OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE

DEPARTMENT OF BUILDING

FACULTY OF ENVIRONMENTAL DESIGN AND MANAGEMENT

B.Sc. BUILDING, HARMATTAN SEMESTER EXAMINATIONS 2010/2011 SESSION

BLD 401 – Theory of Structures Time Allowed: 3HRS

INSTRUCTIONS: (i) In Section A, answer Question 1 and any other. In Section B, answer Question 1

(ii) Provide neat sketches where applicable

(iii) Keep your work neat, logical and orderly

(iv) Indicate appropriate units in all your discussions

(v) All Questions Carry Equal Marks

SECTION A

QUESTION ONE (ONE):

Analyse the beam in Fig.Q1 using Kani's method of structural analysis

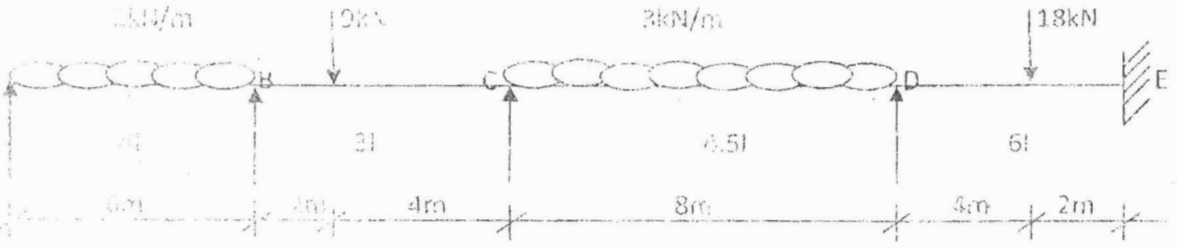

Fig.Q1

QUESTION TWO:

(a) The full plastic moment of mild steel beam is 300kNm. Estimate the uniformly distributed load intensity which may be place on the beam over simple supports spaced at 5m. Take the load factor, f = 1.7

(b) Calculate the plastic moment, the plastic modulus and the shape factor for the I-section beam shown in Fig.Q2b. Assume d=400mm, b=150mm, t_f=12mm, t_w=8mm, σ_y = 290MPa.

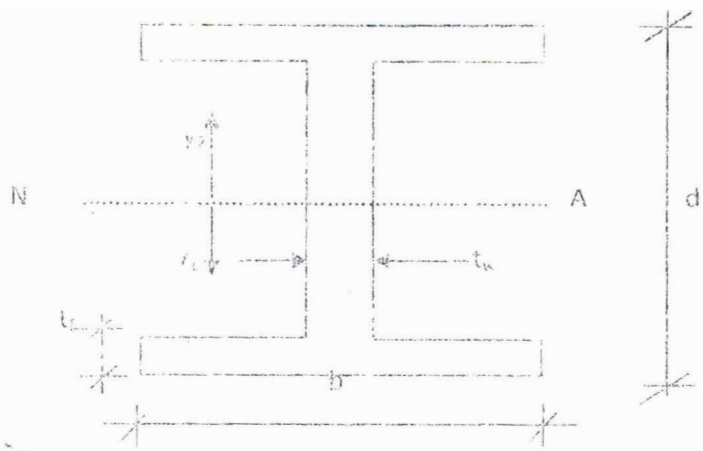

Fig.Q2b

QUESTION THREE:

Compute the ultimate intensity of load for a simply supported beam of rectangular cross- section supporting uniformly distributed load acting over the entire span.

Take the following data: l = 1.5m, h = 100mm, b = 50mm and σ_y = 290MPa.

SECTION B

QUESTION ONE:

(a) Consider a structural member AB of length, l which is under the influence of forces P1, P2 and moments P3, P4 acting at points B and A respectively. If the deflections due to the action of the forces and moments are D1, D2 and D3, D4 at points B and A respectively, determine the stiffness equation of beam AB.

