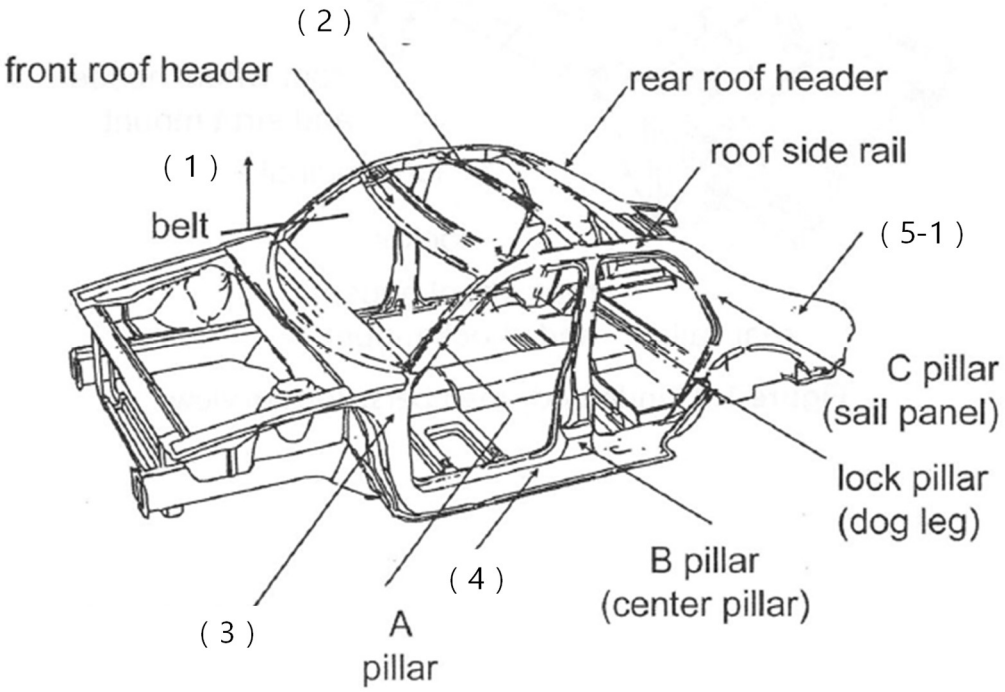
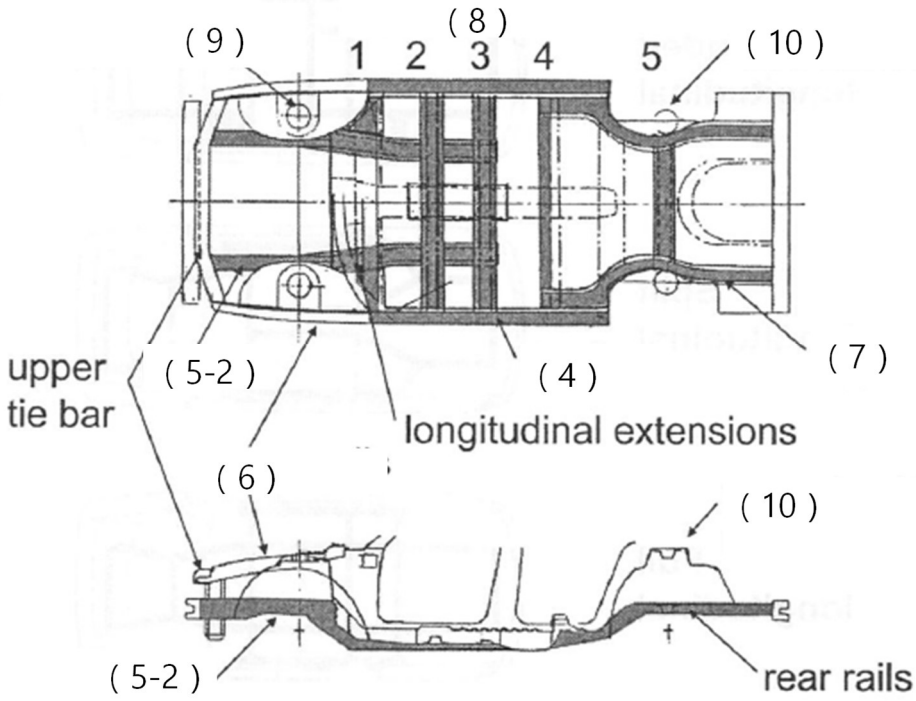
