UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang 1987/88

REW 315 - Teori Struktur Dan Rekabentuk II

Tarikh: 6 November 1987

Masa: 9.00 pagi - 12.00 t/hari
(3 jam)

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

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

BAHAGIAN A (jawab TIGA soalan)

1. (a) Huraikan tentang jenis-jenis struktur dan pengkelasan yang anda ketahui.

(b) Tentukan darjah ketidaktentuan struktur dalam Rajah 1(a) dan 1(b) dan bincangkan tentang daya-daya dalam dan kecacatan yang akan berlaku disebabkan beban.

(c) Tentukan kecacatan memugak di titik 4 disebabkan beban-beban yang dikenakan.

Ambil nilai

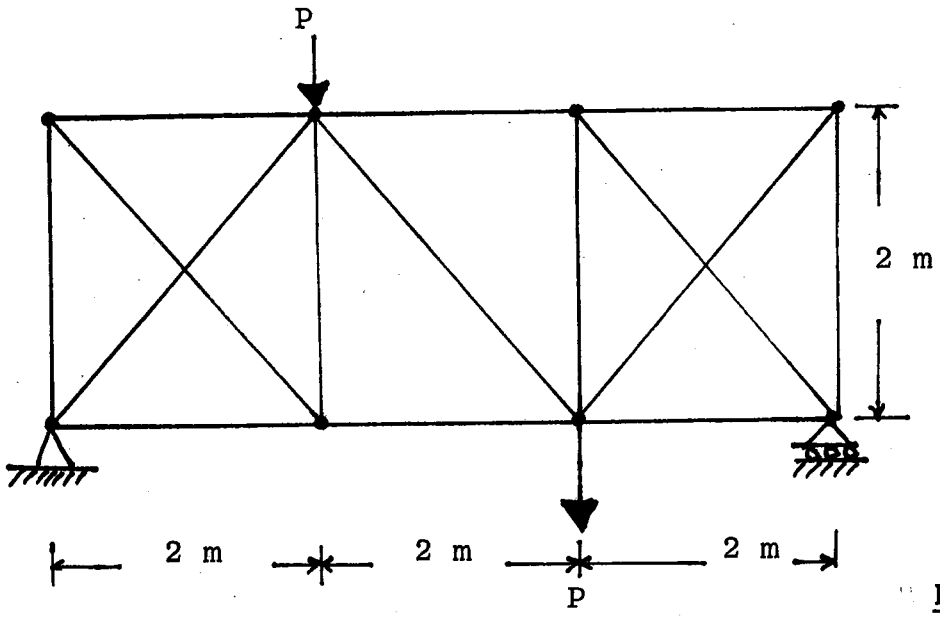
$E = 200\ kN/mm^2$

Ahli tegang = $1500\ mm^2$

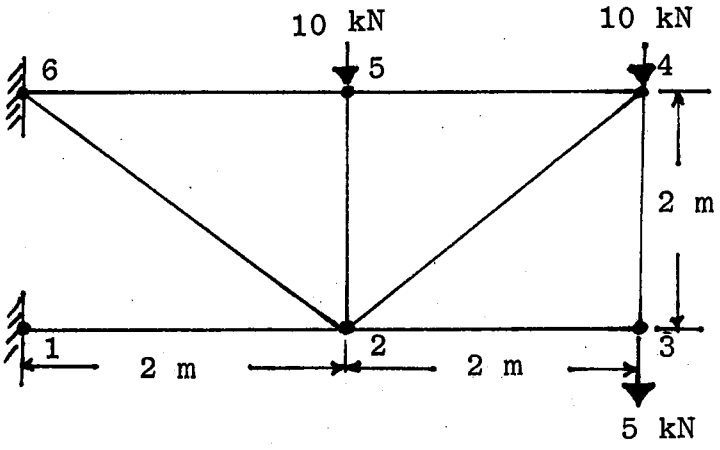
Ahli mampat = $2000\ mm^2$

(20 markah)

...2/-



Rajah 1(a)



Rajah 1(b)

