COST-TU0601

21 to 22 Sept 2009

Use of Applied Element Method to Simulate the Collapse of a Building

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PN II – IDEI_8
Progressive collapse

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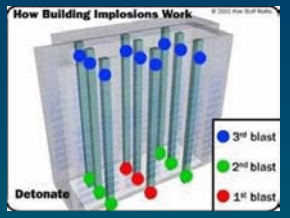
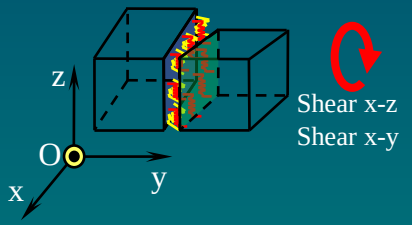
AGENDA

1. Progressive Collapse (Goal of the paper)

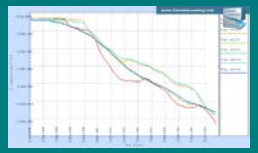


2. Applied Element Method



3. Case study

4. Conclusions



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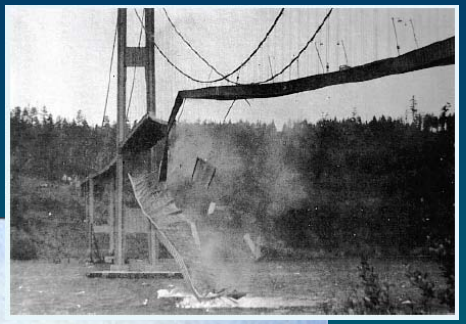
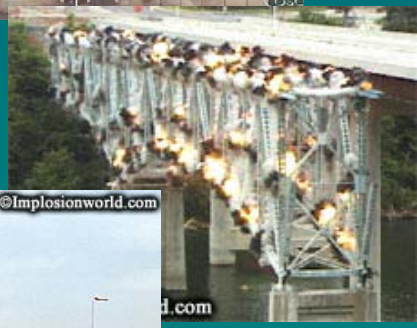
1. Progressive collapse





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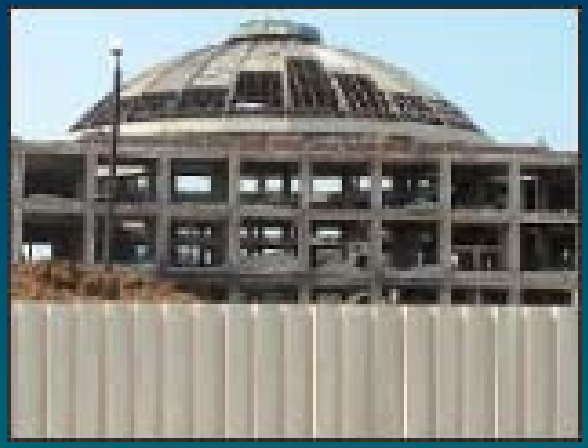
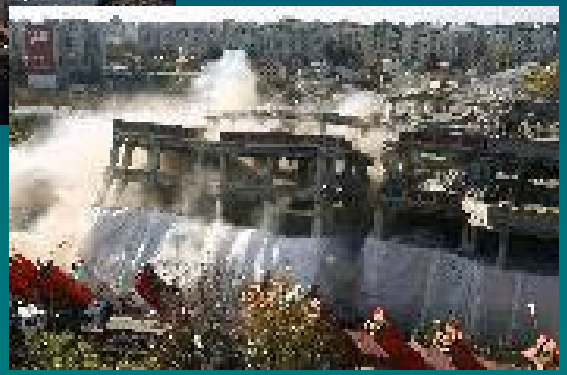
- S = 8000 m2 , h = 30 m.
- Points 3.500 / 75-100 g. propellent explosive



