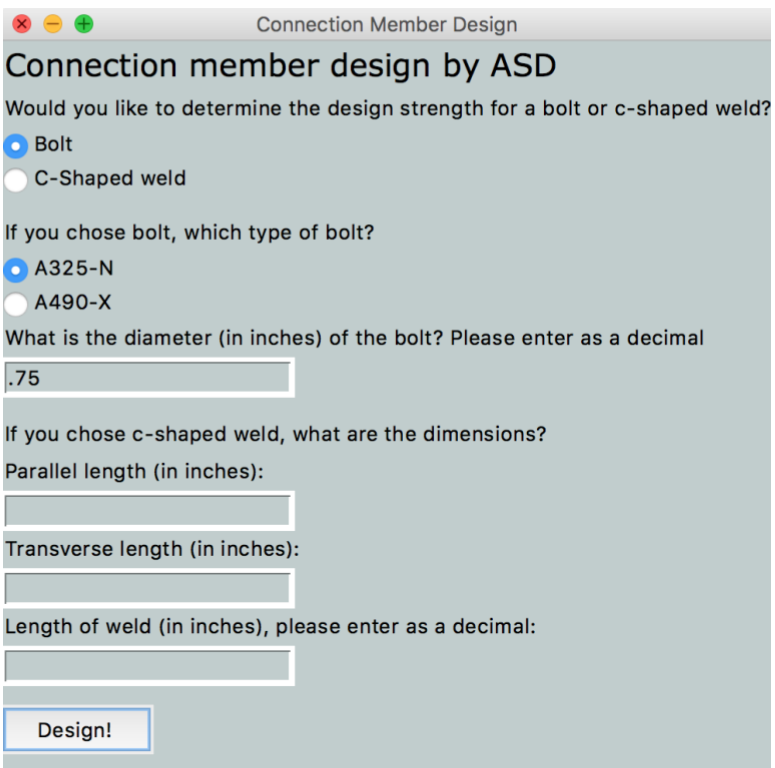
For shear, design strength $= r_n / \Omega$

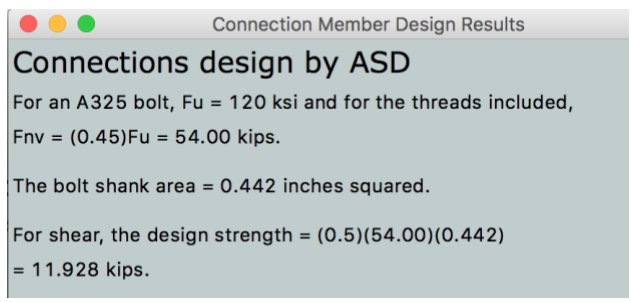
$= 54 kips (.442 in^2)/2$

$= 11.9 kips$


Connection Member Design
Connection member design by LRFD
Would you like to determine the design strength for a bolt or c-shaped weld?
Bolt
C-Shaped weld
If you chose bolt, which type of bolt?
A325-N
A490-X
What is the diameter (in inches) of the bolt? Please enter as a decimal
.75
If you chose c-shaped weld, what are the dimensions?
Parallel length (in inches):
Transverse length (in inches):
Length of weld (in inches), please enter as a decimal:
Design!


Connection Member Design Results
Connections design by LRFD
For an A325 bolt, Fu = 120 ksi and for the threads included,
Fnv = (0.45)Fu = 54.00 kips.
The bolt shank area = 0.442 inches squared.
For shear, the design strength = (0.75)(54.00)(0.442)
= 17.892 kips.


Connection Member Design
Connection member design by ASD
Would you like to determine the design strength for a bolt or c-shaped weld?
Bolt
C-Shaped weld
If you chose bolt, which type of bolt?
A325-N
A490-X
What is the diameter (in inches) of the bolt? Please enter as a decimal
.75
If you chose c-shaped weld, what are the dimensions?
Parallel length (in inches):
Transverse length (in inches):
Length of weld (in inches), please enter as a decimal:
Design!


