UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang 1988/89

Mac/April 1989

REE 311 Rekabentuk Struktur Kayu Dan Logam

Masa : (3 jam)

Sila pastikan bahawa kertas peperiksaan ini mengandungi EMPAT muka surat dan TIGA muka surat Jadual yang tercetak sebelum anda memulakan peperiksaan ini.

Jawab LIMA soalan: DUA dari Bahagian A dan TIGA dari Bahagian B.

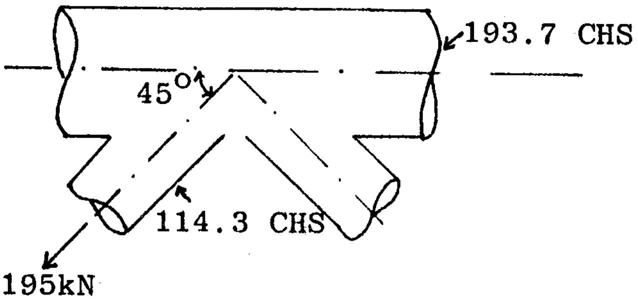
Gunakan buku jawapan yang berasingan bagi setiap bahagian.

Jadual-jadual tertentu disediakan.

BAHAGIAN A (Jawab DUA soalan)

1. (a) Dengan menggunakan lakaran, bincangkan jenis-jenis kimpal.

   (b) Kira panjang kaki kimpal yang dikehendaki untuk sambungan yang diberikan dalam Rajah 1.



Rajah 1

(20 markah)

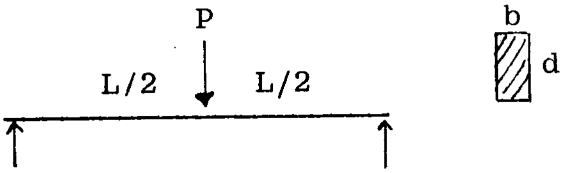
...2/-

2. Sekiranya kayu dianggap sebagai bahan isotropi, maka ia mengandungi 12 pemalar kenyal, 9 daripadanya adalah bebas. Takrifkan 12 pamalar itu dan berikan beberapa kehubungan yang mengurangkannya menjadi 9.

(20 markah)

<u>BAHAGIAN B</u> (Jawab <u>TIGA</u> soalan)

3. Rajah 2 menunjukkan pembebanan yang bertindak keatas sebatang rasuk kayu yang disokong mudah.



Rajah 2

Diberi:

τ^* = tegasan ricih selari dengan ira yang dibenarkan.

σ^* = tegasan lenturan yang dibenarkan.

E^* = modulus kekenyalan yang dibenarkan.

kL = pesongan yang dibenarkan.

Lakarkan lengkung L/d apabila rekabentuk dikawal oleh:

(a) Tegasan ricih selari dengan ira.

(b) Tegasan Lenturan.

(c) Pesongan yang disebabkan oleh lenturan.

Apakah yang kamu faham daripada rekabentuk sekiranya diberi spesis kayu yang mempunyai ciri berikut:

$k = 0.003$

$\tau^* = 0.76\ \text{N/mm}^2$

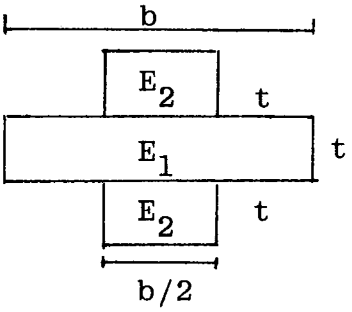
$\sigma^* = 6.2\ \text{N/mm}^2$

$E^* = 8300\ \text{N/mm}^2$

(20 markah)

4. (a) Tunjukkan bahawa kekukuhan lenturan rasuk tiga lapis (Rajah 3) dinyatakan oleh:

$$\frac{1}{12} bt^3 \left(E_1 + 13E_2\right)$$



Rajah 3

(b) Terbitkan persamaan-persamaan bagi taburan tegasan ricih meliputi keseluruhan tebal bagi rasuk (lihat Rajah 3) dan buktikan bahawa tegasan ricih maksimum dinyatakan oleh:

$$\tau = \frac{3V}{2bt} \left[\frac{E_1 + 8E_2}{E_1 + 13E_2}\right]$$

di sini V = daya ricih pada keratan.

