UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2017/2018

COURSE NAME	:	MECHANICS OF MATERIALS
COURSE CODE	:	DAC 20703
PROGRAMME CODE	:	DAA
EXAMINATION DATE	:	DECEMBER 2017 / JANUARY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN SECTION A AND **THREE (3)** QUESTIONS IN SECTION B.

THIS QUESTION PAPER CONSISTS OF **FOURTEEN (14)** PAGES

BAHASA MELAYU

BAHAGIAN A

S1 (a) Terangkan dengan terperinci hubungan tegasan dan terikan.

(4 markah)

(b) Bar segiempat tepat seperti yang ditunjukkan dalam **Rajah 1(b)** mempunyai lebar dan tinggi sebanyak 40 mm. Jika beban paksi sebanyak 800 N dikenakan di sepanjang titik centroid di permukaan luas bar itu, tentukan;

(i) Tegasan normal purata and tegasan ricih purata untuk seksyen *a-a*

(4 markah)

(ii) Tegasan normal purata dan tegasan ricih purata untuk seksyen *b-b*

(4 markah)

(c) Dua element dengan sambungan pin seperti ditunjukkan dalam **Rajah 1(c)**. Pandangan atas untuk sambungan pin di A dan B turut disertakan. Jika sambungan setiap pin mempunyai tegasan ricih izin sebanyak 90 MPa dan tegasan terikan izin untuk rod CB ialah 115 MPa, tentukan;

(i) Diameter terkecil yang dibenarkan untuk pin A dan B

(4 markah)

(ii) Diameter yang diperlukan untuk rod CB menampung beban

(4 markah)

TERBUKA

S2 (a) Definisikan tegasan utama dan satah utama.

(4 markah)

(b) **Rajah S2(b)** menunjukkan satu rasuk berukuran 10mm x 150mm yang dikenakan daya tegangan 500 N selari dengan paksi x. Kirakan σ_x , σ_n dan τ bagi satu elemen yang diambil pada kedudukan 45° dari pugak pada rasuk.

(8 markah)

(c) **Rajah S2(c)** menunjukkan satu elemen yang telah dikenakan tegasan normal pada paksi paksi y dan x dan tegasan ricih pada paksi xy. Lukiskan bulatan Mohr menggunakan skala yang sesuai untuk elemen tersebut dan kirakan nilai nilai berikut:

(i) Tegasan utama minimum dan maksimum

(4 markah)

(ii) Tegasan ricih maksimum

(2 markah)

(iii) Nilai tegasan terus pada permukaan satah ricih maksimum

(2 markah)

BAHAGIAN B

S3 (a) Tentukan tindakbalas pada penyokong A dan B untuk rasuk dan beban yang ditunjukkan dalam **Rajah S3(a).**

(6 markah)

(b) **Rajah S3(b)** menunjukkan sebuah rasuk yang dibebani beberapa beban tumpu.

(i) Kirakan daya-daya pada penyokong

(6 markah)

(ii) Lukiskan gambarajah daya ricih

(4 markah)

(iii) Lukiskan gambarajah momen lentur

(4 markah)

S4 (a) Definisikan terikan normal dalam rasuk.

(3 markah)

(b) **Rajah Q4(b)** menunjukkan beban teragih seragam, 20 kN/m dikenakan pada rasuk C seksyen.

(i) Menggunakan **a-a** sebagai garis rujukan, kirakan nilai **y** dalam **Rajah Q4(b).**

(5 markah)

(ii) Tentukan tegasan ricih pada titik C yang berada pada jarak 2 m dari sokong A dan pada jarak 100 mm dari bawah rasuk.

(4 markah)

(c) **Rajah S4(c)** menunjukkan rasuk berbentuk T yang dikenakan daya kenaan dan daya beban teragih seragam. Tentukan perkara-perkara berikut:

(i) Lukiskan Gambarajah Daya Ricih (GDR) dan Gambarajah Momen Lentur (GML)

(4 markah)

(ii) Berdasarkan GML, kirakan tegasan lentur tegangan dan mampatan di mana momen lentur maksimum

(4 markah)

S5 (a) Satu rasuk segiempat sama yang disokong mudah oleh sokong pin A dan sokong rola di F menanggung beban seperti yang ditunjukkan dalam **Rajah 5(a)**. Dengan menggunakan Kaedah Macaulay, tentukan;

(i) Tindakbalas di sokong A dan sokong F

(2 markah)

(ii) Pesongan pada titik D

(4 markah)

(iii) Cerun pada titik B

(4 markah)

(iv) Gambarajah daya ricih

(3 markah)

(v) Gambarajah momen lentur

(3 markah)

(b) Sekiranya pengiraan dilakukan menggunakan kaedah kamiran berganda, tentukan

(i) Bilangan pemalar yang akan diterbitkan dan perlu diselesaikan

(2 markah)

(ii) Kedudukan dan keadaan sempadan (boundary condition) yang boleh digunakan.

