PAST AND PRESENT RESEARCH AREAS

Assoc. Prof. **Dietlinde Köber**

Reinforced Concrete Department, Technical University Bucharest

Past and present research areas

- general torsion of structures
- design of discontinuity regions for RC elements
- alternative seismic design methodology for RC wall buildings
- structural design in seismic areas

General torsion of structures

Simplified Method for the Assessment of General Torsion Effects on Structural Displacements – SESA

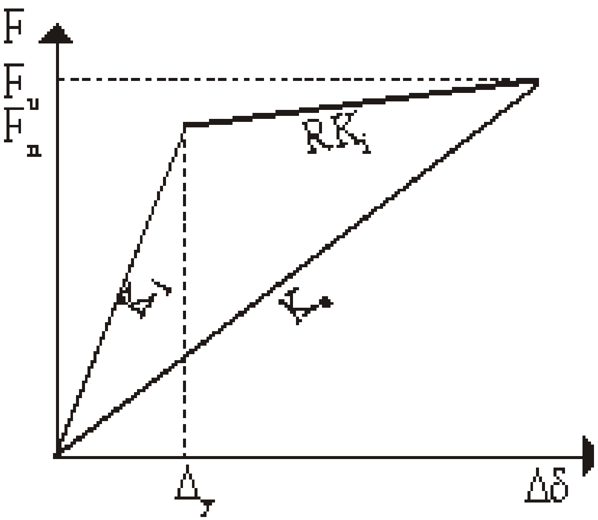
superposition of modal effects

extended to nonlinear behaviour by using overdamped displacement response spectra

applies for the estimation of the displacement amplification due to torsion

General torsion of structures

using the SESA method implies following steps:



- m, J, r
- calculation initial translational stiffnesss, K_t = f (T_t)
- determination of the translation equivalent structure (equivalent damping and eigenperiod)
- calculation of equivalent translational stiffness Kt,eq = f(Teq)
- calculation equivalent rotational stiffness, considering the same stiffness reduction as for translation, for all structural walls.

General torsion of structures

- calculation eigenvalues symmetric system, ω_θ and ω_y
- calculation eigenvalues unsymmetric system, by modal analysis:

$$\frac{\omega_i}{\omega_y} = \left(\frac{1+\hat{e}^2+\Omega^2}{2} \pm \sqrt{\left(\frac{1+\hat{e}^2+\Omega^2}{2}\right)^2 - \Omega^2} \right)^{1/2}$$

i = 1, 2

$\hat{e} = e / r$

$\Omega = \omega_\theta / \omega_y$

- determination maximum modal response in CM, using overdamped response spectra:

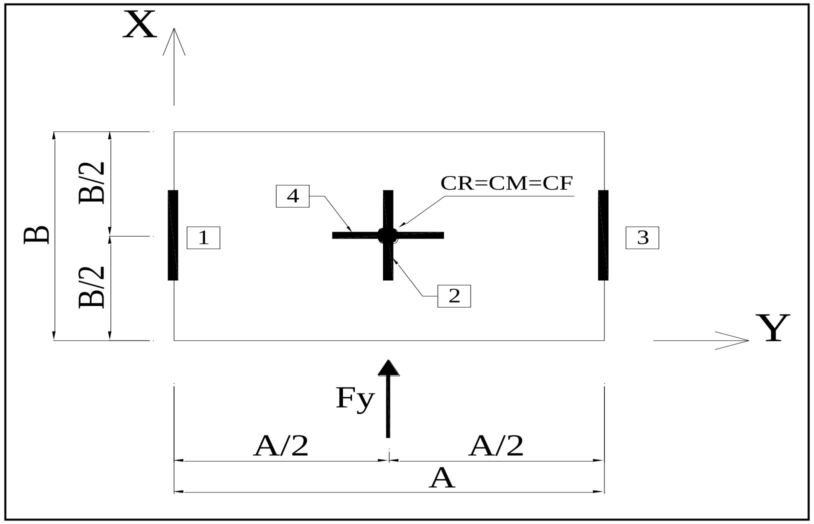
$$\begin{pmatrix} u_{yi} \\ r\,u_{\theta i} \end{pmatrix} = \begin{pmatrix} \phi_{yi} \\ \phi_{\theta i} \end{pmatrix} \frac{\phi_{yi}}{\omega_i^2} SA_i$$

