SESI LATIHAN DALAMAN 2016: DESIGN OF STRUCTURES

Understanding the Design Parameters

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- Current perception
- Design Parameters
- Impact on design
- Conclusion

Presentation Outline

3.4.4.4 *Design formulae for rectangular beams.* The f
ing equations, which are based on the simplified stres
block of figure 3.3, are also applicable to flanged bea
where the neutral axis lies within the flange:

$K' = 0.156$ where redistribution does not exceed 1
(this implies a limitation of the neutral axis d
to $d/2$); or

$K' = 0.402(\beta_b - 0.4) - 0.18(\beta_b - 0.4)^2$ where redistribution exceeds 10 %

and $K = M/bd^2 f_{cu}$

If $K \leqslant K'$, compression reinforcement is not required

$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K}{0.9}\right)}\right\}$$

but not greater than $0.95d$

$$x = (d - z)/0.45$$

$$A_s = M/0.87 f_y z$$

BS8110 : Part 1: 1987

If $K \le K'$, compression reinforcement is not required and:

$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K}{0.9}\right)}\right\}$$

but not greater than 0.95*d*.

$$x = (d - z)/0.45$$

$$A_s = M/0.95 f_y z$$

BS8110 : Part 1: 1997

If $K > K'$, compression reinforcement is required and:

$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K'}{0.9}\right)}\right\}$$

$$x = (d - z)/0.45$$

$$A_s' = (K - K')f_{cu}bd^2/0.95f_y(d - d')$$

$$A_s = (K' f_{cu}bd^2/0.95f_y z) + A_s'$$

Issued September 1998

If d'/x exceeds 0.37 (for f_y = 460 N/mm^2), the compression stress will be less than $0.95f_y$ and should be ...

If $K \leq K'$, compression reinforcement is not required and:

$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K}{0.9}\right)}\right\}$$

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BS8110 : Part 1: 1997

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Issued in May 2002

If $K \leq K'$, compression reinforcement is not required and:

$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K}{0.9}\right)}\right\}$$

but not greater than $0.95d$.

$x = (d - z)/0.45$

$A_s = M/0.87 f_y z$

$d = h - c -$

$d' = c + \phi$

Max. $= 0.95\ d$

BS8110 : Part 1: 1997

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$$z = d\left\{0.5 + \sqrt{\left(0.25 - \frac{K'}{0.9}\right)}\right\}$$