(2 markah)

TERBUKA

S6 (a) Sebatang aci besi berlubang mempunyai diameter luar iaitu 200 mm dan diameter dalam iaitu 100 mm. Aci tersebut dikenakan putiran sebanyak 40 kNm. Modulus ketegasan besi tersebut ialah 70 GPa. Tentukan:

(i) Momen sifatekun kutub (J)

(5 markah)

(ii) Tegasan ricih pada bahagian luar aci besi

(5 markah)

(iii) Tegasan ricih pada bahagian dalam aci besi

(5 markah)

(iv) Magnitud sudut piuhan pada 2.5 m panjang

(5 markah)

SOALAN TAMAT

ENGLISH

PART A

Q1 *(a) Explain in details the stress and strain relationship.*

(4 marks)

*(b) A square bar as shown in **Figure 1(b)** has width and height of 40 mm. If an axial load force of 800 N is applied along the centroidal axis of the bar's cross sectional area, determine;*

(i) The average normal stress and average shear stress acting along section plane a-a

(4 marks)

(ii) The average normal stress and average shear stress acting along section plane b-b

(4 marks)

*(c) Two members are pinned together as shown in **Figure 1(c)**. Top views of the pin connections at A and B are also given. If the pins have an allowable shear stress of 90 MPa and allowable tensile stress of rod CB is 115 MPa, determine;*

(i) The smallest allowable diameter of pins A and B

(4 marks)

(ii) The diameter of rod CB necessary to support the load

(4 marks)

TERBUKA

Q2 (a) *Define principal stress and principal plane.*

(4 marks)

*(b) **Figure Q2(b)** shows a beam with dimension of 10mm x 150mm subjected to tension force of 500 N acting parallel to x axis. Calculate σ_x , σ_n and τ for an element taken from a surface incline at 45° from vertical.*

(8 marks)

*(c) **Figure Q2(c)** shows an element subjected to normal stress from y and x direction as well as a shear stress on surface xy. Draw the corresponding Mohr circle for the element using suitable scale and indicate the following values:*

(i) Maximum and minimum principle stresses

(4 marks)

(ii) Maximum shear stress

(2 marks)

(iii) Normal stress corresponding to maximum shear stress plane

(2 marks)

PART B

Q3 (a) *Determine the reactions at support A and B for the beams and loading as shown in **Figure Q3(a).***

(6 marks)

(b) ***Figure Q3(b)** shows a beam with point loads.*

(i) Determine the reactions at the support

(6 marks)

(ii) Draw the shear force diagram (SFD)

(4 marks)

(iii) Draw the bending moment diagram (BMD)

(4 marks)

Q4 (a) *Define normal strain in beam.*

(3 marks)

(b) ***Figure Q4(b)** shows uniform distributed load 40 kN/m inserted to a beam with C cross section.*

*(i) Using **a-a** as reference, calculate value for **y** in **Figure Q4(b)***

(5 marks)

(ii) Determine shear stress at point C located 2 m from support A and 100 mm from below of the beam.

TERBUKA

(4 marks)

*(c) **Figure Q4(c)** shows uniform distributed load 20 kN/m inserted to a beam with T cross section.*

*(i) Using **a-a** as reference, calculate value for **y** in **Figure Q4(c)***

(4 marks)

(ii) Determine shear stress at point C located 2 m from support A and 100 mm from below of the beam.

