

**Basic studies for building type and code
development – as one of many contributions to
the SERAMAR project**

M.Sc. Alper Kırıkkaya

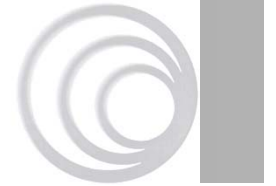
(Dr.-Ing. Jochen Schwarz, Dipl.-Ing. Lars Abrahamczyk)

Bauhaus-Universität Weimar, Earthquake Damage Analysis Center

**** Closing Workshop September 30 – October 2, 2010 ****

*** Antakya, Hatay (Turkey) ***

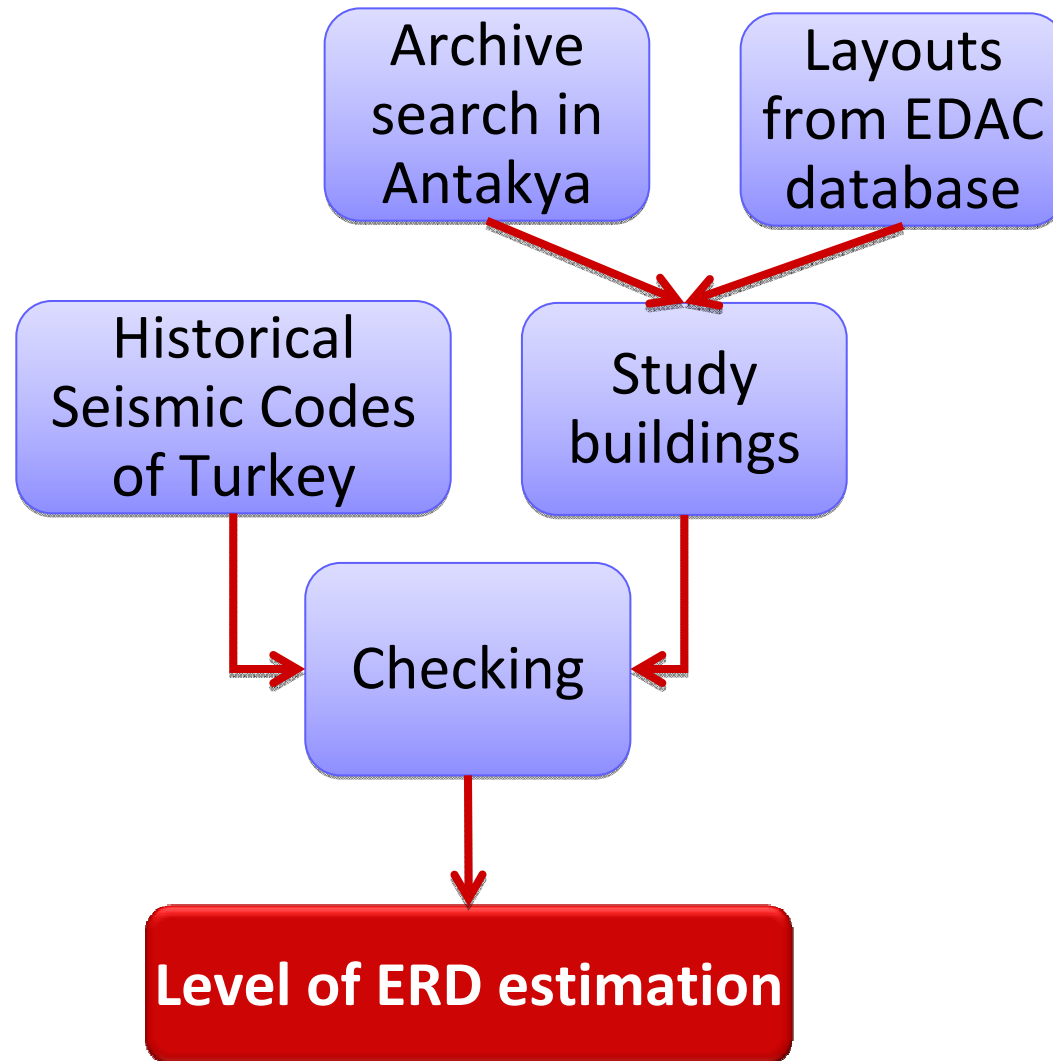
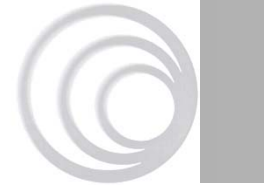
Overview

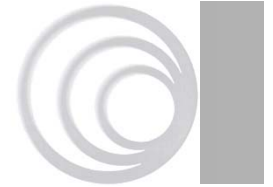


Purpose: To estimate level of earthquake resistant design in precode buildings and new buildings

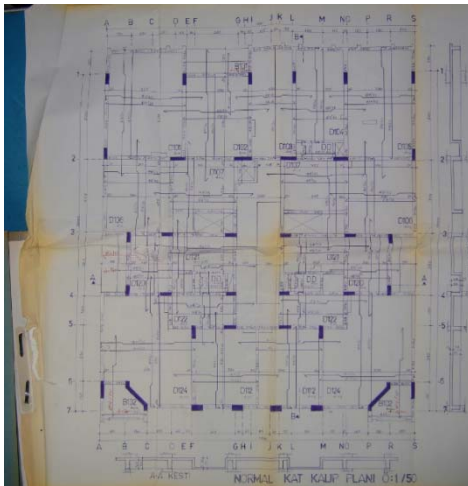
- I. Archive work
- II. Simple Elaboration:
 - Column- Wall index (*A.Hassan, M. Sözen*)
 - Reinforcement ratios on the vertical elements at ground floor
 - Stress values (due to dead load and live load) on the vertical elements at ground floor
- III. Pushover analysis for a sample building and comparison with Simple Elaboration
- IV. Outcomes

