UNIVERSITI SAINS MALAYSIA

2nd. Semester Examination
2005/2006 Academic Session
Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April / May 2006

EAS 254E/3 – Structural Analysis

EAS 254E/3 – Analisis Struktur

Duration: 3 hours
Masa : 3 jam

Instructions To Candidates:
Arahan Kepada Calon:

1. Ensure that this paper contains **TEN (10)** printed pages including appendices before you start your examination.
   *Sila pastikan kertas peperiksaan ini mengandungi **SEPULUH (10)** muka surat bercetak termasuk lampiran sebelum anda memulakan peperiksaan ini.*

2. This paper contains **FIVE (5)** questions. Answer **ALL (5)** questions.
   *Kertas ini mengandungi **LIMA (5)** soalan. Jawab **SEMUA (5)** soalan.*

3. Each question **MUST BE** answered on a new sheet.
   Tiap-tiap jawapan MESTILAH dimulakan pada muka surat yang baru.

4 All questions **CAN BE** answered in English or Bahasa Malaysia or combination of both languages.
   Semua soalan boleh dijawab dalam Bahasa Inggeris atau Bahasa Malaysia ataupun kombinasi kedua-dua bahasa.

5. Write the answered question numbers on the cover sheet of the answer script.
   Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.

1. (a) Figure 1 shows a truss acted on by a force **F** kN applied at joint B. Use the energy method to determine the vertical deflection at joint E. EA is constant.

*Rajah 1 menunjukkan satu kekuda yang dikenakan satu daya **F** pada sambungan B. Dengan menggunakan kaedah tenaga, tentukan pesongan menegak di sambungan E. EA adalah malar.*

(15 marks)

(b) Determine the maximum value for the force **F**, so that the vertical deflection at joint E does not exceed 30 mm. Given E = 200 GPa and A = 500 mm^2.

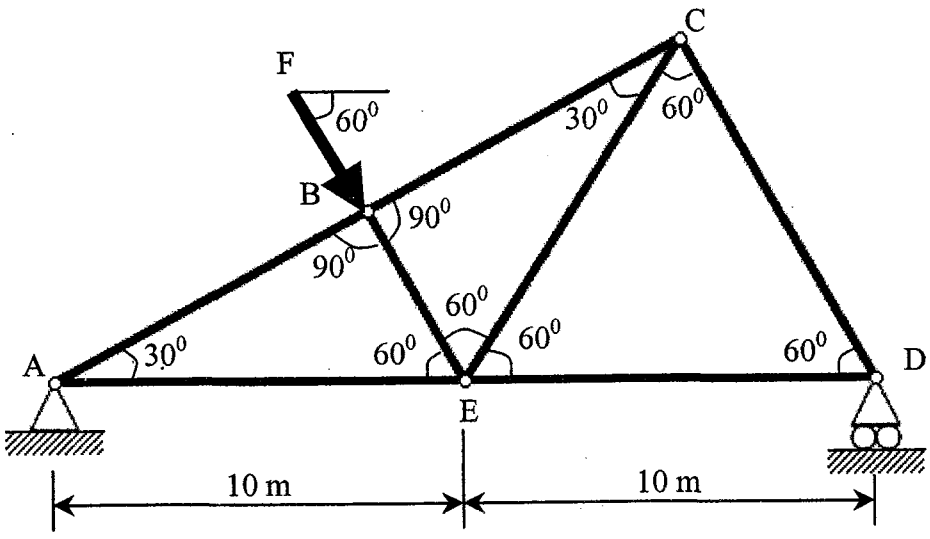
*Tentukan nilai maksimum bagi daya **F** supaya pesongan menegak pada sambungan E tidak melebihi 30 mm. Guna E = 200 GPa dan A = 500 mm^2.*

(2 marks)

(c) If the cross-sectional area *A* for one of the members of the truss shown will be increased to *2A*, explain briefly which member of the truss should be enlarged in order to give the smallest vertical deflection at joint E by using the calculation in Part (b).

Jika luas keratan rentas A bagi salah satu anggota dalam kekuda yang diberikan akan ditambah menjadi 2A, jelaskan secara ringkas anggota mana yang patut dibesarkan supaya pesongan menegak pada sambungan E adalah paling kecil dengan menggunakan pengiraan di bahagian (b).

