
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2007/2008

April 2008

EAS 452/3 – Pre-Stressed Concrete Design
[Rekabentuk Konkrit Pra-Tegasan]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of **SEVEN (7)** printed pages including appendix before you begin the examination.

*[Sila pastikan kertas peperiksaan ini mengandungi **SEVEN (7)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.]*

Instructions: This paper consists of **FIVE (5)** questions. Answer **ALL** questions. All questions carry the same marks.

[Arahan: Kertas ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA** soalan. Semua soalan membawa jumlah markah yang sama.]

You may answer the question either in Bahasa Malaysia or English.

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

All questions **MUST BE** answered on a new page.

*[Semua soalan **MESTILAH** dijawab pada muka surat baru.]*

Write the answered question numbers on the cover sheet of the answer script.

[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

- 1(a) A rectangular prestressed beam with double tendon is anchored at end block as shown in Figure 1. Design and provide the reinforcement detailing for the end block if the jacking force at transfer (P_o) is 1860 kN.

Satu rasuk prategasan mempunyai dwi-tendon ditambat di blok hujung seperti di Rajah 1. Rekabentuk dan sediakan perincian tetulang blok hujung sekiranya daya tujahan masa pindah (P_o) adalah 1860 kN.

(16 marks / 16 markah)

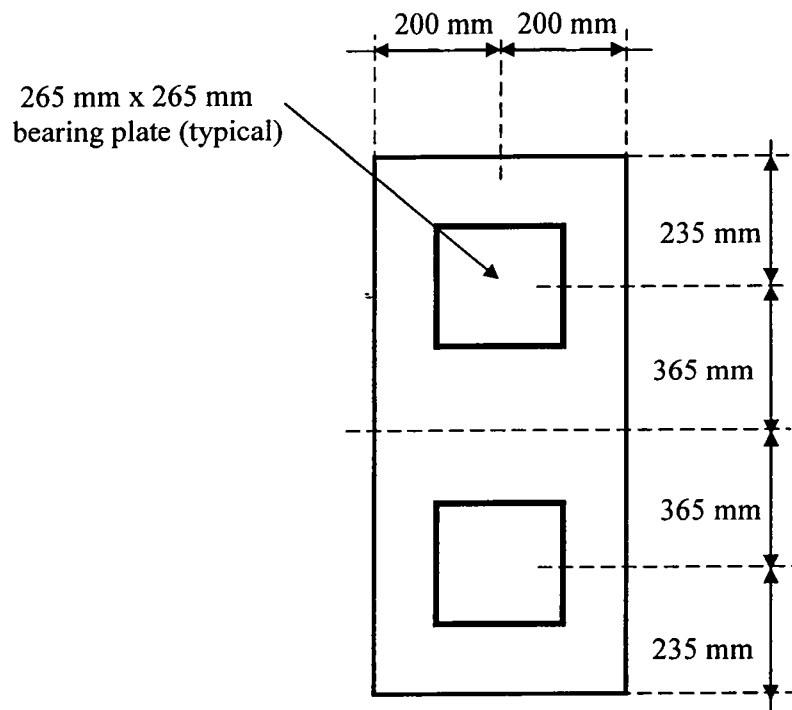


Figure 1 : Front View of End Block

- (b) Briefly explain the effect of bending moment and spalling moment at the end block of a prestressed concrete beam.

Terangkan dengan ringkas kesan momen lentur dan momen serpihan di blok hujung rasuk konkrit prategasan.

(4 marks / 4 markah)

2. (a) Design the shear reinforcement at section of a rectangular beam given as follow :-

Shear force at section considered, V_L	= 500 kN
Moment at section considered, M	= 750 kNm
Width, B	= 250 mm
Effective depth, d	= 800 mm
Overall depth, H	= 1000 mm
Tendon cross sectional area, A_{ps}	= 1700 mm ²
Characteristic strength of tendon, f_{pu}	= 1750 N/mm ²
Effective tensile prestress in tendon, f_{pe}	= 0.6 f_{pu}
Tendon eccentricity, E_s	= 300 mm
Angle of tendon inclination, β	= 5°
Duct diameter	= 100 mm
Area of main reinforcement in tension zone, A_s	= 2455 mm ²
Characteristic strength of concrete at ultimate, f_{cu}	= 50 N/mm ²
Characteristic strength of shear reinforcement, f_{yv}	= 250 N/mm ²
M_o	= $\frac{0.8 f_{pt} I}{y}$

