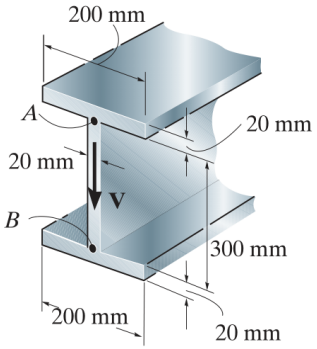
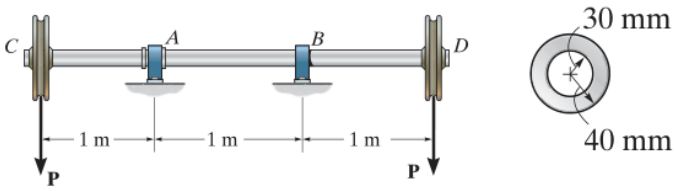
Tutorial Sheet 3: Bending of Beams (Shear)

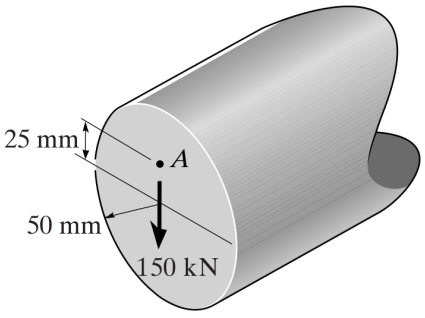
1. If the wide-flange beam is subjected to a shear of $V = 20$ kN, determine the shear force resisted by the web of the beam. [19.0 kN]



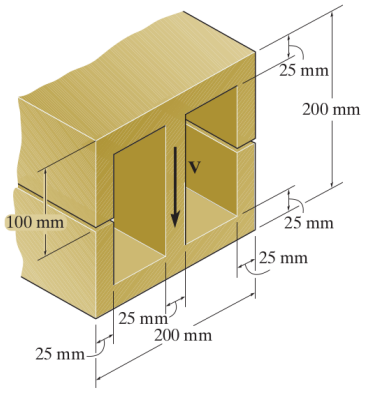
2. The shaft is supported by a smooth thrust bearing at A and a smooth journal bearing at B. If $P = 20$ kN, determine the absolute maximum shear stress in the shaft. [17.9 MPa]



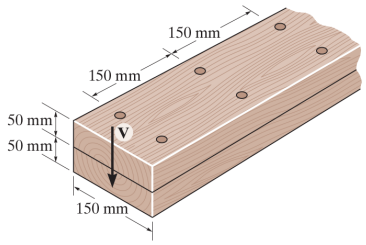
3. The steel rod is subjected to a shear force of 150 kN as shown in the figure. Determine the sehar stress at point A. [19.1 MPa]



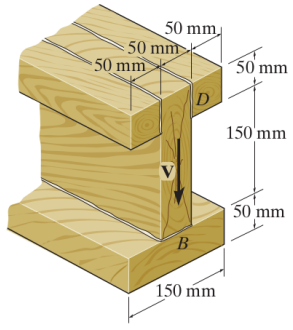
4. The beam is slit longitudinally along both sides as shown. The slit thickness is negligible. If the beam is subjected to a shear force of $V = 250$ kN at the cross-section, compare the maximum shear stress developed in the beam before and after the slits were made. [Before: 22.0 MPa; After: 66.0 MPa]



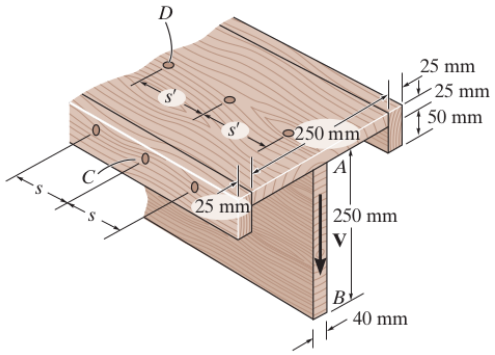
5. The beam is constructed from two boards fastened together at the top and bottom with two rows of nails spaced every 150 mm. If each nail can support a 2.5 kN shear force, determine the maximum shear force V that can be applied to the beam. [2.222 kN]



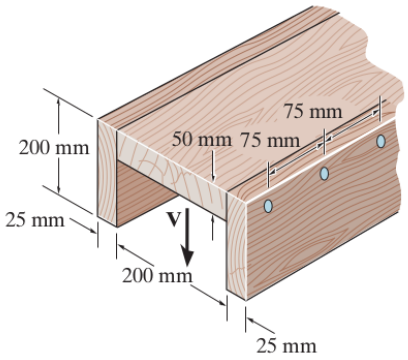
6. The boards are glued together to form the built-up beam. If the wood has an allowable shear stress of $\tau_{\text{allow}} = 3$ MPa, and the glue seams at B and D can each withstand a maximum shear stress of 1.5 MPa, determine the maximum allowable internal shear force V that can be developed in the beam. [16.7 kN]



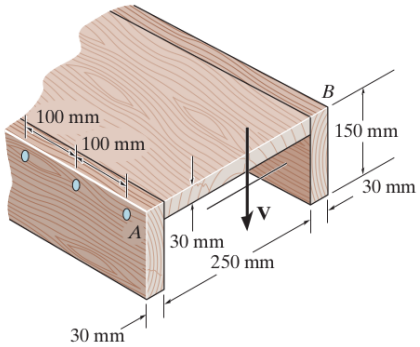
7. The beam is made from four boards nailed together as shown. If the nails can each support a shear force of 500 N, determine their required spacing s and s' if the beam is subjected to a shear force of $V = 3.5$ kN. [$s = 216.6$ mm, $s' = 30.7$ mm]



8. The beam is subjected to a shear of $V = 2$ kN. Determine the average shear stress developed in each nail if the nails are spaced 75 mm apart on each side of the beam. Each nail has a diameter of 4 mm. [35.2 MPa]



9. The beam is subjected to a shear of $V = 800$ N. Determine the average shear stress developed in the nails along the sides A and B if the nails are spaced $s = 100$ mm apart. Each nail has a diameter of 2 mm. [97.2 MPa]



10. A steel bar and an aluminium bar are bonded together as shown to form a composite beam. Knowing that the vertical shear in the beam is 18 kN and that the Young's moduli for steel and aluminium are 200 GPa and 73 GPa, respectively, determine the average stress at the bonded surface and the maximum shearing stress in the beam. [6.65 MPa; 10.90 MPa]