(3 marks)



EA = constant

Figure 1

2. (a) Give **TWO (2)** reasons why calculation of deflections forms an essential part of structural analysis.

(4 marks)

*Berikan **DUA (2)** sebab mengapa pengiraan pesongan merupakan satu bahagian penting dalam analisis struktur.*

(b) Figure 2(a) shows a frame with pin and roller support at A and C, respectively. A decision has been made to introduce an additional roller support at D as shown in Figure 2(b). Compute:

(i) the reaction force at support D and

(ii) percentage changes in magnitude of reaction forces at A and C due to the introduction of additional roller support at D.

Use method of consistent deformation.

(iii) If EI of vertical member BC for the frame shown in Figure 2(b) is changed to 0.5EI, compute the corresponding percentage change in the magnitude of reaction force at D.

(16 marks)

Rajah 2(a) menunjukkan satu kerangka dengan penyokong pin pada A dan penyokong rola pada C. Satu keputusan telah diambil untuk memperkenalkan satu peyokong rola tambah pada D seperti yang ditunjukkan dalam Rajah 2(b). Kirakan:

(i) daya tindakbalas pada penyokong D; dan

(ii) peratus perubahan dalam magnitud daya-daya tindakbalas pada A dan C akibat penambahan penyokong rola pada D.

Gunakan kaedah ubahbentuk konsisten.

(iii) Sekiranya EI untuk anggota pugak BC dalam kerangka yang ditunjukkan dalam Rajah 2(b) ditukar ke 0.5EI, kirakan peratus perubahan dalam magnitud daya tindakbalas pada D.

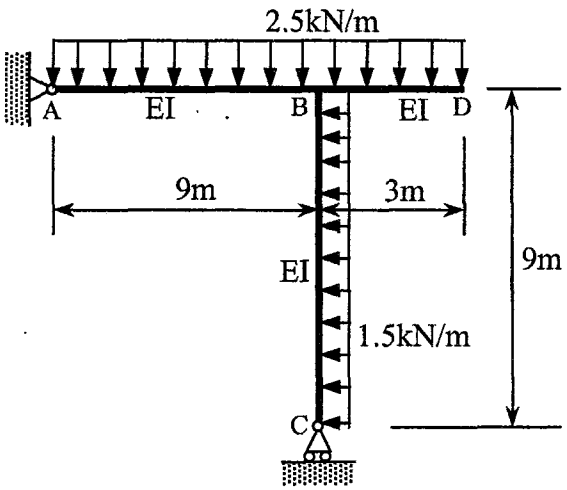


Figure 2(a)

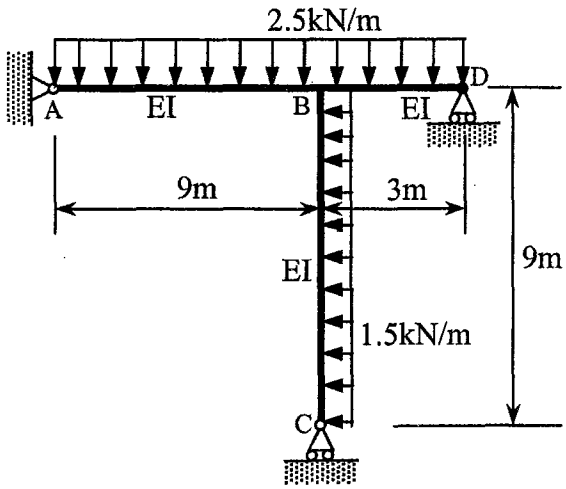


Figure 2(b)

3. (a) Show that the reaction force at A is equal to $\frac{3}{8}$wL for the propped cantilever beam shown in Figure 3(a). Use method of least work.

(8 marks)

Tunjukkan bahawa daya tindakbalas pada A adalah sama dengan $\frac{3}{8}$wL *untuk rasuk julur tertopang seperti yang ditunjukkan dalam Rajah 3(a). Gunakan kaedah kerja terkurang.*

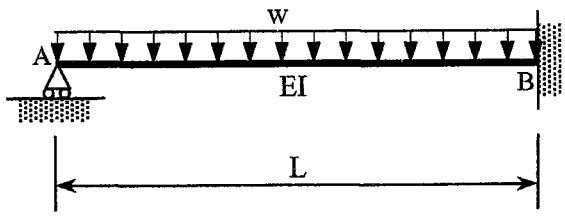


Figure 3(a)

(b) Figure 3(b) shows the original design of a truss tower. Supports A and B are of pin and roller types, respectively. It is later found that due to some construction errors, the horizontal movement of support B has been restrained to be zero.

