WORKSHOP 12-13 febbraio 2007
Materiali ed Approcci Innovativi per il Progetto in Zona Sismica e la Mitigazione della Vulnerabilità delle Strutture

Progettazione sismica di edifici con controventi concentrici

E. Grande, G. Brandonisio, A. De Luca & E Mele

Università degli Studi di Napoli "*Federico II*"
Facoltà di Ingegneria
DAPS – *Dipartimento di Analisi e Progettazione Strutturale*

Seismic design of CBFs

- Design approach of recent seismic codes
  - capacity design concept for CBFs
  - ductile ultimate behaviour
- Design Provisions
  - slenderness of braces
  - (over)strength of beams, columns, connections

Influence of code provisions in the seismic design of ductile CBFs

plan – brace - building

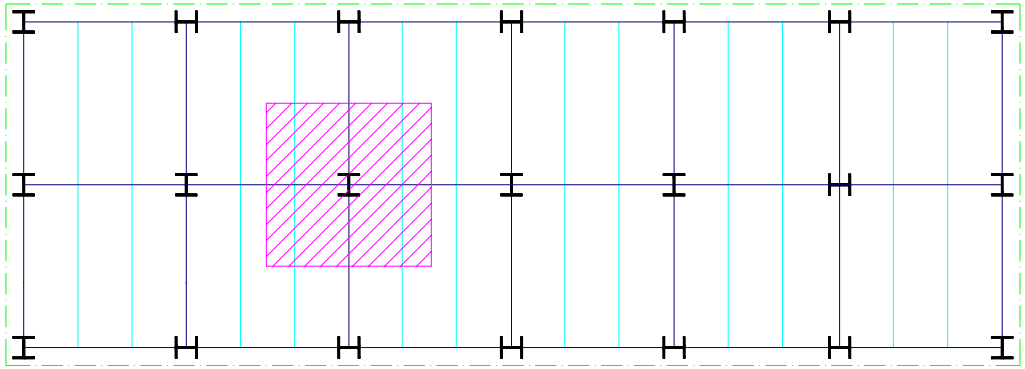
Examination of code provisions

- **EC8 (march'94 and decemb.'03)**
- **OPCM (march'03 and may'05)**

Design of CBF buildings:

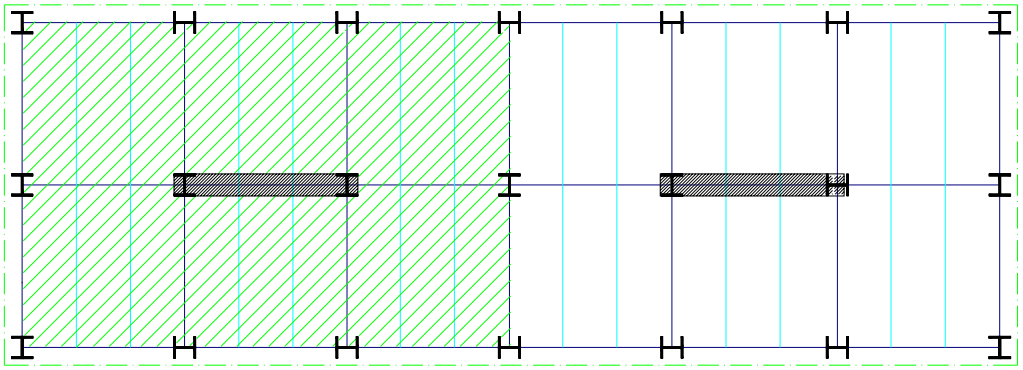
- **geometric plan-structure dimensions**
- **CBFs arrangement in plan**