Connection Member Design Results
Connections design by ASD
For an A325 bolt, Fu = 120 ksi and for the threads included,
Fnv = (0.45)Fu = 54.00 kips.
The bolt shank area = 0.442 inches squared.
For shear, the design strength = (0.5)(54.00)(0.442)
= 11.928 kips.

C. Determine the design strength for a C-shaped weld with $l_p = 4in$, $l_T = 6in$, using LRFD. Assume E70 electrodes and a 7/8 in weld.

$$\phi R_{nwl} = 2(4)(14)(1.392) = 156 \text{ kips}$$
$$\phi R_{nwt} = 6(14)(1.392) = 117 \text{ kips}$$

$$\phi R_n = R_{nwl} + R_{nwt}$$
$$= 156 \text{ kips} + 117 \text{ kips}$$
$$= 273 \text{ kips}$$

$$\phi R_n = .85 R_{nwl} + 1.5 R_{nwt}$$
$$= .85(156 \text{kips}) + 1.5(117 \text{kips})$$
$$= 308 \text{ kips}$$

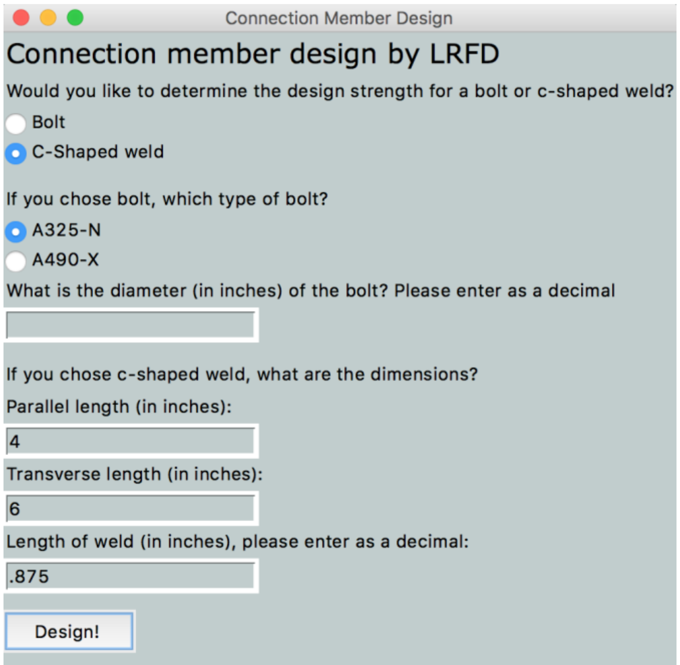
Select larger → 308 kips

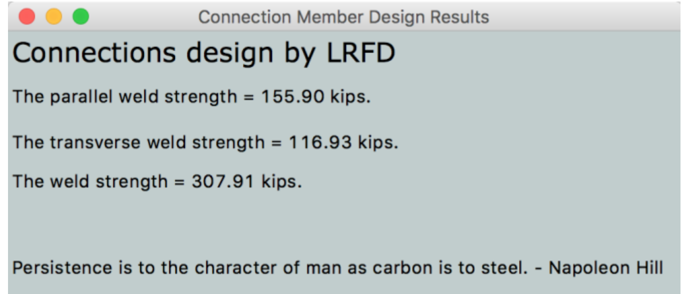
D. Use ASD

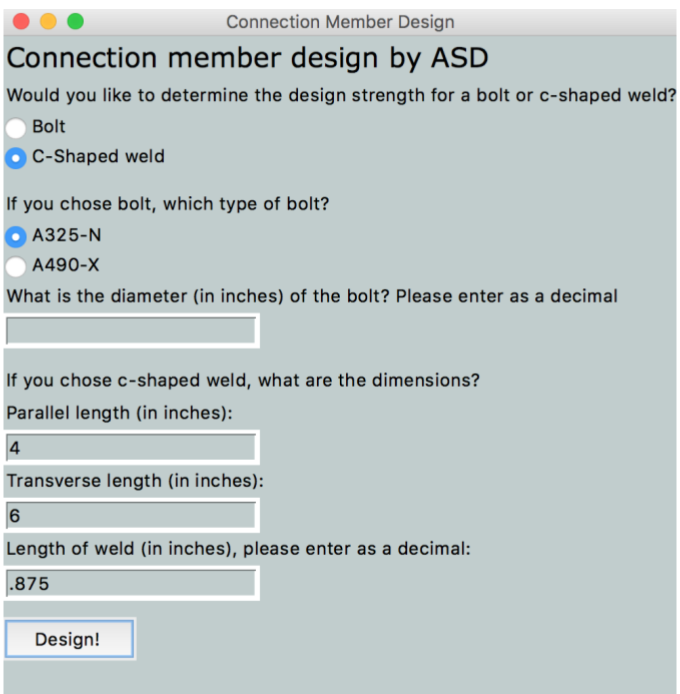
$$R_{nwl}/\Omega = 2(4)(14)(.928) = 104 \text{ kips}$$
$$R_{nwt}/\Omega = 6(14)(.928) = 78 \text{ kips}$$

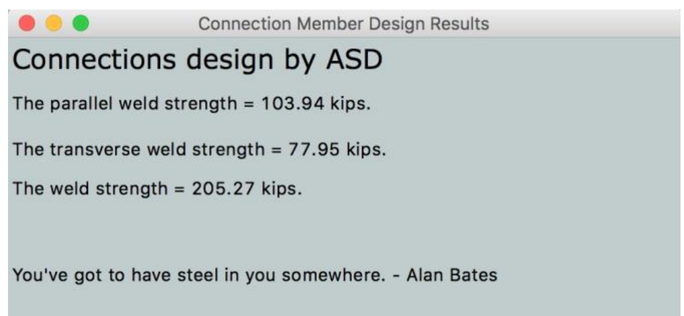
$$\phi R_n = \max \begin{cases} 104 + 78 = 182 \text{ kips} \\ .85(104) + 1.5(78) = \\ 88.4 + 117 = 205.4 \text{ kips} \end{cases}$$

Select larger → 205 kips


Connection Member Design
Connection member design by LRFD
Would you like to determine the design strength for a bolt or c-shaped weld?
Bolt
C-Shaped weld
If you chose bolt, which type of bolt?
A325-N
A490-X