(i) Compute the percentages change in the magnitude of all member forces due to horizontal restraint of support B.

(ii) If EA of members AC and BC is increased by 20%, compute the corresponding percentage change in the magnitude of the horizontal reaction force at support B.

Use method of least work.

(12 marks)

Rajah 3(b) menunjukkan rekabentuk asal satu struktur menara kekuda di mana penyokong A adalah jenis pin manakala penyokong B adalah jenis rola. Akibat kesilapan semasa pembinaan, didapati bahawa anjakan ufuk penyokong B telah dikekang menjadi kosong.

(i) Kirakan peratus perubahan dalam magnitud daya anggota akibat kekangan anjakan ufuk pada penyokong B.

(ii) Sekiranya EA untuk anggota AC dan BC ditingkatkan sebanyak 20%, kirakan peratus perubahan dalam magnitud daya tindakbalas ufuk pada penyokong B.

Guna kaedah kerja terkurang.

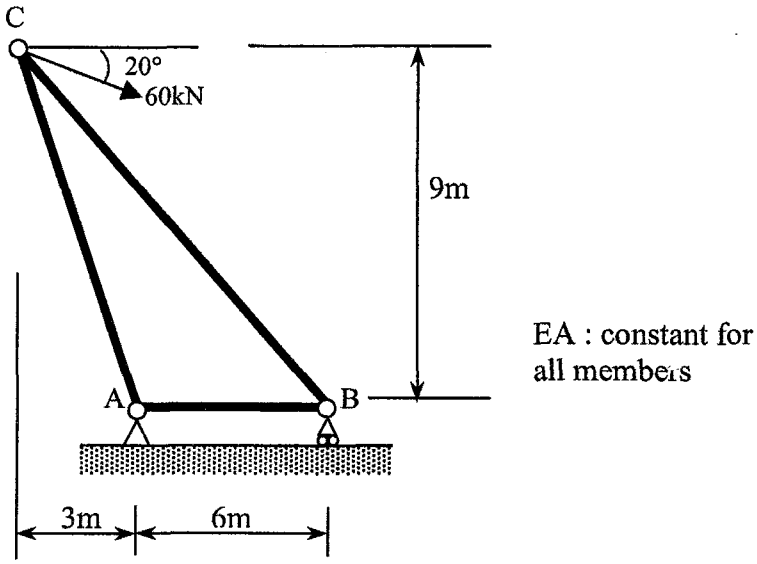


Figure 3(b)

4. (a) Figure 4(a) shows a frame carrying a uniformly distributed load of 30 kN/m on span BC. Support A is fixed and support C is roller. EI value for all member is constant, value of E = 200 GPa and value of I = 400 x 10^6 mm^4. Using the Slope Deflection Method, calculate the rotation at joint B and C and moment at all joints for the frame. Then sketch the deflected shape and bending moment diagram of the frame. Neglect axial deformation.

(15 marks)

Rajah 4(a) menunjukkan satu kerangka yang membawa beban teragih seragam 30kN/m bertindak di sepanjang rentang BC. Penyokong A adalah jenis tegar dan penyokong D ialah rola. Nilai EI adalah malar untuk semua anggota dan nilai E = 200 GPa dan I = 400 x 10^6 mm^4. Dengan menggunakan Kaedah Cerun Pesongan, kira nilai putaran di sambungan B dan C dan momen di setiap sambungan kerangka. Seterusnya lakarkan bentuk terpesong kerangka tersebut dan rajah momen lentur. Abaikan pesongan paksi.

4. (b) If additional horizontal force P (kN) is applied at the mid – height of the column AB as shown in Figure 4(b), sketch the new deflected shape and bending moment diagram without additional calculation.

(5 marks)

Sekiranya satu daya tumpu mengufuk, P (kN) dikenakan di tengah rentang AB seperti yang ditunjukkan dalam Rajah 4(b), lakarkan gambarajah pesongan dan rajah momen lentur yang baru tanpa sebarang pengiraan.