(4 marks))

Q5 (a) *A simply supported beam with pin support at point A and roller support at F has a rectangular cross section is subjected to loads as shown in* ***Figure Q5(a)****. By using Macaulay method, determine;*

(i) Reaction at support A and F

(2 marks)

(ii) Deflection at point D

(4 marks)

(iii) Slope at point B

(4 marks)

(iv) Shear force diagram

(3 marks)

(v) Bending moment diagram

(3 marks)

(b) If the calculation is made by using Double Integration method, determine the required;

(i) Number of coefficient

(2 marks)

(ii) Location and the boundary condition

(2 marks)

Q6 (a) *A hollow steel shaft has an outside diameter of 200 mm and an inside diameter 100 mm. The shaft is subjected to a torque of 40 kNm. The modulus of rigidity for the steel is 70 GPa. Determine:*

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(i) Polar moment of inertia of the cross sectional area (J) of the shaft

(5 marks)

(ii) The shearing stress at the outside surface of the shaft.

(5 marks)

(iii) The shearing stress at the inside surface of the shaft.

(5 marks)

(iv) The magnitude of the angle of twist in a 2.5 m length.

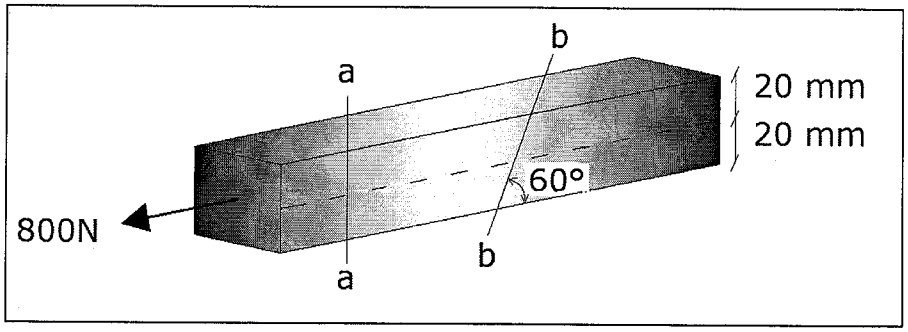
(5 marks)

END OF QUESTIONS

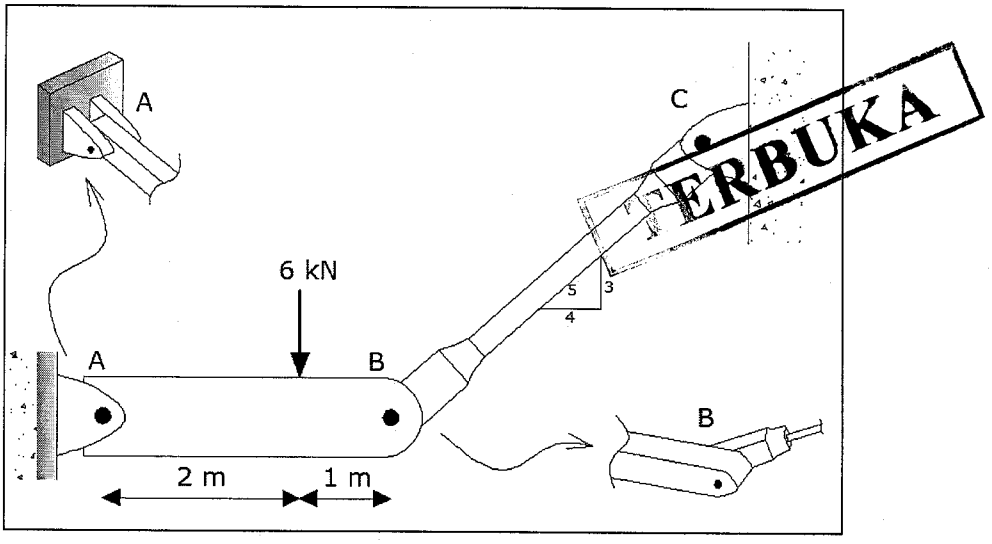
PEPERIKSAAN AKHIR

SEMESTER / SESI : SEM I / 2017/2018 KOD PROGRAM : 2 DAA

NAMA KURSUS : MEKANIK BAHAN KOD KURSUS : DAC 20703



Rajah S1(b)/Figure Q1(b)



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Rajah S1(c)/Figure Q1(c)

