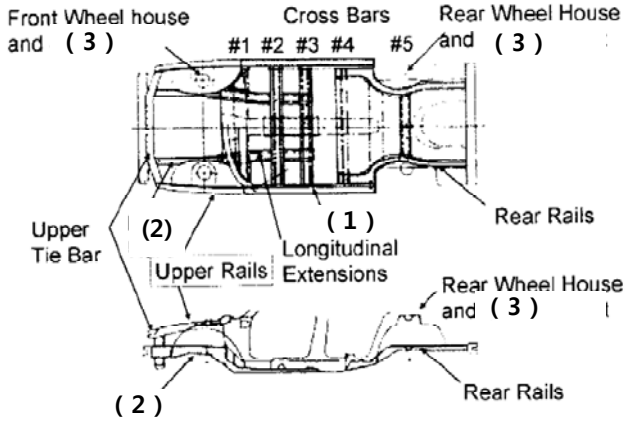
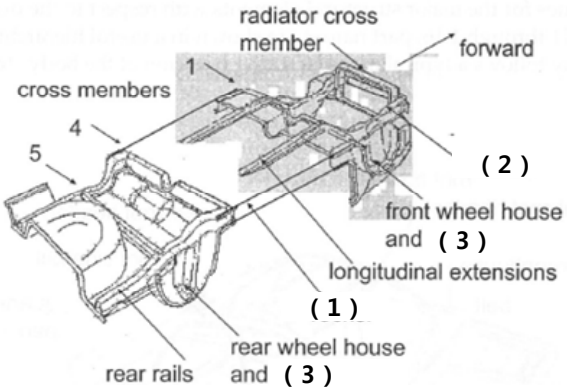
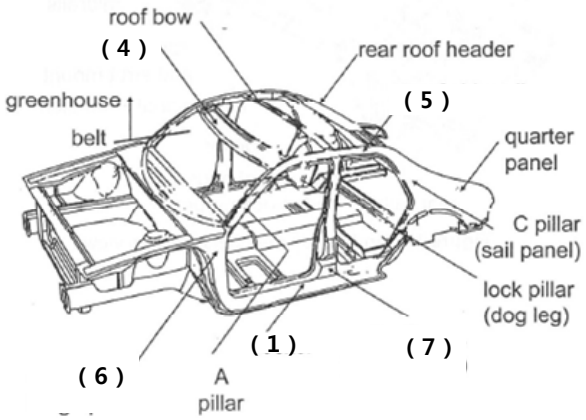
1. Fill in the blanks. (2 pts each)







* The condition of a single spot weld loaded by equal and opposite tensile loads is referred to as ((8)) loading. The loads act on the centerline of the flange thickness and the offset between centerline creates a moment at the weld. Another loading configuration ((9)) loading increased this detrimental offset even more. Comparing weld strength for an individual weld shows the effect of increasing the loading offset. Because of this effect, good design practice is to use part geometry to put welds into ((8)) loading rather than ((9)) loading.

* When a spot-welded flange is present in a section and a shear load is introduced at the weld interface, a longitudinal deflection will occur. This deflection is proportional to ((10)) of the weld pitch. The deflection occurs whenever a shear across the weld is present, during both section bending or in torsion.

2. Describe three categories of structural requirements by drawing a typical load-deflection curve. (12 pts)

3. The general behavior of a compressively loaded plate is to react load by direct stress. However, if the plate is sufficiently thin, it bifurcates into the buckled shape. The compressive stress at which this occurs depends on the plate width-to-thickness ratio(b/t). Relate (b/t) ratio to critical compressive plate buckling stress(σ_{CR}) for a simply supported plate substituting values of mild steel ($E = 207,000\, N/mm^2$, $\mu = 0.3$, $\sigma_Y = 207\, N/mm^2$). Draw the design stress curve for a thin plate under compressive loading with respect to (b/t). (8 pts)

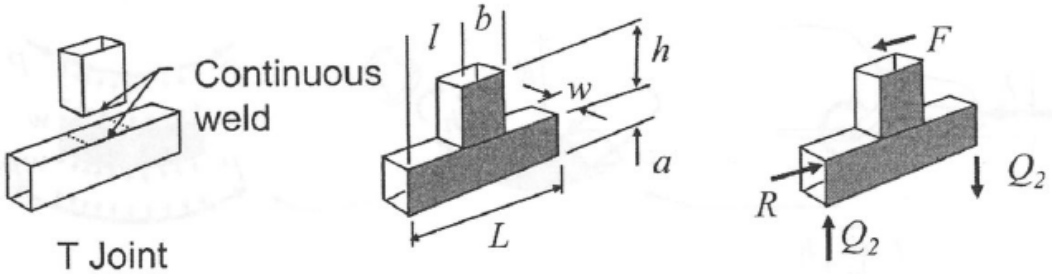
4. The thin-walled T joint shown is loaded by a force F along side edges. The reactions to ground are limited to R and Q_2.

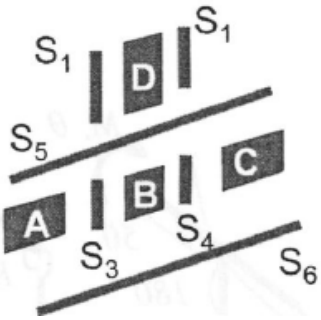
(1) Compute all the internal forces for the first-order shear panel/bar model shown. (5 pts)

(2) Compute the loads, F, at which shear buckling occurs in panels A, B, C and D. (10 pts)

(3) Which panel dominates the strength of the joint? (5 pts)

(4) Using the fact that external work equals internal strain energy, what is the deflection in the direction of load F? (10 pts)





(Dimensions)

$b = 100mm,\ h = 200mm,\ a = 100mm,\ w = 75mm$

$L = 500mm,\ l = 200mm$

(Panel thickness)

$t_A = t_B = t_C = 0.89mm,\ t_D = 1mm$

(Material: steel)

$E = 207{,}000\ N/mm^2,\ \sigma_Y = 207\ N/mm^2$

(buckling constant in the buckling equation) $k = 5$

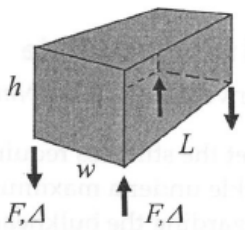
5. Consider the van box model for torsion.

(1) Determine the shear loads in each panel when $F = 8{,}000N$. (5 pts)

(2) Show that the torsional stiffness of box is $K = \dfrac{T}{\theta} = (2wh)^2 \Big/ \sum_{\text{all surfaces}} \left[\dfrac{ab}{(Gt)}\right]_i$. (10 pts)

(3) What is the torsional stiffness if all panels are perfectly flat steel panels 1mm thick?. (G=80,000N/mm^2) (5 pts)

(4) The van now has a roof with 20 mm crown height. Determine the van torsional stiffness with this crown panel. (10 pts)



L=3000 mm
h=1300 mm
w=1500 mm