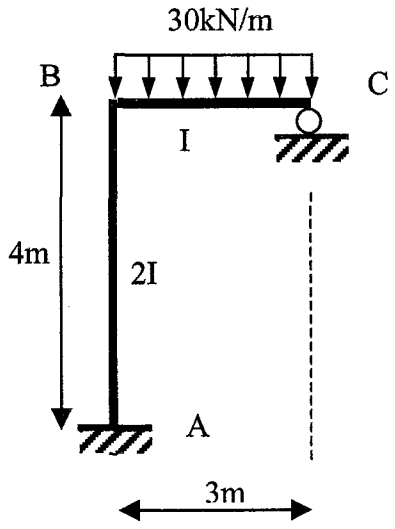


Figure 4(a)

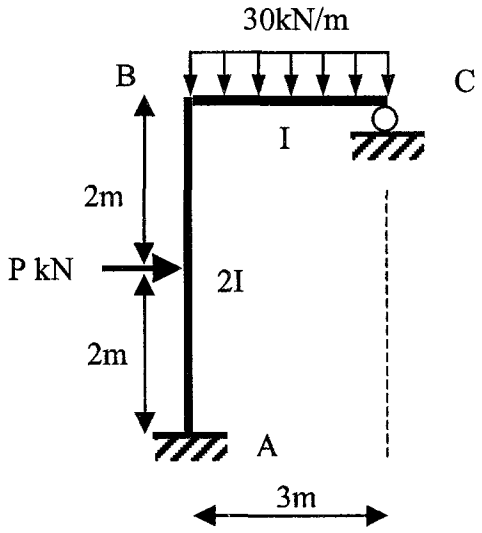
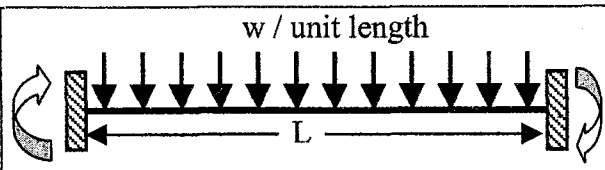
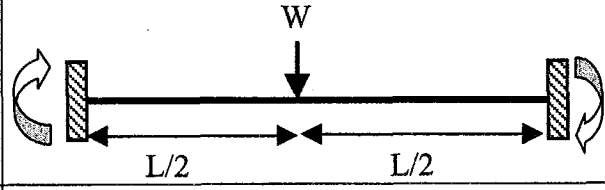
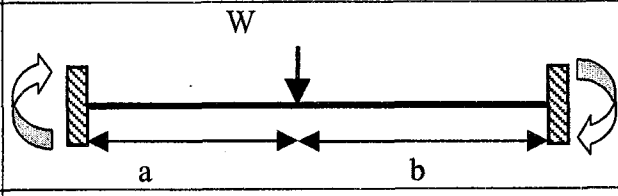
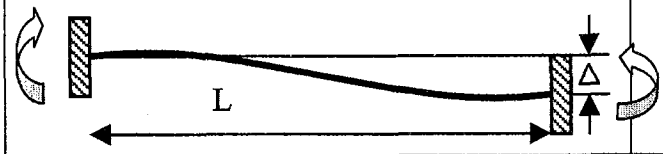
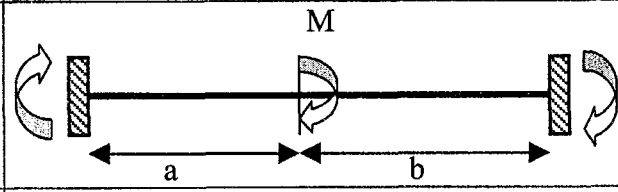
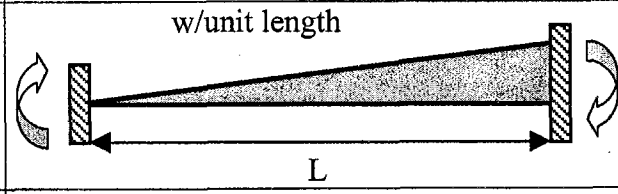
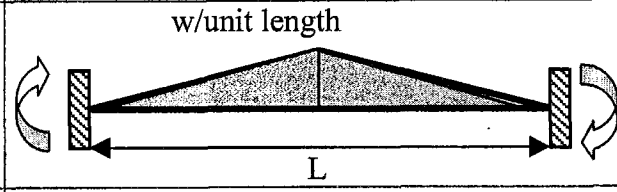
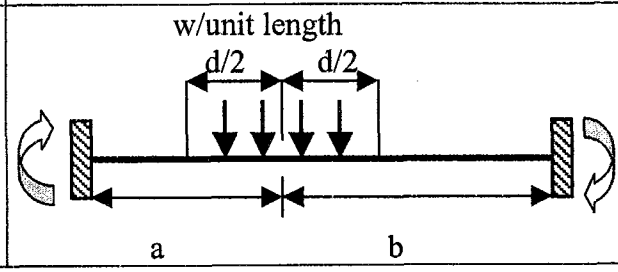


