Internal Training Session 2017

Redistribution of Moments

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Presentation Outline

- Empowering clauses
- Principles of redistribution
- Potential benefits
- Worked example
- Conclusions

BS 8110-1:1997

3.2.2 *Redistribution of moments*

3.2.2.1 *General*

Redistribution of the moments obtained by means of a rigorous elastic analysis or by the simplified methods of **3.2.1.2** and **3.2.1.3** may be carried out provided the following conditions are satisfied.

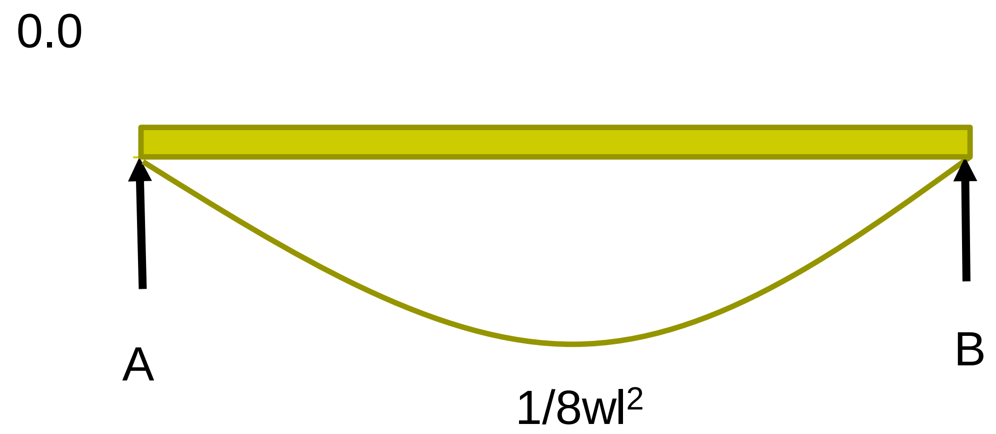
a) *Condition 1.* Equilibrium between internal and external forces is maintained under all appropriate combinations of design ultimate load.

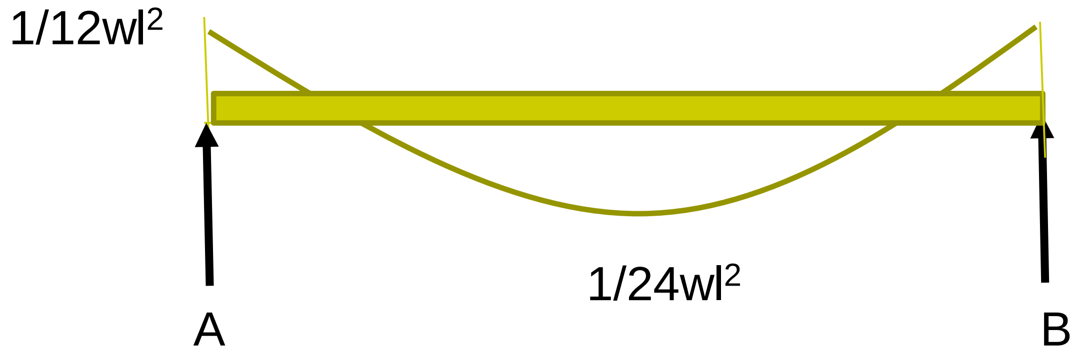
b) *Condition 2.* Where the design ultimate resistance moment of the cross-section subjected to the largest moment within each region of hogging or sagging is reduced, the neutral axis depth x should be checked to see that it is not greater than $(\beta_b - 0.4)d$ where d is the effective depth and β_b is the ratio:

$$\frac{(\text{moment at the section after redistribution})}{(\text{moment at the section before redistribution})} \leq 1$$

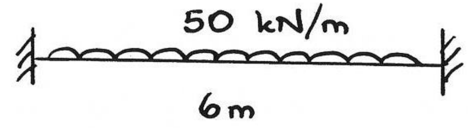
from the respective maximum moments diagram.

c) *Condition 3.* Resistance moment at any section should be at least 70 % of moment at that section obtained from an elastic maximum moments diagram covering all appropriate combinations of design ultimate load (but see **3.2.2.2** for tall structures).


