UNIVERSITI TUN HUSSEIN ONN MALAYSIA

TEST 2
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	REINFORCED CONCRETE DESIGN I
COURSE CODE	:	BFC 32102
PROGRAMME	:	3 BFF
EXAMINATION DATE	:	MAY 2014
DURATION	:	1 HOUR 30 MINUTES
INSTRUCTION	:	ANSWER ALL QUESTIONS

Q1 (a) The durability of concrete involves the environmental condition. The condition exposure includes chemical and physical attacks. In that particular, list three from each exposure.

(6 marks)

(b) What is the purpose of determine a minimum concrete cover in reinforced concrete structures?

(4 marks)

(c) In order to achieve the required design working life of the structure, list all the durability requirement need to consider to make sure the structural element are protected against the relevant environmental action.

(10 marks)

Q2 A simply supported beam of 5.6 m is to carry a design moment of 300kNm. The beam is 250 x 500mm (bxh). Assume f_{ck}= 25N/mm^2 and f_{yk} = 500N/mm^2. The beam is inside building (XC 1), subjected to 1 hour fire resistance and design life of 50 years. Assume diameter of bar used are 16mm for compression (if required) and 20mm for tension. Diameter of the link is 8mm.

(a) Calculate nominal cover for the beam

(6 marks)

(b) Calculate the amount and number of reinforcement needed for the beam

(12 marks)

(c) Verify that area of steel determined in (b) is within the limit required by the EC2

(4 marks)

(d) Verify the deflection of the beam

(8 marks)

FORMULA

$$A_S' = \frac{(K - K_{bal}) f_{ck} b d^2}{0.87 f_{yk} (d - d')} \quad \text{if} \quad d'/x \leq 0.38 \text{ or}$$

$$A_S' = \frac{(K - K_{bal}) f_{ck} b d^2}{f_{sc} (d - d')} \quad \text{if} \quad d'/x > 0.38$$

$$f_{sc} = 700\left(1 - \frac{d'}{x}\right)$$

$$\frac{l}{d} = K\left(11 + 1.5\sqrt{f_{ck}}\,\frac{\rho_o}{\rho} + 3.2\sqrt{f_{ck}}\left(\frac{\rho_0}{\rho} - 1\right)^{3/2}\right) \text{ if } \rho < \rho o$$

$$A_S = \frac{K_{bal} f_{ck} b d^2}{0.87 f_{yk} (d - d')} + A_S'\left(\frac{f_{sc}}{0.87 f_{yk}}\right)$$

$$A_s = \frac{K_{bal} f_{ck} b d^2}{0.87 f_{yk} z} + A_s'$$

$$A_{s,min} = 0.26\left(\frac{f_{ctm}}{f_{yk}}\right) b d > 0.0013 b d$$

$$f_s = \frac{f_{yk}}{1.15}\left[\frac{G_k + 0.3 Q_k}{1.35 G_k + 1.5 Q_k}\right]\frac{1}{\delta}$$

$$\frac{l}{d} = K\left(11 + 1.5\sqrt{f_{ck}}\,\frac{\rho_o}{\rho - \rho'} + \frac{1}{12}\sqrt{f_{ck}}\sqrt{\frac{\rho'}{\rho}}\right) \text{ if } \rho > \rho_0$$

$$\rho_0 = \sqrt{f_{ck}}$$

$$\rho_0 = \frac{A_{s,req}}{bd}$$

$$z = d\left[0.5 + \sqrt{(0.25 - K/1.134)}\right]$$

$$\rho' = \frac{A_{s',req}}{bd}$$

$$A_{s,max} = 0.04 A_c$$

$$C_{\min} = \max\{C_{\min,b*}; C_{\min,dur} + \Delta C_{dur,\gamma} - \Delta C_{dur,st} - \Delta C_{dur,add}; 10mm\}$$

$$C_{nom} = C_{\min} + \Delta C_{dev}$$

$$z = d\left[0.5 + \sqrt{(0.25 - K_{bal}/1.134)}\right]$$

$$C_{min} = a_{sd} - \emptyset_{link} - \frac{\emptyset_{bar}}{2}$$

$$x = (d - z)/0.4$$

Table 5.5: Minimum dimensions and axis distances for simply supported beams made with reinforced and prestressed concrete

Standard fire resistance	Minimum dimensions (mm)						
	Possible combinations of a and b_{min} where a is the average axis distance and b_{min} is the width of beam				Web thickness b_w		
					Class WA	Class WB	Class WC
1	2	3	4	5	6	7	8
R 30	b_{min} = 80 a = 25	120 20	160 15*	200 15*	80	80	80
R 60	b_{min} = 120 a = 40	160 35	200 30	300 25	100	80	100
R 90	b_{min} = 150 a = 55	200 45	300 40	400 35	110	100	100
R 120	b_{min} = 200 a = 65	240 60	300 55	500 50	130	120	120
R 180	b_{min} = 240 a = 80	300 70	400 65	600 60	150	150	140
R 240	b_{min} = 280 a = 90	350 80	500 75	700 70	170	170	160
a_{sd} = a + 10mm (see note below)							

For prestressed beams the increase of axis distance according to 5.2(5) should be noted.

a_{sd} is the axis distance to the side of beam for the corner bars (or tendon or wire) of beams with only one layer of reinforcement. For values of b_{min} greater than that given in Column 4 no increase of a_{sd} is required.

* Normally the cover required by EN 1992-1-1 will control.