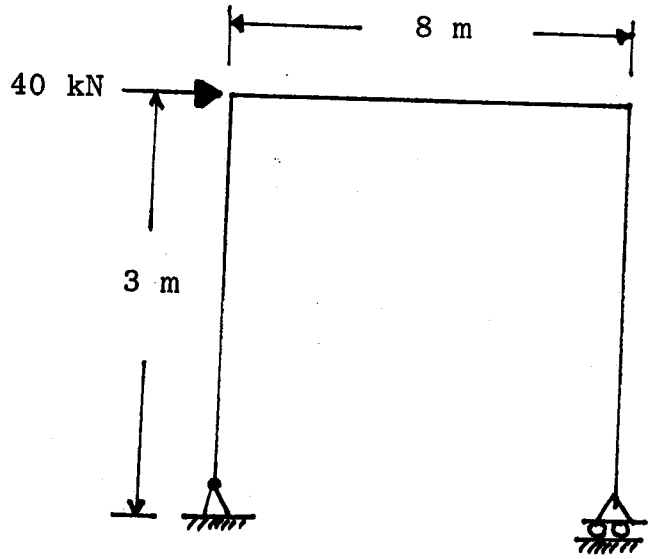
2. (a) Lukiskan gambarajah daya ricih dan momen lentur untuk struktur-struktur yang mempunyai beban seperti dalam Rajah 2(a) dan 2(b).

(b) Tentukan nilai-nilai daya tindakbalas serta lukisan gambarajah daya ricih dan momen lentur untuk struktur dalam Rajah 2(c) menggunakan kaedah Kelenturan.

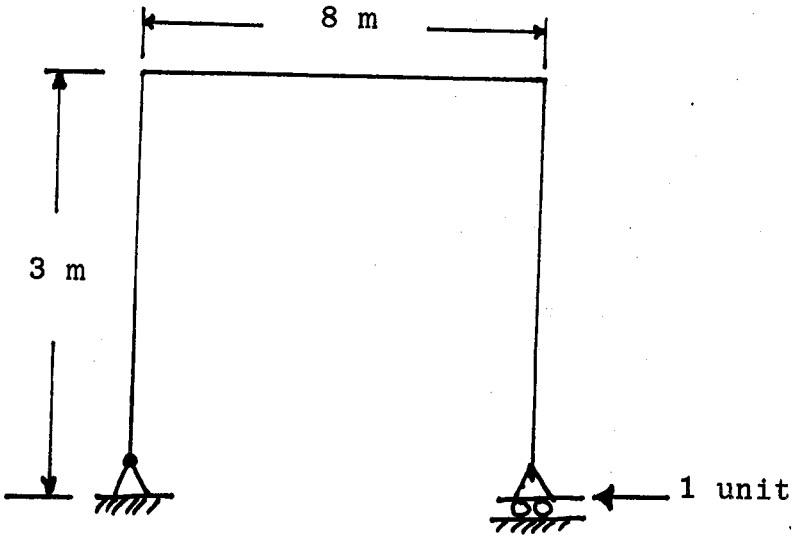
Anggapkan nilai EI sama untuk seluruh struktur.

(20 markah)

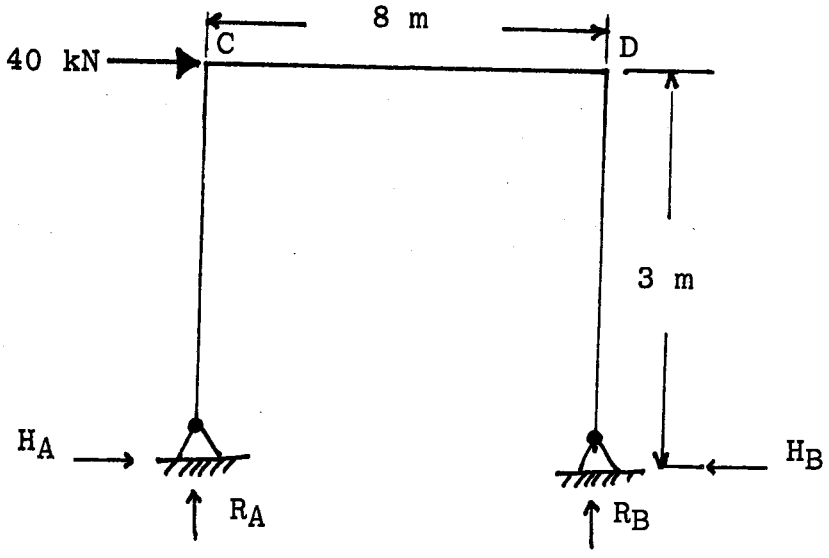
...3/-



Rajah 2(a)