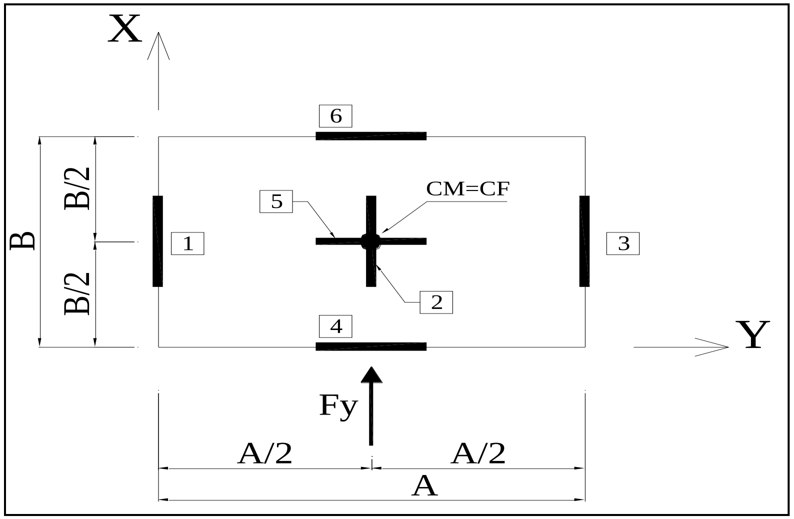
$$\begin{cases} u_{yi}^{P1} = u_{yi}^{CM} + u_{\theta i} d_1 \\ u_{yi}^{P3} = u_{yi}^{CM} + u_{\theta i} d_3 \end{cases} \quad \text{or} \quad \begin{cases} u_{yi}^{P1} = u_{yi}^{CM} - u_{\theta i} d_1 \\ u_{yi}^{P3} = u_{yi}^{CM} - u_{\theta i} d_3 \end{cases}$$

d – distance between CM and the weight center of the wall

General torsion of structures

- determination of maximum total response by modal combination rules (ABSSUM, SRSS, CQC)
- displacements, rotations, torsional moments