Rekabentuk tetulang ricih pada keratan satu rasuk prategasan segiempat tepat, diberikan :-

Daya ricih pada keratan yang dipertimbangkan, V_L	= 500 kN
Momen pada keratan yang dipertimbangkan, M	= 750 kNm
Lebar, B	= 250 mm
Dalam berkesan, d	= 800 mm
Dalam keseluruhan, H	= 1000 mm
Luas keratan rentas tendon, A_{ps}	= 1700 mm ²
Kekuatan ciri tendon, f_{pu}	= 1750 N/mm ²
Tegangan berkesan prategasan dalam tendon, f_{pe}	= 0.6 f_{pu}
Kesipian tendon, E_s	= 300 mm
Sudut kecondongan tendon, β	= 5°
Garispusat salur	= 100 mm
Luas tetulang utama dalam zon tegangan, A_s	= 2455 mm ²
Kekuatan ciri konkrit pada had muktamad, f_{cu}	= 50 N/mm ²
Kekuatan ciri tetulang ricih, f_{yv}	= 250 N/mm ²
M_o	= $\frac{0.8 f_{pt} I}{Y}$

(15 marks / 15 markah)

(b) Briefly discuss the types of shear crack with respect to ultimate shear resistance of a prestressed concrete beam. Use suitable sketches.

Terangkan dengan ringkas jenis-jenis retakan ricih yang berkaitan dengan keupayaan ricih muktamad rasuk konkrit prategasan. Gunakan lakaran yang sesuai.

(5 marks / 5 markah)

3. (a) Briefly describe the loss of stress due to anchorage slip in post-tensioning system of prestress concrete.

Huraikan dengan ringkas kehilangan tegasan disebabkan kegelinciran tambatan dalam sistem pasca tegangan konkrit prategasan.

(5 markah / 5 markah)

- (b) Briefly explain two types of stresses loss due to friction.

Terangkan dengan ringkas dua jenis kehilangan tegasan akibat geseran

(5 marks / 5 markah)

A post tensioned cable of beam 10 m is initially tensioned up to a stress level of 1000N/mm^2 at one end. The tendons are curved with the slope of 1:24 and the area of tendons are 600mm^2 .

Sebuah rasuk prategasan mempunyai panjang rentang 10m dikenakan tegasan awal 1000N/mm^2 pada kabel secara pasca tegangan pada satu hujung. Kecerunan lendutan tendon ialah 1:24 dan luas tendon ialah 600mm^2 .

- i. Calculate the loss of prestress due to friction using the following data. Coefficient at friction between duct and cable, 0.55, friction coefficient for 'wave' effect, 0.0015 per meter.

Kirakan kehilangan tegasan disebabkan geseran mengikut data yang diberikan dibawah. Pekali geseran antara sesalur dan kabel, 0.55. Pekali geseran untuk kesan gelombang, 0.0015 setiap meter.

(5 marks / 5 markah)

- ii. If there is a slip of 3mm at the jacking end during anchoring, calculate the final force in the cable and percentage of loss of prestress due to friction and slip. Assume $E_s = 210\text{kN/mm}^2$.

Jika berlaku kegelinciran sebanyak 3 mm pada hujung bicu semasa penambatan kirakan daya akhir kabel dan peratus kehilangan tegasan disebabkan geseran dan kegelinciran. Anggap, $E_s = 210\text{kN/mm}^2$.

(5 marks / 5 markah)

4. (a) Sketch the stress strain relationship of strand, wire and bar for prestressed concrete in the same graph.