Figure 4(b)

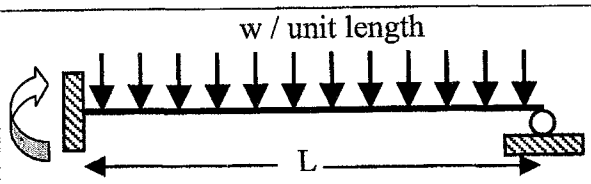
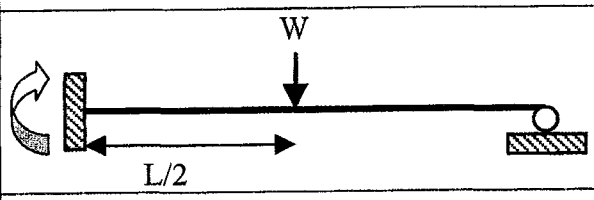
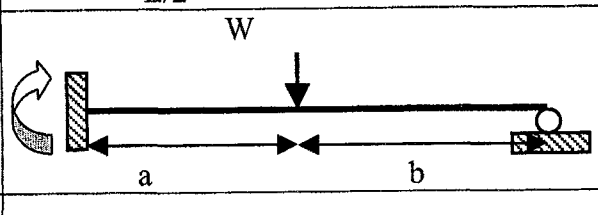
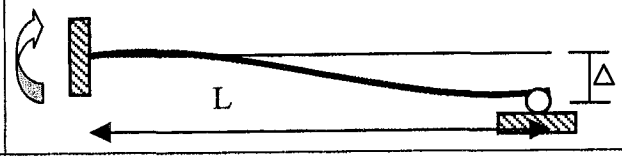
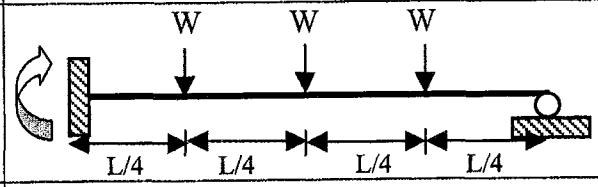
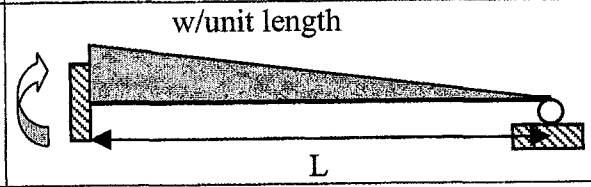
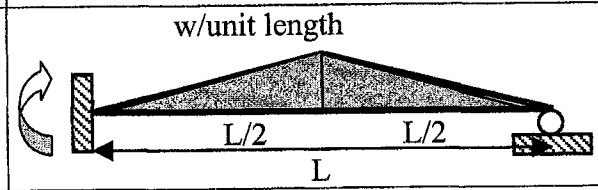
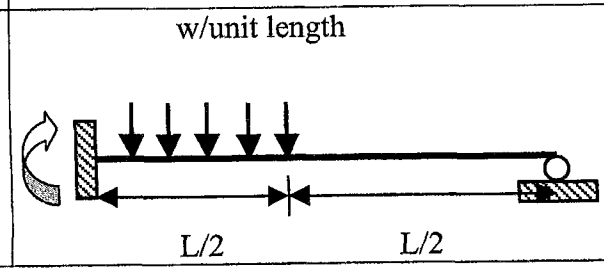
ATTACHMENT