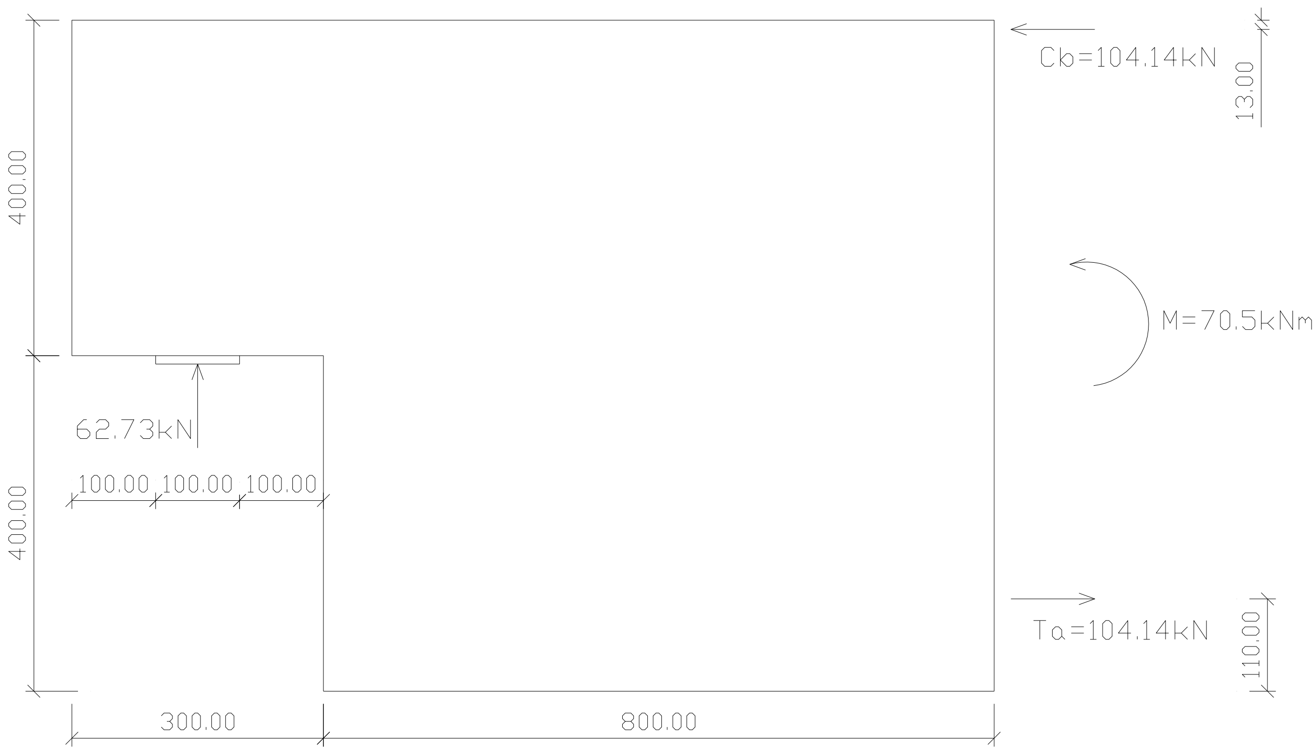




- SESA results compared with DNA
- extension to multi-story structures

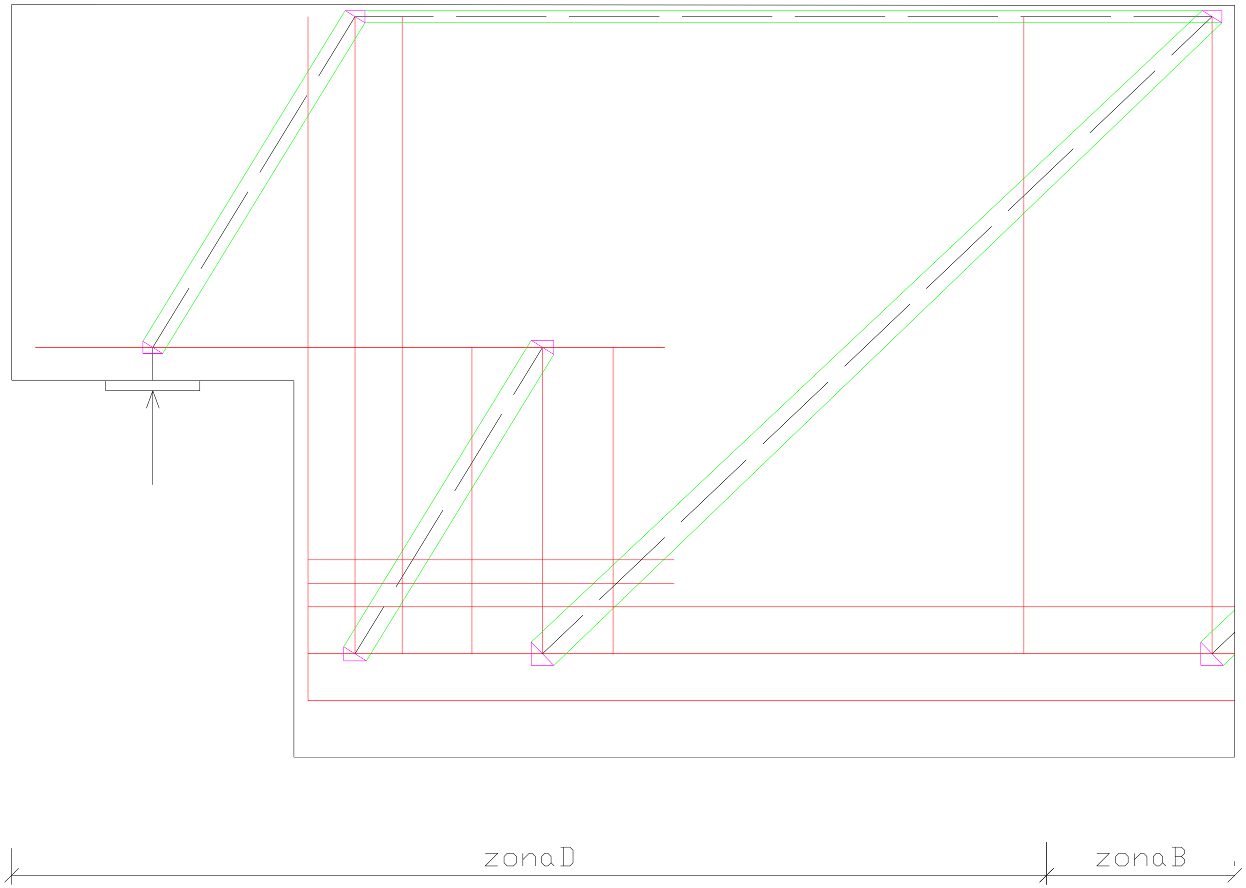
Design of discontinuity regions for RC structures