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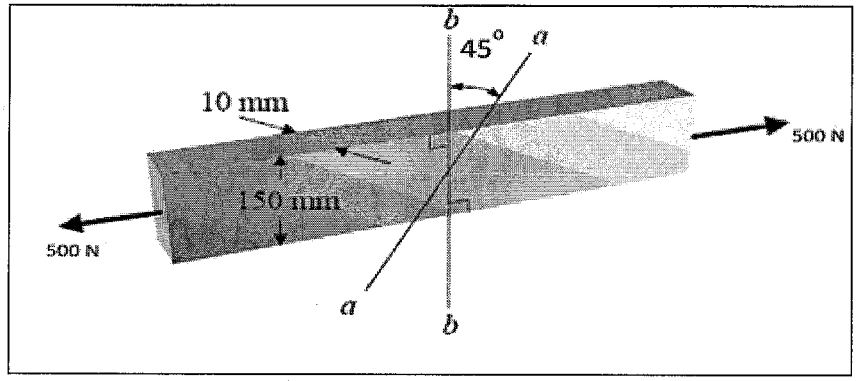

Rajah S2(b)/Figure Q2(b)

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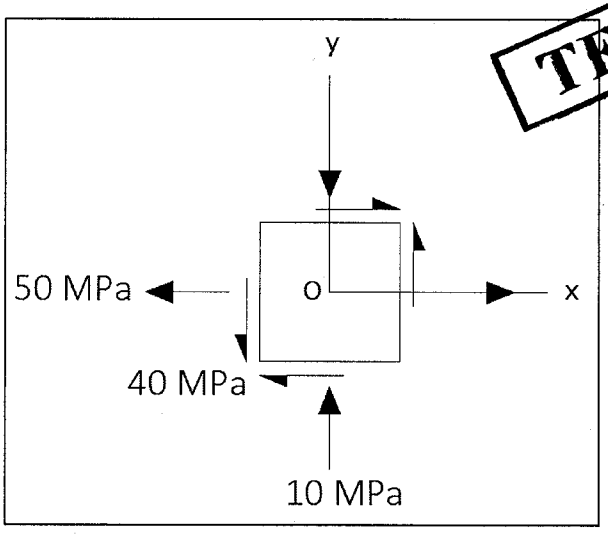

Rajah S2(c)/Figure Q2(c)

PEPERIKSAAN AKHIR

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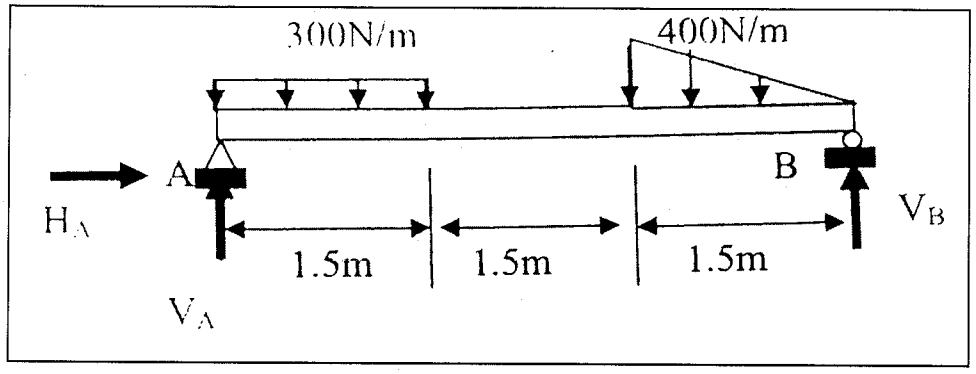

Rajah S3(a)/Figure Q3(a)

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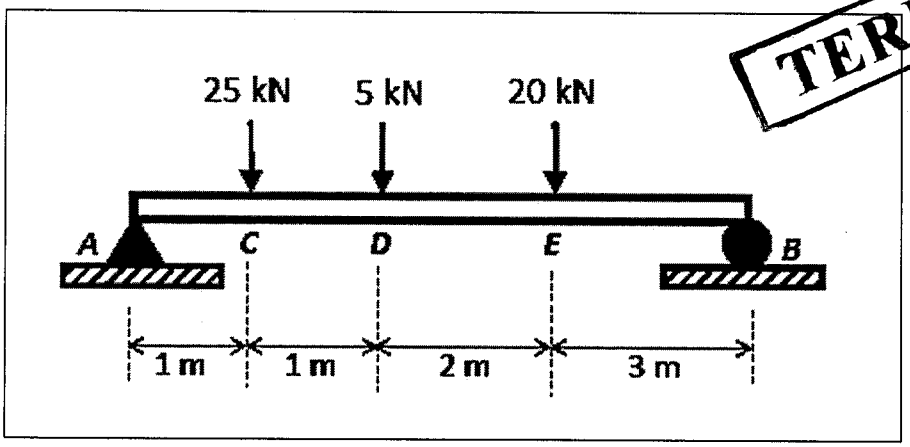

