EML5526 HW 8 Fully-Stressed Design of a Ten-bar Truss

Fully-stressed design is often used for truss structures. The idea is that we should remove material from members that are not fully stressed unless prevented by minimum cross-sectional area constraint. Practically, at every design cycle, the new cross-sectional area can be found using the following relation:

$$A_{\text{new}}^{\langle e \rangle} = \frac{s_{\text{old}}^{\langle e \rangle}}{s_{\text{allowable}}^{\langle e \rangle}} A_{\text{old}}^{\langle e \rangle}$$

A 10-bar truss structure shown in the figure is under two loads, P_1 and P_2. The design goal is to minimize the weight, W, by varying the cross-sectional areas, A_i, of the truss members. The stress of the member should be less than the allowable stress with the safety factor. For the manufacturing reason, the cross-sectional areas should be greater than the minimum value. Input data are summarized in the table. Find optimum design using fully-stressed design.

Parameters	Values
Dimension, b	360 inches
Safety factor, S_F	1.5
Load, P_1	66.67 kips
Load, P_2	66.67 kips
Density, ρ	0.1 lb/in^3
Modulus of elasticity, E	10^4 ksi
Allowable stress, $s_{\text{allowable}}$	25 ksi*
Initial area A_i	1.0 in^2
Minimum cross-sectional area	0.1 in^2

*for Element 9, allowable stress is 75 ksi

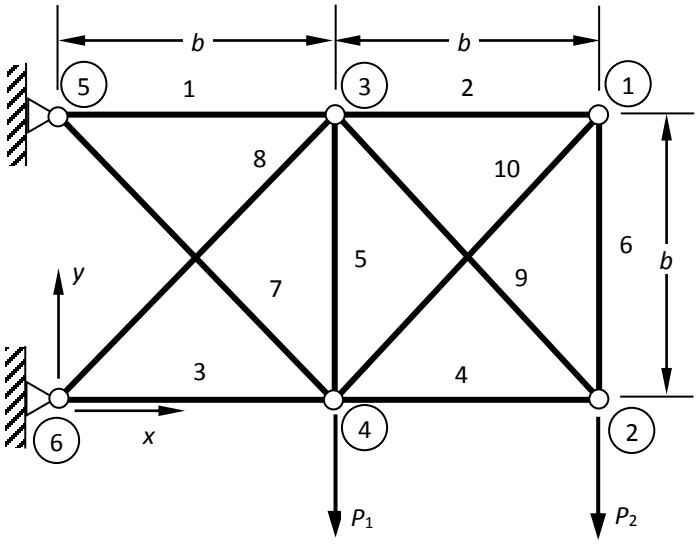

Figure **Error! No text of specified style in document.**.1: Ten-bar truss structure for Project 2.4