Fixed End Moment

$-\frac{wL^2}{12}$		$\frac{wL^2}{12}$
$-\frac{WL}{8}$		$\frac{WL}{8}$
$-\frac{Wab^2}{L^2}$		$\frac{Wba^2}{L^2}$
$-\frac{6EI\Delta}{L^2}$		$\frac{6EI\Delta}{L^2}$
$-\frac{Mb(2a-b)}{L^2}$		$\frac{Mb(2b-a)}{L^2}$
$-\frac{wL^2}{30}$		$\frac{wL^2}{20}$
$-\frac{5wL^2}{96}$		$\frac{5wL^2}{96}$
$-\frac{wd}{L^2}\left(ab^2+\frac{(a-2b)d^2}{12}\right)$		$\frac{wd}{L^2}\left(a^2b+\frac{(b-2a)d^2}{12}\right)$

ATTACHMENT

Fixed End Moment

$-\frac{wL^2}{8}$		
$-\frac{3WL}{16}$		
$-\frac{W}{L^2}\left(b^2a+\frac{a^2b}{12}\right)$		
$-\frac{3EI\Delta}{L^2}$		
$-\frac{45WL}{96}$		
$-\frac{wL^2}{15}$		
$-\frac{5wL^2}{64}$		
$-\frac{9WL^2}{128}$		