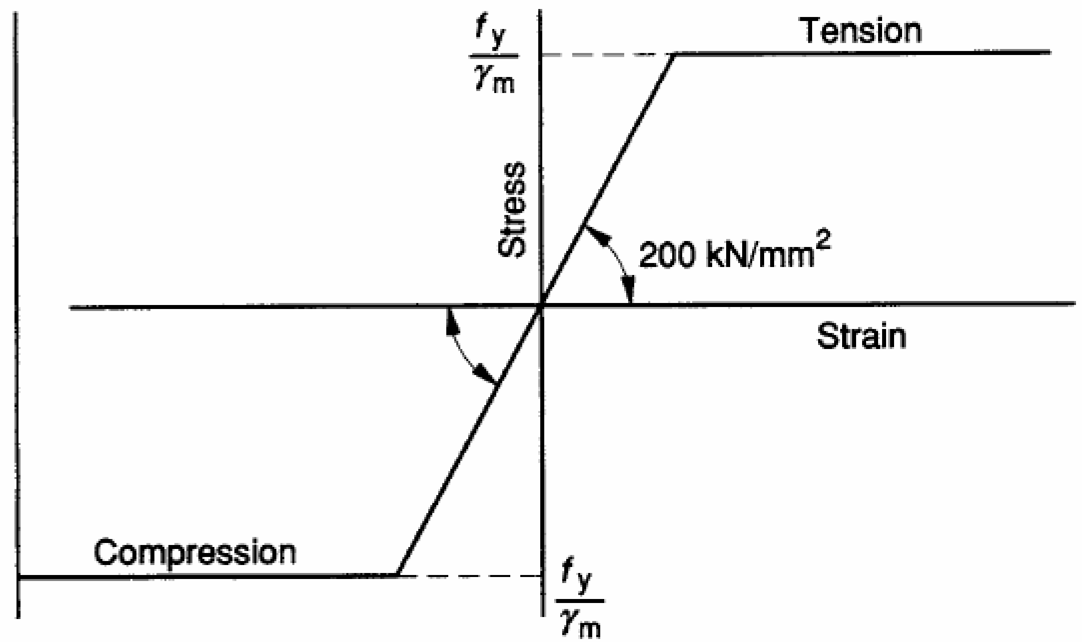
$x = (d - z)/0.45$

$A_s' = (K - K') f_{cu} b d^2 / 0.87 f_y (d - d')$

$A_s = (K' f_{cu} b d^2 / 0.87 f_y z) + A_s'$

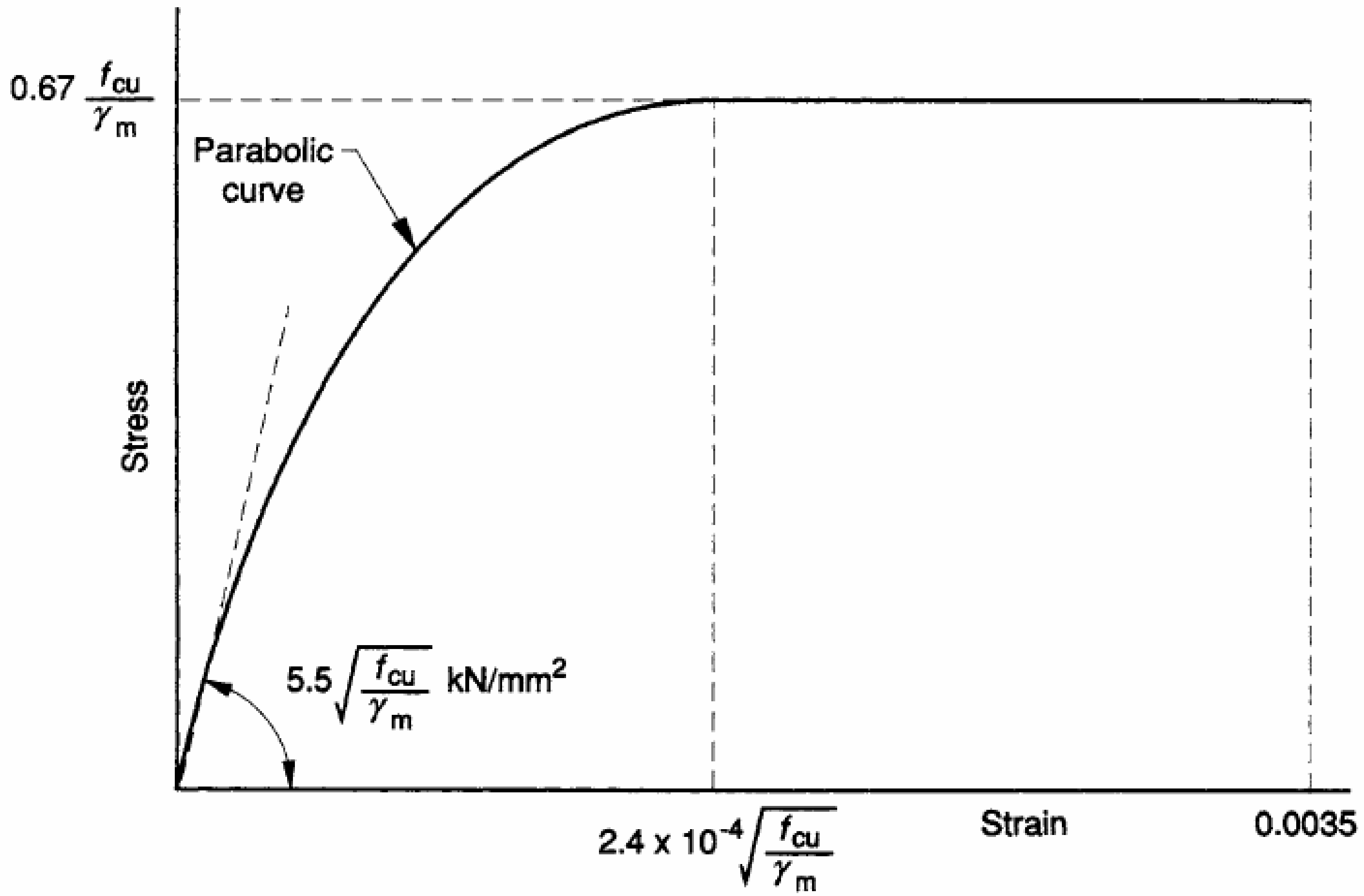
K' max $= 0.156$

Issued in 2007



NOTE f_y is in N/mm^2.

