UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	STRUCTURAL ANALYSIS
COURSE CODE	:	BFC 21403/BFC 3023
PROGRAMME	:	2 BFF/4 BFF
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ONLY **FOUR** QUESTIONS FROM SIX QUESTIONS PROVIDED

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

Q1 **Figure Q1** shows a truss of residential house support by pinned at A and roller at C. 20 kN horizontal point load is applied at point F and 20 kN vertical point load is applied at joint E and D. Given A = 500 mm^2 and E = 200 kN/mm^2 for all members.

a) Classify the truss

(2 marks)

b) Determine the reaction at A and C.

(3 marks)

c) Calculate all internal force of truss

(5 marks)

d) Calculate the vertical displacement at joint B

(15 marks)

Q2 A truss as shown in **Figure Q2** is supported with roller at C, D and F, and subjected to point load at A and B. The modulus of elasticity (E) and cross-section area of each member are given in **Table Q2**. If the member BF are assuming redundant,

(a) Classify the truss structure.

(2 marks)

(b) Determine the internal forces of each member.

(23 marks)

Table Q2

Member	(E) (kN/mm^2)	Area (mm^2)	Member	(E) (kN/mm^2)	Area (mm^2)
AD	250	300	BF	200	250
AB	250	400	CE	200	250
AE	200	250	CF	250	300
BD	200	250	DE	250	400
BC	250	400	EF	250	400

Q3 Truss structure in **Figure Q3** is supported by fixed end at A, C, D and E. Using Moment Distribution Method :

(a) Determine the distribution factor

(8 marks)

(b) Calculate the Fixed End Moment

(4 marks)

(c) Calculate the end moment at support A, C, D and E

(7 marks)

(d) Determine the reaction at the support

(6 marks)

Q4 (a) Describe briefly **THREE (3)** Muller-Breslau's principles of influence line for reaction force, shear and bending moment at the particular point of determinate beam due to vertical force.

(3 marks)

(b) Consider the Pratt bridge truss shown in **Figure Q4(a)** with a unit load moves from left to right. Draw the influence lines for the vertical reactions at support A and E, as well as for the axial forces in members CD and DK.

(14 marks)

(c) If an object as illustrated in **Figure Q4(b)** moves with velocity of 15m/s that has kinetic energy equal to 37500kJ. Determine the maximum axial force in member CD and draw the possible positions of the loadings. Assume that the kinetic energy is equal to one half the mass of the body times the square of its speed.

(8 marks)

Q5 (a) Sketch possible collapse mechanism for the three-span continuous beam in **Figure Q5(a)**.

(5 marks)

(b) A continuous steel beam as shown in **Figure Q5(b)** is fixed at support A and roller support located at joint B and C. Joint C is real plastic hinge, where Mp = 0. The beam is subjected to three point loads of 20 kN. Determine the plastic moment of the beam, including the failure mode.

(20 marks)

Q6 (a) Describe **FIVE (5)** classifications of instability that probably happen within the elastic range of I-shape steel column if the eccentric load acts on the top structure.

(5 marks)

(d) A rigid jointed steel frame ABC carry a transfer load from unstable beam BD as shown in **Figure Q6**. The beam is supported by roller at the both ends that produce elastic instability to the frame. The Young's modulus of steel is 210GPa

i) Formulate the conditions of stable, unstable and critical for the frame structure.

(2 marks)

ii) Calculate the strength ratio and instability criterion of the frame ABC. Members AB and BC have square dimension with size 110mm × 110mm and 100mm × 100mm respectively

(12 marks)

iii) Determine the critical load that can be hold by the frame ABC if the uniform load from beam BD is transferred simultaneously to its beneath structures. Consider **SIX (6)** trials only with $\rho = 0$, 1.0, 2.0, 2.20, 2.36 and 2.40.