Rajah 2(b)



Rajah 2(c)

...4/-

3. (a) Sebuah rasuk ABC (Rajah 3(a)) yang mempunyai keratan lintang seperti dalam Rajah 3(b) dibebankan dengan beban seragam sebanyak 18 kN/m (beban rekabentuk). Tentukan kesesuaian keratan tersebut dari segi keselamatan jika bahan rasuk mempunyai.

(i) Tegasan alah dalam mampatan adalah 25 n/mm^2

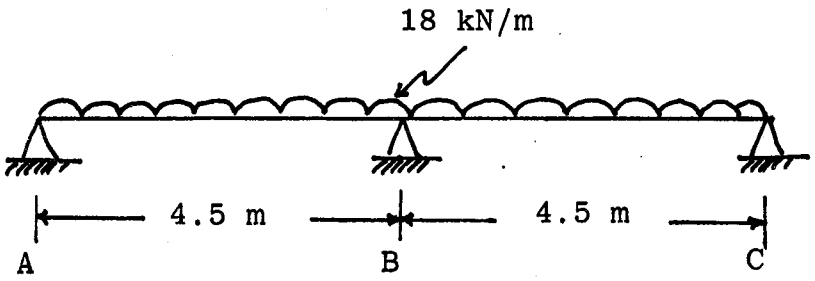
(ii) Tegasan alah dalam tegangan adalah 3 N/mm^2

(iii) Tegasan ricih yang dibenarkan adalah 2 N/mm^2

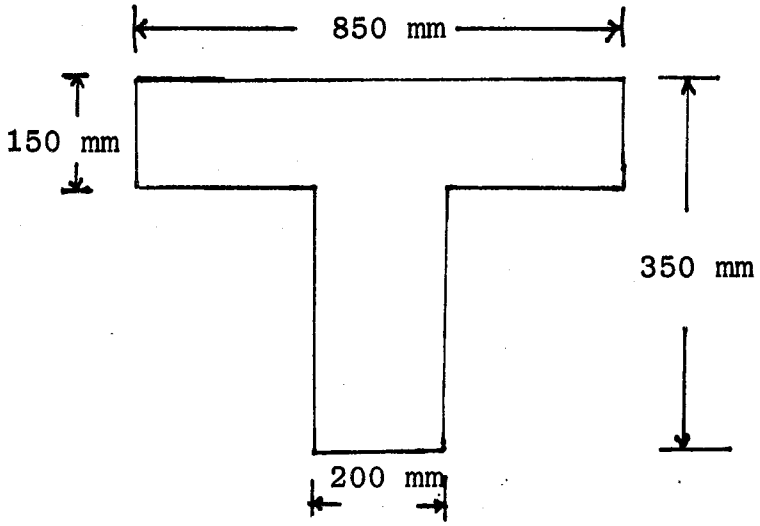
Ambil faktor keselamatan untuk mampatan dan tegangan sebagai 1.3.

(b) Jika penatang di A merupakan sebuah kolum dan tindak-balas di A adalah daya paksi yang mempunyai kesipian e = 75 mm (lihat Rajah 3(c)) lukiskan agihan tegasan melalui keratan tersebut. Anggapkan bahawa kolum tersebut adalah pendek dan berembat (braced).

