3.4. SUPPORT SETTLEMENTS IN MOMENT DISTRIBUTION METHOD.

3.4.1 SUPPORT SETTLEMENT IN STRUCTURAL ANALYSIS:

Support settlements may be caused by **soil erosion**, dynamic soil effects during earthquakes, or by partial failure or settlement of supporting structural elements. Supports could also potentially heave due to frost effects (this could be considered a negative settlement).

3.4.2. INTRODUCTION:

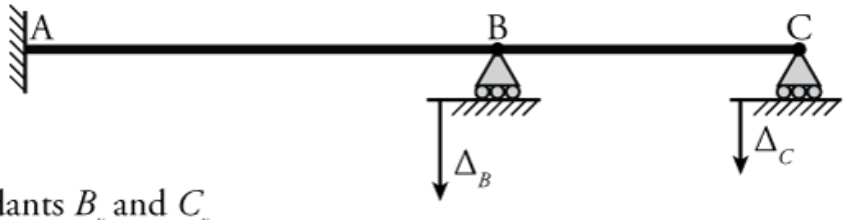
In the last lesson, the force method of analysis of statically indeterminate beams subjected to external loads was discussed. It is however, assumed in the analysis that the supports are unyielding and the temperature remains constant. In the design of indeterminate structure, it is required to make necessary provision for future unequal vertical settlement of supports or probable rotation of supports. It may be observed here that, in case of determinate structures no stresses are developed due to settlement of supports. The whole structure displaces as a rigid body. Hence, construction of determinate structures is easier than indeterminate structures.

The statically determinate structure changes their shape due to support settlement and this would in turn induce reactions and stresses in the system. Since, there is no external force system acting on the structures, these forces form a balanced force system by themselves and the structure would be in equilibrium. The effect of temperature changes, support settlement can also be easily included in the force method of analysis. In this lesson few problems, concerning the effect of support settlement are solved to illustrate the procedure.

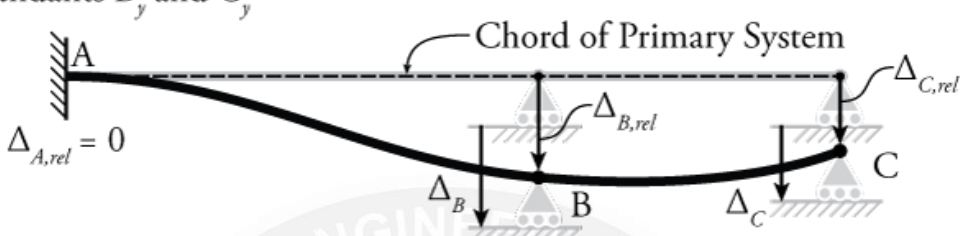
3.4.3. SUPPORT DISPLACEMENTS:

The whole structure displaces as a rigid body. Hence, construction of determinate structures is easier than indeterminate structures. The statically determinate structure changes their shape due to support settlement and this would in turn induce reactions and stresses in the system.