Introduction



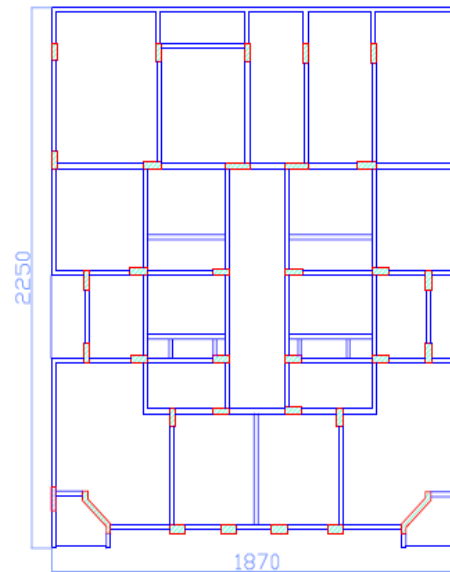


Archive work



Photograph of a layout

Digitizing

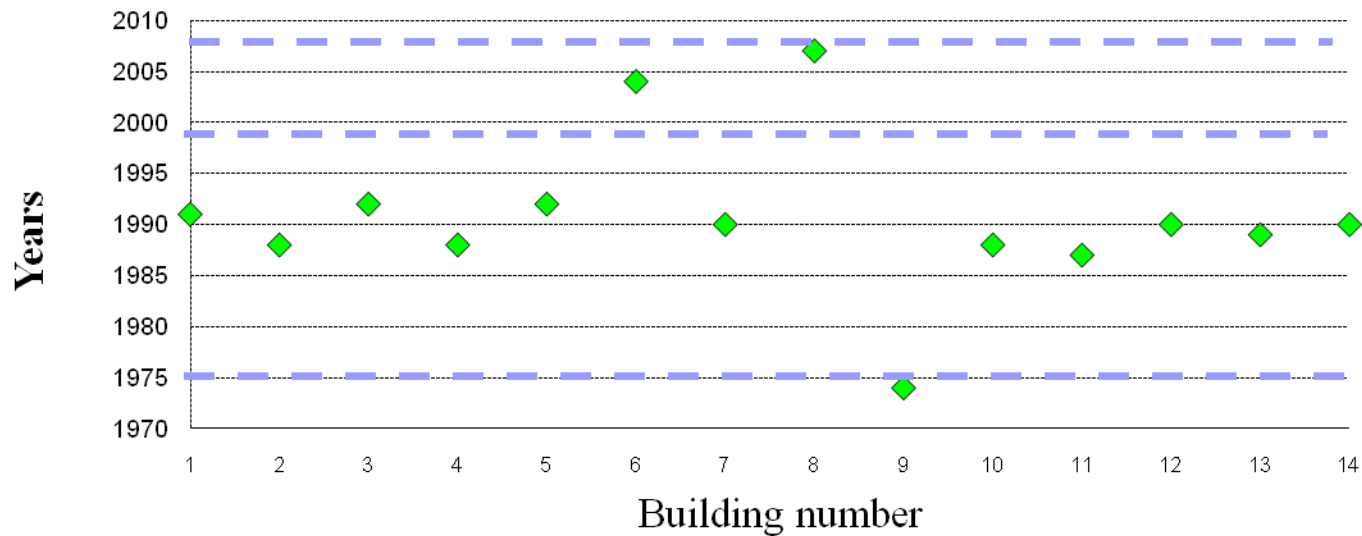


Digitized layout



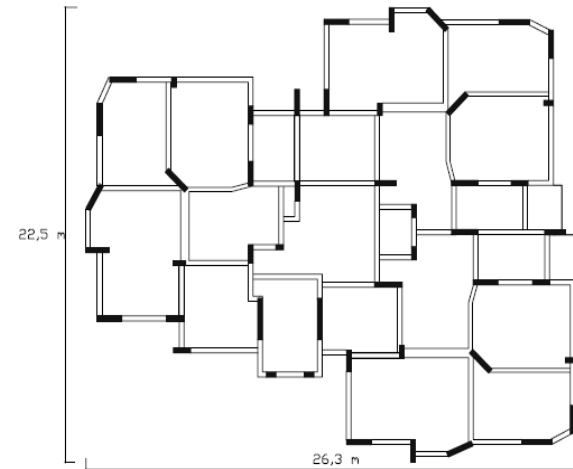
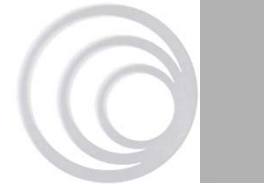
Studied buildings

Storey number	4	5	6	7	8	9
Number of Studied Buildings	1	2	0	6	3	2



Construction years of the studied buildings

Sample building

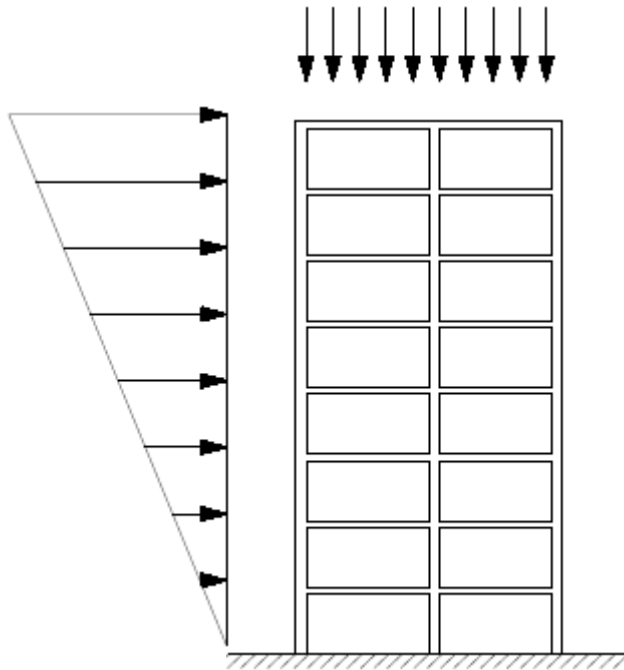
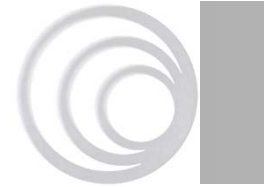