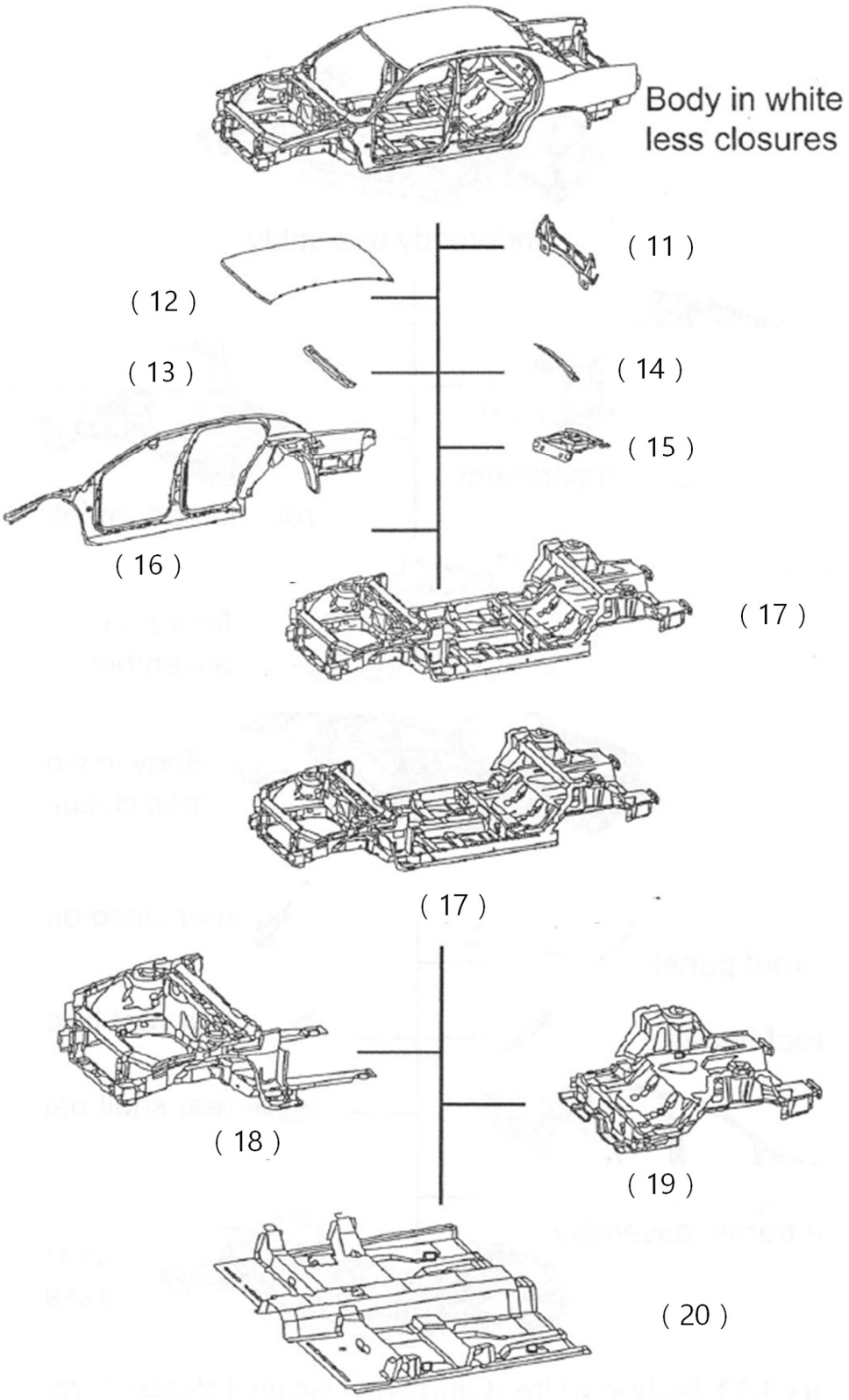
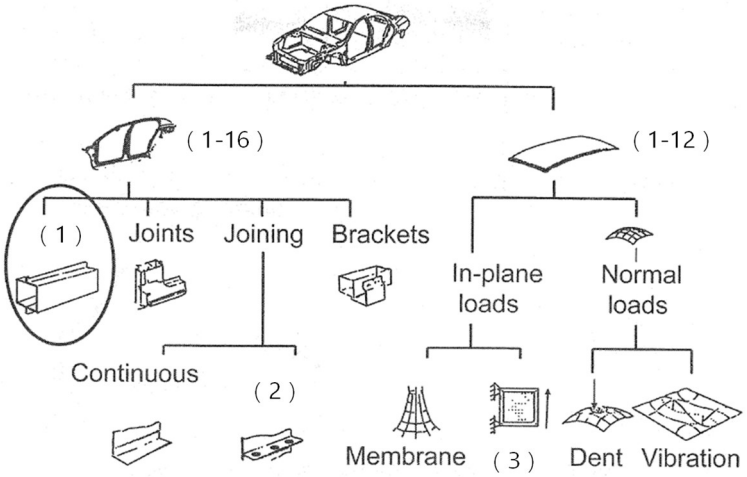
1. Fill in the blanks. (1 pts each)

