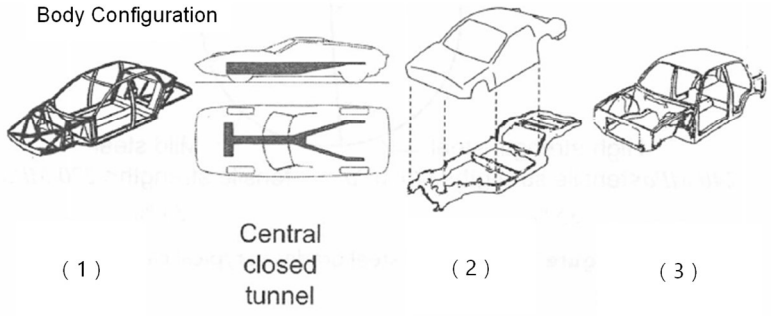
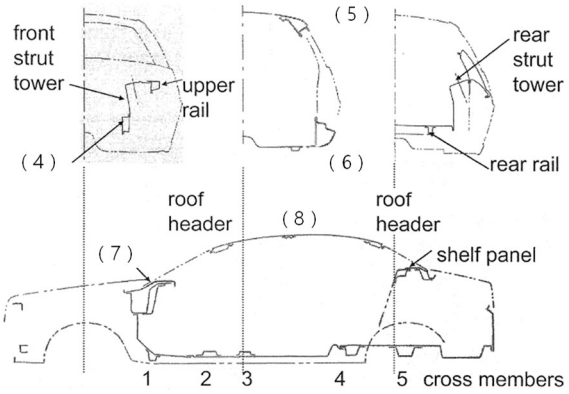
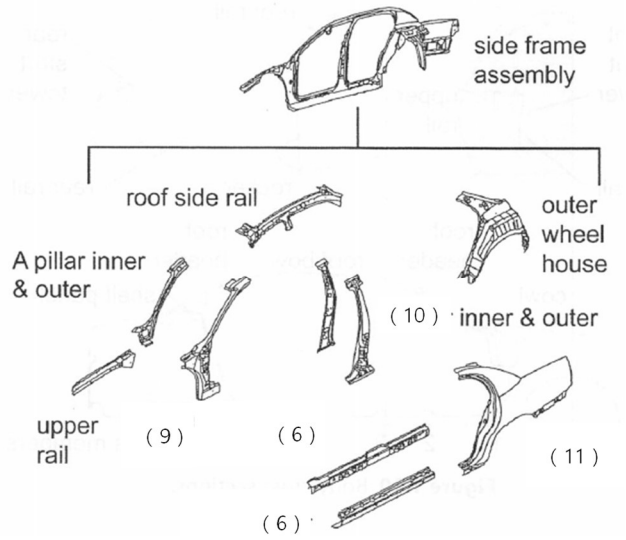
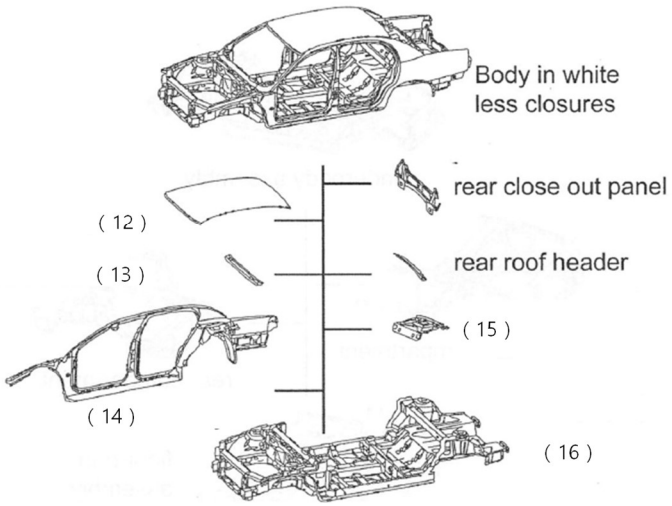
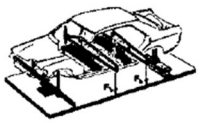
1. Fill in the blanks. (1 pts each)