- 9 storey + basement, 32m height
- 4.8 m ground floor, 3 m normal floors
- C-16, St-I (?)
- Construction date: ~ 1990

(?) Spilling of cover concrete and corrosion

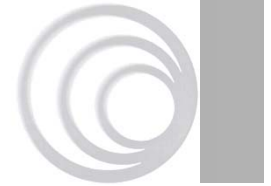


Simple elaboration

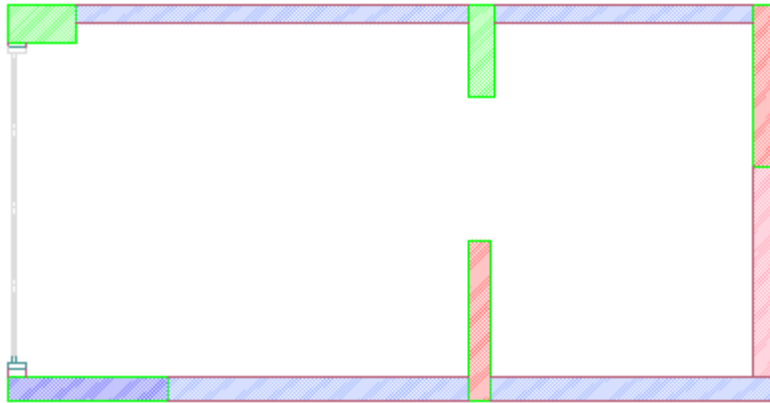


- Column- Wall index (*A.Hassan, M. Sözen*)
- Distribution of reinforcement ratios and stress values (due to dead load and live load) on the vertical elements

Column-Wall Index



What is Column- Wall Index ? (*A. Hassan, M. Sözen*)

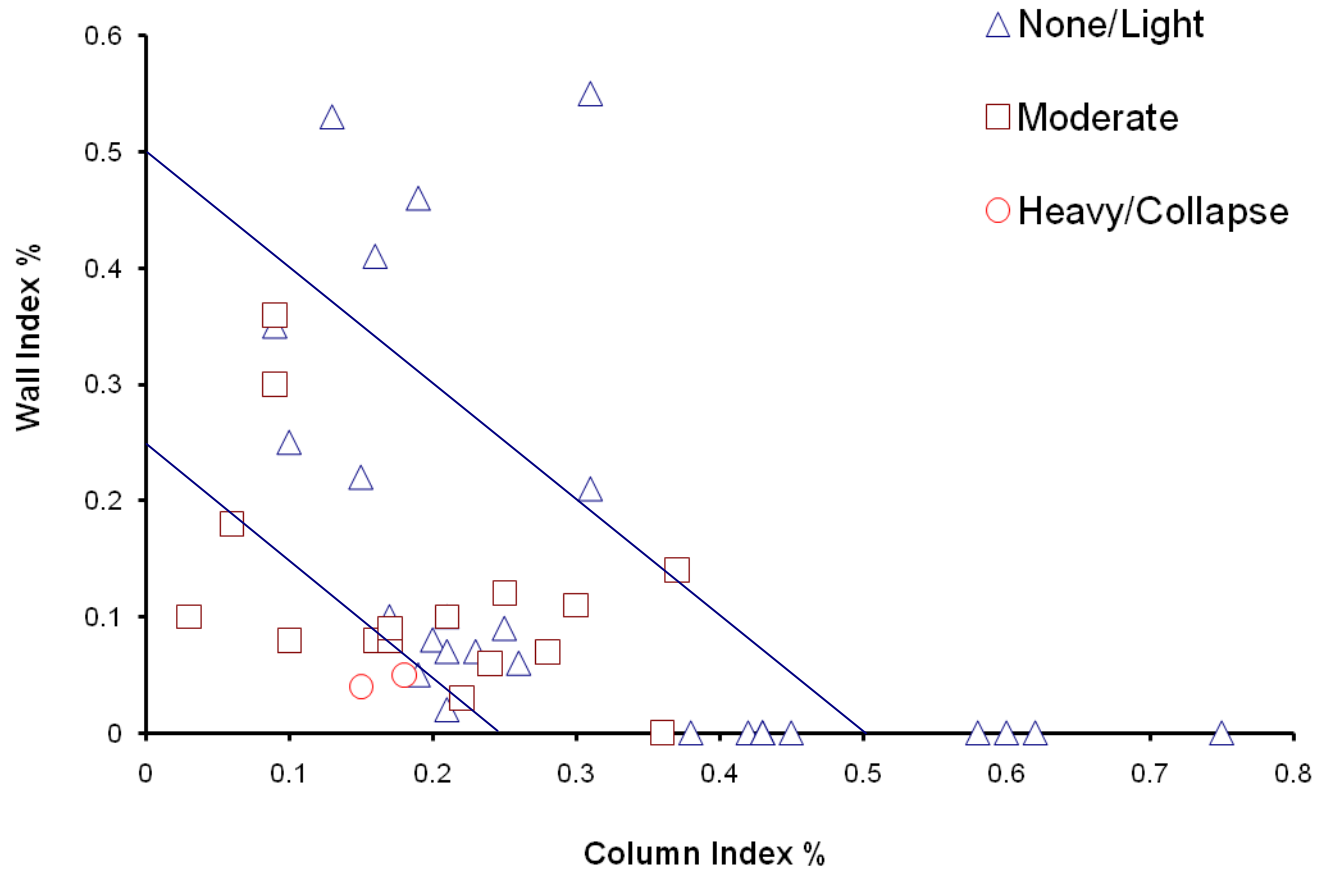
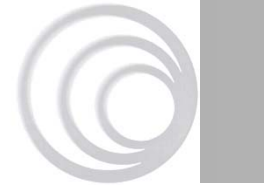