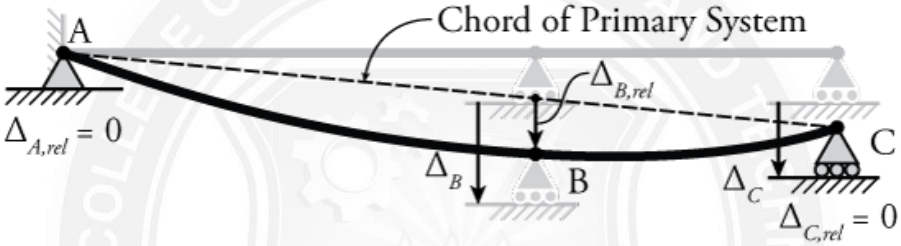
INDETERMINATE PROPPED CANTILEVER



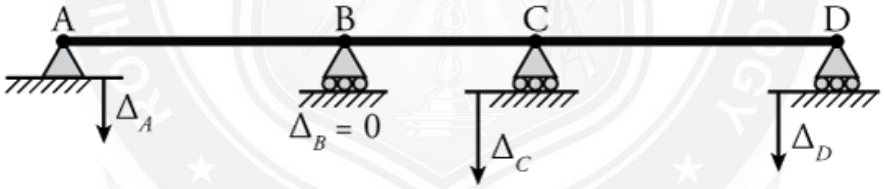
Redundants B_y and C_y



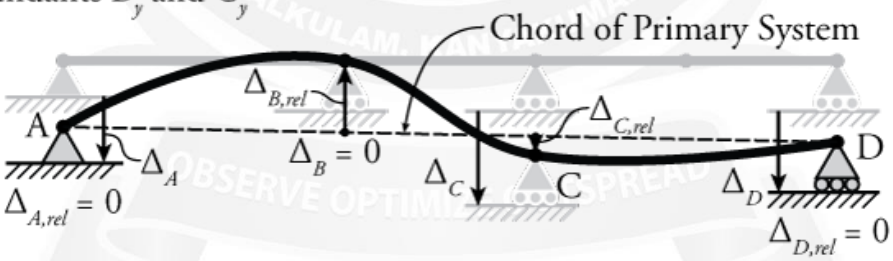
Redundants M_A and B_y



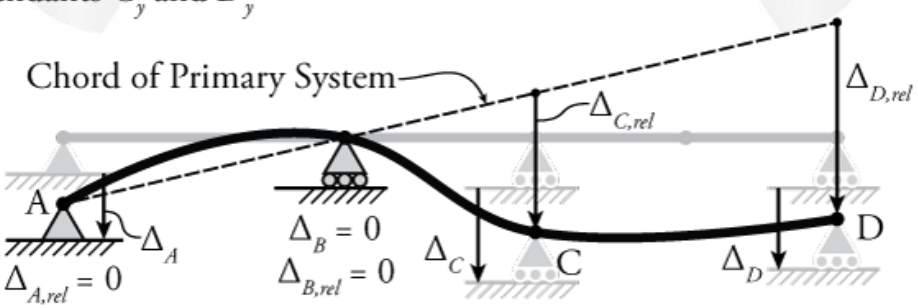
INDETERMINATE BEAM WITH MULTIPLE REDUNDANTS



Redundants B_y and C_y



Redundants C_y and D_y



Support settlements in continuous beams

3.4.4. NUMERICAL EXAMPLES ON(CONTINUOUS BEAMS):

PROBLEM NO:01

Analysis the continuous beam shown in fig.2.10,Calculate the support moments using moment distribution method.Support B settlememts by 10mm below the levels of A,C and D.Take E = 2 x 10^5 N/mm^2,I = 132 x 10^6 mm^4.Sketch the SF and BM diagrams.

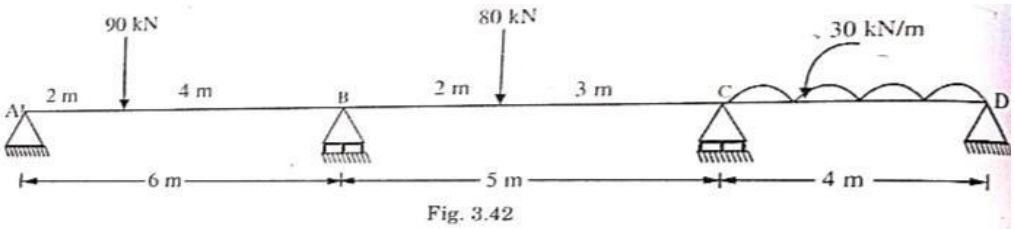
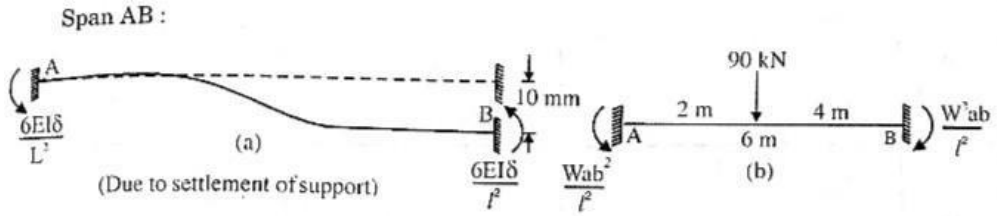


Fig. 3.42

Solution:

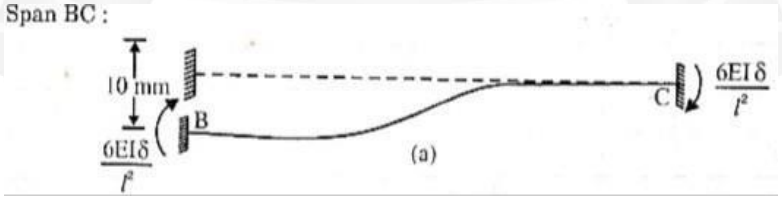
- **Fixed End Moments:**



MFAB = -6EIδ/l^2 - Wab^2/l^2= -6x26400x10x10^{-3}/6^2-90x2x4^2/6^2 = -124 kNm;

MFBA = -6EIδ/l^2 + Wa^2b/l^2 = -6x26400x10x10^{-3}/6^2+90x2x4^2/6^2 = - 4 kNm.