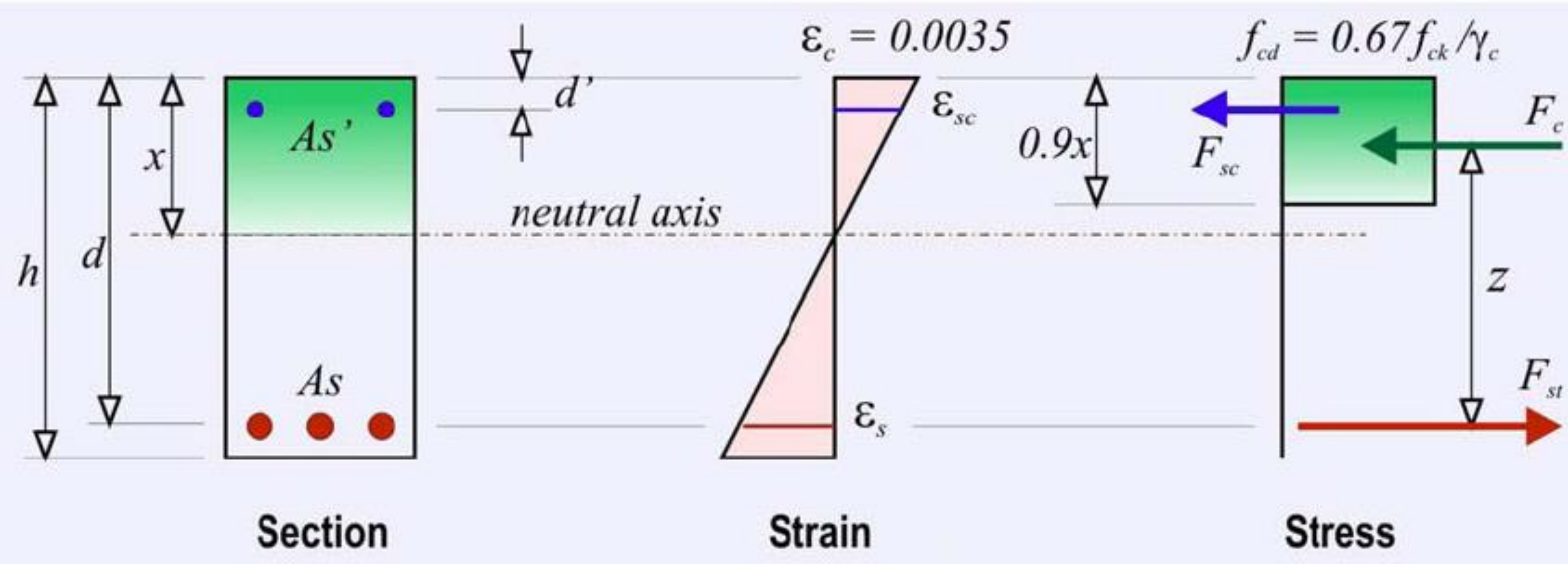
Figure 2.2 — Short term design stress-strain curve for reinforcement



NOTE 1 0.67 takes account of the relation between the cube strength and the bending strength in a flexural member. It is simply a coefficient and not a partial safety factor.

NOTE 2 f_{cu} is in N/mm².