(c) Lakarkan taburan tegasan ricih pada rasuk 'tiga lapis' itu apabila ira pada lapisan permukaan selari dengan panjangnya rasuk itu jika $E_2 < E_1$.

(d) Berbantukan lakaran, nyatakan sama ada lapisan-lapisan itu tertakluk kepada ricih gelangsar, punding atau guling.

(20 markah)

...4/-

5. Rajah 4 menunjukkan keratan rasuk kayu Chengal disokong mudah berjarak rentang 3 m dan dibiar terbakar di empat permukaannya.

   Berpandukan data serta jadual yang dilampirkan, anda diminta menyiasat keadaan kekuatan rasuk ini selepas terbakar selama 30 minit.

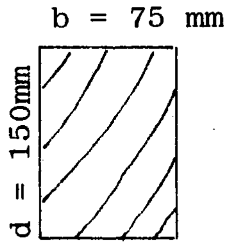
   Diberi:

   kadar kebakaran kayu = 20 mm/30 min

   beban kenaan = 1.5 kN/m panjang

   Faktor tegasan yang dibenarkan = (2.00 (untuk $b < 70$ mm)
   (2.25 (untuk $b \geqslant 70$ mm)

   Pesongan yang dibenarkan = $\frac{1}{30}$ x jarak rentang

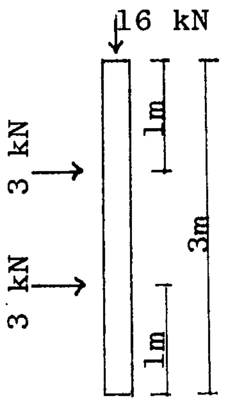


Rajah 4

6. Rajah 5 menunjukkan sistem pembebanan yang bertindak keatas sebuah tiang kayu Chengal Gred Biasa.

   Tentukan keratan kayu Chengal yang sesuai berasaskan kepada tegasan kering menggunakan jadual-jadual yang dilampirkan.

   Sebarang andaian hendaklah diterangkan dengan jelas.



Rajah 5

(20 markah)

212

(REE 311)

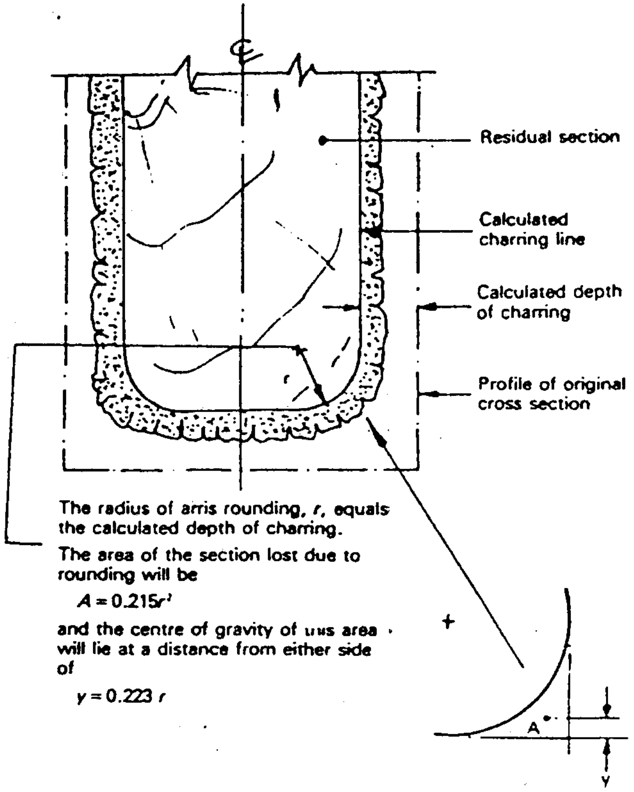
JADUAL

REE 311

Table 4. STRENGTH OF FILLET WELDS. GRADE 43 STEEL

(Allowable stress = 115 N/mm², Strength = leg length×0.7×115 N/mm)

Imperial sizes			S.I. sizes	
Leg length		Strength	Leg length	Strength
(in)	(mm)	(N/mm)	(mm)	(N/mm)
			3	242
3/16	4.77	384	4	322
1/4	6.35	511	5	402
5/16	7.93	638	6	483
3/8	9.53	766	8	644
7/16	11.1	894	10	805
1/2	12.7	1020	12	965
9/16	14.4	1160	14	1128
5/8	15.9	1280	16	1288
11/16	17.5	1410	18	1450
3/4	19.0	1530	20	1610



The radius of arris rounding, r, equals the calculated depth of charring.