Presented results



Gravity Loads Resisting System

Single column Tributary area for **gravity loads** resistance



Seismic Loads Resisting System

Braced Frames

single brace tributary area for **seismic loads** resistance

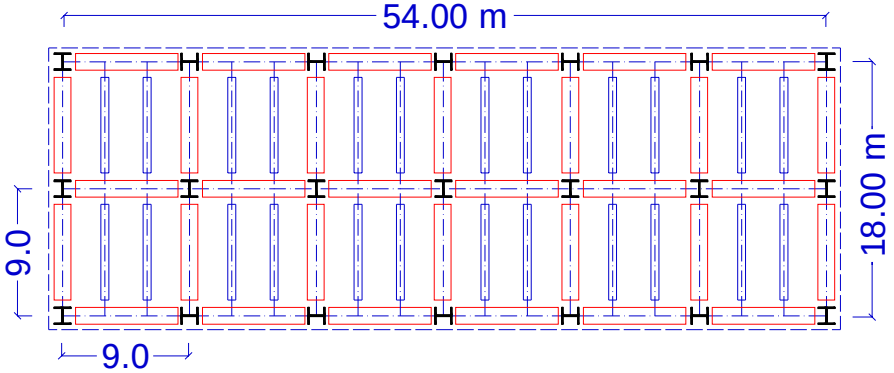
1. Design solutions:

Y = n. of grid units / n. of braces (12/2=6)

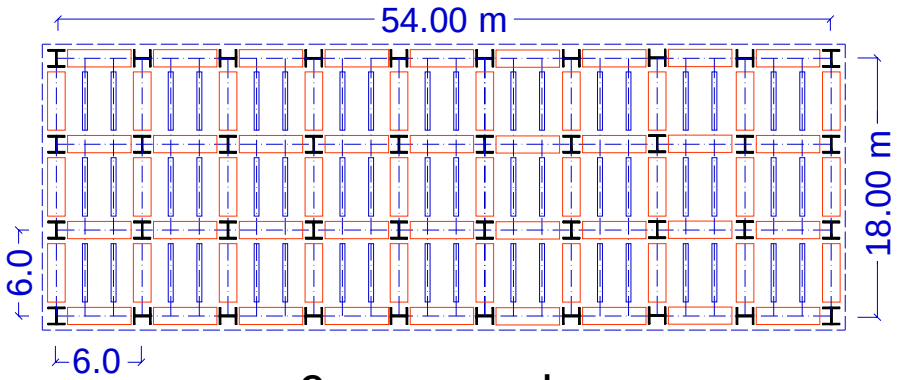
2. Structural weight:

$$\frac{P_{CBF}}{P_{NF}} = \frac{\text{Structural weight of gravity load resisting system}}{\text{Structural weight of CBF system}}$$

Examined structures

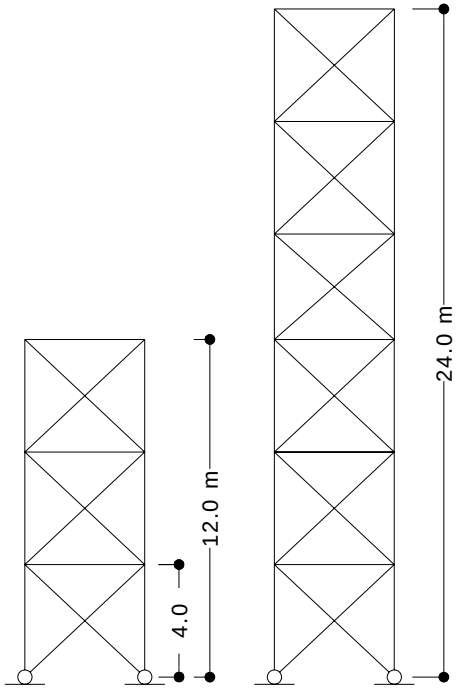


6 m span bays



9 m span bays

- building plan
- n. of stories: 3 and 6 story buildings
- seismic codes: EC8– OPCM
  DM96 and *elastic design*
- number of truss frames in plan
- max col. section : HE1000M (S355)



DESIGN PROVISIONS

1) Slenderness of diagonal members

$\overline{\lambda} \leq \overline{\lambda}_{max}$ ⇒ min. size of diagonal sections

