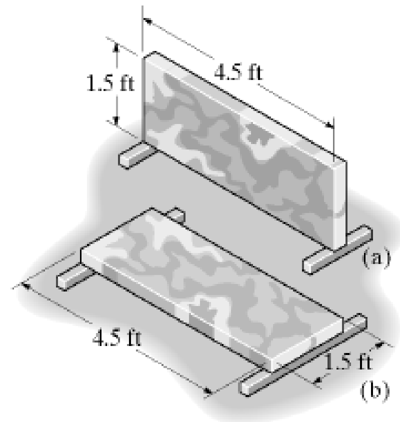
6–47. The slab of marble, which can be assumed a linear elastic brittle material, has a specific weight of 150 lb/ft^3 and a thickness of 0.75 in. Calculate the maximum bending stress in the slab if it is supported (a) on its side and (b) on its edges. If the fracture stress is $\sigma_f = 200$ psi, explain the consequences of supporting the slab in each position.



Support Reactions: As shown on FBD(a).
Maximum Moment: In both cases, the maximum moment occurs at midspan as shown on FBD(b).

Maximum Bending Stress: Applying the flexure formula $\sigma_{max} = \dfrac{Mc}{I}$

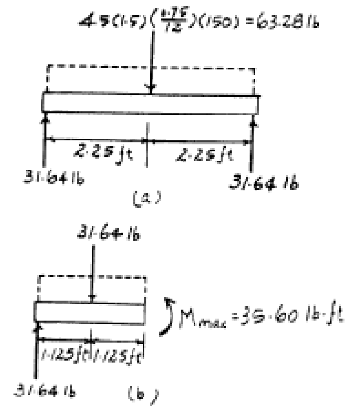
a)

$$\sigma_{max} = \frac{35.60(12)(9)}{\frac{1}{12}(0.75)(18^3)} = 10.5 \text{ psi} \qquad \textbf{Ans}$$

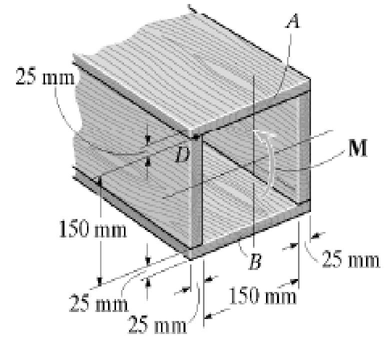
b)

$$\sigma_{max} = \frac{35.60(12)(0.375)}{\frac{1}{12}(18)(0.75^3)} = 253 \text{ psi} \qquad \textbf{Ans}$$

The marble slab will break if it is supported as in case (b).



6–46. Determine the moment M that should be applied to the beam in order to create a compressive stress at point D of $\sigma_D = 30$ MPa. Also sketch the stress distribution acting over the cross section and compute the maximum stress developed in the beam.



Section Property:

$$I = \frac{1}{12}(0.2)\left(0.2^3\right) - \frac{1}{12}(0.15)\left(0.15^3\right) = 91.14583\left(10^{-6}\right)\ \text{m}^4$$

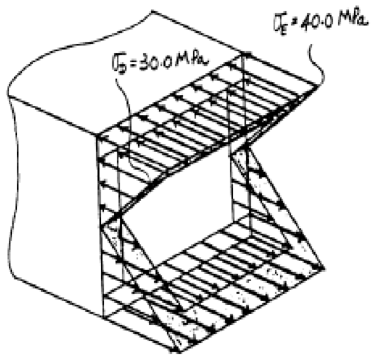
Bending Stress: Applying the flexure formula

$$\sigma = \frac{My}{I}$$

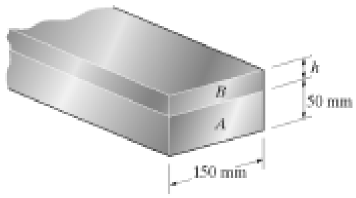
$$30\left(10^6\right) = \frac{M(0.075)}{91.14583(10^{-6})}$$

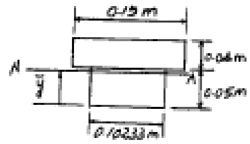
$$M = 36458\ \text{N}\cdot\text{m} = 36.5\ \text{kN}\cdot\text{m} \qquad \textbf{Ans}$$

$$\sigma_{max} = \frac{Mc}{I} = \frac{36458(0.1)}{91.14583(10^{-6})} = 40.0\ \text{MPa} \qquad \textbf{Ans}$$



***6–120.** The composite beam is made of 6061-T6 aluminum (A) and C83400 red brass (B). If the height $h = 40$ mm, determine the maximum moment that can be applied to the beam if the allowable bending stress for the aluminum is $(\sigma_{allow})_{al} = 128$ MPa and for the brass $(\sigma_{allow})_{br} = 35$ MPa.