The floor above base level

$$\text{Column Index} = \frac{1 A_{\text{column}}}{2 \sum A_{\text{Floor}}}$$

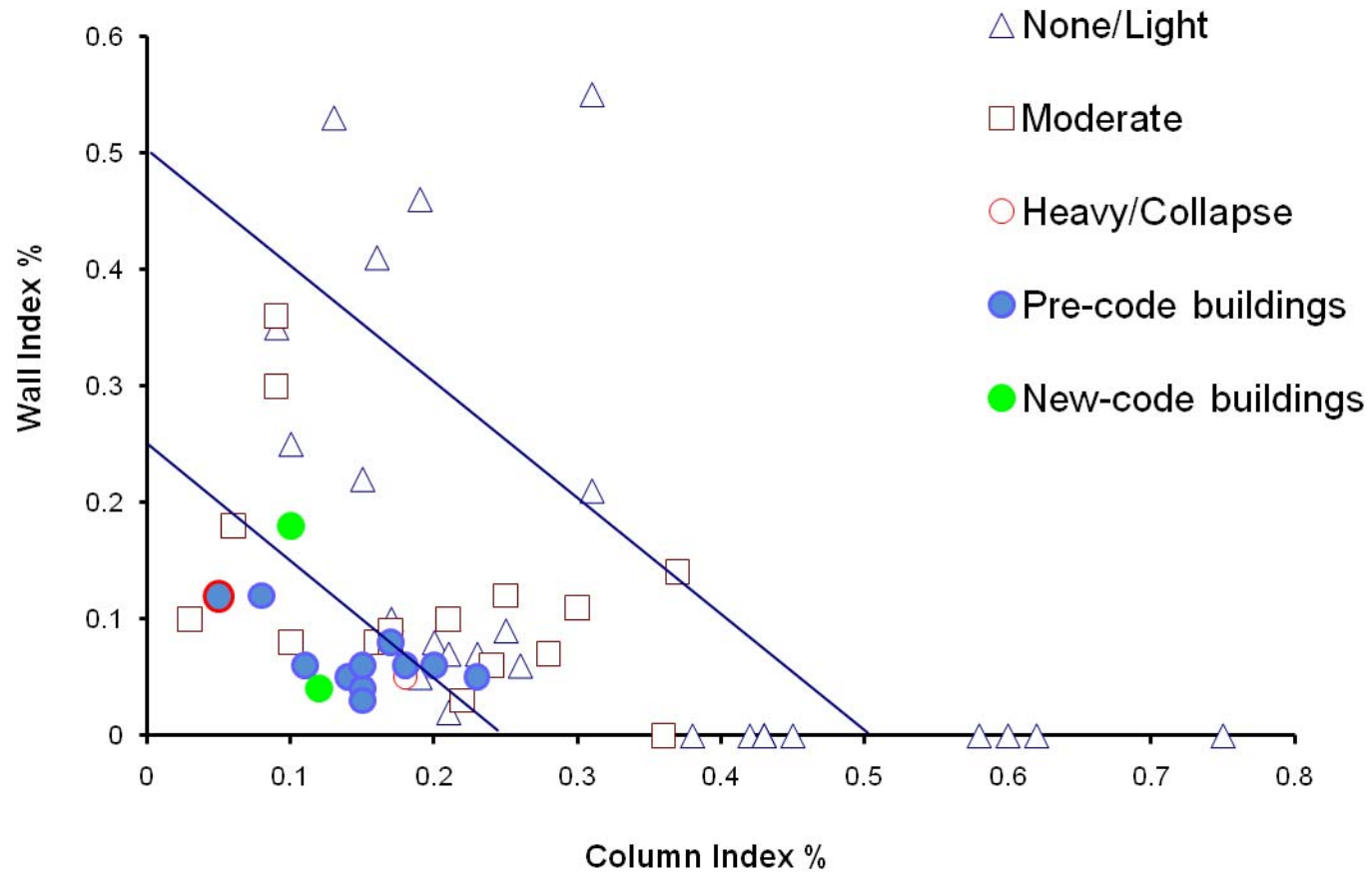
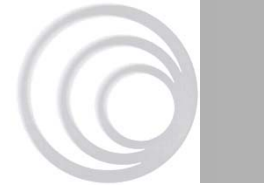
$$\text{Wall Index} = \frac{A_{\text{RCWalls}} + \frac{1}{10} A_{\text{MasonryWalls}}}{\sum A_{\text{Floor}}}$$