0.0
A
B
1/8wl2


1/12wl2
1/24wl2
A
B

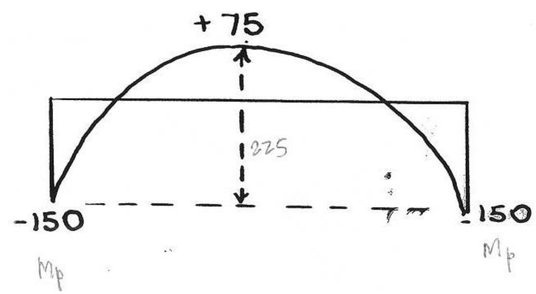
Simple application :



Elastic moments

$- \frac{wL^2}{12} = -150 \text{ kNm}$

$+ \frac{wL^2}{24} = +75 \text{ kNm}$

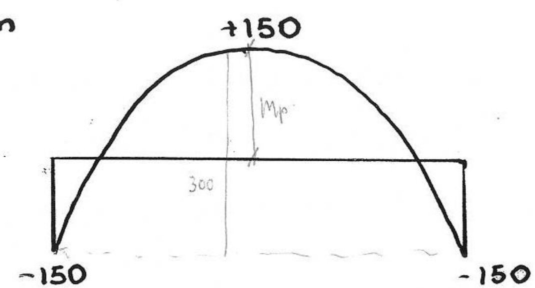


Hold M_p = 150 kNm

Increase load until

mid-span mom. = 150 kNm

∴ W = 66.7 kNm

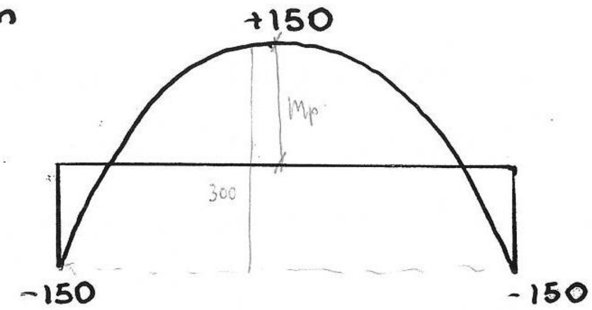


But we want W = 50

not 66.7 kN/m

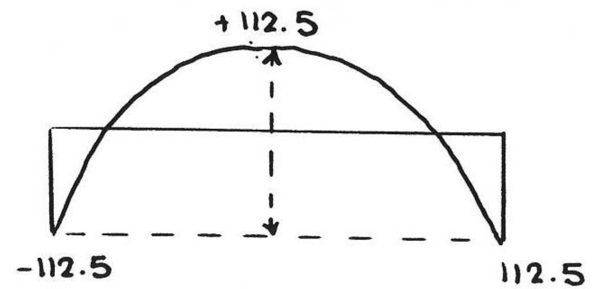
mid-span mom. = 150 kNm

∴ W = 66.7 kNm



But we want W = 50 not 66.7 kN/m

∴ reduce $M_p \times \frac{50}{66.7}$ =