$\overline{\lambda} > \overline{\lambda}_{min}$ ⇒ max. size of diagonal sections

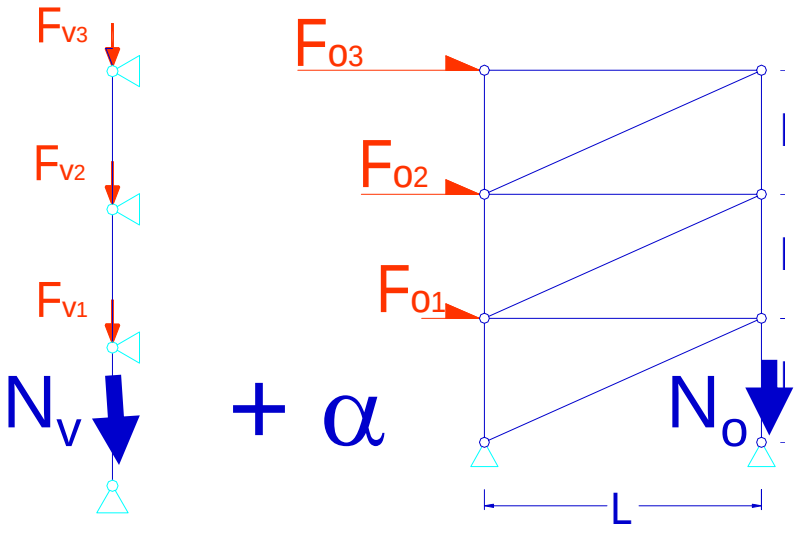
2) Strength of columns and beams

overstrength factor: $\alpha_i = \left[\frac{N_{pl,diag,i}}{N_{sd,diag,i}}\right]$