The area of the section lost due to rounding will be

$A = 0.215r^2$

and the centre of gravity of this area will lie at a distance from either side of

$y = 0.223\,r$

Fig. 14 Radius of arris rounding.

[Note: For periods of fire exposure not exceeding 30 mins. where the least dimension of the rectangular residual sections is not less than 50 mm, rounding is insignificant and may be disregarded.]

...6/-

213

JADUAL

TABLE VII
DRY STRESSES AND MODULI OF ELASTICITY

REE 311

(Stresses and moduli experssed in N/mm^2 or Megapascal)

NOTE: These stresses apply to timber having a moisture content not exceeding 19 per cent.

g and Tension l to the Grain		Compression Parallel to the Grain				Compression Perpendicular to the Grain				Shear Parallel to the Grain				Modulus of Elasticity for all Grades	
Standard Grade	Common Grade	Basic	Select Grade	Standard Grade	Common Grade	Basic	Select Grade	Standard Grade	Common Grade	Basic	Select Grade	Standard Grade	Common Grade	Mean	Minimum
–	–	–	–	–	–	–	–	–	–					–	
15.9	12.6	22.3	17.8	14.0	11.1	1.93	1.59	1.52	1.45	3.24	2.78	1.79	1.45	14,800	10,800
12.5	9.9	17.7	14.1	11.2	8.8	0.96	0.83	0.76	0.69	2.96	2.14	1.66	1.31	14,000	9,700
28.3	22.5	45.1	36.0	28.4	22.5	4.28	3.59	3.38	3.17	4.13	2.96	2.28	1.86	23,000	19,200
28.1	22.3	39.9	31.9	25.1	19.9	4.21	3.52	3.31	3.10	4.34	3.10	2.41	1.93	19,000	13,200
10.3	8.2	14.3	11.4	9.0	7.1	0.76	0.62	0.59	0.55	1.93	1.38	1.03	0.83	11,700	7,000
12.8	10.1	15.7	12.6	9.9	7.9	1.24	1.03	0.96	0.90	2.41	1.72	1.31	1.03	11,200	8,500
–	–	–	–	–	–	–	–	–	–		–	–	–	–	–
–	–	–	–	–	–	–	–	–	–			–	–	–	–
23.4	18.6	29.2	23.3	18.3	14.6	3.79	3.17	3.03	2.83	4.96	3.52	2.76	2.21	16,100	9,700
8.9	7.1	11.6	9.2	7.2	5.8	0.83	0.69	0.62	0.59	1.66	1.17	0.90	0.69	8,100	5,600
–	–	–	–	–	–	–	–	–	–	–		–	–	–	–
13.2	10.6	18.2	14.6	11.4	9.1	1.59	1.31	1.24	1.17	2.48	1.79	1.38	1.10	11,900	8,700
26.2	20.8	32.9	26.3	20.7	16.4	3.86	3.24	3.03	2.90	4.41	3.17	2.41	1.93	18,400	12,700
12.5	9.9	16.1	12.8	10.1	8.0	1.59	1.31	1.24	1.17	2.48	1.79	1.38	1.10	11,900	7,200
18.3	14.6	31.2	24.9	19.6	15.6	2.41	2.00	1.93	1.79	3.52	2.48	1.93	1.59	17,700	14,000
21.6	17.2	28.6	22.9	18.0	14.3	3.65	3.10	2.90	2.69	3.38	2.41	1.86	1.52	19,800	14,700
16.1	12.8	23.2	18.5	14.6	11.6	1.52	1.24	1.17	1.10	2.69	1.93	1.45	1.17	16,300	13,300
19.4	15.4	28.1	22.5	17.7	14.1	1.68	1.38	1.31	1.24	3.24	2.28	1.79	1.47	14,300	11,000
15.0	11.9	19.1	14.5	11.4	9.0	1.86	1.59	1.45	1.38	2.90	2.07	1.59	1.31	10,600	7,300
10.9	8.7	14.8	11.9	9.3	7.4	2.07	1.72	1.66	1.52	3.24	2.28	1.79	1.45	14,100	7,000
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
12.3	9.8	17.9	14.3	11.2	9.0	0.96	0.83	0.76	0.69	2.41	1.72	1.31	1.03	9,900	8,200
–	–	–	–	–	–	–	–	–	–			–	–	–	–
12.8	10.1	19.6	15.7	12.3	9.8	1.38	1.17	1.10	1.03	2.90	2.07	1.59	1.31	11,700	5,700
17.2	13.8	23.2	18.5	14.6	11.6	2.76	2.34	2.21	2.07	3.52	2.48	1.93	1.59	10,100	12,100
12.7	10.1	24.1	19.2	15.1	12.0	1.31	1.10	1.03	0.96	4.00	1.86	1.46	1.17	13,700	8,700
–	–	–	–	–	–	–	–	–	–		–	–	–	–	–
14.3	11.4	17.4	13.9	11.0	8.7	1.24	1.03	0.98	0.90	2.62	1.86	1.45	1.17	11,900	9,400
14.3	11.4	17.4	13.9	11.0	8.7	1.24	1.03	0.96	0.90	2.62	1.86	1.46	1.17	11,900	9,400