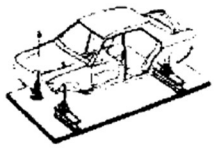




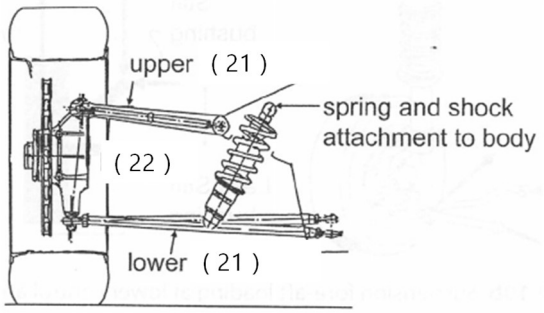


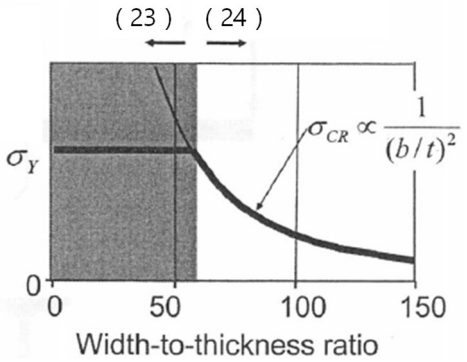


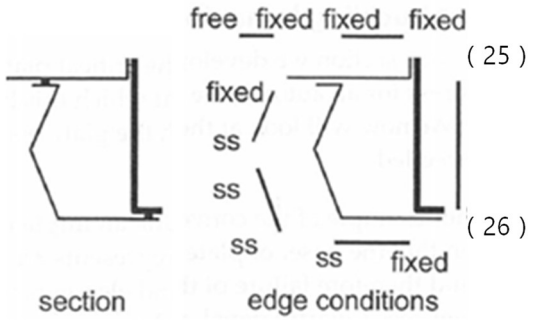


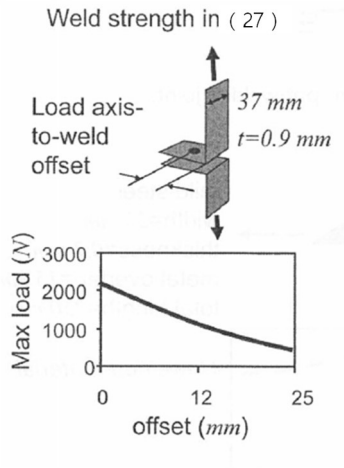


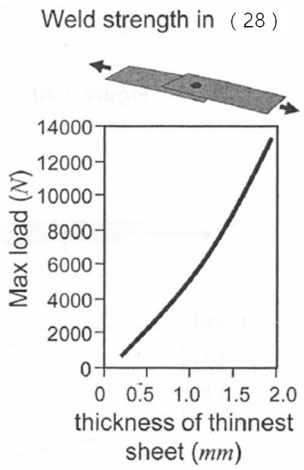
Bending Stiffness	Bending Strength	Torsion Stiffness	Torsion Strength
Nominal Value Stiffness = (17)	Nominal Value (18) no permanent deformation	Nominal Value Stiffness = (19)	Nominal Value (20) no permanent deformation