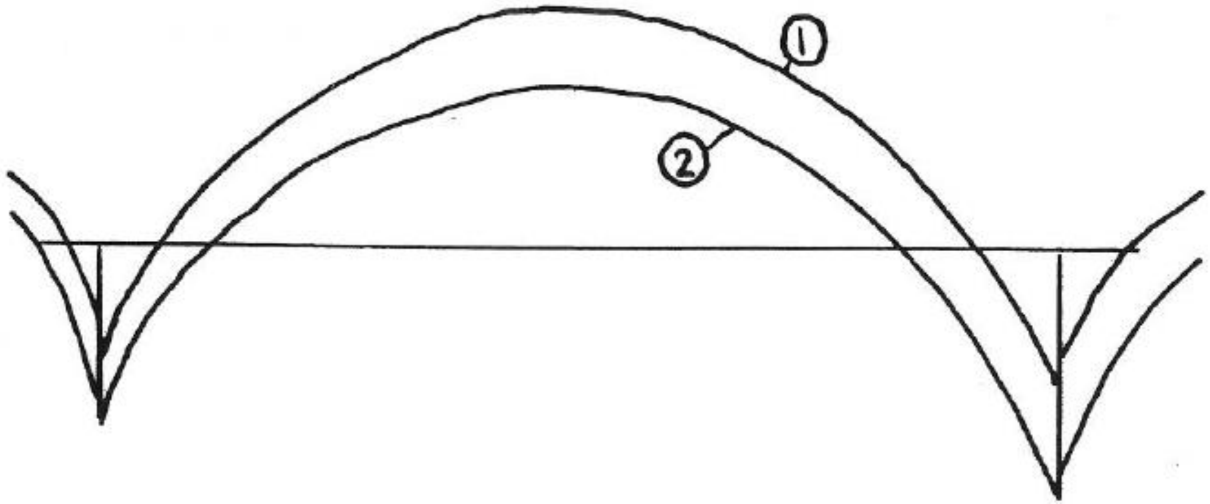
∴ for same load as original

M = 112.5 kNm

$\therefore \beta_b = \frac{112.5}{150} = 0.75$ redistribution

But in doing so, mid-span moment has increased from + 75 to + 112.5 kNm, so where is the saving?

In most structures there are several load cases leading to maxima and minima from different load cases.

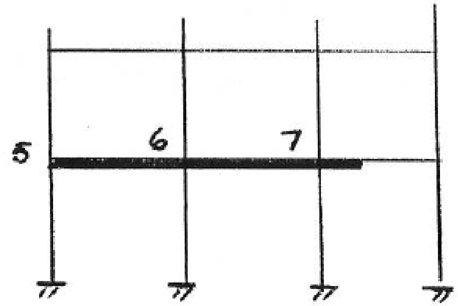


∴ the support moment in load case ② can be reduced until the mid-span moment equals that in load case ①.

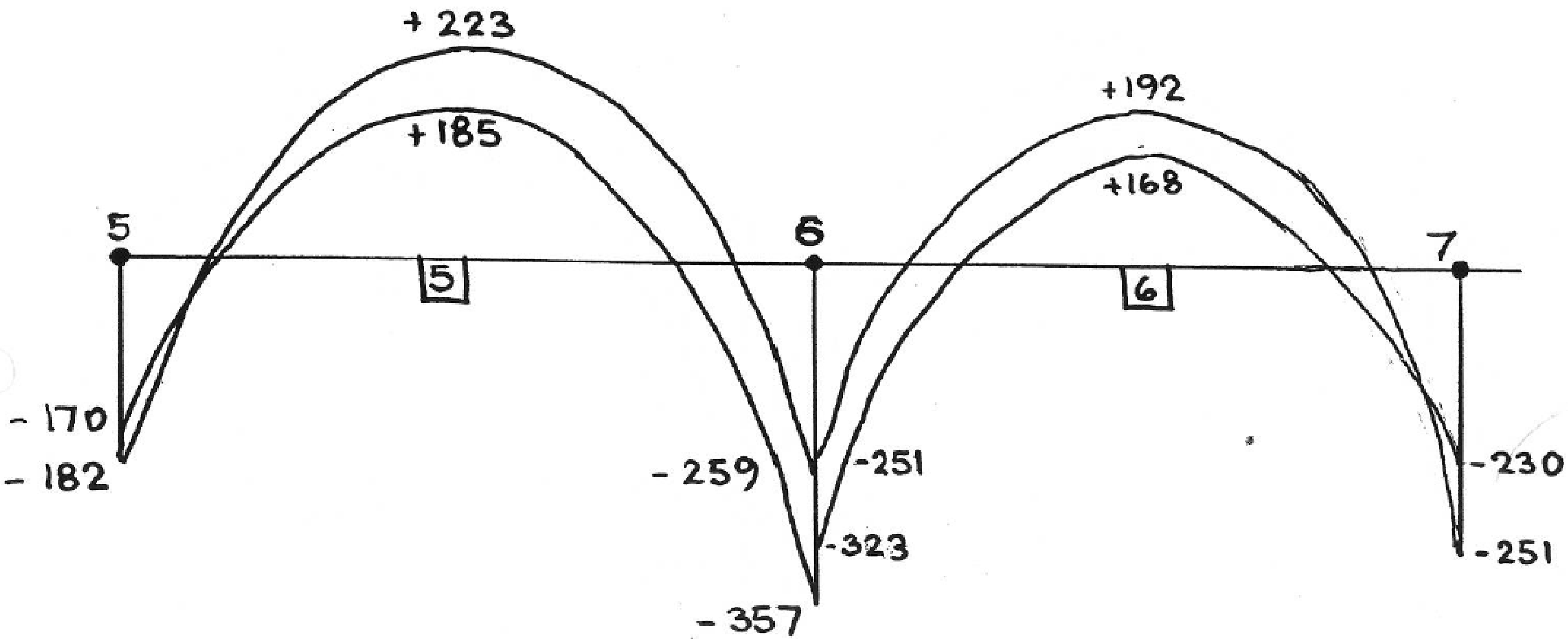
Note - field moment does not change!