(6 marks)

-END OF QUESTION-

S1 **Rajah Q1** menunjukkan kekuda sebuah rumah kediaman yang mempunyai sokong pin di A dan rola di C. Beban titik ufuk 20 kN dikenakan di F dan beban titik tegak 20 Kn dikenakan di E dan D. Diberi A = 500 mm^2 dan E = 200 Kn/mm^2 untuk semua anggota.

(a) Kelaskan kekuda tersebut

(2 markah)

(b) Tentukan tindakbalas pada sokong

(3 markah)

(c) Kirakan daya dalaman semua anggota kekuda tersebut

(5 markah)

(d) Kirakan anjakan tegak dititik B

(15 markah)

S2 Struktur kekuda seperti di **Rajah Q2** disokong dengan penyokong rola di C, D dan F, dan dikenakan daya titik pada A dan B. Modulus elasticity(E) dan 5riteri rentas untuk setiap anggota seperti didalam **Jadual Q2**. Jika anggota BF dianggap lebihan,

(a) Kelaskan struktur kekuda tersebut.

(2 markah)

(b) Kira daya dalaman setiap anggota.

(23 markah)

Jadual Q2

Anggota	(E) (Kn/mm^2)	Luas (mm^2)	Anggota	(E) (Kn/mm^2)	Luas (mm^2)
AD	250	300	BF	200	250
AB	250	400	CE	200	250
AE	200	250	CF	250	300
BD	200	250	DE	250	400
BC	250	400	EF	250	400

S3 Struktur kekuda di dalam **Rajah Q3** di sokong oleh hujung terikat pada A, C, D dan E. Menggunakan kaedah agihan momen,

(a) Tentukan faktor agihan

(8 markah)

(b) Kirakan momen hujung terikat

(4 markah)

(c) Kirakan momen akhir pada sokong A, C, D dan E

(7 markah)

(d) Tentukan tindakbalas pada sokong

(6 markah)

S4 (a) Huraikan secara ringkas **TIGA (3)** prinsip-prinsip Muller-Breslau bagi garis imbas daya tidakbalas, daya ricih dan momen lentur pada satu-satu lokasi rasuk boleh tentu yang disebabkan oleh daya menegak.

(3 markah)

(c) Pertimbangkan kerangka jambatan jenis Pratt seperti yang ditunjukkan dalam **Rajah Q5(a)** dengan satu unit daya bergerak dari kiri ke kanan. Lukiskan garis pengaruh bagi tindakbalas menegak pada penyokong A dan E, juga bagi daya paksi di dalam anggota CD dan DK.

(14 markah)

(d) Sekiranya satu objek seperti yang digambarkan dalam **Rajah Q5(b)** bergerak dengan kelajuan 15m/s yang mempunyai tenaga 6riteri bersamaan 37500Kj. Tentukan daya paksi maksimum bagi anggota CD dan lukiskan kebarangkalian kedudukan daya. Anggap tenaga 6riteri adalah bersamaan dengan separuh jisim objek didarab dengan kuasa dua kelajuan objek tersebut.

(8 markah)

S5 (a) Lukis mekanisme runtuhan untuk tiga rentang rasuk seperti di Rajah **Q5(a).**

(5 markah)

(b) **Rajah Q5(b)** menunjukkan rasuk keluli yang dikekang di A dan disokong dengan penyokong beroda di B dan C. Penyokong di C merupakan '*real hinge*' dimana Mp = 0. Terdapat tiga beban titik sebanyak 20 Kn dikenakan keatas rasuk tersebut. Kirakan momen plastic bagi rasuk tersebut, juga dapatkan mod kegagalan.

(20 markah)

S6 (a) Huraikan **LIMA (5)** klasifikasi ketidakstabilan yang mungin berlaku dalam lingkungan 7riteri bagi tiang keluli berbentuk-I sekiranya beban sisi bertindak di bahagian atas struktur berkenaan.