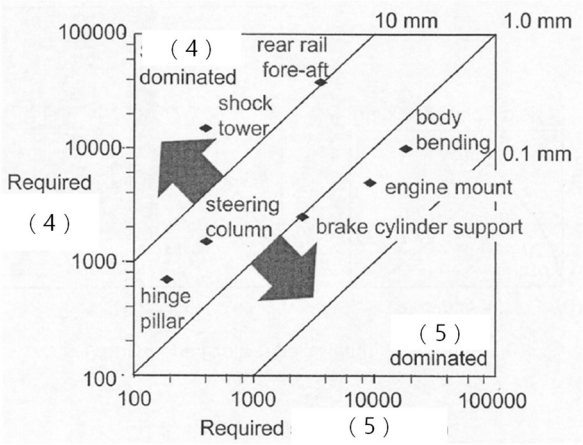





Body in white
less closures
(11)
(12)
(13)
(14)
(15)
(16)
(17)
(17)
(18)
(19)
(20)

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





3. Describe the followings. (5 pts each)

(1) difference between the monocoque body and the body-on frame.

(2) lightweight index of the automotive body structure

(3) way to predict deflections and stresses in a beam with a non-symmetric section and loaded in some arbitrary direction

(4) effect of spot-weld on longitudinal stiffness

(5) effect width of the plate

(6) joint efficiency

4. Explain strategies (5 pts each)

(1) to reduce local distortion under a point load so that the ideal beam stiffness is more fully utilized

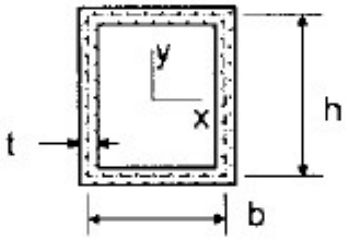
(2) to inhibit plate buckling

(3) to reduce the relatively high compression in shear panel at the intersection of the beams

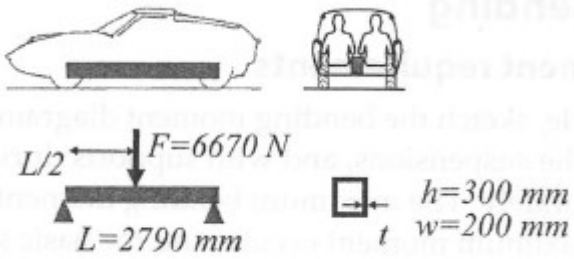
5. Body structure typically consists of beams with thin walled sections in which the width to thickness ratio, b/t is large ($b/t > 60$).

(1) Write an expression for the exact area moment of inertia about the x axis, I_{xx}. (5 pts)

(2) When t is very small compared to the other section dimensions, we can approximate the exact I_{xx} with an expression linear in t. Using either a Talyor expansion of (1) or by elimination of terms of t of second and higher order write the linear approximation for I_{xxx}. (5 pts)



6. One topology for resisting bending load is a back bone beam down the center of the vehicle. The back-bone can be idealized as a uniform beam supported at the axle position. The test load condition is shown. Assume the material is steel with E = 207,000 N/mm^2, $\sigma_{allowable}$ = 175 N/mm^2. [Use I obtained in Problem 5 (2)]

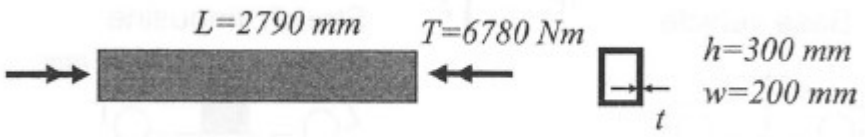


(1) Compute the minimum thickness to meet the strength requirement of supporting a 6670 N load. (5 pts)

(2) Compute the minimum thickness if the deflection at center span is to be at most 1 mm. (5 pts)

(3) How short does the wheel base L need to be before strength and stiffness criteria require the same thickness? (10 pts)

The twisted ditch torque is 6780 Nm with an allowable shear stress $\tau_{allowable}$ = 86 N/mm^2. Also, the stiffness requirement for torsion is 12,000 Nm/degree measured between the axles (L = 2790 mm). Assume the material is steel with G = 83,000 N/mm^2.



(4) Compute the required thickness to meet the twisted ditch strength requirement. (5 pts)

(5) Compute the required thickness to meet the torsional stiffness requirement. (5 pts)

(6) Which is the dominant requirement? (5 pts)