And $\beta_b \nless 0.7$

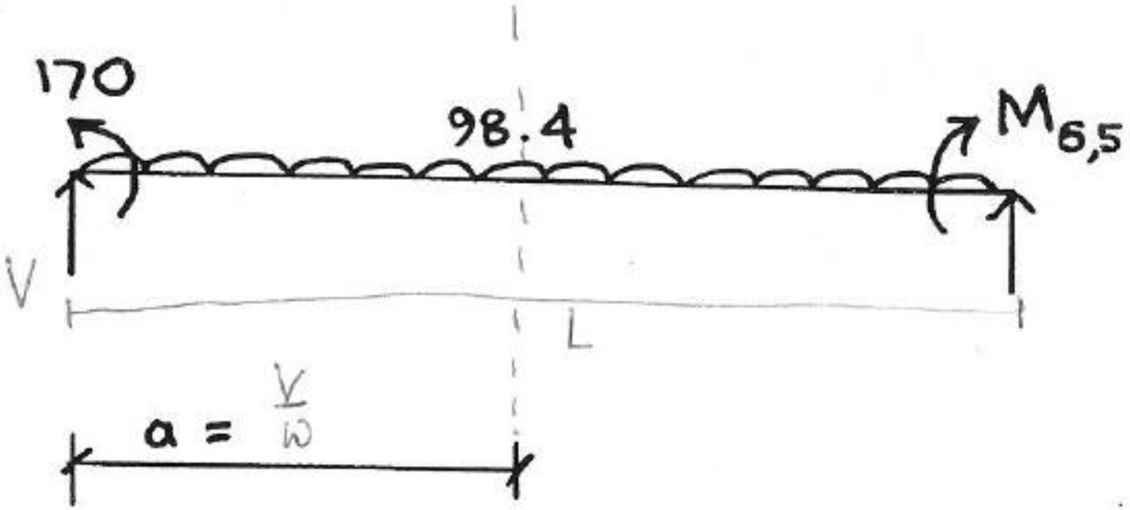
Frame F1.