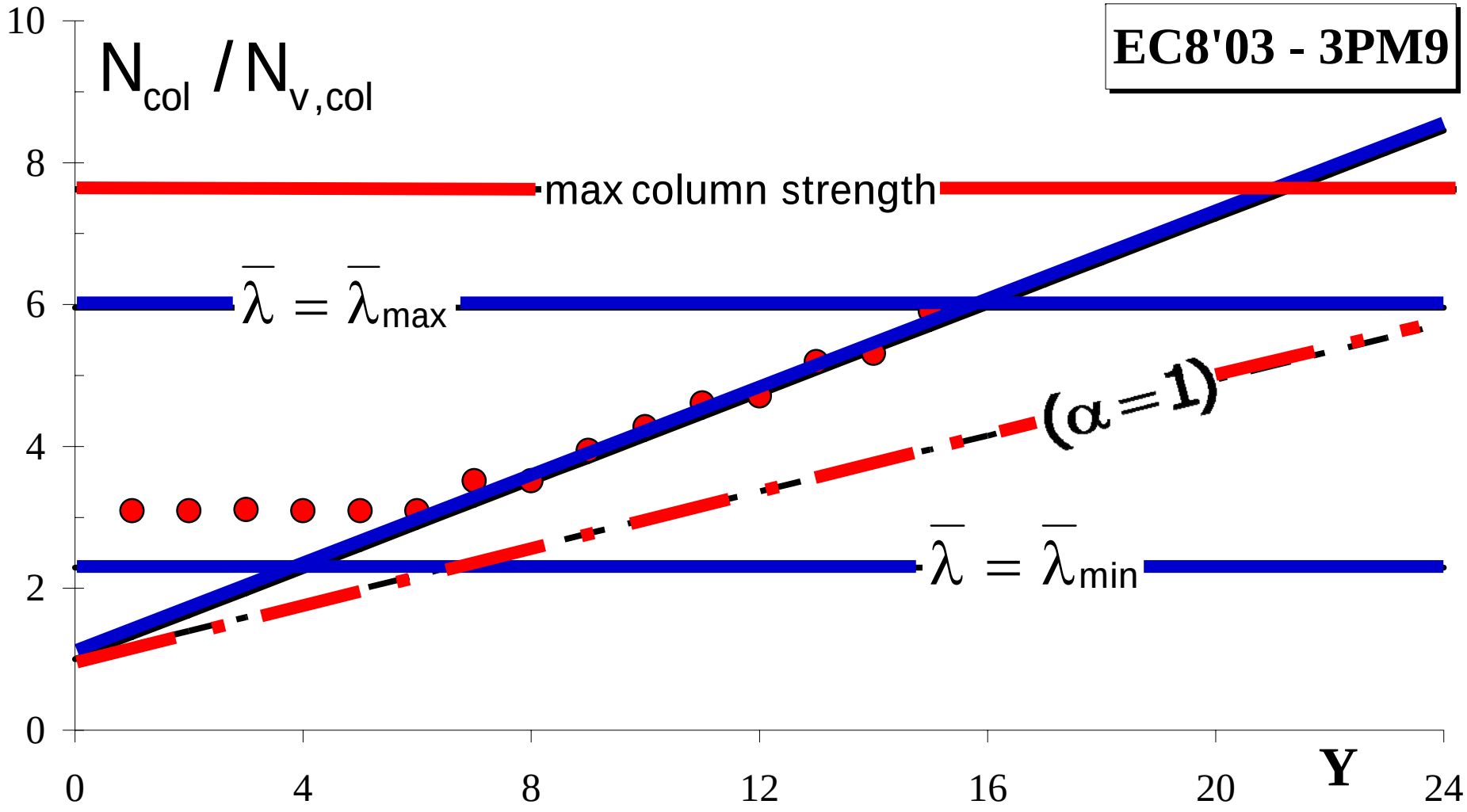
$$N_{col} = N_v + \alpha N_o$$

⇓

min. size of column sections

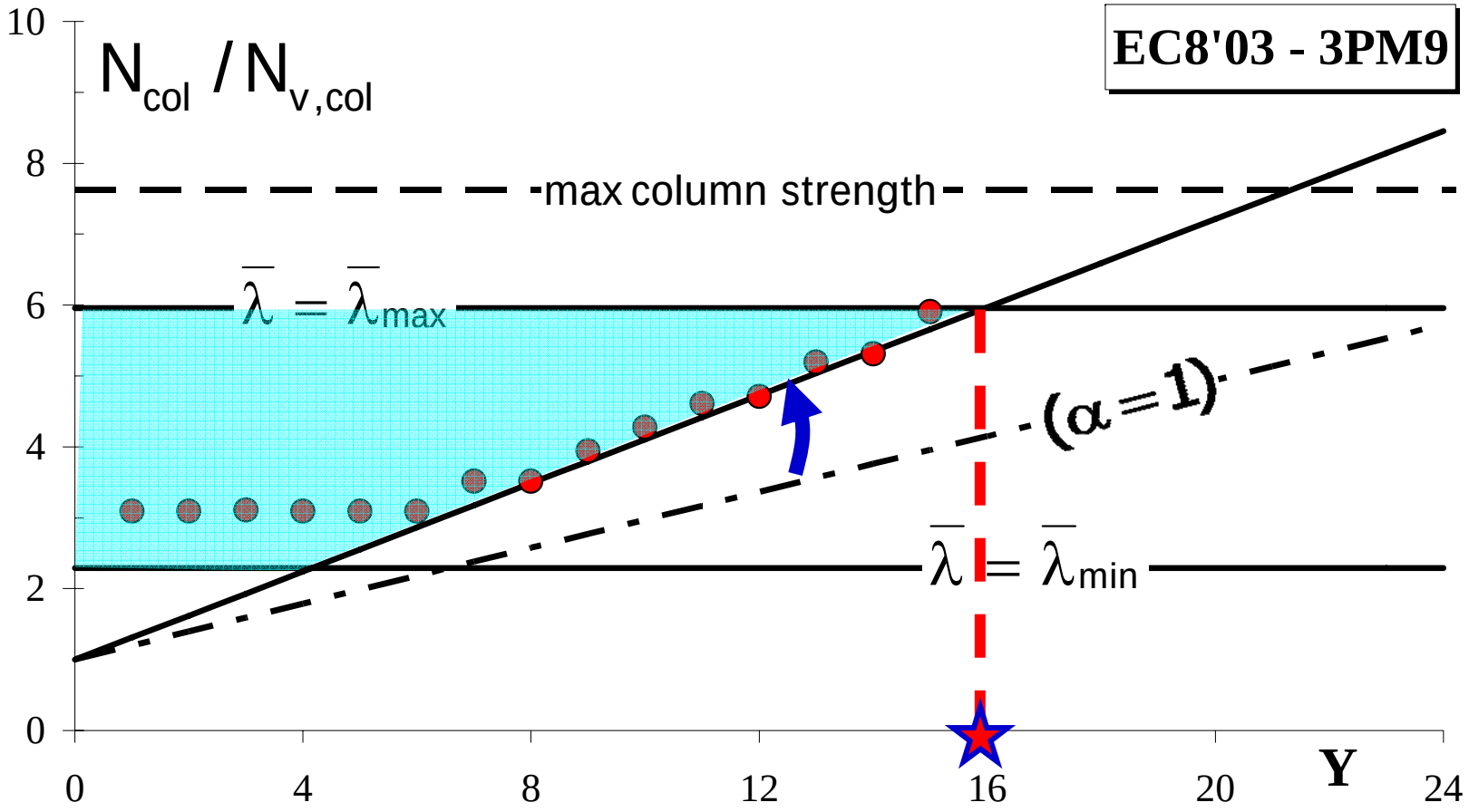