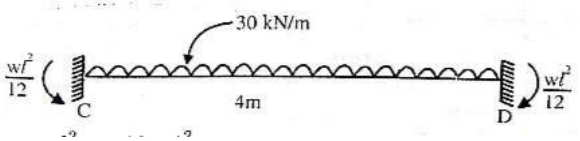
Span BC:



MFBC = 6EIδ/l^2 - Wab^2/l^2= 6x26400x10x10^{-3}/5^2-80x2x3^2/5^2 = 5.76 kNm;

MFCB = 6EIδ/l^2 + Wa^2b/l^2 = 6x26400x10x10^{-3}/5^2+80x2^2x3/5^2 = 101.76 kNm.

Span CD:



MFCD = $-Wl^2/12 = -30x4^2/12 = -40$ kNm;

MFDC = $Wl^2/12 = 30x4^2/12 = 40$ kNm;

- **Distribution Factor Table:**

Joint	Member	k	Σk	Distribution factor (k/Σk)
B	BA	3/4xl/6 = I/8	13I/40	0.385
	BC	l/5 = I/5		0.615
C	CB	l/5 = I/5	31I/80	0.516
	CD	3/4xl/4 = 3I/16		0.484

- **Free BMD:**

MAB = MCD = Wab/l= 90x2x4/6= 120 kNm;

MBC = MCD = Wab/l= 80x2x3/4 = 96 kNm;

MCD = $Wl^2/8 = 30x4^2/8$ = 60 kNm.

- **Final Moments:**

MAB = 0

MBA = 35.841 kNm

MBC = - 35.841 kNm

MCB = 71.648 kNm

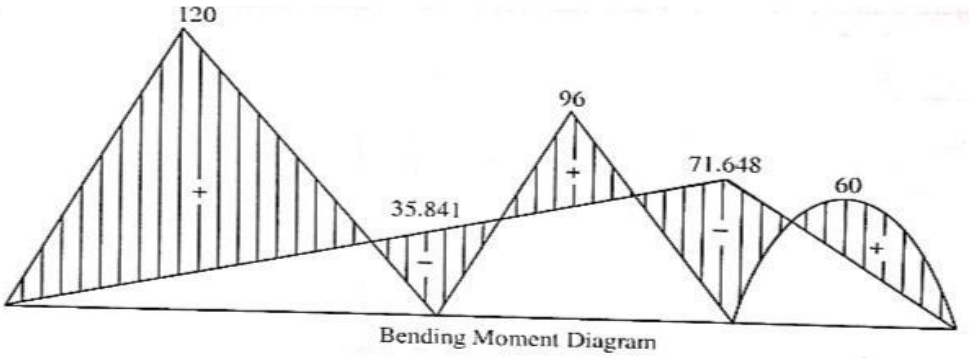
MCD = - 71.648 kNm

MDC = 0

- **Moment Distribution Table**:

Joint	A	B		C		D
Member	AB	BA	BC	CB	CD	DC
D.F	-	0.385	0.615	0.516	0.484	-
F.E.M	-124	-4	5.76	101.76	-40	40
Balance A & D	124					-40
Carry over		62			-20	
Initial Moments	0	58	5.76	101.76	-60	0
Balance B & C		-24.548	-39.212	-21.548	-20.212	
Carry Over			-10.774	-19.606		
Balance B & C		4.148	6.626	10.117	9.489	
Carry Over			5.059	3.313		
Balance B & C		-1.948	-3.111	-1.709	-1.604	
Carry Over			-0.855	-1.556		
Balance B & C		0.329	-0.526	0.803	0.753	
Carry Over			0.402	0.263		
Balance B & C		-0.155	-0.247	-0.136	-0.127	
Carry Over			-0.068	-0.124		
Balance B & C		0.026	0.042	0.064	0.06	
Carry Over			0.032	0.021		
Balance B & C		-0.012	-0.019	-0.011	-0.01	
Net Moment	0	35.841	-35.841	71.648	-71.648	0

- **Bending Moment Diagram**:



Bending Moment Diagram