Section Properties: For transformed section.

$$n = \frac{E_{al}}{E_{br}} = \frac{68.9(10^9)}{101.0(10^9)} = 0.68218$$

$$b_{br} = nb_{al} = 0.68218(0.15) = 0.10233 \text{ m}$$

$$\bar{y} = \frac{\Sigma\bar{y}A}{\Sigma A} = \frac{0.025(0.10233)(0.05) + (0.07)(0.15)(0.04)}{0.10233(0.05) + 0.15(0.04)}$$

$$= 0.049289 \text{ m}$$

$$I_{NA} = \frac{1}{12}(0.10233)\left(0.05^3\right) + 0.10233(0.05)(0.049289 - 0.025)^2 + \frac{1}{12}(0.15)\left(0.04^3\right) + 0.15(0.04)(0.07 - 0.049289)^2$$

$$= 7.45799\left(10^{-6}\right) \text{ m}^4$$

Allowable Bending Stress: Applying the flexure formula

Assume failure of red brass

$$(\sigma_{allow})_{br} = \frac{Mc}{I_{NA}}$$

$$35\left(10^6\right) = \frac{M(0.09 - 0.049289)}{7.45799(10^{-6})}$$

$$M = 6412 \text{ N}\cdot\text{m} = 6.41 \text{ kN}\cdot\text{m} \ (\textit{controls!}) \qquad \textbf{Ans}$$

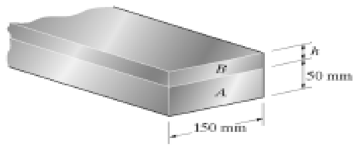
Assume failure of aluminium

$$(\sigma_{allow})_{al} = n\frac{Mc}{I_{NA}}$$

$$128\left(10^6\right) = 0.68218\left[\frac{M(0.049289)}{7.45799(10^{-6})}\right]$$

$$M = 28391 \text{ N}\cdot\text{m} = 28.4 \text{ kN}\cdot\text{m}$$

***6–120.** The composite beam is made of 6061-T6 aluminum (A) and C83400 red brass (B). If the height $h = 40$ mm, determine the maximum moment that can be applied to the beam if the allowable bending stress for the aluminum is $(\sigma_{allow})_{al} = 128$ MPa and for the brass $(\sigma_{allow})_{br} = 35$ MPa.



Section Properties: For transformed section.

$$n = \frac{E_{al}}{E_{br}} = \frac{68.9(10^9)}{101.0(10^9)} = 0.68218$$

$$b_{br} = nb_{al} = 0.68218(0.15) = 0.10233 \text{ m}$$

$$\bar{y} = \frac{\Sigma \bar{y}A}{\Sigma A}$$

$$= \frac{0.025(0.10233)(0.05) + (0.07)(0.15)(0.04)}{0.10233(0.05) + 0.15(0.04)}$$

$$= 0.049289 \text{ m}$$

$$I_{NA} = \frac{1}{12}(0.10233)\left(0.05^3\right) + 0.10233(0.05)(0.049289 - 0.025)^2$$
$$+ \frac{1}{12}(0.15)\left(0.04^3\right) + 0.15(0.04)(0.07 - 0.049289)^2$$
$$= 7.45799\left(10^{-6}\right) \text{ m}^4$$

Allowable Bending Stress: Applying the flexure formula

Assume failure of red brass

$$(\sigma_{allow})_{br} = \frac{Mc}{I_{NA}}$$

$$35\left(10^6\right) = \frac{M(0.09 - 0.049289)}{7.45799(10^{-6})}$$

$$M = 6412 \text{ N}\cdot\text{m} = 6.41 \text{ kN}\cdot\text{m} \ (\textit{controls!}) \qquad \text{Ans}$$

Assume failure of aluminium

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