Figure 2.1 — Short term design stress-strain curve for normal-weight concrete



BS8110 stress block

3.2.1.2 *Monolithic frames not providing lateral stability*

3.2.1.2.1 *Simplification into sub-frames*

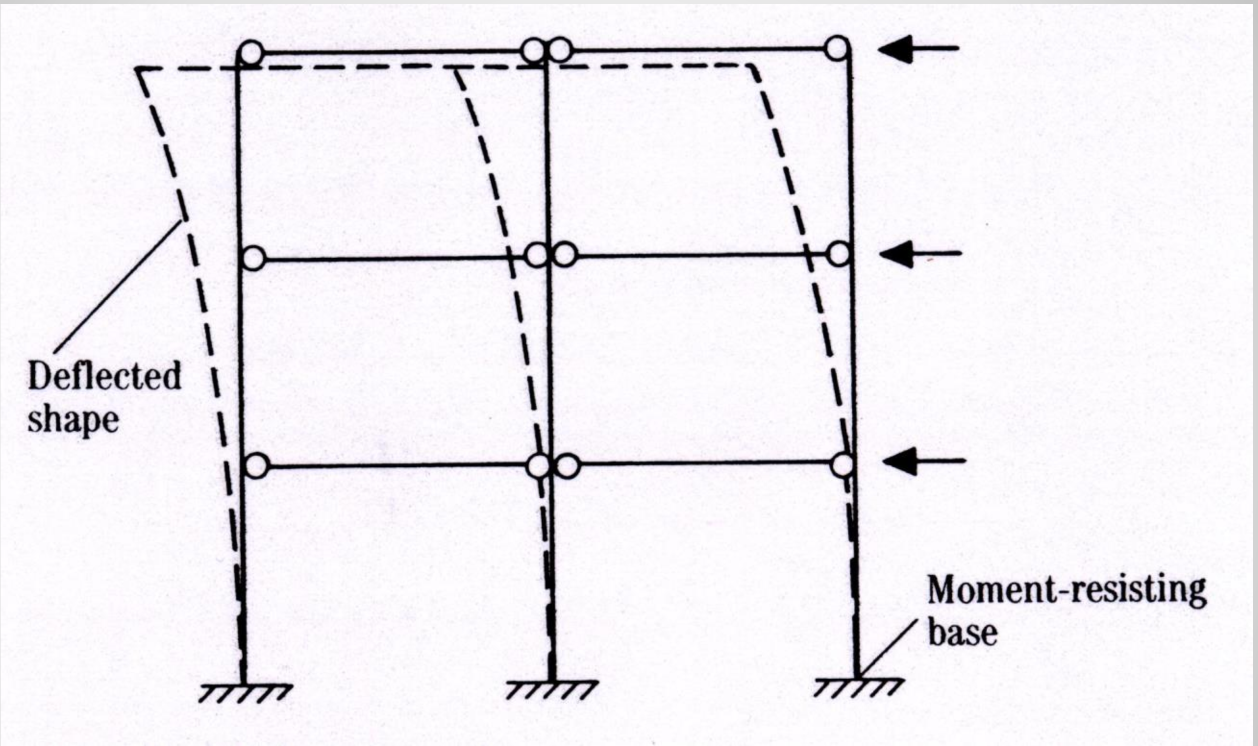
The moments, loads and shear forces to be used in the design of individual columns and beams of a frame supporting vertical loads only may be derived from an elastic analysis of a series of sub-frames (but see **3.2.2** concerning redistribution of moments). Each sub-frame may be taken to consist of the beams at one level together with the columns above and below. The ends of the columns remote from the beams may generally be assumed to be fixed unless the assumption of a pinned end is clearly more reasonable (for example, where a foundation detail is considered unable to develop moment restraint).

3.2.1.2.2 *Choice of critical loading arrangements*

It will normally be sufficient to consider the following arrangements of vertical load:

a) all spans loaded with the maximum design ultimate load ($1.4G_k + 1.6Q_k$);

b) alternate spans loaded with the maximum design ultimate load ($1.4G_k + 1.6Q_k$) and all other spans loaded with the minimum design ultimate load ($1.0G_k$).



Unbraced frame

3.2.1.3 ***Frames providing lateral stability***

3.2.1.3.1 *General*

Where the frame provides lateral stability to the structure as a whole, sway should be considered. In addition, if the columns are slender, additional moments (e.g. from eccentricity) may be imposed on beams at beam-column junctions (see **3.8.3**). The load combinations 2 and 3 (see **2.4.3.1**) should be considered in addition to load combination 1.