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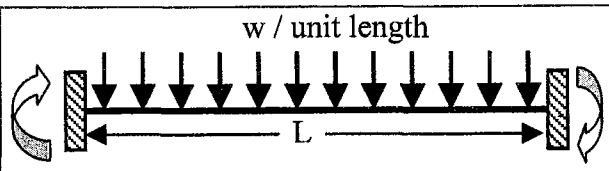
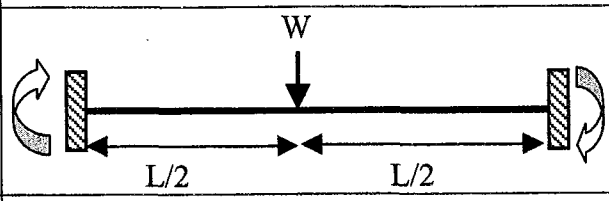
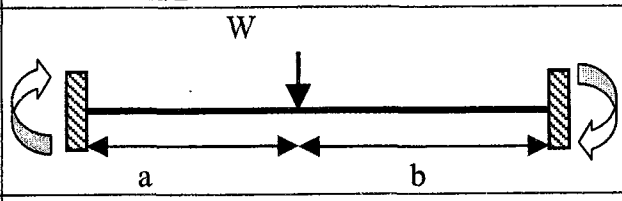
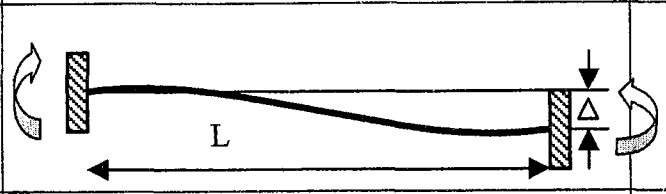
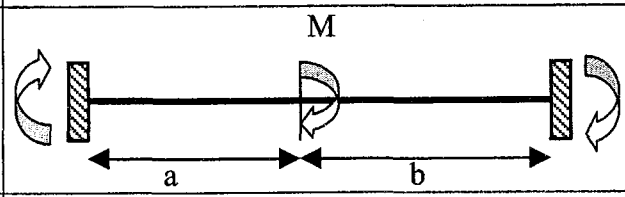
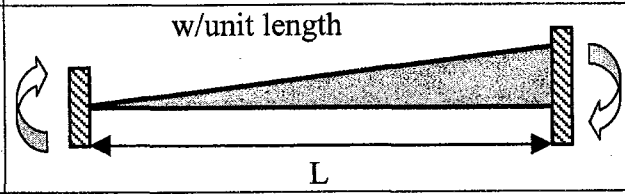
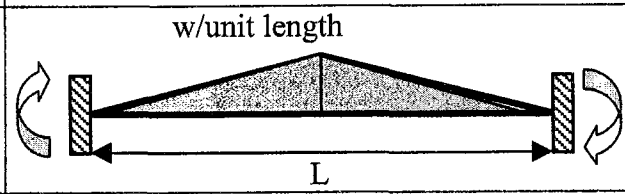
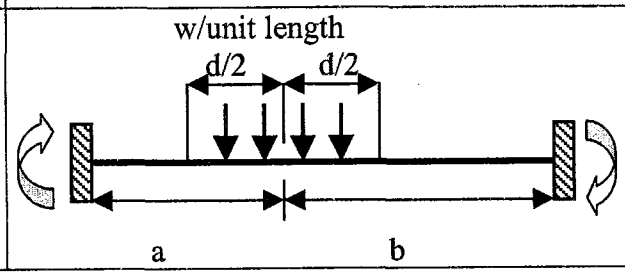
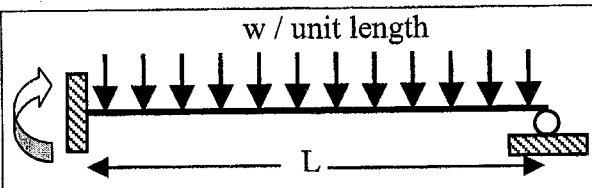
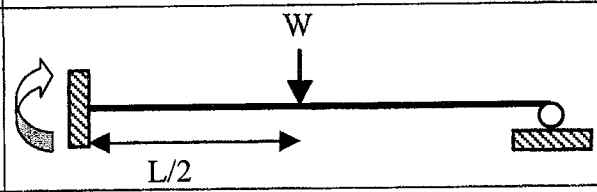
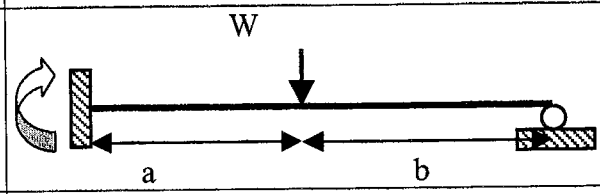
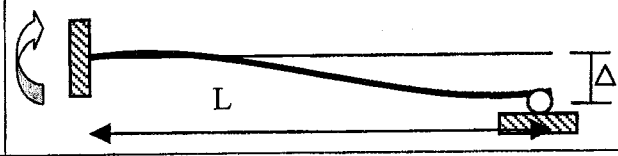
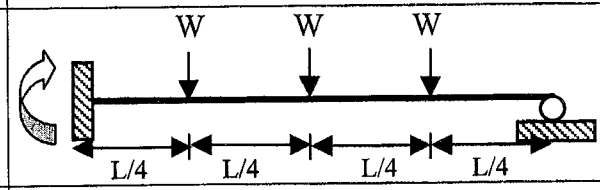
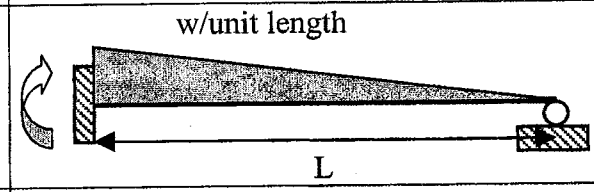
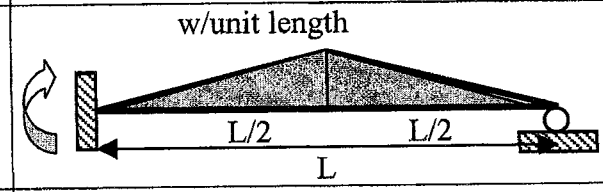
$-\frac{wL^2}{12}$		$\frac{wL^2}{12}$
$-\frac{WL}{8}$		$\frac{WL}{8}$
$-\frac{Wab^2}{L^2}$		$\frac{Wba^2}{L^2}$
$-\frac{6EI\Delta}{L^2}$		$\frac{6EI\Delta}{L^2}$
$-\frac{Mb(2a-b)}{L^2}$		$\frac{Mb(2b-a)}{L^2}$
$-\frac{wL^2}{30}$		$\frac{wL^2}{20}$
$-\frac{5wL^2}{96}$		$\frac{5wL^2}{96}$
$-\frac{wd}{L^2}\left(ab^2+\frac{(a-2b)d^2}{12}\right)$		$\frac{wd}{L^2}\left(a^2b+\frac{(b-2a)d^2}{12}\right)$

ATTACHMENT

Fixed End Moment

$-\frac{wL^2}{8}$		
$-\frac{3WL}{16}$		
$-\frac{W}{L^2}\left(b^2a+\frac{a^2b}{12}\right)$		
$-\frac{3EI\,\Delta}{L^2}$		
$-\frac{45WL}{96}$		
$-\frac{wL^2}{15}$		
$-\frac{5wL^2}{64}$		
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