What is the diameter (in inches) of the bolt? Please enter as a decimal
If you chose c-shaped weld, what are the dimensions?
Parallel length (in inches):
4
Transverse length (in inches):
6
Length of weld (in inches), please enter as a decimal:
.875
Design!


Connection Member Design Results
Connections design by LRFD
The parallel weld strength = 155.90 kips.
The transverse weld strength = 116.93 kips.
The weld strength = 307.91 kips.
Persistence is to the character of man as carbon is to steel. - Napoleon Hill


Connection Member Design
Connection member design by ASD
Would you like to determine the design strength for a bolt or c-shaped weld?
Bolt
C-Shaped weld
If you chose bolt, which type of bolt?
A325-N
A490-X
What is the diameter (in inches) of the bolt? Please enter as a decimal
If you chose c-shaped weld, what are the dimensions?
Parallel length (in inches):
4
Transverse length (in inches):
6
Length of weld (in inches), please enter as a decimal:
.875
Design!


Connection Member Design Results
Connections design by ASD
The parallel weld strength = 103.94 kips.
The transverse weld strength = 77.95 kips.
The weld strength = 205.27 kips.
You've got to have steel in you somewhere. - Alan Bates

Daniel Tjondro
CEE 467 Final Project

Assess your code by clearly identifying what works well with it and what does not. What does this say about our code based approach to steel design?