- prestressed RC beam with end geometry variation
- vertical loading



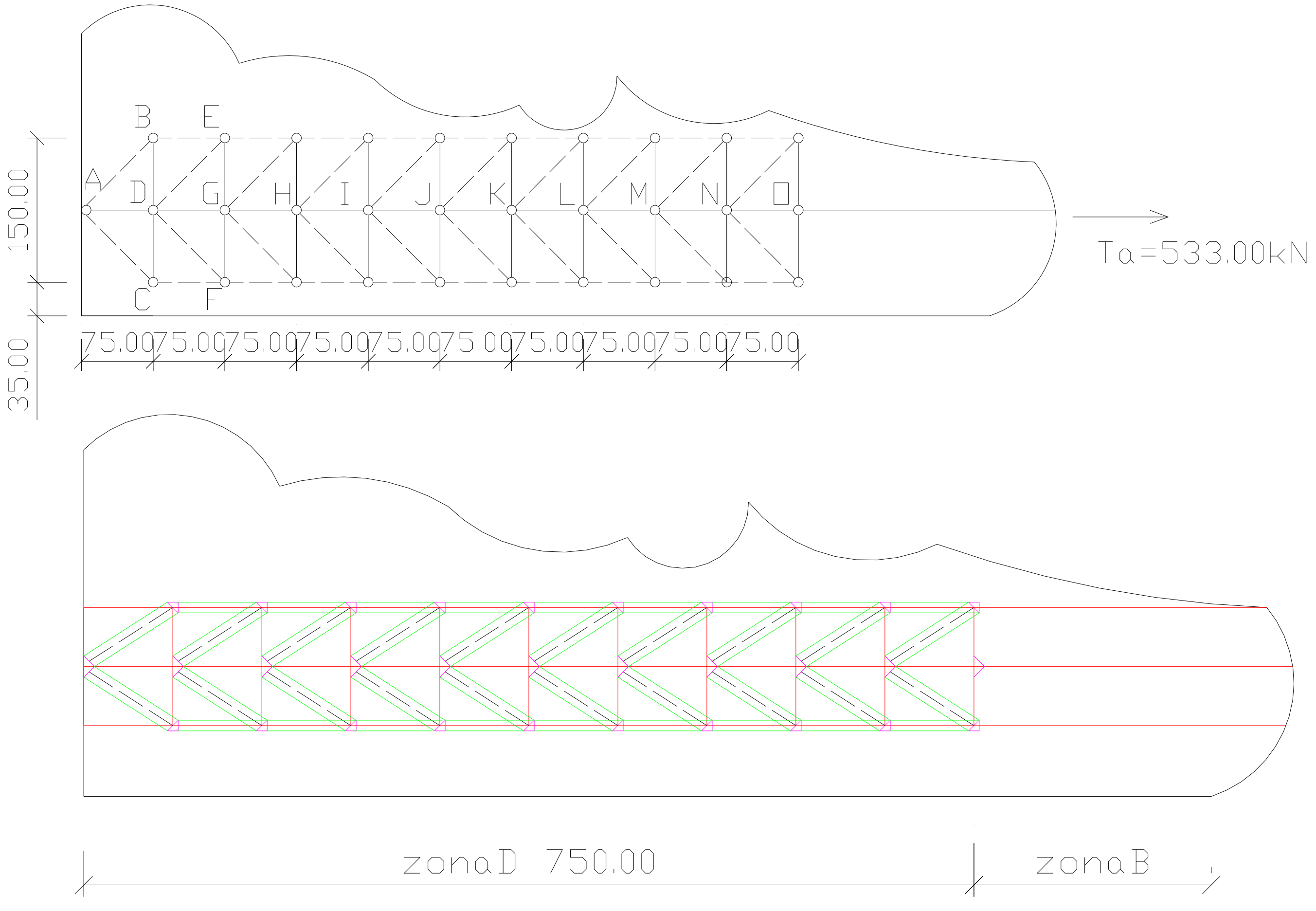
Design of discontinuity regions for RC structures