Influence of Design Provisions



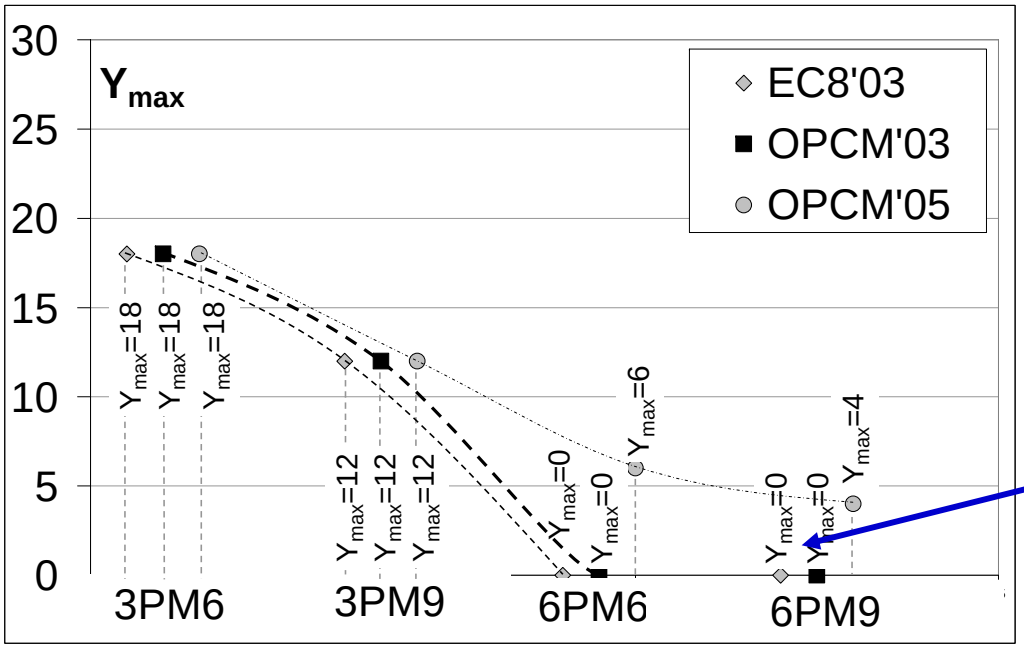
column strength requirements

Influence of Design Provisions