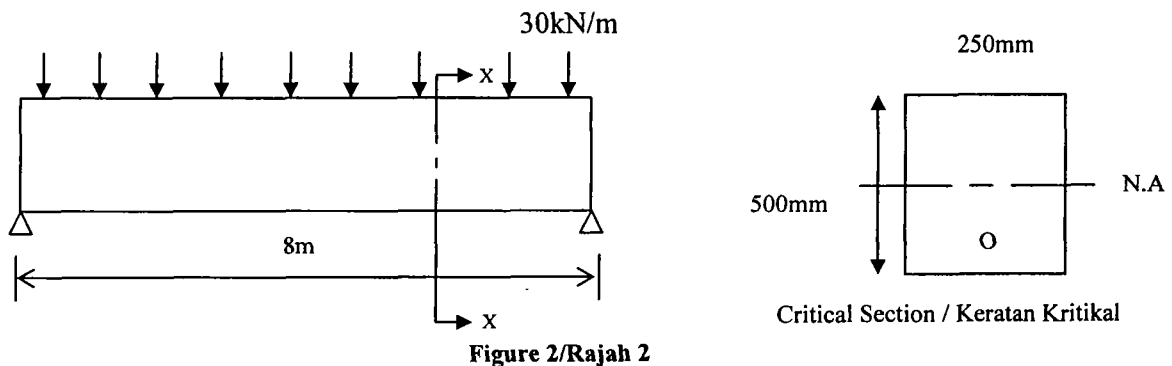
Lakarkan hubungan tegasan-terikan untuk strand, dawai dan bar pada graf yang sama.

(5 marks / 5 markah)

- (b) Determine the stresses (upper extreme fibre, lower extreme fibre) at midspan of a simply supported beam with section as shown in Figure 2. The beam carries a total uniform load (including selfweight) of 30kN/m and prestressed with a force of 1500 kN at eccentricity of 150mm below neutral axis.

Tentukan tegasan-tegasan (fiber teratas, fiber terbawah) pada tengah rentang rasuk mudah dengna kerton seperti ditunjukkan dalam Rajah 2. Rasuk tersebut membawa beban seragam (termasuk swa-berat) 30kN/m dan prategasan dengan daya 1500kN pada kesipian 150mm dibawah paksi neutral.

(15 marks / 15 markah)



5. (a) Briefly explain the differences between pre-tensioned and post-tensioned.

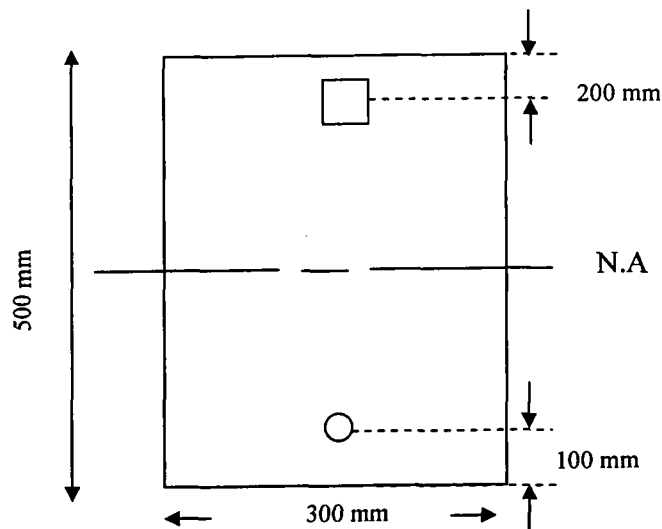
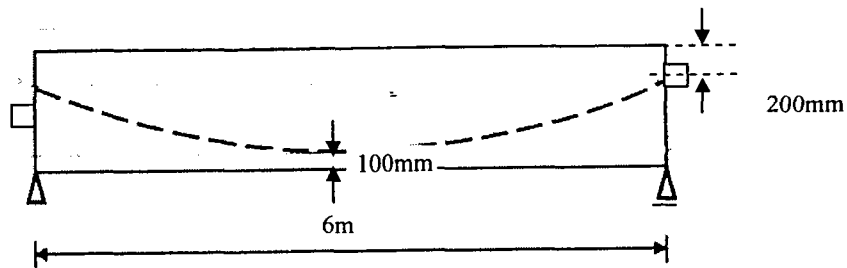
Terangkan secara ringkas perbezaan di antara system pra-tegasan dan pasca-tegasan.