(20 markah)

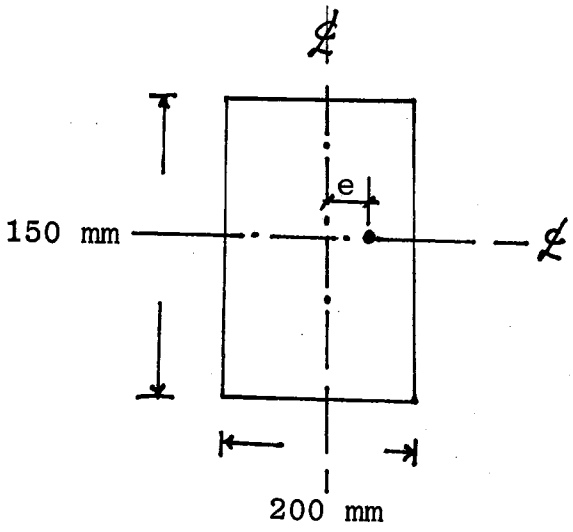


Rajah 3(a)



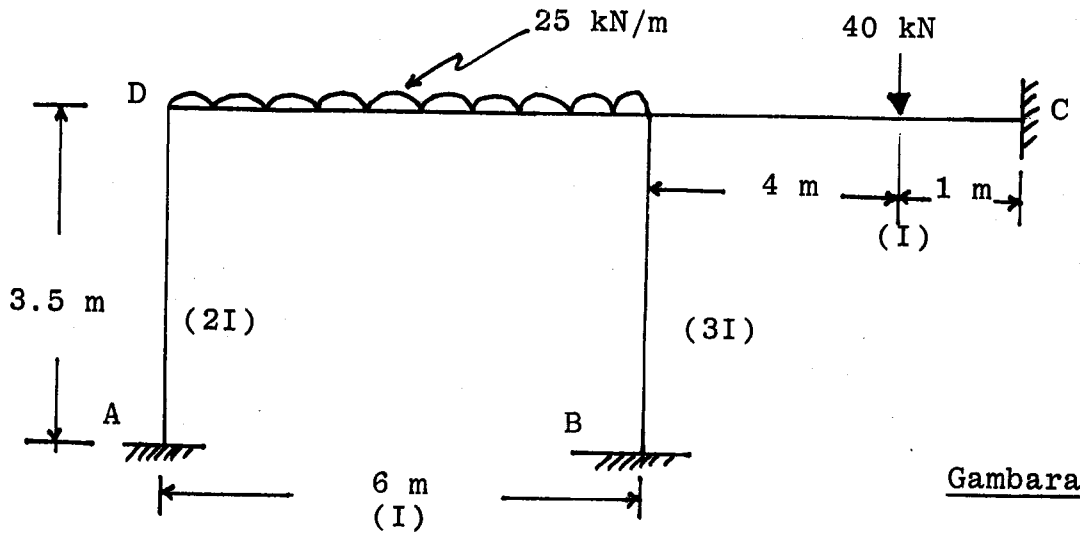
Rajah 3(b)

...5/-



Rajah 3(c)

4.



Gambarajah 4

(a) Gunakan cara Agihan Momen untuk melukiskan gambarajah Daya Ricih dan Momen Lentur bagi struktur yang dibebankan di atas. Gunakan cara Agihan Momen.

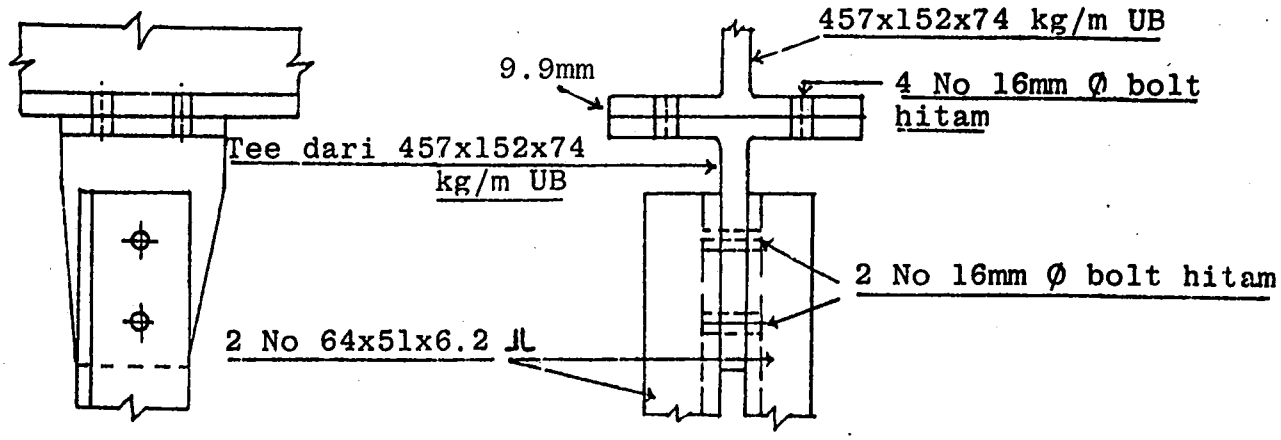
(20 markah)