(b) Determine the flexibility matrix for the cantilever beam shown **Fig.Q1b** below:

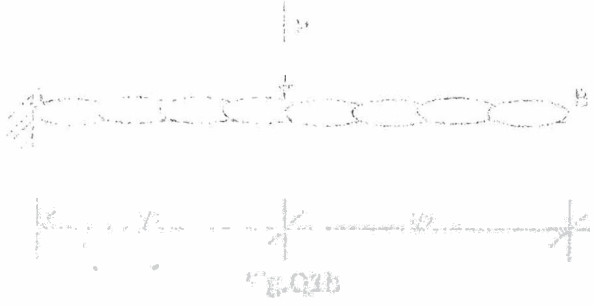

Fig.Q1b

(c) Determine the forces in the members of the frame shown **Fig.Q1c** below

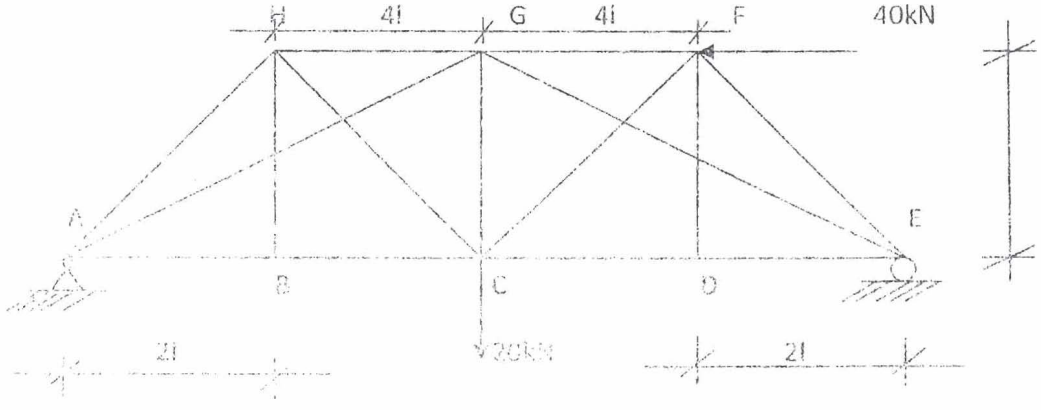

Fig.Q1b

FIXED END MOMENTS FOR PRISMATIC MEMBERS

Symmetrical loads	Fixed both ends	Fixed–hinged	Asymmetrical loads	Fixed both ends (left)	Fixed both ends (right)	Fixed–hinged	Hinged–fixed
1	$\frac{PL}{8}$	$\frac{3}{16}PL$	21	$\frac{PAB^2}{L^2}$	$\frac{PA^2B}{L^2}$	$(L^2-B^2)\frac{PB}{2L^2}$	$(L^2-A^2)\frac{PA}{2L^2}$
2	$\frac{2}{9}PL$	$\frac{PL}{3}$	22	$2[ab^2-(3b-1)e^2]PL$	$2[a^2b-(3a-1)e^2]PL$	$(1-b^2-3e^2)PbL$	$(1-a^2-3e^2)PaL$
3	$\frac{5}{16}PL$	$\frac{15}{32}PL$	23	$[1+(3b+2)b]\frac{WaL}{12}$	$(3b+1)\frac{WaL}{12}a$	$(b+1)^2\frac{WaL}{8}$	$(2-a^2)\frac{WaL}{8}$
4	$(1+c)\frac{PaL}{2}$	$3(1+c)\frac{PaL}{4}$	24	$[ab^2-(3b-1)\frac{e^2}{3}]WL$	$[a^2b-(3a-1)\frac{e^2}{3}]WL$	$(1-b^2-e^2)\frac{WaL}{2}$	$(1-a^2-e^2)\frac{WaL}{2}$
5	$(1-\frac{1}{n^2})\frac{nPL}{12}$	$(1-\frac{1}{n^2})\frac{nPL}{8}$	25	$(3a+1)b\frac{WbL}{12}$	$[1+(3a+2)a]\frac{WbL}{12}$	$(2-b^2)\frac{WbL}{8}$	$(a+1)^2\frac{WbL}{8}$
6	$(1+\frac{1}{2n^2})\frac{nPL}{12}$	$(1+\frac{1}{2n^2})\frac{nPL}{8}$	26	$[1+\frac{1}{5}\cdot\frac{s-t}{s+t}]\frac{WL}{12}$	$[1+\frac{1}{5}\cdot\frac{t-s}{t+s}]\frac{WL}{12}$	$[1-\frac{1}{15}\cdot\frac{s-t}{s+t}]\frac{WL}{8}$	$[1+\frac{1}{15}\cdot\frac{t-s}{t+s}]\frac{WL}{8}$
7	$\frac{wL^2}{12}$	$\frac{wL^2}{8}$	27	$\frac{WL}{15}$	$\frac{WL}{10}$	$\frac{7}{60}WL$	$\frac{2}{15}WL$
8	$(3-c^2)\frac{cwL^2}{24}$	$(3-c^2)\frac{cwL^2}{16}$	28	$[1+3(2b+1)b]\frac{WaL}{15}$	$(4b+1)a\frac{WaL}{2?}$ [illegible]	$[7+3(7+4b)b]\frac{WaL}{60}$	$(5-3a^2)\frac{WaL}{15}$
9	$(2+c)\frac{wa^2L^2}{6}$	$(2+c)\frac{wa^2L^2}{4}$	29	$[ab^2-(3a-1)\frac{be}{3}-(3b-1)\frac{e^2}{3}+\frac{e^3}{5}]WL$ [partly illegible]	[illegible]	[illegible]	$[(1-e^2)a-(3a^2-1)\frac{e}{3}-ae^2-\frac{e^3}{5}]\frac{WL}{2}$ [partly illegible]