Span = 6.00 m
UDL = 98.4 kN/m



Reduce -357 so +185 → 223



$223 = Va - \frac{wa^2}{2} - 170$

$393 = \frac{V^2}{2w}$

$\therefore V = \sqrt{2w \cdot 393}$

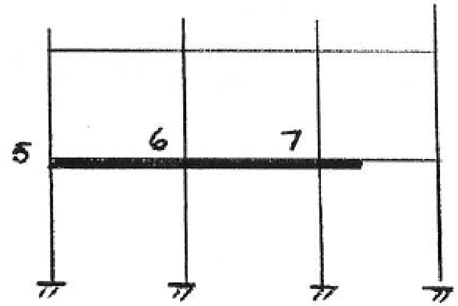
$V = 2.$

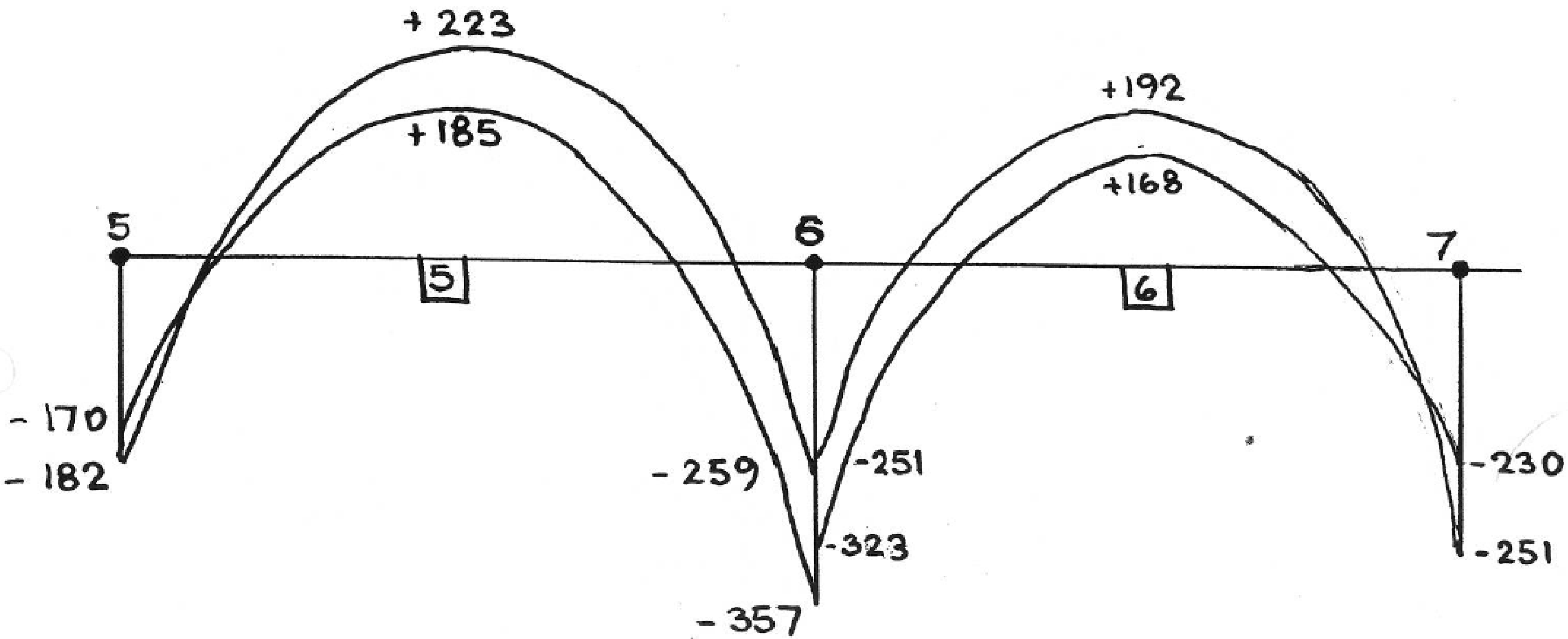
Solution $M_{6,5} = VL - \frac{wL^2}{2} - 170$

$a = 2\cdot$

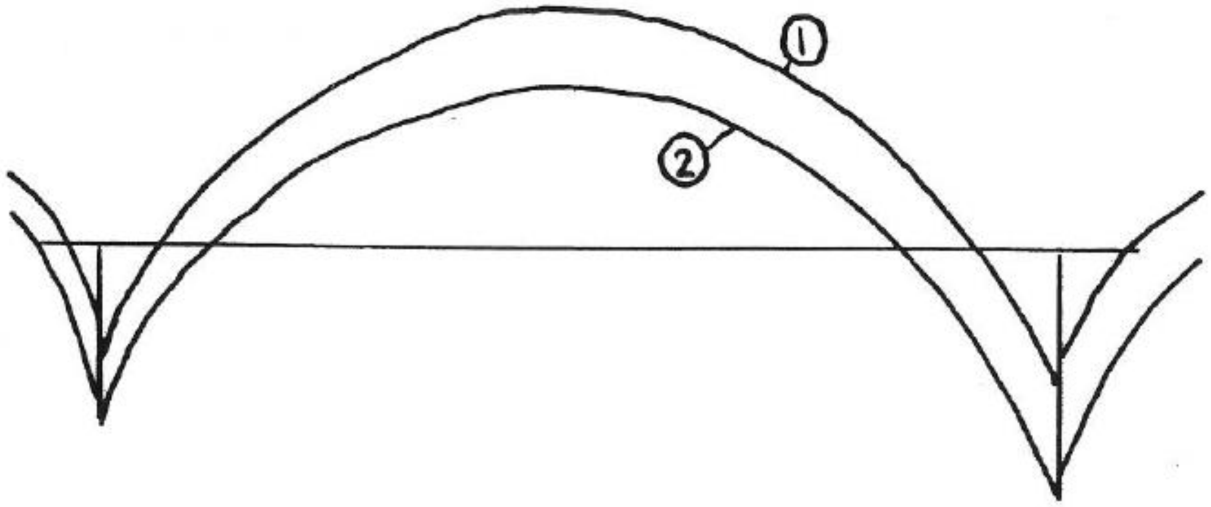
$M_{sag} =$

Frame F1.





Repeat exercise to reduce -323 so +168 → +192
(if possible ?)



∴ the support moment in load case ② can be reduced until the mid-span moment equals that in load case ①.

Note - field moment does not change!

And $\beta_b \nless 0.7$

Thank you

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