My code performs well in the sense that it will run the numbers you give it through the correct formulas without making any mathematical errors. If you tell it to design for the least-weight wide flange member with a 20 ft span and P_D = 8.0 kips and P_L = 24.0 kips acting at midspan using LRFD and A992 steel, my app will tell you to use a W18 x 35. It reached this conclusion by looking for the lightest member that met the required plastic section modulus. And indeed, a W18 x 35 has Z = 66.5 in^3 which is greater than Z_{req} = 64.5 in^3. Additionally, it will present the steps that it went through to reach its final conclusion. It won't simply recommend a W18 x 35, but also show the P_u and M_u values as well as the additional required strength as a result of the member's self-weight. This allows the user to follow the code's thought process.

However, my code suffers from a lack of "engineering judgement" that inhibits its ability to automate steel design. Inherent to any computational aid, my code can run through the formulas and handle numbers with ease, but it cannot by itself decide if a steel member should be treated as a tension, compression, bending or connection member. That is up to the engineer to decide when he/she is designing how the structure will carry loads. But that is of course based on his/her experience with engineering. Only once the type of member has been decided will my code become helpful. Engineering judgement is also important when it comes to deciding how conservative to be. If a certain W14 provides sufficient strength, even if it's only by a few kips, my code will not bat an eyelash when it recommends that W14 to the user.

However, the engineer may deem that margin too slim. He/she would then have to check one or two shapes up and find a more appropriate dimension.

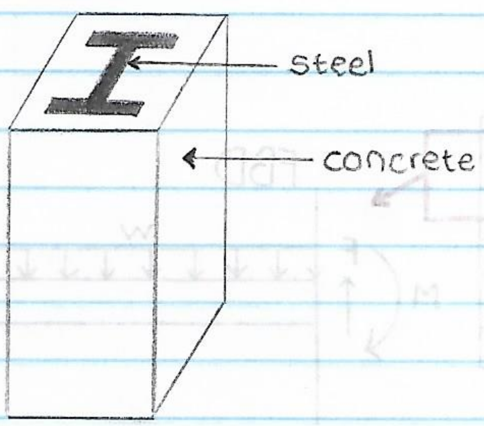
Additionally, although my code can design a single steel member very well based on what it is given, it knows nothing about the rest of the structure. Given a tension member experiencing certain live and dead loads, my code can produce which shape is the most economical to carry the loads. However, that is all. For example, there may be circumstances in which the architect would not agree with what my code produces because although the beam it recommends is economical and carries the load, it may not completely align with the architect's vision for the structure. It may be too large, too small, or not be of the ideal shape. There are many ways for a member to carry load in tension, but my code can only design for certain shapes, namely WT9, WT12, W14 and double-angles. It can't design for sag rods, wire rope, single angles, steel cables or hollow structural steel (HSS) shapes, etc. Although it is theoretically possible for my app to be able to design for all of those shapes, practically speaking, information on those shapes are not readily available, and even if it were, my code would have to parse through a large amount of data.

All these points go to show that my code is nothing more than a design aid. Although it may give off the illusion of "automating" steel design, it merely supports the process. At the end of the day, my app is only as good as the engineer using it. One of my professors has a saying when it comes to computer programs or code: "Garbage in, garbage out." Essentially, if the user tells the code to design a compression member and passes all the necessary numbers, my app will not disappoint. But if the member shouldn't be treated as one in compression, then my code is all for naught. Unless my code is given sensible information, what it produces is going to be useless. Thus, it is up to the creativity and ingenuity of the engineer to determine how to carry the loads of the structure he/she is designing for. Will the structure utilize tension members? Compression members?

But even if the information my app is given is sound, the results it produces should always be taken with a grain of salt. The results will be mathematically correct, but not always applicable in practice. My app is simple enough for a non-engineer to use, but unless the person using my app is constantly performing sanity checks and thinking about how the results of the app fit in accordance with the big picture, my app is about as useful as a red rubber ball manual (not very). Our code approach to steel design has its shortcomings, but if the code is used correctly, as a guide rather than the be-all and end-all, it can serve as a quick way to run your numbers and make sure you are in the correct ballpark.