- strut and tie model for vertical loading



Design of discontinuity regions for RC structures

- strut and tie model for prestressed reinforcement

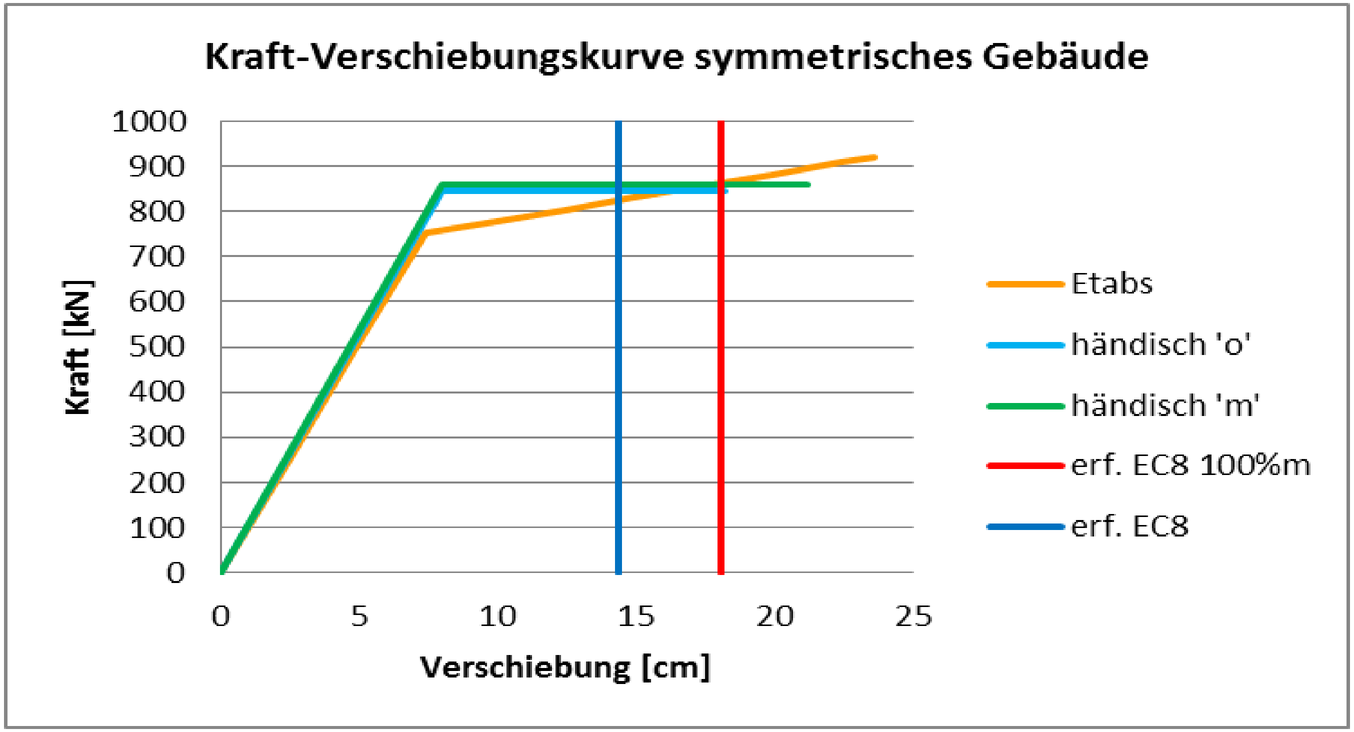


Alternative seismic design methodology for RC wall buildings

- ➢ based on prediction of wall displacements
- ➢uses realistic cracked member stiffness
- ➢ allows explicitly for additional wall displacements related to torsion
- ➢ suited for earthquake design separately in the principal directions of the building
- ➢ check by push-over analysis
- ➢ single story RC wall structures with flat slabs

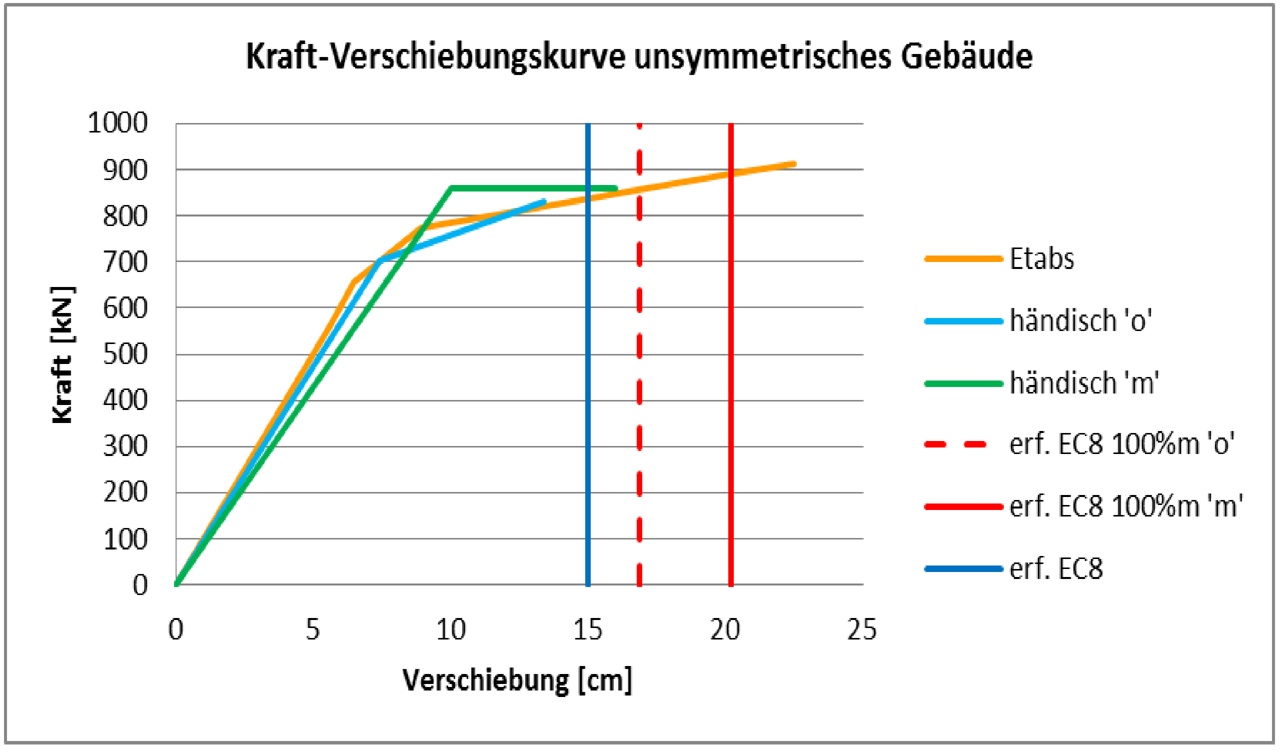
Alternative seismic design methodology for RC wall buildings