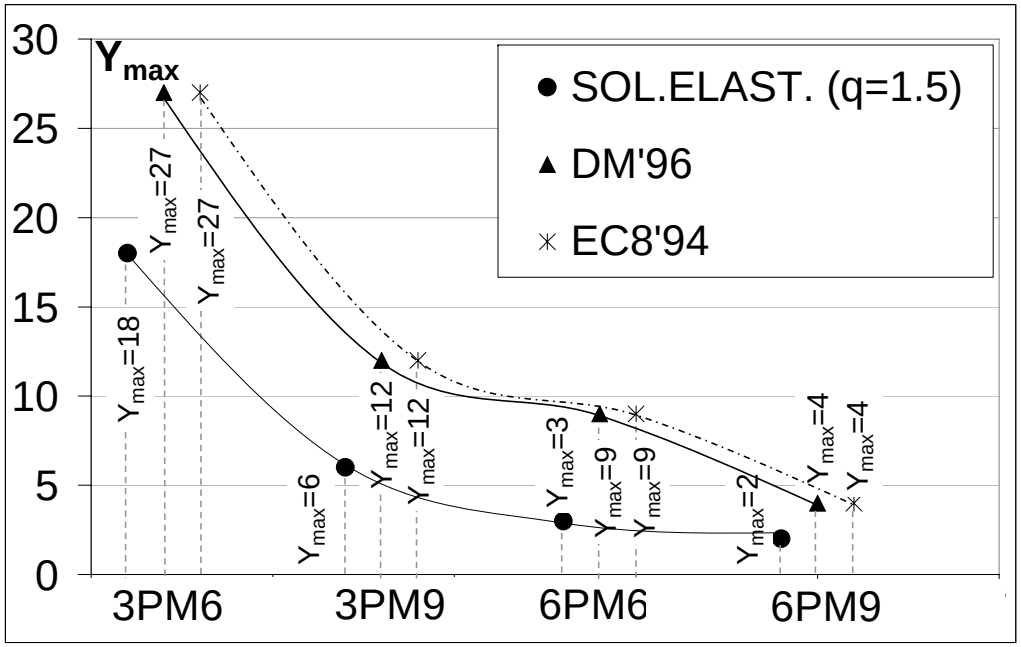
- Increasing of required column strengths
- Domain of admissible cases
- Design limits ⇒ Ymax