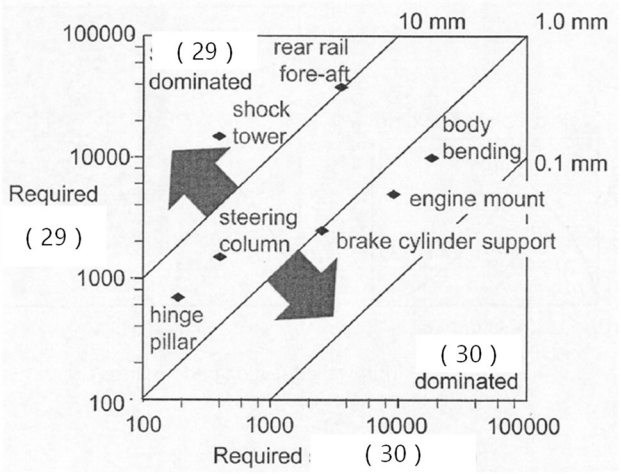












2. Describe the followings. (5 pts each)

(1) all modes to calculate the steady-state maximum front tire patch loads

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

(3) lightweight index of the automotive body structure

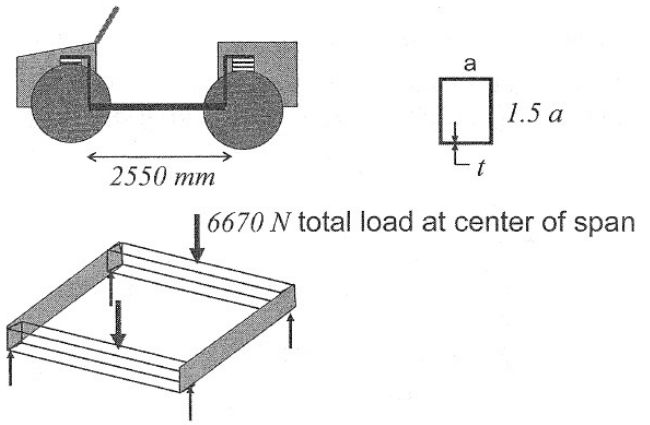
(4) effect of spot-weld on longitudinal stiffness

(5) effective width of the plate

(6) joint efficiency

3. Describe the procedure to calculate the body torsional stiffness analytically. (10 pts)

4. The desired maximum deflection for the convertible is 1 *mm* elastic under a load of 6670 *N*, or the stiffness requirement is: $K \geq (6670N)/(1mm) = 6670\,N/mm$. Also the rocker fails at a minimum load of 6670 *N* in yield or buckling. Determine a and t to minimize rocker mass. (15 pts)



$$I = \frac{(1.5a)^2\, t\,(3a + 1.5a)}{6} = \frac{27}{16} a^3 t$$

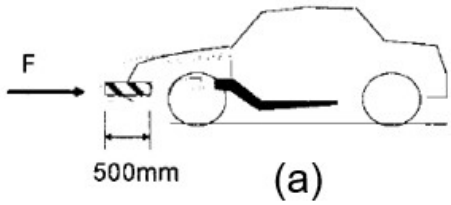
$$\delta = \frac{FL^3}{48EI}$$

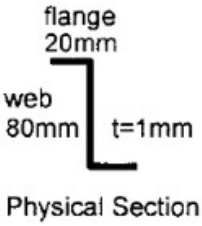
$$\sigma = \frac{My}{I} \rightarrow \sigma_{design} = \begin{cases} \sigma_{yield} = 207\ N/mm \\ \sigma_{buckle} = \dfrac{748355}{(a/t)^2}\ N/mm \end{cases}$$

5. A Z section beam is part of a bumper reaction structure. ($E = 207\,N/mm^2$, $\nu = 0.3$, $\sigma_Y = 207\,N/mm^2$) (15 pts)

(1) Calculate the ultimate compressive load for this section.

(2) Consider again the Z section under compressive loading, but now with buckling inhibiting techniques. Calculate the ultimate load and compare with the result of (1).





Physical Section

$$\sigma_{cr} = k\frac{E\pi^2}{12(1-\nu^2)}\frac{1}{(b/t)^2},\ w = \frac{1}{2}\left(1+\frac{\sigma_{cr}}{\sigma_s}\right)b$$

Case	Boundary Condition	Loading	k
(a)	ss ss ss ss	Compression	4.0
(b)	ss fixed fixed ss	Compression	6.97
(c)	ss ss free ss	Compression	0.425
(d)	ss fixed free ss	Compression	1.277
(e)	ss fixed ss ss	Compression	5.42
(f)	ss ss ss ss	Shear	5.34
(g)	ss fixed free ss	Shear	8.98
(h)	ss ss ss ss	Bending	23.9
(i)	fix fixed fixed fix	Bending	41.8