10	$\frac{5}{48}WL$	$\frac{5}{32}WL$	30	$(5-3b)b\frac{WbL}{30}$	$(3b^2+10a)\frac{WbL}{30}$ [partly illegible]	$(10-3b^2)\frac{WbL}{60}$ [partly illegible]	$[3+3(a+3)a]\frac{WbL}{60}$ [partly illegible]
11	$\frac{WL}{16}$	$\frac{3}{32}WL$	31	$\frac{WL}{10}$	$\frac{WL}{15}$	$\frac{2}{15}WL$	$\frac{7}{60}WL$
12	$(5+3c)\frac{WaL}{24}$	$(5+3c)\frac{WaL}{16}$	32	$(3a^2+10b)\frac{WaL}{30}$	$(5-3a)a\frac{WaL}{30}$	$[8+3(b+5)b]\frac{WaL}{60}$	$(10-3a^2)\frac{WaL}{60}$
13	$(3+c)\frac{WaL}{24}$ [partly illegible]	$(3+c)\frac{WaL}{16}$ [partly illegible]	33	[illegible]	[illegible]	[illegible]	[illegible]
14	$(2-c^2)\frac{WL}{16}$	$\frac{WL}{32}$ [partly illegible]	34	$(4a+1)b\frac{WbL}{10}$	$[1+3(2a+1)a]\frac{WbL}{15}$ [partly illegible]	$(5-3b^2)\frac{WbL}{15}$ [partly illegible]	$[7+3(7+4a)a]\frac{WbL}{60}$
15	$(6-c^2)\frac{WL}{32}$	$(6-c^2)\frac{WL}{32}$ [partly illegible]	35	$[2(3b+1)a^2+3(3a+1)b^2]\frac{WL}{30}$ [partly illegible]	[illegible]	[illegible]	$[2(3b+1)a^2+7(3a+1)b^2]\frac{WL}{60}$ [partly illegible]
16	$(5-c^2)\frac{WL}{32}$ [partly illegible]	[illegible]	36	$[ab^2-(3b-1)\frac{e^2}{6}]WL$	[illegible]	$(1-b^2-\frac{e^2}{?})\frac{WbL}{2}$ [partly illegible]	$(1-a^2-\frac{e^2}{2})\frac{WaL}{2}$
17	[illegible]	[illegible]	37	$[ab^2-(3b-1)\frac{e^2}{2}]WL$	[illegible]	[illegible]	$(1-a^2-\frac{3e^2}{2})\frac{WaL}{2}$
18	[illegible]	[illegible]	38	$\frac{M}{4}$	[illegible]	[illegible]	$\frac{M}{8}$
19	[illegible]	[illegible]	39	$(3a-1)bM$	[illegible]	$(1-3b^2)\frac{M}{2}$ [partly illegible]	$(1-3a^2)\frac{M}{2}$
20	[illegible]	[illegible]	40	$6(3b-1)eM$	[illegible]	[illegible]	$6aeM$

2EIθ 4EIθ

3EIΔ/L²

W = EQUAL UNIFORMLY DISTRIBUTED LOAD
P = CONCENTRATED LOAD
w = DISTRIBUTED LOAD PER UNIT LENGTH
T = TEMPERATURE [illegible]
[illegible] DISTRIBUTED [illegible]
[illegible] COEFFICIENT OF THERMAL EXPANSION