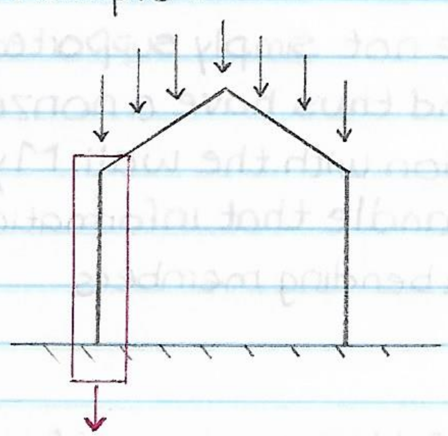
Example 2

encased column

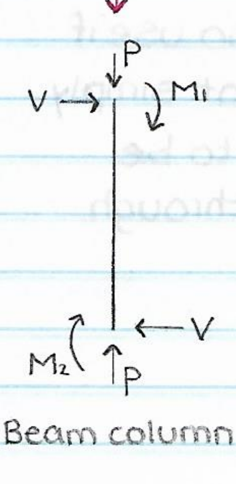


This is a steel column fully encased in concrete. Although such a column will serve as a compression member, my code cannot design for composite members such as this one. My app can only design compression members that are made entirely of A992 steel. It cannot take into account the additional strength provided by the concrete.

Example 3



This is a steel frame in which the vertical members experience both axial loads and bending moments. The columns are essentially both compression members <u>and</u> bending members simultaneously.

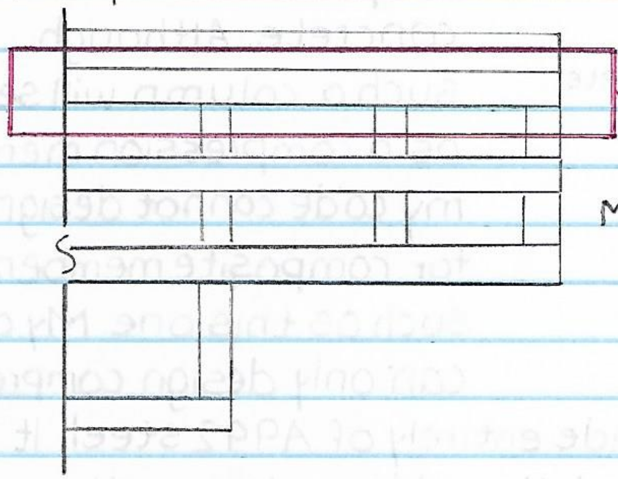


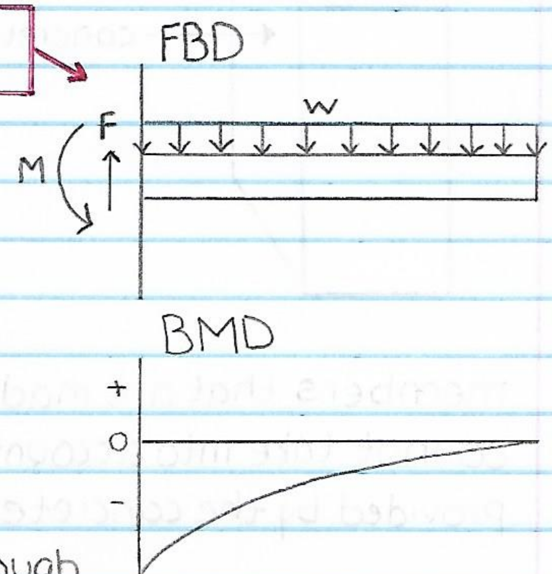
Beam column

Although my app can handle compression members and bending members individually, it cannot design for this specific column because it experiences concentrated moment at its ends.

There are many steel structures that cannot be designed using my code:

Example 1





This structure would not fit with my code because although the horizontal members are experiencing bending, they are not simply supported. In fact, they are cantilevers and thus have a nonzero moment value at the connection with the wall. My app does not know how to handle that information. It only knows how to design bending members that are simply supported.

In general, my code will be of little to no use if the bending member to be designed is not simply supported. My app assumes the member to be simply supported when it runs the inputs through.