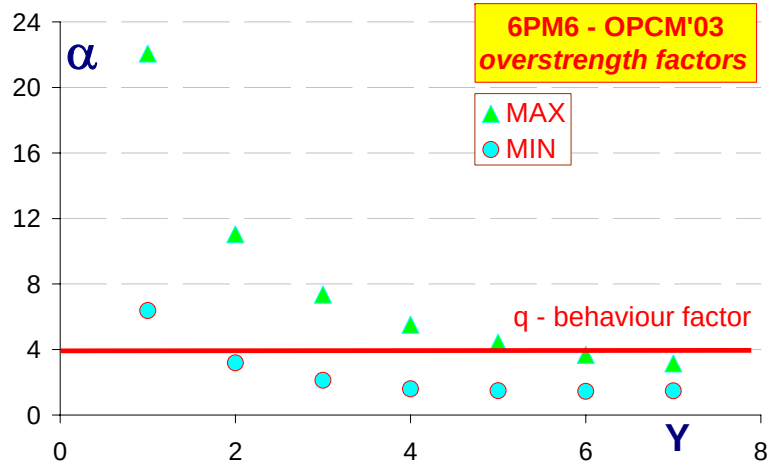
Influence of Design Provisions



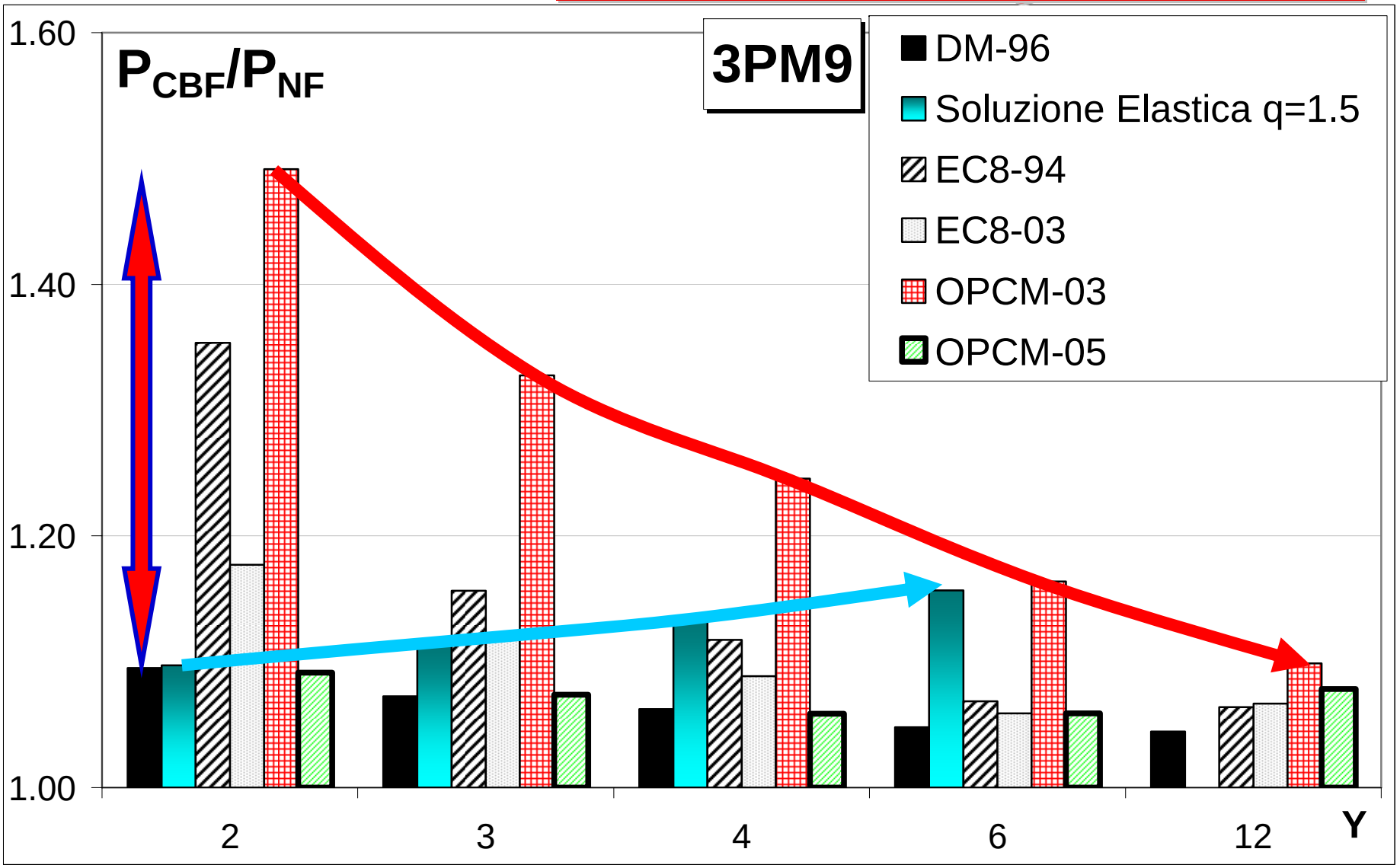
Y_{max} = max n. of grid units sustained by the single braced frame

- **6 story sol: no feasible sol. for EC8'03 and OPCM'03**





Influence of Design Provisions



structural weight

CONCLUSIVE REMARKS

- Geometric/structural parameters affecting X-CBF bldg design – domain of feasible structural solutions
- Limitations on diagonal slenderness and overstrength requirements for columns (and beams) strongly affects the dimensioning process of CBFs
- Weight premium due to capacity design can be high
- Elastic design of CBFs is more convenient in terms of structural weight when the diagonal stress level s low (high number of braces in plan) or when high overstrength factors are required