(5 marks / 5 markah)

- (b) Determine the total deflections of the beam at midspan (critical section) due to prestress and selfweight as shown in **Figure 3**. Assume the density of concrete, 24kN/m^3 with prestress force of 5000kN . Standard formulae for deflection at midspan is given in **Appendix A**.

Tentukan jumlah pesongan pada bahagian tengah rasuk (keratan kritikal) disebabkan prategasan dan swa-berat. Anggap ketumpatan konkrit = 24kN/m^3 , daya prategasan = 5000kN . Persamaan piawai bagi pesongan di tengah rentang diberikan di Lampiran A.

(15 marks / 15 markah)

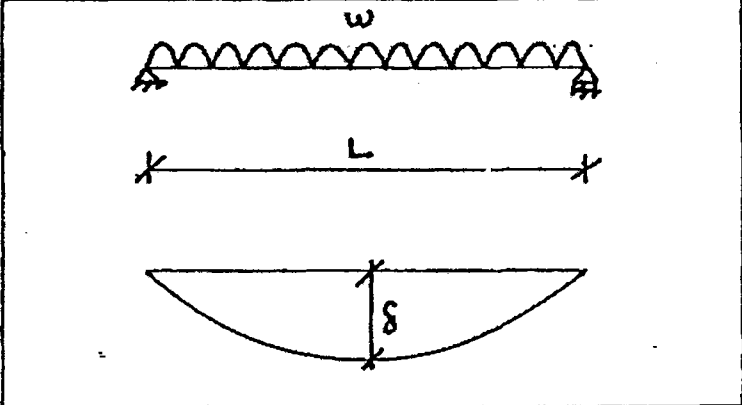
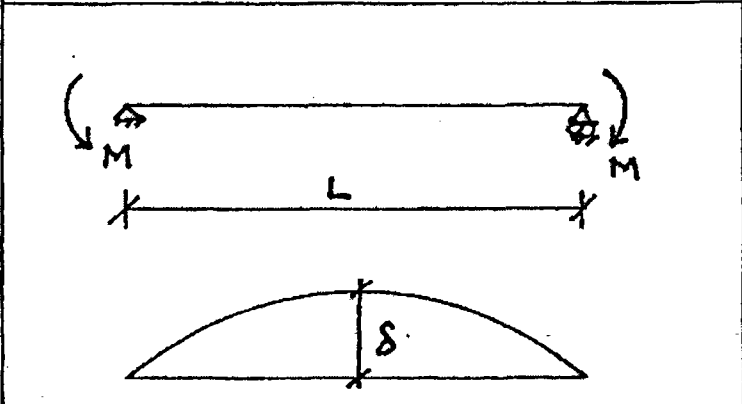
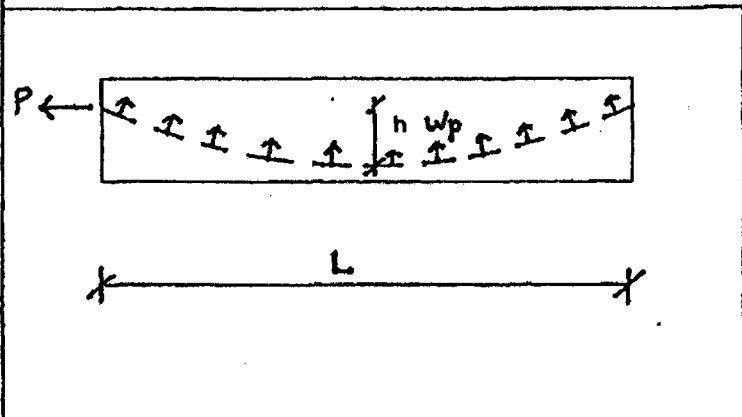


Critical Section/
Keratan Kritikal

(Figure 3/Rajah 3)

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STANDARD FORMULAE/FORMULA PIAWAI

KES BEBAN/LOAD CASE	DEFLECTION AT MIDSPAN/ PESONGAN DITENGAH RENTANG
	$\frac{5 wL^4}{384 EI}$
	$\frac{ML^2}{8 EI}$
	<p style="text-align: center;">w_p</p> $\frac{8 P h}{L^2}$