(5 markah)

(b) Satu kerangka keluli ABC yang bersambung secara tegar membawa beban agihan daripada rasuk BD yang tidak stabil seperti yang ditujukkan dalam **Rajah Q6**. Rasuk tersebut disokong secara roller pada kedua-dua hujung yang menyebabkan ketidakstabilan elastik terhadap kerangka tersebut. Elastik modulus bagi keluli adalah 210Gpa.

i) Rumuskan keadaan-keadaan stabil, tidak stabil dan kritikal bagi struktur kerangka tersebut.

(2 markah)

ii) Kira nisbah kekuatan dan Kriteria ketidakstabilan kerangka ABC. Anggota AB dan BC mempunyai dimensi segi empat tepat, masing-masing bersaiz 110mm × 110mm dan 100mm × 100mm.

(12 markah)

iii) Tentukan beban kritikal yang boleh ditanggung oleh kerangka AB sekiranya beban seragam daripada rasuk BD diagihkan secara serentak kepada struktur dibawahnya. Pertimbangkan **ENAM(6)** kali percubaan sahaja dengan ρ = 0 , 1.0, 2.0, 2.20, 2.36 dan 2.40

(6 markah)

-SOALAN TAMAT-

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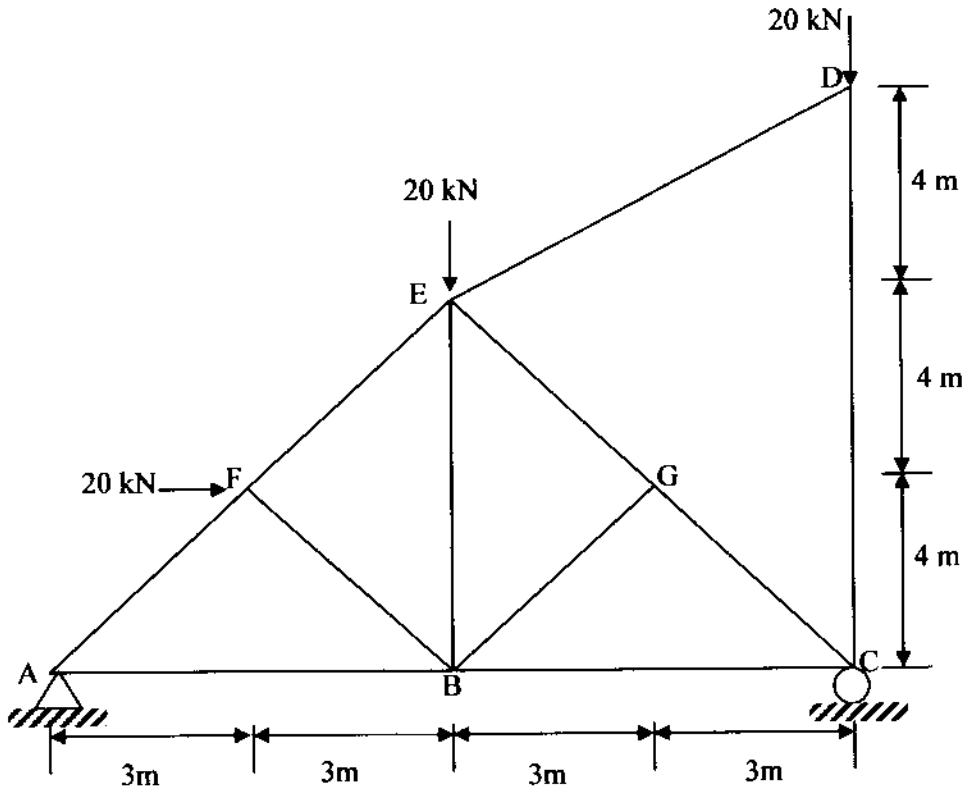

