Steps for Selecting a Properly Sized Steel Beam for a Given Load

Step 1. Record all the KNOWNS
Examples:
L = Length of the Beam (ft)
P = Concentrated Force(s) (lb)
W = uniform Load (lb/ft)

Table 13-1
Case 1 a = distance concentrated force is from the left end of the beam
b = distance concentrated force is from the left end of the beam

Case 2 a = distance concentrated force is from both ends of the beam (symmetrical loads)

A36 Steel
σ_{allow} = 24 ksi
τ_{allow} = 14.5 ksi

Step 2. Determine V_{max} and M_{max}
Use Table 13-1 and Superpostion, if applicable
If not, sketch the V & M diagrams for the beam and the applied load(s)

Step 3. Determine the required section modulus

$$S_{req} = \frac{M_{max}}{\sigma_{allow}}$$

Step 4. Find a Beam that satisfies the required section modulus
Table A-1(a) Wide Flange Beam (W Shapes)
Table A-2(a) I-Beam (S Shapes)

Choose beam based on parameters if specified. i.e Lightest, shortest depth, etc.
Record selection(s)
Note: If the weight of the beam has been included in the load, no further check is required for the additional load due to the weight of the beam. If NOT included, must check that the additional beam weight will not cause normal stress (bending moment) failure.

Check for Shear Stress Failure
For beam selected record: Depth (d) (in.) and Web thickness (t_w) (in.)
Calculate average shear stress and compare to the allowable shear stress

$$\tau_{avg} = \frac{V_{max}}{d\ t_w}$$

If $\tau_{avg} < \tau_{allow}$ ok for shear

Steps for Selecting a Properly Sized Rectangular Wood Beam for a Given Load

Step 1. Record all the KNOWNS
Examples:
L = Length of the Beam (ft)
P = Concentrated Force(s) (lb)
W = uniform Load (lb/ft)
Table 13-1
Case 1 a = distance concentrated force is from the left end of the beam
b = distance concentrated force is from the left end of the beam
Case 2 a = distance concentrated force is from both ends of the beam (symmetrical loads)

Table 15-1
σ_{allow} = given species of timber
τ_{allow} = given species of timber

Step 2. Determine V_{max} and M_{max}
Use Table 13-1 and Superposition, if applicable
If not, sketch the V & M diagrams for the beam and the applied load(s)

Step 3. Determine the required section modulus

$$S_{req} = \frac{M_{max}}{\sigma_{allow}}$$

Step 4. Determine the required cross-sectional area

$$A_{req} = \frac{1.5\ V_{max}}{\tau_{allow}}$$

Step 5. Table A-6(a) Find a Beam that satisfies the required section modulus and area
Choose beam based on parameters if specified. i.e Lightest, shortest depth, etc.
Record selection(s):

Selection 1	Nominal Size	Area (in^2)	S (in^3)	wt (lb.ft)
Selection 2	Nominal Size	Area (in^2)	S (in^3)	wt (lb.ft)

…
For beam selected with only a uniform load determine:

$$\% = \frac{\text{wt of Beam}}{\text{Uniform Load}}$$

$\frac{\text{Extra S}}{S_{req}}$ Must be greater than percentage above to be OK for bending

$\frac{\text{Extra A}}{A_{req}}$ Must be greater than percentage above to be OK for shear

If weight of beam is included in the uniform load these checks are not necessary. If the load has a concentrated force and/or uniform load must check using ratio of moments.