- symmetric structure



Alternative seismic design methodology for RC wall buildings

- unsymmetric structure



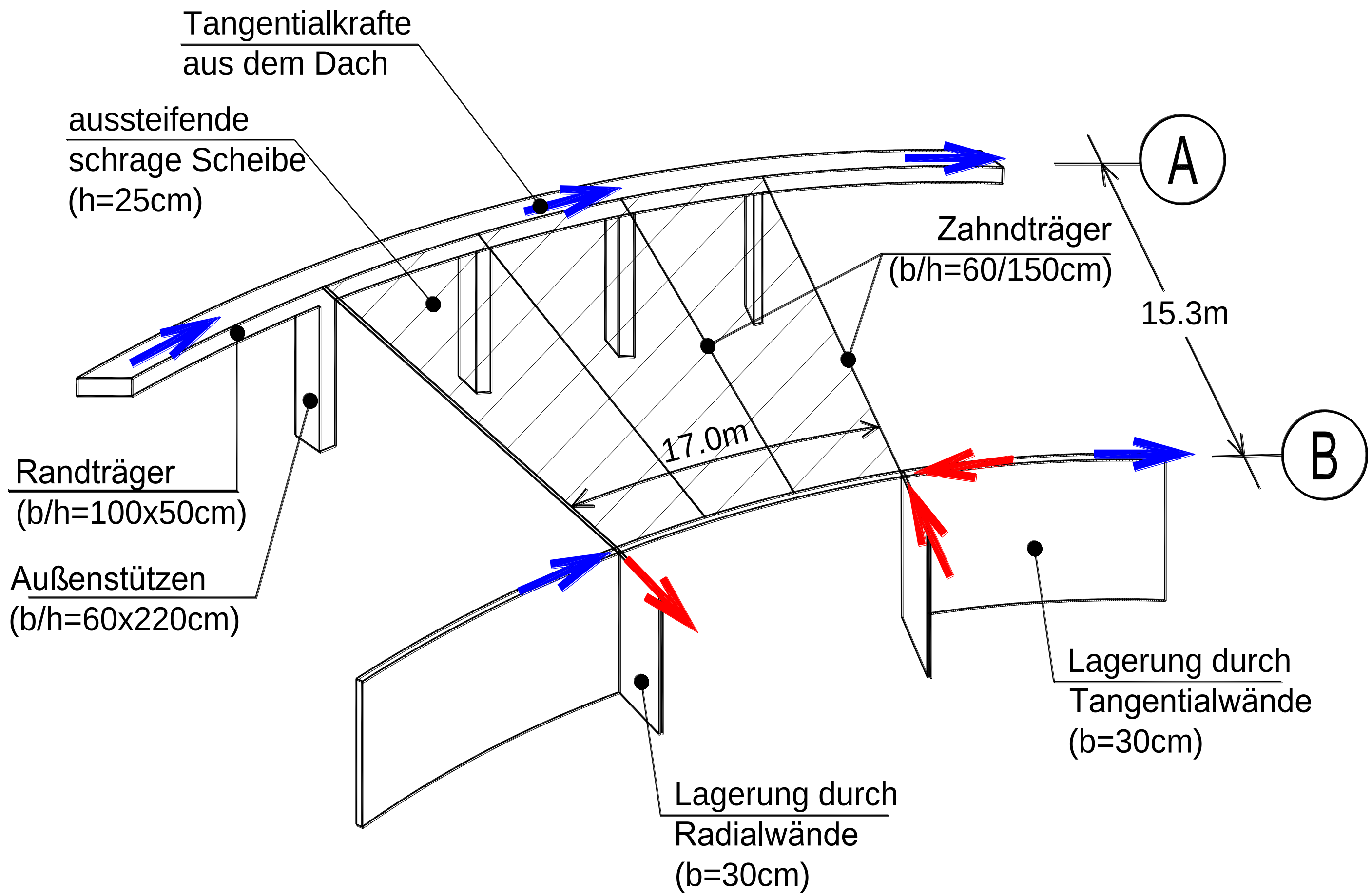
Structural design in seismic areas

- capacity design for RC structures

Bautechnik Vol.1-2015, pg. 65-76

Structural design in seismic areas

- capacity design for RC structures



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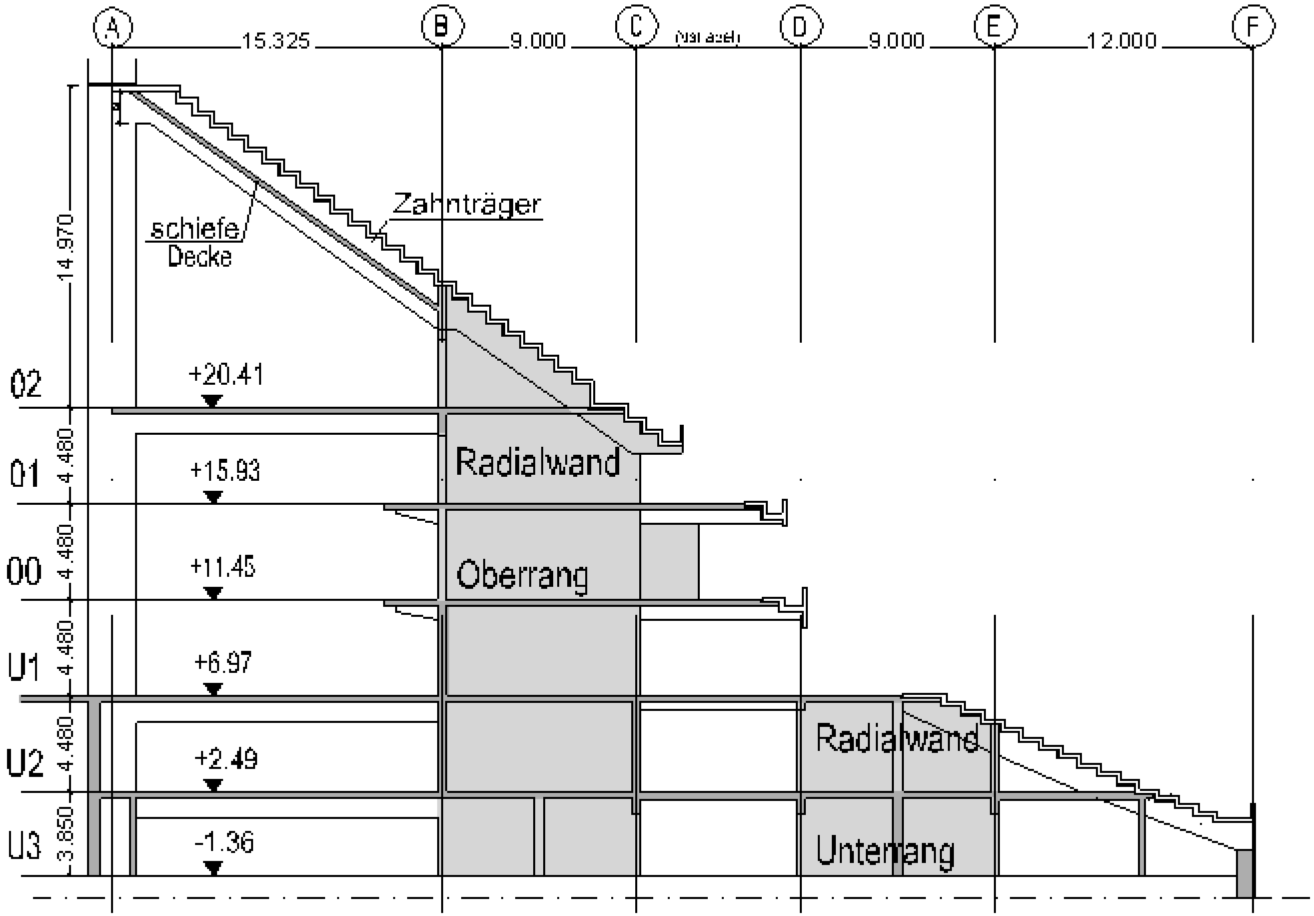
Structural design in seismic areas