Column-Wall Index



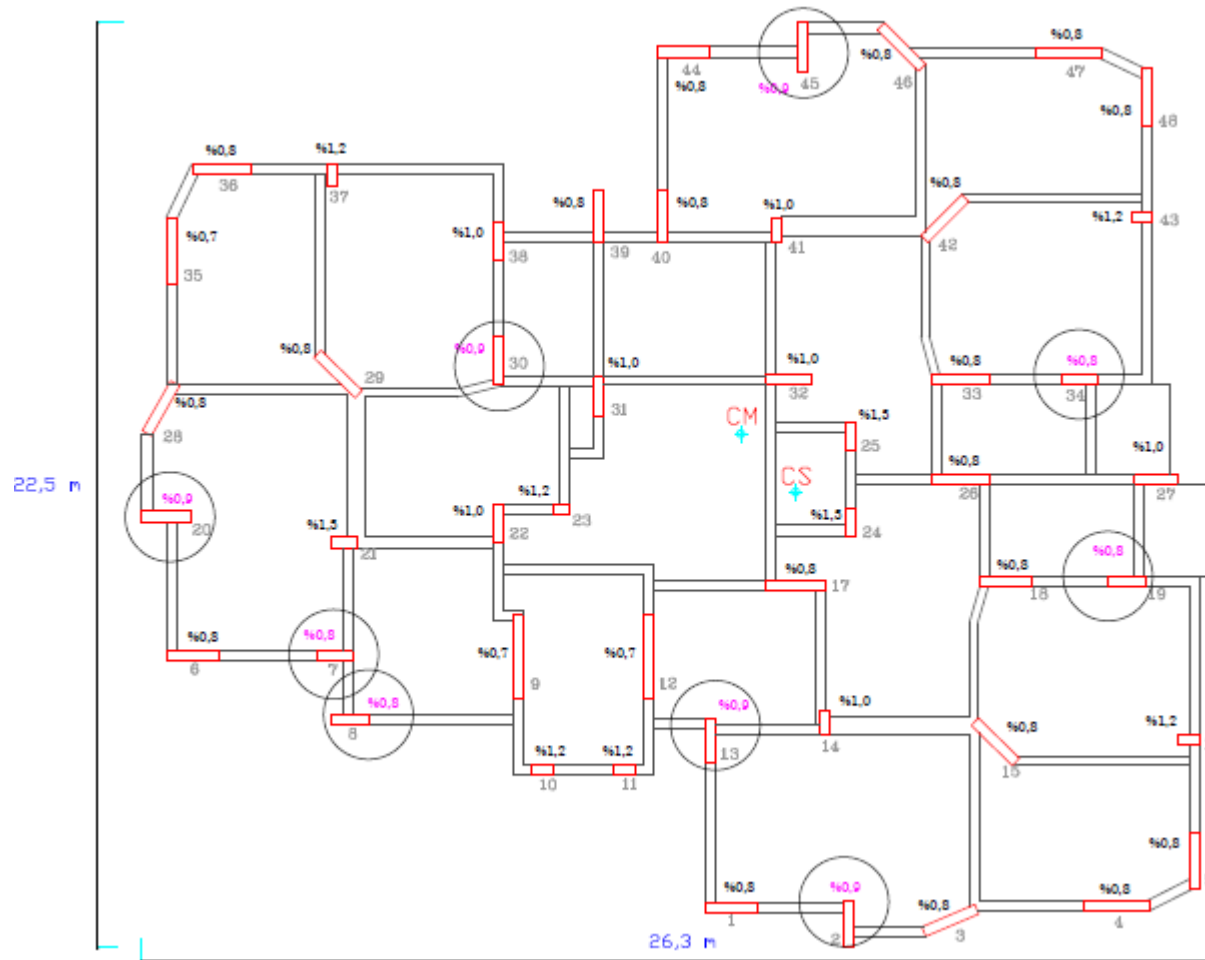
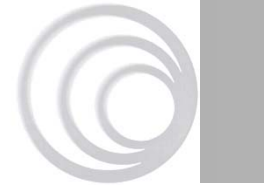
Metu data from Erzincan (1992)

Column-Wall Index



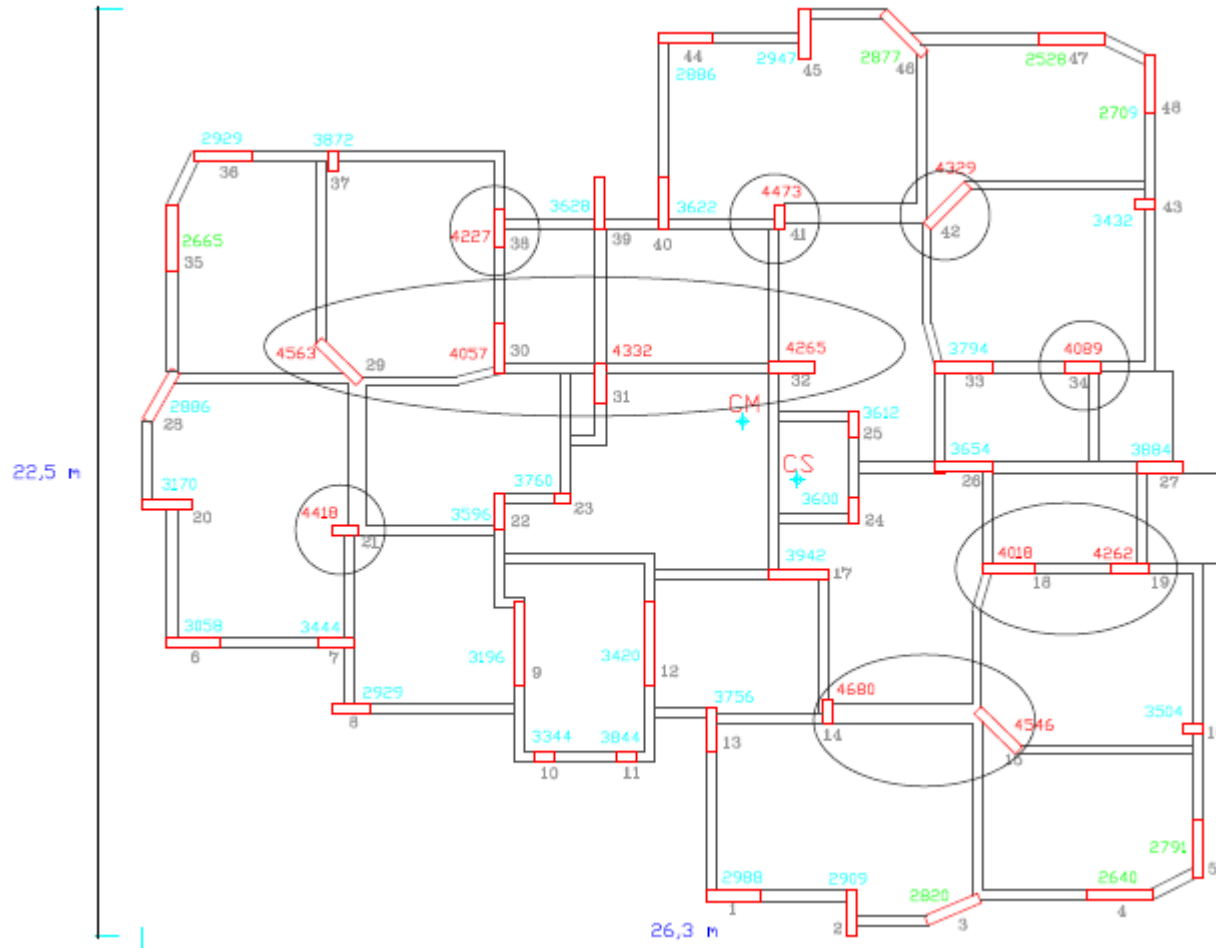
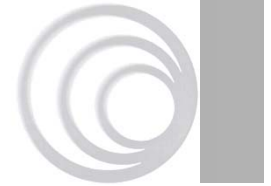
Metu data (Erzincan 1992) and EDAC data Hatay (2009)