...6/-

Soalan Bahagian Kayu dan Logam

BAHAGIAN B (jawab DUA soalan)

5. Gambarajah 5 menunjukkan satu sambungan keluli dimana bolt-bolt hitam dalam ricih dan tegang. Cari kekuatan sambungan ini berasas pada bolt-bolt.



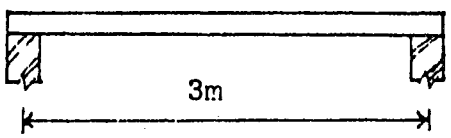
Gambarajah 5

(20 markah)

6. Gambarajah 6 menunjukkan satu rasuk terletak dari kayu Gred Pilihan (Select Grade).

(a) Dengan bebanan 8 kN/m panjang rasuk, cari keratan kayu (saiz) keruing yang sesuai.

Segala andaian mesti diterang dengan jelas.



Gambarajah 6

(20 markah)

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TABLE VII
DRY STRESSES AND MODULI OF ELASTICITY

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

NOTE: These stresses apply to timber having a moisture content not exceeding 18 per cent.

SPECIES	Bending and Tension Parallel to the Grain				Compression Parallel to the Grain				Compression Perpendicular to the Grain				Shear Parallel to the Grain				Modulus of Elasticity for all Grades	
	Basic	Select Grade	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
Keruing	25.6	20.5	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

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_{13} for duration of loading on flexural members and members in tension

Duration of loading	Value of K_{13}
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 1. CLOSE-TOLERANCE BOLTS: TENSION, SHEAR, AND BEARING VALUES FOR ISO METRIC CLOSE-TOLERANCE TURNED BOLTS,‡ STRENGTH GRADE 4.6, COARSE PITCH SERIES. BS 4190:1967

Nominal size of bolt (mm)	Area of shank (mm²)	Area at root of thread (mm²)	Tension value at 130 N/mm² (kN)	Shear value at 95 N/mm²		Enclosed bearing value at 300 N/mm² (kN)† Thickness of plate passed through or of enclosed plate (mm)									
				Single shear (kN)	Double shear (kN)	6	(¼ in) 6.35	(5/16 in) 7.93	8	(⅜ in) 9.53	10	12	(½ in) 12.7	(⅝ in) 15.8	16
12	113	84.3	10.9	10.7	21.4	21.6	22.8	28.5	28.8	34.3	36	43.2	44.5	56.8	57.5
16	201	157	20.4	19.1	38.2	28.8	30.4	38	38.4	45.7	48	57.6	59.3	75.7	76.6
20	314	245	31.9	29.8	59.6	36	38	47.5	48	57.1	60	72	74.2	94.8	96
22*	380	303	39.4	36.1	72.2	39.6	41.8	52.2	52.7	62.9	66	79.3	81.5	104	105.7
24	453	353	45.9	43	86	43.1	45.6	57	57.5	68.5	72	86.5	89	113.5	115.2
27*	573	459	59.6	54.4	108.8	48.5	51.4	64	64.7	77.2	81	97.3	100	128	129.7
30	706	561	73	67	134	54	57	71.2	71.9	85.7	90	108	111.2	142	144
33*	856	694	90.3	81.3	162.6	59.4	62.8	78.3	79	94.2	99	119	122.5	156	158.5
36	1020	817	106.5	96.8	193.6	64.8	68.5	85.5	86.3	103	108	130	133.5	170.5	173

*Non-preferred sizes
†Single bearing value is 80% of enclosed bearing value.
‡These are metric hexagon head bolts faced under head and turned on shank.

Table 2. BLACK BOLTS: TENSION SHEAR, AND BEARING VALUES FOR ISO METRIC BLACK HEXAGON BOLTS, STRENGTH GRADE 4.6, COARSE PITCH SERIES. BS 4190:1967.