FIGURE Q1

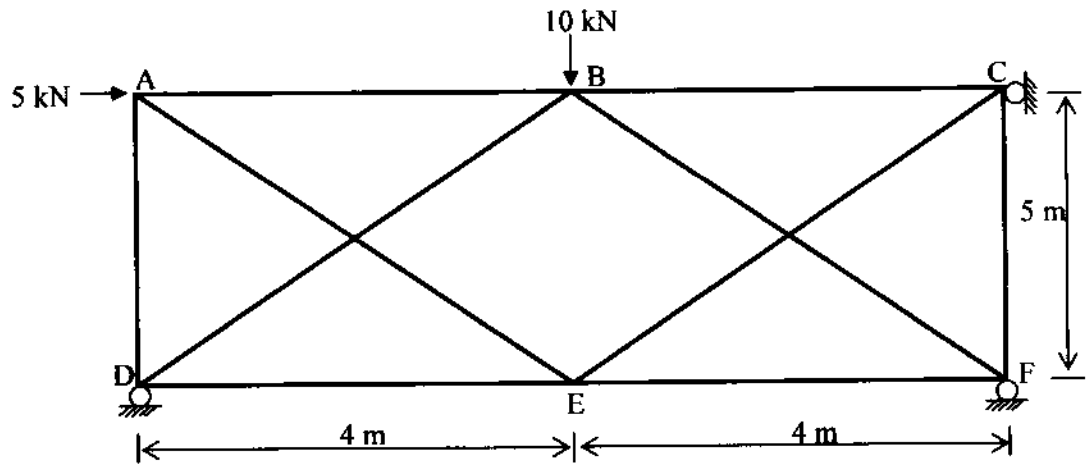

FIGURE Q2

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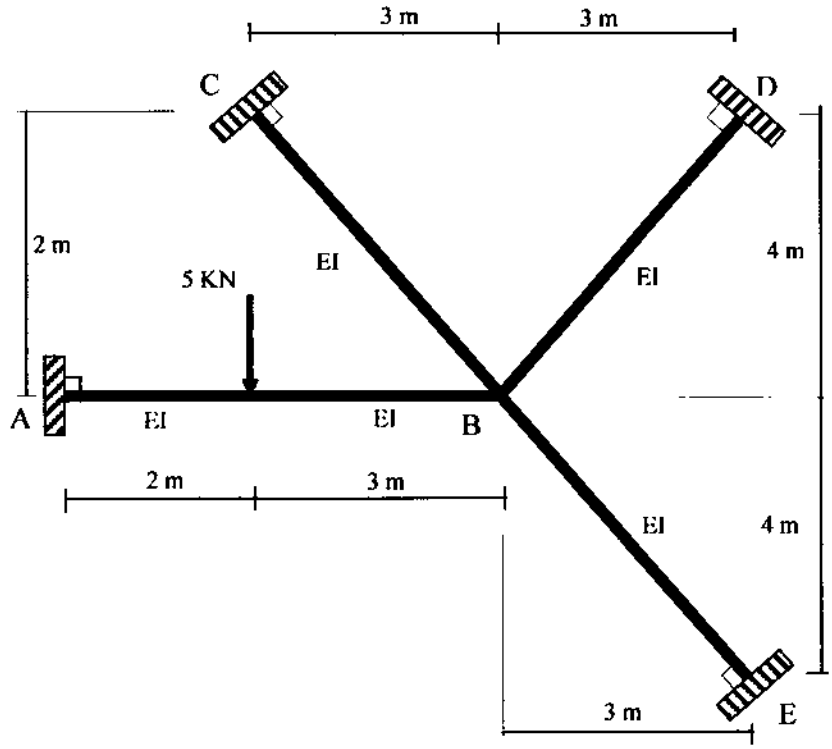