Reinforcement ratios



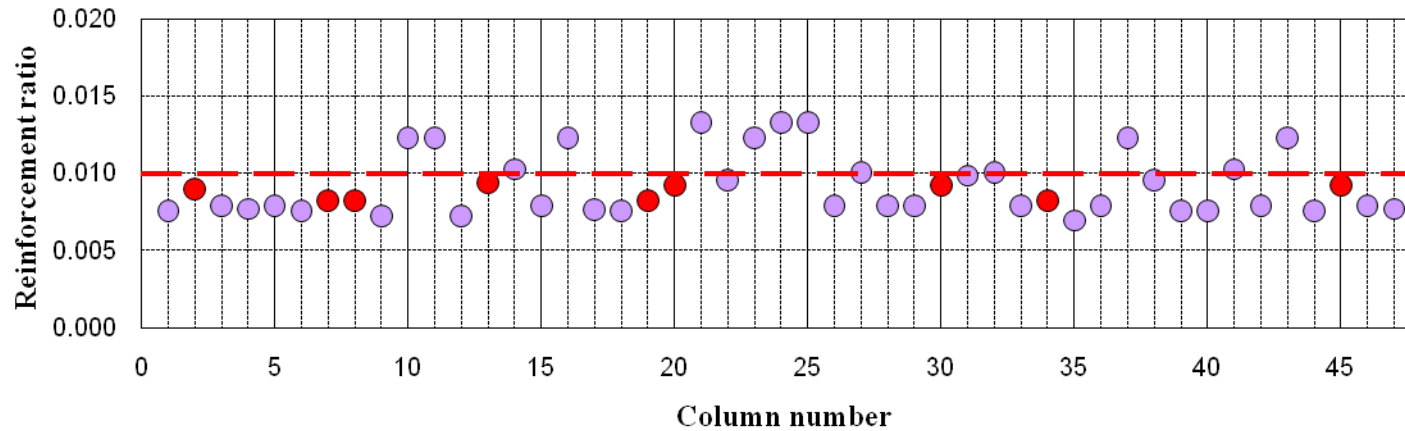
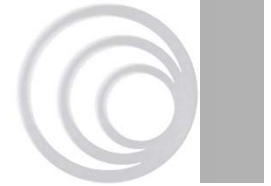
Reinforcement ratio of vertical elements at ground floor