Nominal size of bolt (mm)	Area of shank (mm²)	Area at root of thread (mm²)	Tension value at 130 N/mm² (kN)	Shear value at 80 N/mm²		Enclosed bearing value at 200 N/mm² (kN)† Thickness of plate passed through or of enclosed plate (mm)									
				Single shear (kN)	Double shear (kN)	6	(¼ in) 6.35	(5/16 in) 7.93	8	(⅜ in) 9.53	10	12	(½ in) 12.7	(⅝ in) 15.8	16
12	113	84.3	10.9	9.03	18.1	14.4	15.2	19	19.2	22.9	24	28.8	30.5	37.9	38.4
16	201	157	20.4	16.1	32.2	19.2	20.3	25.4	25.6	30.5	32	38.4	40.7	50.5	51.2
20	314	245	31.9	25.1	50.2	24.0	25.4	31.7	32	38.1	40	48	50.8	63.2	64
22*	380	303	39.4	30.4	60.8	26.4	28	34.9	35.2	41.9	44	52.8	55.9	69.5	70.5
24	453	353	45.9	36.3	72.6	28.8	30.5	38	38.4	45.7	48	57.6	61	75.8	76.8
27*	573	459	59.6	45.8	91.6	32.4	34.3	42.8	43.2	51.5	54	64.9	68.6	85.3	86.5
30	706	561	73	56.3	112.6	36.0	38.1	47.5	48	57.2	60	72	76.2	94.8	96
33*	856	694	90.3	68.5	137	39.6	41.9	52.3	52.8	62.9	66	79.2	83.9	104.2	105.6
36	1020	817	106.5	81.5	163	43.1	45.7	57	57.6	68.5	72	86.5	91.5	113.8	115

*Non-preferred sizes.
†Single bearing value is 80% of enclosed bearing value.

Permissible stresses:

Plates in tension (table 19, BS 449)	p_t = 155 N/mm²
Black bolts in shear (table 20, BS 449)	p_t = 80 N/mm²
Black bolts in bearing (enclosed) (table 20, BS 449)	p_t = 200 N/mm²

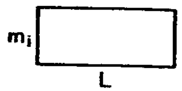
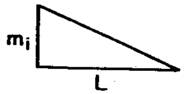
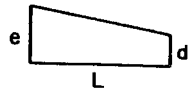
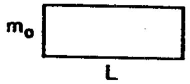
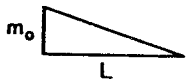
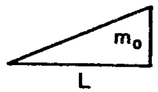
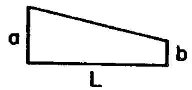
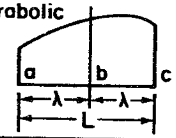
			
	$L\,(m_i m_o)$	$\frac{L}{2}(m_i m_o)$	$\frac{L}{2}(m_o)(e+d)$
	$\frac{L}{2}(m_i m_o)$	$\frac{L}{3}(m_i m_o)$	$\frac{L}{6}(m_o)(d+2e)$
	$\frac{L}{2}(m_i m_o)$	$\frac{L}{6}(m_i m_o)$	$\frac{L}{6}(m_o)(2d+e)$
	$\frac{L}{2}(m_i)(a+b)$	$\frac{L}{6}(m_i)(2a+b)$	$\frac{L}{6}[d(a+2b)+e(2a+b)]$
Parabolic 	$\frac{L}{6}(m_i)(a+4b+c)$	$\frac{L}{6}(m_i)(a+2b)$	$\frac{L}{6}[e(a+2b)+d(2b+c)]$

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

Basic size mm	Minimum size mm	Area 10^3 mm^2	Section modulus About x-x 10^3 mm^3	Section modulus About y-y 10^3 mm^3	Second moment of area (I) About x-x 10^4 mm^4	Second moment of area (I) About y-y 10^4 mm^4	Radius of gyration About x-x mm	Radius of gyration About y-y mm
40 × 75	37 × 72	2·66	32·0	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 × 225	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 8 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	0·88
90	26·0	0·61	0·68	0·72
100	28·8	0·53	0·58	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	0·25
180	52·0	0·20	0·20	0·20