FIGURE Q3

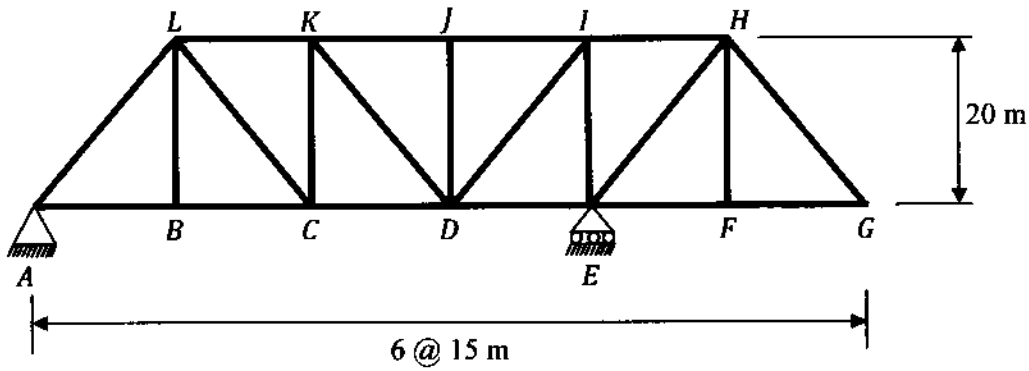

FIGURE Q4(a)

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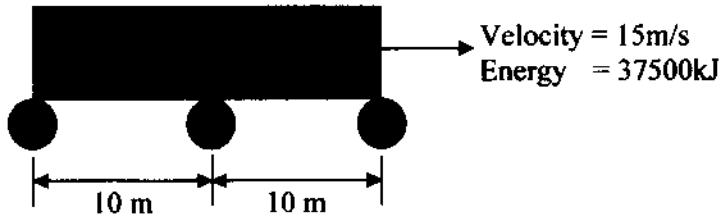

FIGURE Q4(b)

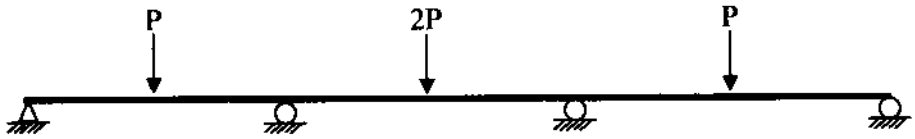

FIGURE Q5(a)

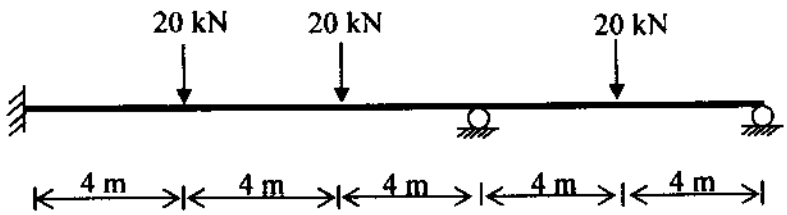

FIGURE Q5(b)

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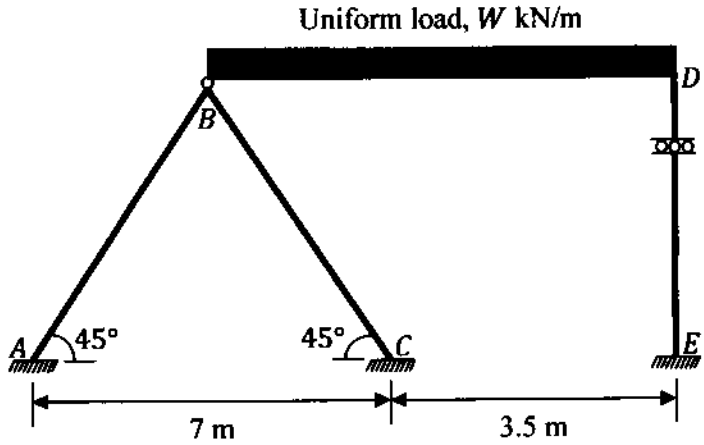

FIGURE Q6

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APPENDIX

Equation:

$k = ½ mv^2$

Table 1: Fixed End moment

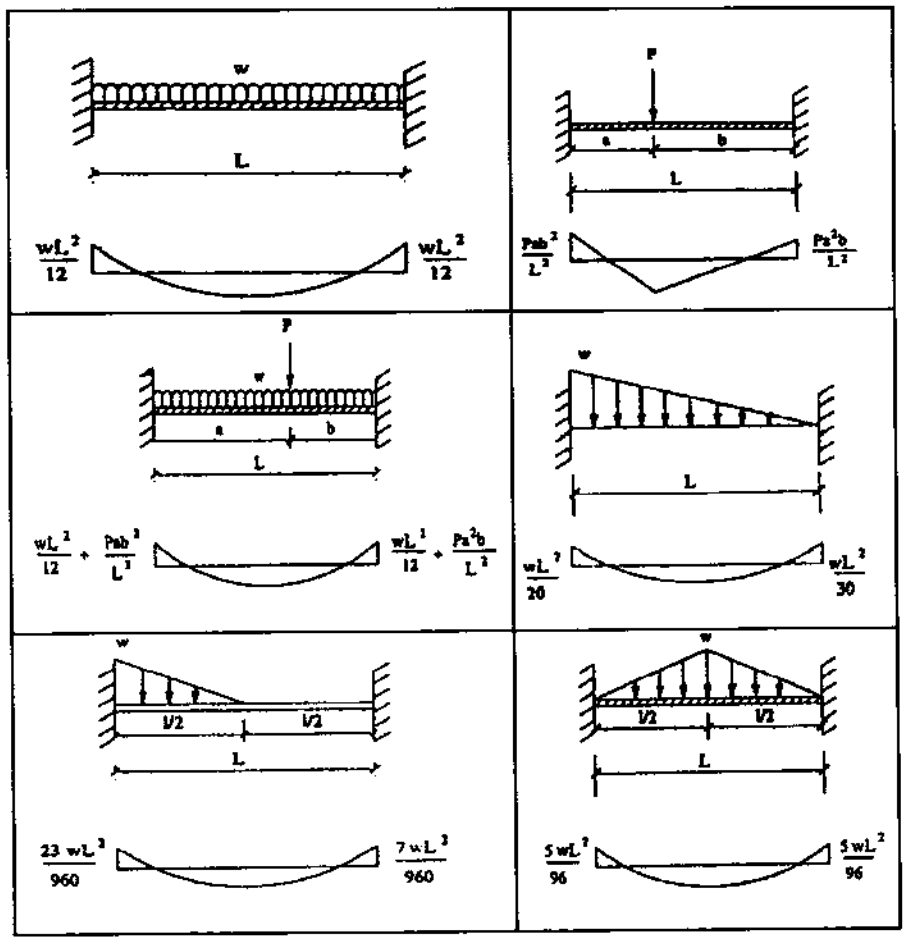

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Table 2: Tabulated selected values of stability functions (compression)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
0·00	4·000	0·500	3·000	4·000
0·04	3·947	0·510	2·920	4·053
0·08	3·894	0·521	2·838	4·109
0·12	3·840	0·532	2·755	4·166
0·16	3·785	0·543	2·669	4·224
0·20	3·730	0·555	2·581	4·285
0·24	3·674	0·568	2·490	4·348
0·28	3·617	0·581	2·397	4·413
0·32	3·560	0·595	2·302	4·480
0·36	3·502	0·609	2·204	4·549
0·40	3·444	0·624	2·102	4·621
0·44	3·385	0·640	1·997	4·695
0·48	3·325	0·657	1·889	4·773
0·52	3·264	0·675	1·777	4·852
0·56	3·203	0·694	1·662	4·935
0·60	3·140	0·714	1·541	5·021
0·64	3·077	0·735	1·417	5·110
0·68	3·013	0·757	1·287	5·202
0·72	2·948	0·781	1·151	5·299
0·76	2·883	0·806	1·010	5·398
0·80	2·816	0·833	0·862	5·502
0·84	2·748	0·862	0·707	5·610
0·88	2·680	0·893	0·544	5·722
0·92	2·610	0·926	0·373	5·839
0·96	2·539	0·962	0·192	5·961
1·00	2·467	1·000	−0·000	6·088
1·04	2·394	1·042	−0·204	6·221
1·08	2·320	1·087	−0·420	6·359
1·12	2·245	1·136	−0·652	6·503
1·16	2·168	1·190	−0·901	6·654
1·20	2·090	1·249	−1·169	6·812
1·24	2·011	1·314	−1·459	6·977
1·28	1·930	1·386	−1·775	7·150
1·32	1·848	1·465	−2·120	7·331
1·36	1·764	1·555	−2·501	7·521
1·40	1·678	1·656	−2·922	7·720
1·44	1·591	1·770	−3·393	7·930
1·48	1·502	1·900	−3·923	8·150
1·52	1·411	2·051	−4·527	8·381
1·56	1·319	2·227	−5·222	8·625
1·60	1·224	2·435	−6·032	8·881
1·64	1·127	2·684	−6·992	9·152
1·68	1·028	2·988	−8·150	9·438
1·72	0·927	3·367	−9·580	9·739
1·76	0·823	3·852	−11·395	10·059
1·80	0·717	4·497	−13·743	10·397
1·84	0·608	5·393	−17·018	10·755
1·88	0·496	6·722	−21·935	11·135
1·92	0·382	8·899	−29·847	11·538