- capacity design for RC structures



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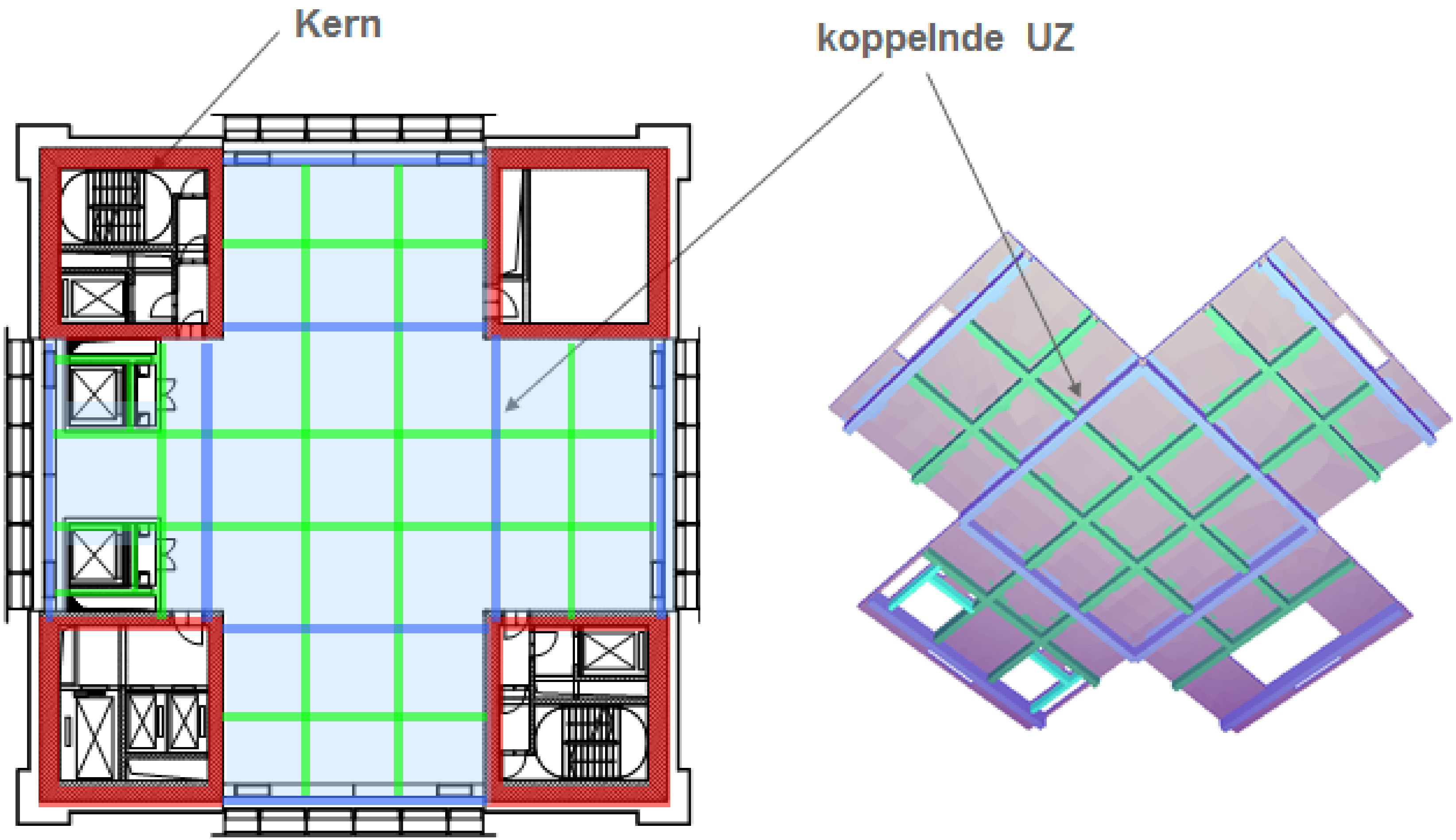
Structural design in seismic areas