Rajah S3(b)/Figure Q3(b)

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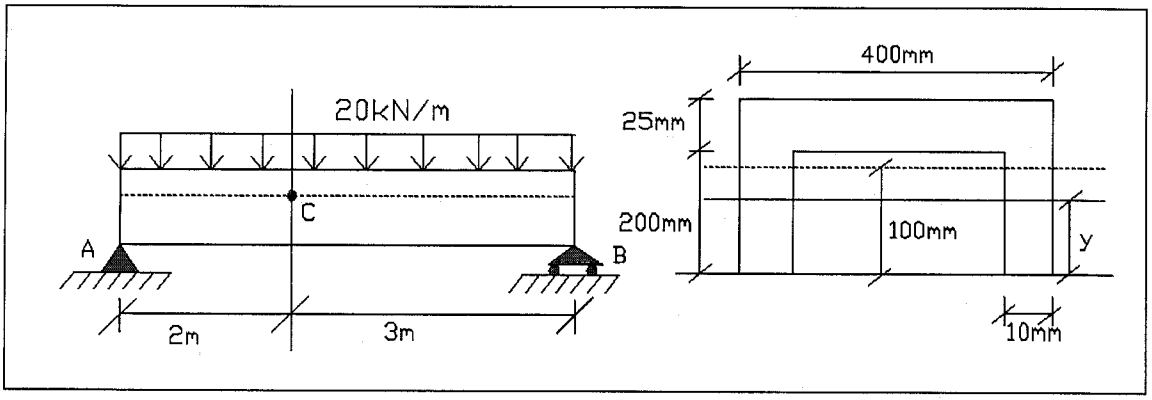
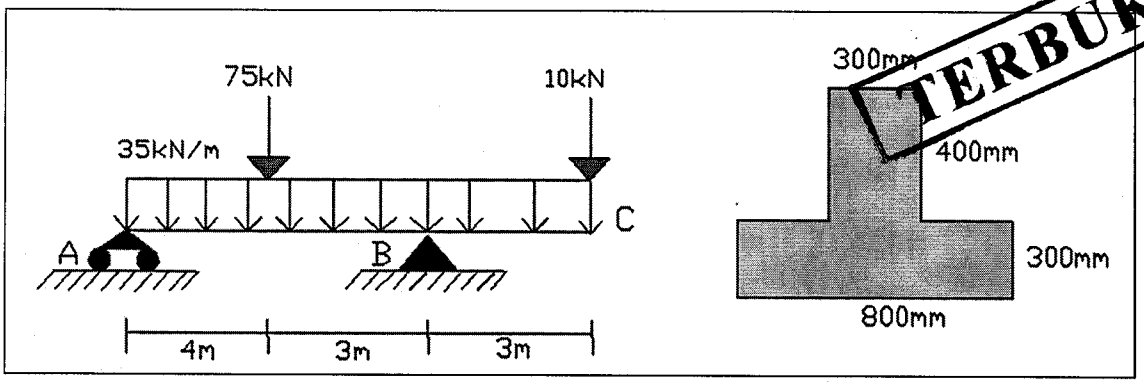


Rajah S4(b)/Figure Q4(b)



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Rajah S4(c)/Figure Q4(c)

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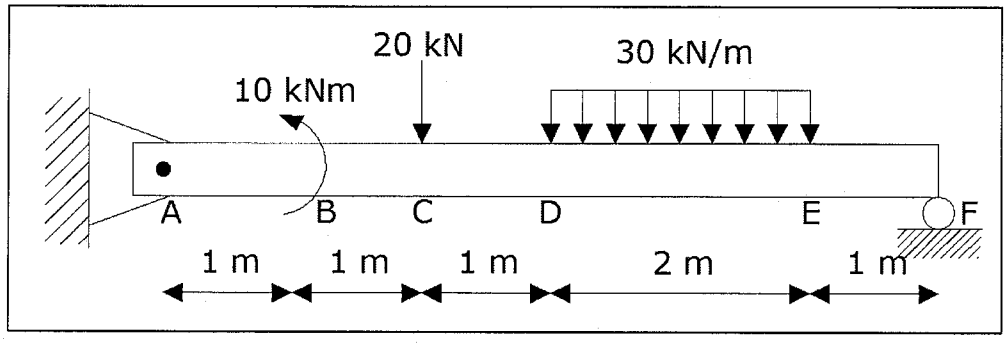
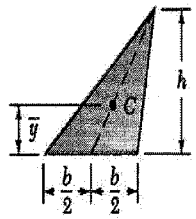
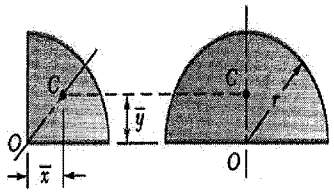


