1. Get loads and estimate a weight for the beam. The weight of the beam is treated as a uniform load across the length of the beam.

2. Draw shear and moment diagrams OR use standard formulas to determine the maximum bending moment the beam will need to resist.

3. Determine the required (minimum) section modulus for the beam using the equation:

   \[
   S_{\text{REQUIRED}} = \frac{M}{\sigma_d}
   \]

   The design stress is typically taken as a limit strength, such as yield strength, divided by a design factor. Wide-flange beams are currently made from high-strength, low alloy steel designated as ASTM A992. This material has a minimum yield strength of 50 ksi and an ultimate strength of 65 ksi. Other structural shapes (C, M, S, L) are typically available in ASTM A36 steel which has \( S_y = 36 \) ksi and \( S_u = 58 \) ksi. Hollow structural shapes (HSS) are available in ASTM A500 Gr. B steel which has \( S_y = 46 \) ksi and \( S_u = 58 \) ksi. For static beam applications, the design factor for bending can be taken as 1.5.

4. Generate a list of candidate beam sections having a section modulus greater than \( S_{\text{REQUIRED}} \).

5. From the list of candidates, pick the lightest section or the one that satisfies the size requirements of the application.

6. Verify that the actual weight of the beam is less than or equal to the value assumed in step 1. If the actual weight is larger than assumed, return to step 1 and repeat with a larger beam weight estimate.

7. Check to verify that the shear stress in the beam is less than an allowable design shear stress. It is common to use a design factor of 1.25 for shear stress in steel beams. Use the thin-web formula to check shear stress in a steel beam:

   \[
   \tau = \frac{V}{t_wd} \leq \tau_d = \frac{0.5 S_y}{N}
   \]

8. While not critical to the safety of the beam, its deflection should be checked to ensure it isn’t excessive. In some cases, too much deformation may cause a machine to not function properly. If deflection is excessive, select a beam having a moment of inertia sufficiently large enough to bring the deflection in acceptable limits. Verify that this new beam strength is sufficient.