Stahlbau Vol.1-2015 pg. 25-37

- capacity design
- composite structure
- push-over analysis
- modal analysis
- high seismic area

  ag = 2,0g
- built for 1000 years

Structural design in seismic areas



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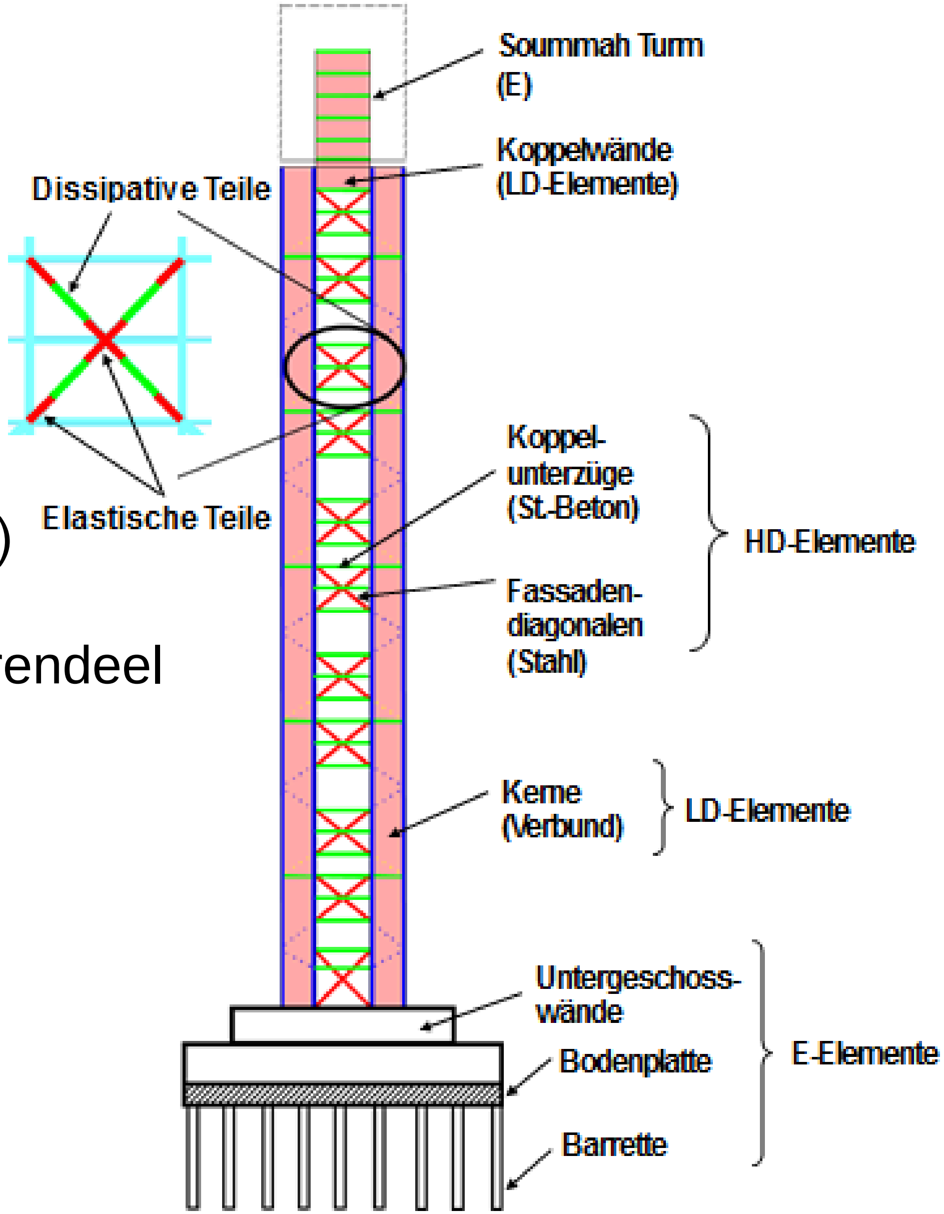
Structural design in seismic areas

RC cores 100 cm → 45 cm
(height / width ≈ 30)

whole structure (height / width ≈ 10)

fassade diagonals → 3D truss, Vierendeel structure



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Thank you for your attention!

D.Köber