214

JADUAL

Table II Geometrical properties of processed timber (reproduced from table 56 CP 112)

Basic size	Minimum size	Area	Section modulus		Second moment of area (I)		Radius of gyration	
			About x-x	About y-y	About x-x	About y-y	About x-x	About y-y
mm	mm	10^3 mm^2	10^3 mm^3	10^3 mm^3	10^6 mm^4	10^6 mm^4	mm	mm
40 × 75	37 × 72	2·66	37·0	16·4	1·15	0·304	20·8	10·7
40 × 100	37 × 97	3·59	58·0	22·1	2·81	0·409	28·0	10·7
40 × 125	37 × 120	4·44	88·8	27·4	5·33	0·507	34·6	10·7
40 × 150	37 × 145	5·36	130	33·1	9·40	0·612	41·9	10·7
40 × 175	37 × 169	6·25	176	38·5	14·9	0·713	48·8	10·7
40 × 200	37 × 194	7·18	232	44·3	22·5	0·819	56·0	10·7
40 × 225	37 × 219	8·10	296	50·0	32·4	0·924	63·2	10·7
44 × 75	41 × 72	2·95	35·4	20·2	1·28	0·414	20·8	11·8
44 × 100	41 × 97	3·98	64·3	27·2	3·12	0·557	28·0	11·8
44 × 125	41 × 120	4·92	98·4	33·6	5·90	0·689	34·6	11·8
44 × 150	41 × 145	5·94	144	40·6	10·4	0·833	41·9	11·8
44 × 175	41 × 169	6·93	195	47·3	16·5	0·971	48·8	11·8
44 × 200	41 × 194	7·95	257	54·4	24·9	1·11	56·0	11·8
44 × 255	41 × 219	8·98	328	61·4	35·9	1·26	63·2	11·8
44 × 250	41 × 244	10·0	407	68·4	49·6	1·40	70·4	11·8
44 × 300	41 × 294	12·1	591	82·4	86·8	1·69	84·9	11·8
50 × 75	47 × 72	3·38	40·6	26·5	1·46	0·623	20·8	13·6
50 × 100	47 × 97	4·56	73·7	35·7	3·57	0·839	28·0	13·6
50 × 125	47 × 120	5·64	113	44·2	6·77	1·04	34·6	13·6
50 × 150	47 × 145	6·82	165	53·4	11·9	1·25	41·9	13·6
50 × 175	47 × 169	7·94	224	62·2	18·9	1·46	48·8	13·6
50 × 200	47 × 194	9·12	295	71·4	28·6	1·68	56·0	13·6
50 × 225	47 × 219	10·3	376	80·7	41·1	1·89	63·2	13·6
50 × 250	47 × 244	11·5	466	89·9	56·9	2·11	70·4	13·6
50 × 300	47 × 294	13·8	677	108	99·5	2·54	84·9	13·6
63 × 100	60 × 97	5·82	94·1	58·2	4·56	1·75	28·0	16·3
63 × 125	60 × 120	7·20	144	72·0	8·64	2·16	34·6	17·3
63 × 150	60 × 145	8·70	210	87·0	15·2	2·61	41·9	17·3
63 × 175	60 × 169	10·1	286	101	24·1	3·04	48·8	17·3
63 × 200	60 × 194	11·6	376	116	36·5	3·49	56·0	17·3
63 × 225	60 × 219	13·1	480	131	5·25	3·94	63·2	17·3
75 × 100	72 × 97	6·98	113	83·8	5·48	3·02	28·0	20·8
75 × 125	72 × 120	8·64	173	104	10·4	3·73	34·6	20·6
75 × 150	72 × 145	10·4	252	125	18·3	4·51	41·9	20·8
75 × 175	72 × 169	12·2	343	146	29·0	5·26	48·8	20·8
75 × 200	72 × 194	14·0	452	168	43·8	6·03	56·0	20·8
75 × 225	72 × 219	15·8	576	189	63·0	6·81	63·2	20·8
75 × 250	72 × 244	17·6	714	211	87·2	7·59	70·4	20·8
75 × 300	72 × 294	21·2	1040	254	152	9·14	84·9	20·8
100 × 100	97 × 97	9·41	152	152	7·38	7·38	28·0	28·0
100 × 150	97 × 145	14·1	340	227	24·6	11·0	41·9	28·0
100 × 200	97 × 194	18·8	608	304	59·0	14·8	56·0	28·0
100 × 250	97 × 244	23·7	962	383	117	18·6	70·4	28·0
100 × 300	97 × 294	28·5	1400	461	205	22·4	84·9	28·0
150 × 150	145 × 145	21·0	508	508	36·8	36·8	41·9	41·9
150 × 200	145 × 194	28·1	910	680	88·2	49·3	56·0	41·9
150 × 300	145 × 294	42·6	2090	1030	307	74·7	84·9	41·9
200 × 200	194 × 194	37·6	1220	1220	118	118	56·0	56·0
250 × 250	244 × 244	59·5	2420	2420	295	295	70·4	70·4
300 × 300	294 × 294	86·4	4240	4240	623	623	84·9	84·9