Stress values

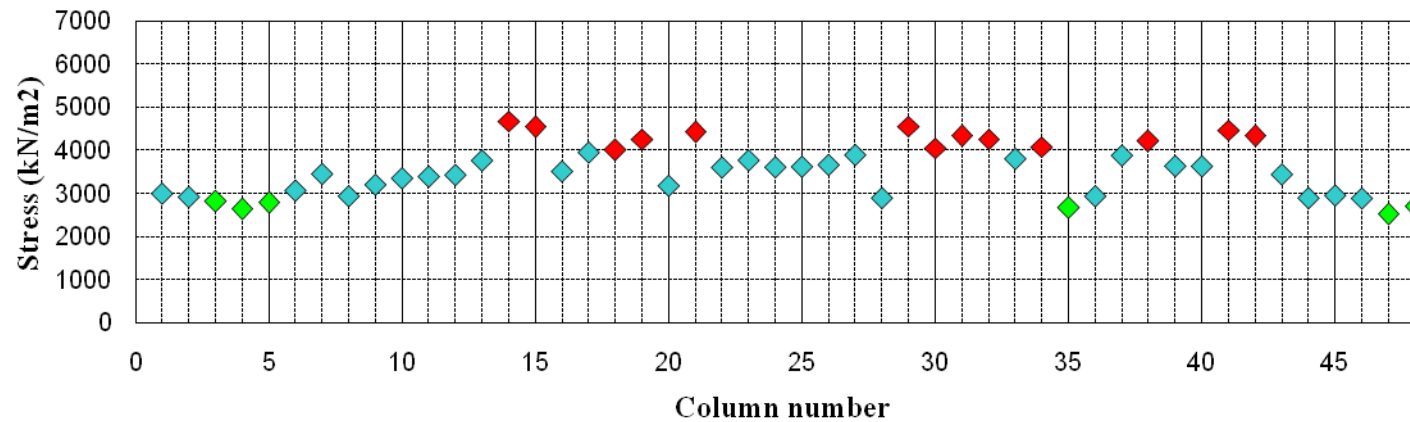


Stress values due to dead+live load on vertical elements at ground floor

Range of the elements

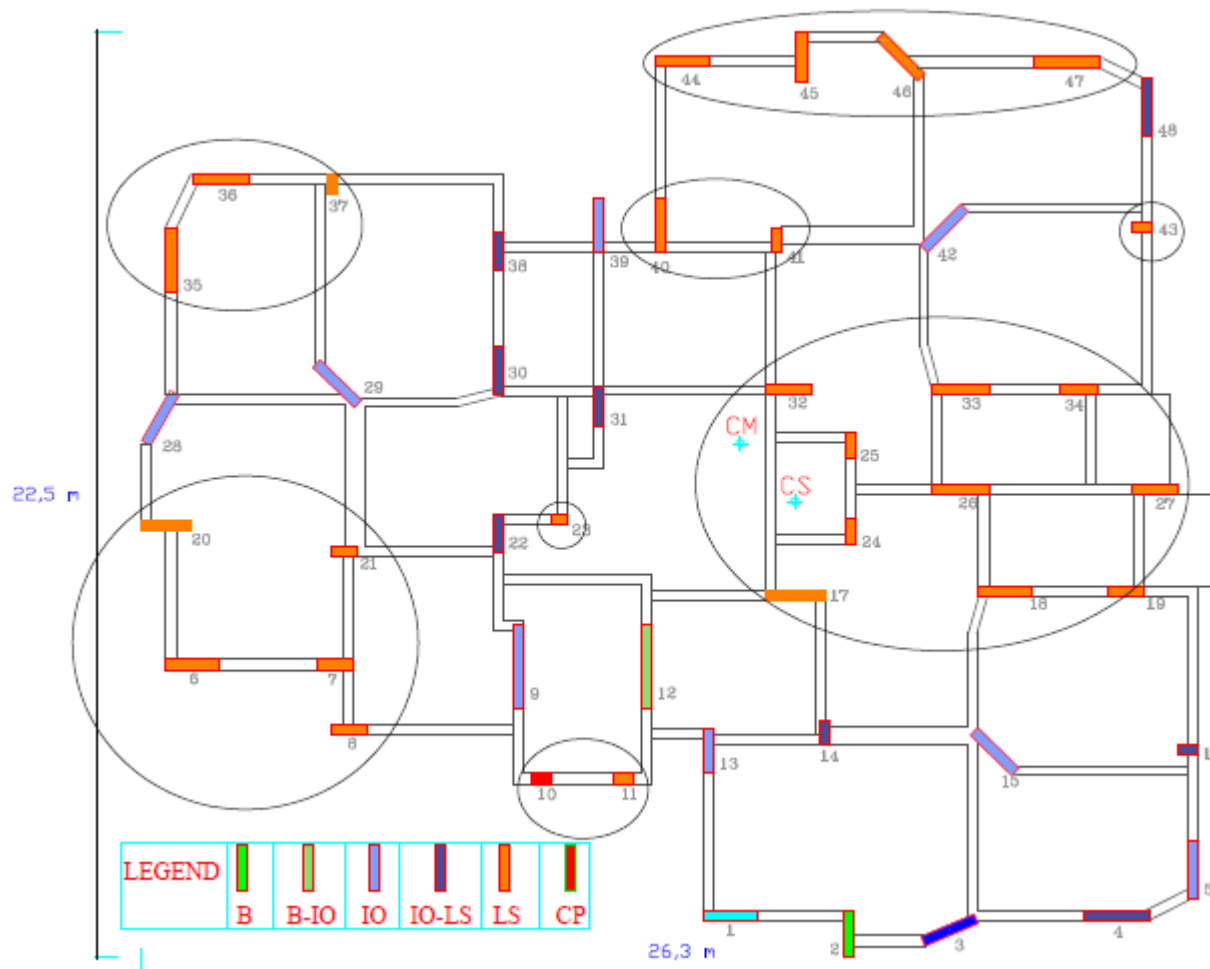
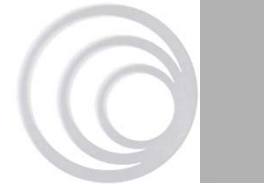


Ratio of longitudinal reinforcement area to cross-sectional area on vertical elements



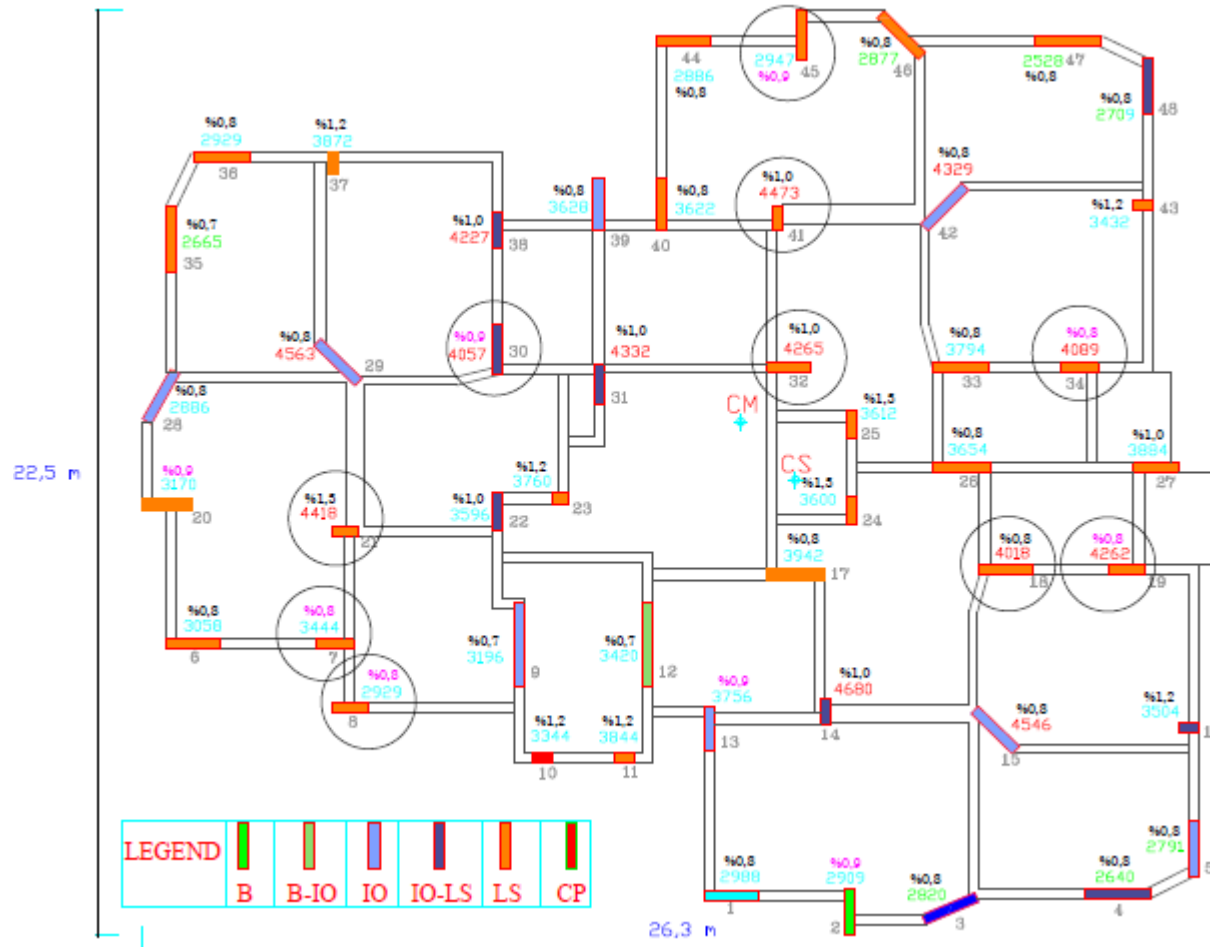
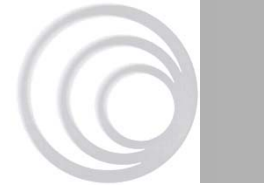
Stress values on vertical elements due to dead+live load