Rajah S5(a)/Figure Q5(a)

Lampiran 1/Appendix 1:

Shape		$\bar{x}$	$\bar{y}$	Area
Triangular area		$\frac{b}{2}$	$\frac{h}{3}$	$\frac{bh}{2}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Semicircular area		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$

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Normal Stress

$$\sigma_{ave} = \frac{N}{A}$$

Normal Strain:

$$\varepsilon = \frac{\delta}{L}$$

Safety Factor

$$F.S. = \frac{\sigma_{fail}}{\sigma_{allow}}$$

Shear Stress

$$\tau_{ave} = \frac{V}{A}$$

Shear Strain

$$\gamma = \frac{\text{angular deformation}}{\text{(in radians)}}$$

Poisson's Ratio

$$\nu = \frac{-\varepsilon_{lateral}}{\varepsilon_{longitudinal}}$$

Hooke's Laws:

$$\sigma = E\varepsilon \qquad \tau = G\gamma$$

Generalized Hooke's Law

$$\varepsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E}$$

$$\varepsilon_y = \frac{\sigma_y}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_z}{E}$$

$$\varepsilon_z = \frac{\sigma_z}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_y}{E}$$

Due to Force

$$\delta = \frac{F\,L}{E\,A}$$

Due to Temperature Change

$$\delta_{Temp} = \alpha\, L\, \Delta T$$

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$$\tau = \frac{T\rho}{J} \quad \text{and} \quad \phi = \frac{TL}{GJ}$$

$$\sigma = -\frac{Mc}{I}$$

$$J_{circle} = \frac{\pi D^4}{32} \qquad I_{circle} = \frac{\pi D^4}{64} \qquad I_{rectangle} = \frac{1}{12}bh^3$$

PEPERIKSAAN AKHIR

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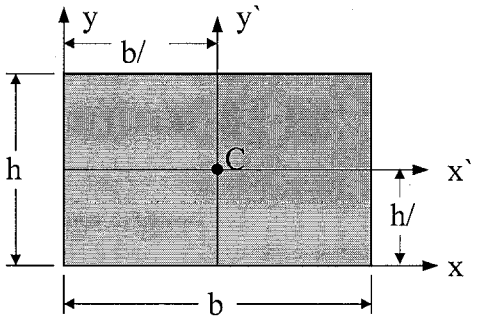
Lampiran 2/Appendix 2

Rectangle:

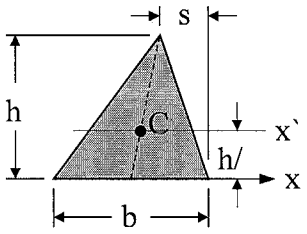
$$\bar{I}_{x'} = \frac{1}{12}bh^3$$

$$\bar{I}_{y'} = \frac{1}{12}b^3h$$



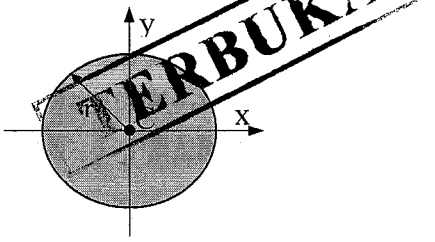
Triangle:

$$\bar{I}_{x'} = \frac{1}{36}bh^3$$



Circle:

$$\bar{I}_x = \bar{I}_y = \frac{1}{4}\pi r^4$$



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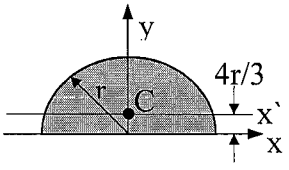
Semi-circle:

$$I_x = \bar{I}_y = \frac{1}{8}\pi r^4 \qquad \bar{I}_{x'} = \left(\frac{\pi}{8} - \frac{8}{9\pi}\right)r^4$$



Parallel axis theorem

$$I_x = \bar{I}_x + Ad^2 \qquad I_y = \bar{I}_y + Ad^2$$