Table I: Maximum depth-to-breadth ratios (solid and laminated members)

Degree of lateral support	Maximum depth-to-breadth ratio
No lateral support	2
Ends held in position	3
Ends held in position and member held in line, as by purlins or tie rods	4
Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists	5
Ends held in position and compression edge held in line, as by direct connection of sheathing, deck or joists, together with adequate bridging or blocking spaced at intervals not exceeding 6 times the depth	6
Ends held in position and both edges firmly held in line	7

Table III Modification factor K_{11} for duration of loading on flexural members and members in tension

Duration of loading	Value of K_{11}
Long term (eg dead + permanent imposed)	1·00
Medium term (eg dead + snow, dead + temporary loads)	1·25
Short term (eg dead + imposed + wind, dead + imposed + snow + wind)	1·5

Table IV Modification factor K_{18} for slenderness ratio and duration of loading on compression members of 40 grade and 50 grade softwood

Slenderness ratio		Values of K_{18}		
Length/radius of gyration	Length/breadth	Long-term loads	Medium-term loads	Short-term loads
Less than 5	1·4	1·00	1·25	1·50
5	1·4	0·99	1·24	1·49
10	2·9	0·98	1·23	1·47
20	5·8	0·96	1·20	1·44
30	8·7	0·94	1·17	1·40
40	11·5	0·91	1·13	1·34
50	14·4	0·87	1·08	1·27
60	17·3	0·83	1·00	1·16
70	20·2	0·77	0·90	1·01
80	23·0	0·70	0·79	0·86
90	26·0	0·61	0·66	0·72
100	28·8	0·53	0·56	0·60
120	34·6	0·40	0·42	0·44
140	40·4	0·31	0·32	0·33
160	46·2	0·24	0·25	0·26
180	52·0	0·20	0·20	0·20
200	57·7	0·16	0·16	0·17

-oooOOooo-