1·96	0·264	13·109	−45·084	11·967
2·00	0·143	24·684	−86·864	12·424
2·04	0·018	197·386	−709·240	12·911
2·08	−0·110	−33·292	121·901	13·431
2·12	−0·242	−15·436	57·487	13·987
2·16	0·379	−10·085	38·132	14·582
2·20	−0·519	−7·511	28·781	15·219
2·24	−0·665	−5·998	23·254	15·904
2·28	−0·815	−5·003	19·592	16·640
2·32	−0·971	−4·299	16·977	17·433
2·36	−1·133	−3·775	15·011	18·288

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Table 3: Tabulated selected values of stability functions (compression)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
2·40	−1·301	−3·370	13·472	19·213
2·44	−1·475	−3·048	12·291	20·215
2·48	−1·656	−2·787	11·205	21·302
2·52	−1·845	−2·570	10·339	22·484
2·56	−2·043	−2·387	9·595	23·773
2·60	−2·249	−2·231	8·948	25·181
2·64	−2·465	−2·097	8·376	26·723
2·68	−2·692	−1·981	7·866	28·417
2·72	−2·930	−1·878	7·407	30·281
2·76	−3·180	−1·788	6·989	32·341
2·80	−3·445	−1·708	6·606	34·623
2·84	−3·725	−1·637	6·252	37·160
2·88	−4·021	−1·573	5·923	39·990
2·92	−4·337	−1·515	5·616	43·159
2·96	−4·673	−1·463	5·326	46·722

Table 4: Tabulated selected values of stability functions (Tension)

ρ	s	c	$s(1-c^2)$	$(sc)^2$
0·00	4·000	0·500	3·000	4·000
−0·20	4·257	0·455	3·374	3·756
−0·40	4·501	0·418	3·714	3·545
−0·60	4·735	0·387	4·025	3·362
−0·80	4·959	0·361	4·314	3·202
−1·00	5·175	0·338	4·583	3·060
−1·20	5·382	0·318	4·837	2·935
−1·40	5·583	0·301	5·077	2·824
−1·60	5·777	0·286	5·305	2·724
−1·80	5·965	0·272	5·523	2·635
−2·00	6·147	0·260	5·731	2·554
−2·20	6·324	0·249	5·932	2·481
−2·40	6·496	0·239	6·125	2·414
−2·60	6·664	0·230	6·311	2·354
−2·80	6·828	0·222	6·491	2·298
−3·00	6·988	0·215	6·666	2·247
−3·20	7·144	0·208	6·836	2·200
−3·40	7·297	0·201	7·001	2·157
−3·60	7·446	0·195	7·162	2·117
−3·80	7·593	0·190	7·319	2·080