Pushover analysis

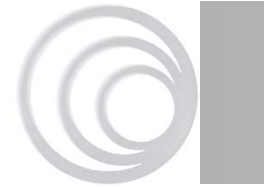


Damage states of vertical elements from pushover analysis

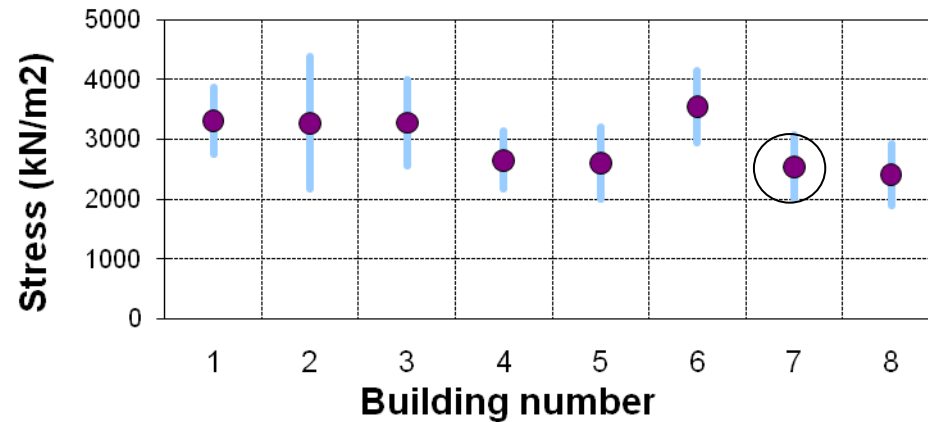
Comparison with simple elaboration



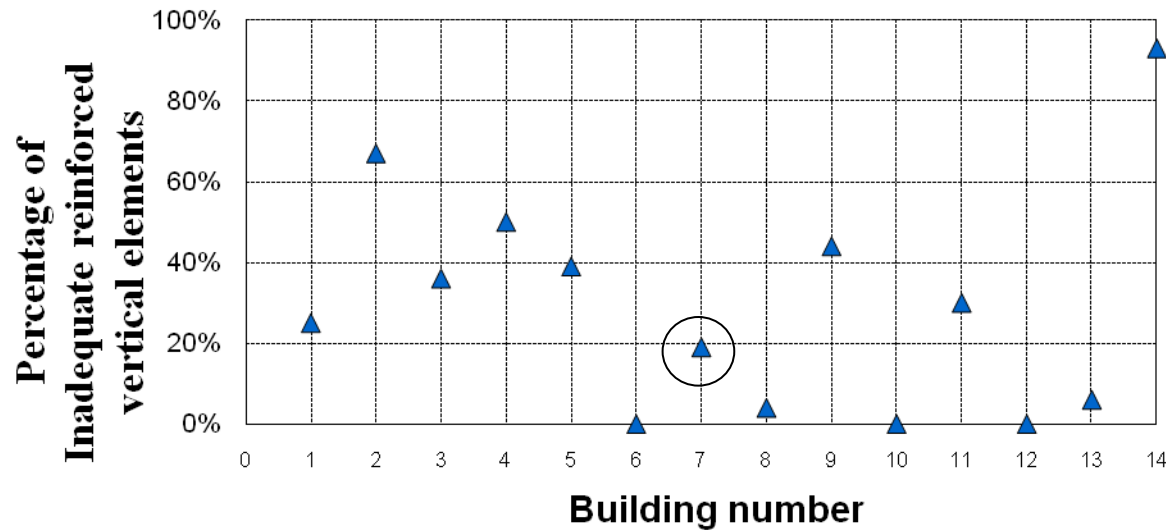
Damage states of vertical elements from pushover analysis



Outcome of all buildings

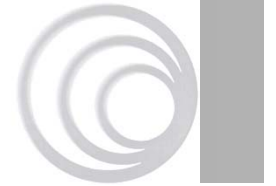


Distribution of stress on the columns; mean value and standard deviation (storey class 3)



Percentage of inadequately reinforced vertical elements in the buildings

Outcomes



- I. To go to Municipality archive was a necessity and successful.
- II. Elaboration procedure is able to predict damage. First attempt and it works. Indicates most vulnerable elements on the structure.
- III. Database of the column-wall index method can be increase by the data in Antakya. New damage boundaries can be developed and refined after damage occurs.

Questions?



Thank you for your attention!