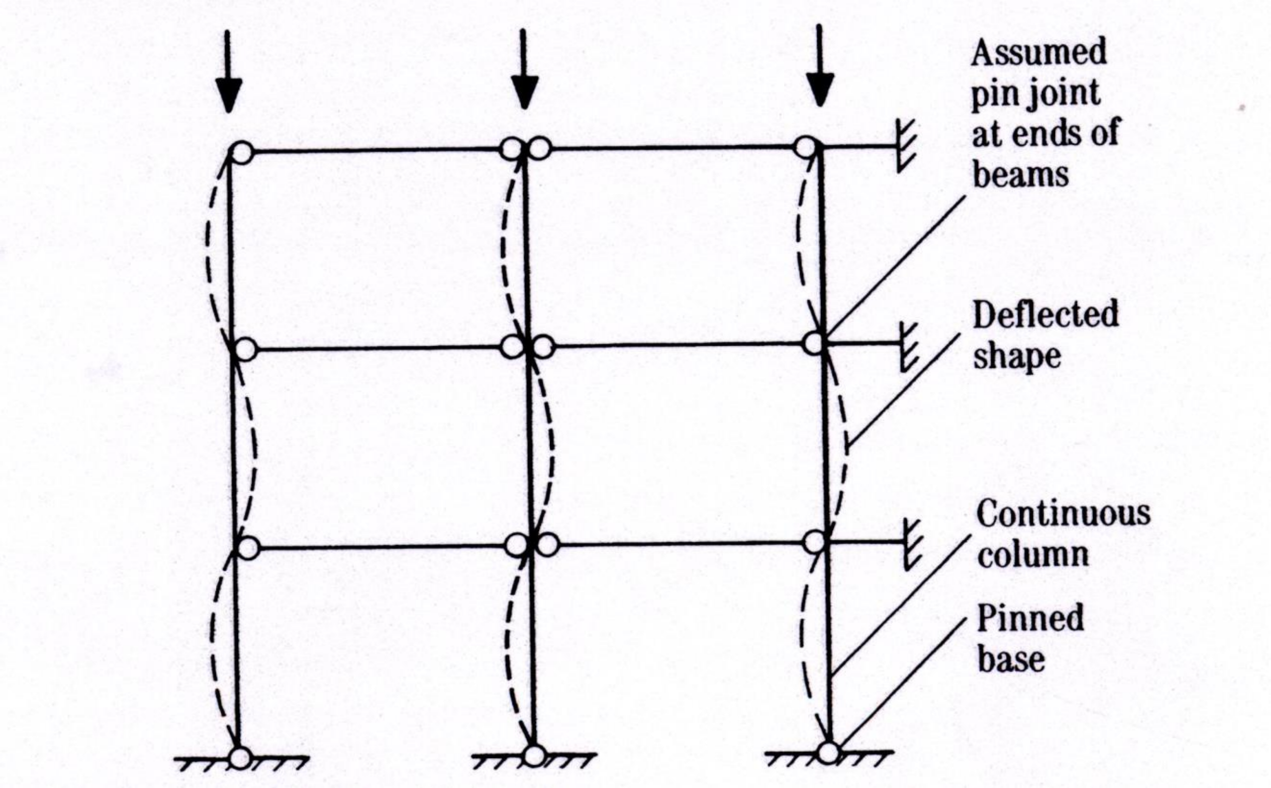
3.2.1.3.2 *Sway-frame of three or more approximately equal bays*

The design of individual beams and columns may be based on either the moments, loads and shear obtained by considering vertical loads only, as in **3.2.1.2.2** or, if more severe, on the sum of those obtained from a) and b) as follows.

a) An elastic analysis of a series of sub-frames each consisting of the beams at one level together with the columns above and below assumed to be fixed at their ends remote from those beams (or pinned if this is more realistic). Lateral loads should be ignored and all beams should be considered to be loaded with their full design load ($1.2G_k + 1.2Q_k$).

b) An elastic analysis of the complete frame, assuming points of contraflexure at the centres of all beams and columns, ignoring dead and imposed loads and considering only the design wind load ($1.2W_k$) on the structure. If more realistic, instead of assuming points of contraflexure at the centres of ground floor columns the feet should be considered pinned.

It will also be necessary to consider the effects of load combination 2 (see **2.4.3.1**) i.e. $1.0G_k + 1.4W_k$.



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Thank you

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