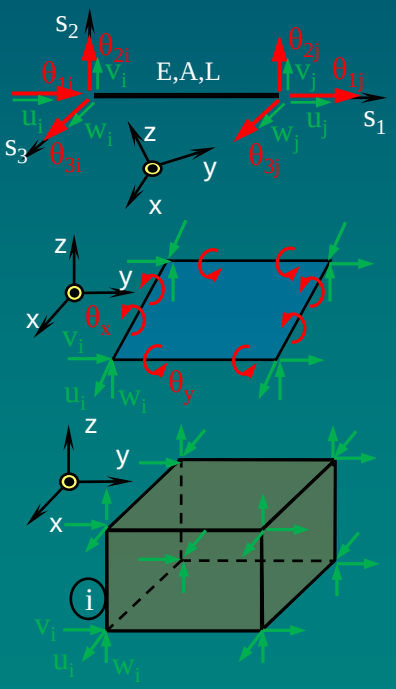


Neighbour church protection

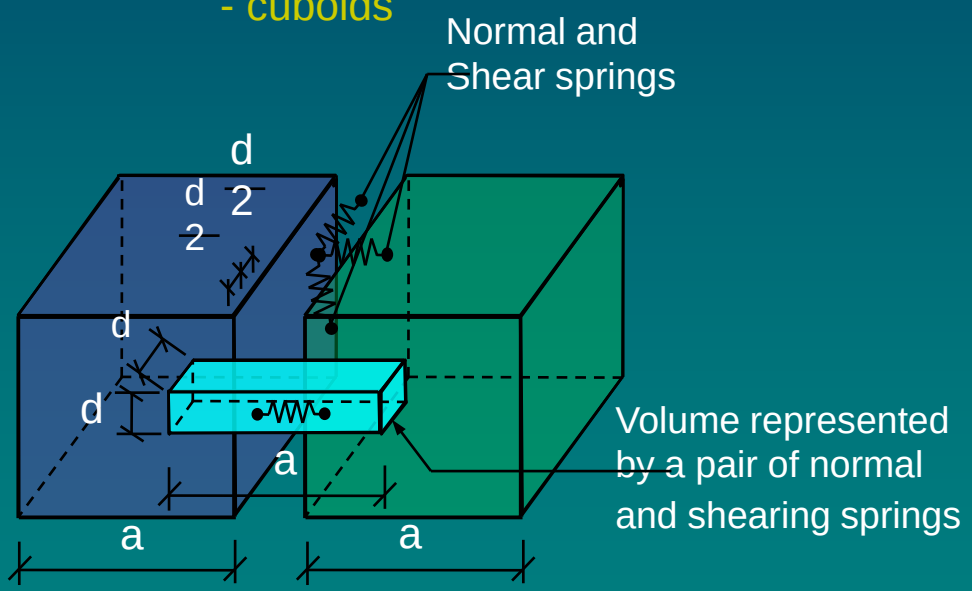
2. Applied Element Method

- Beginning 1996, Professors Hatem TAGEL-DIN and Kimiro MEGURO have developed a new method for structure modeling.
- **AEM** combines features from finite element and discrete element methods.

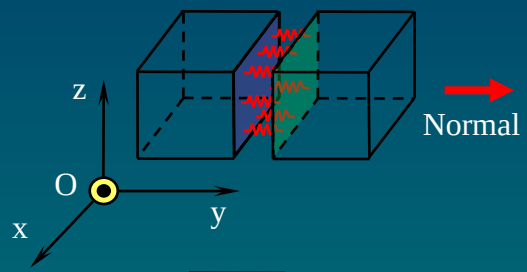
finite element methods

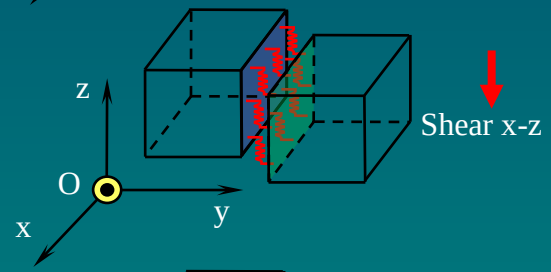


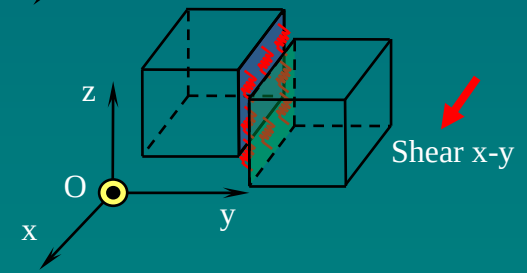
- There is a single type of element - cuboids



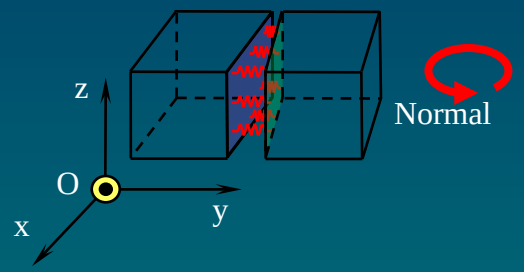
- Two elements are connected through a series of contact points. In every point are attached three springs.

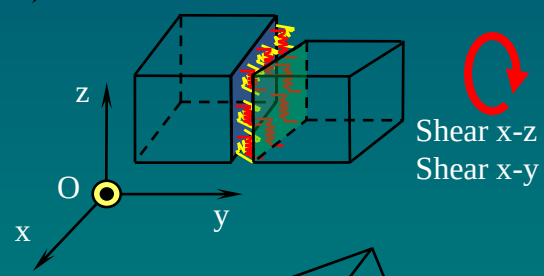


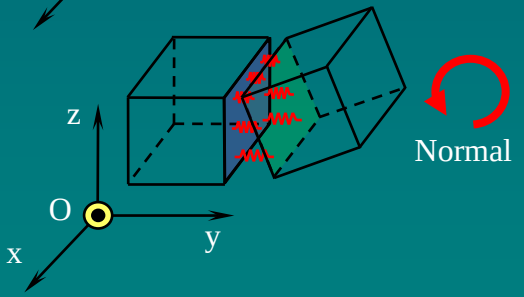




Translation



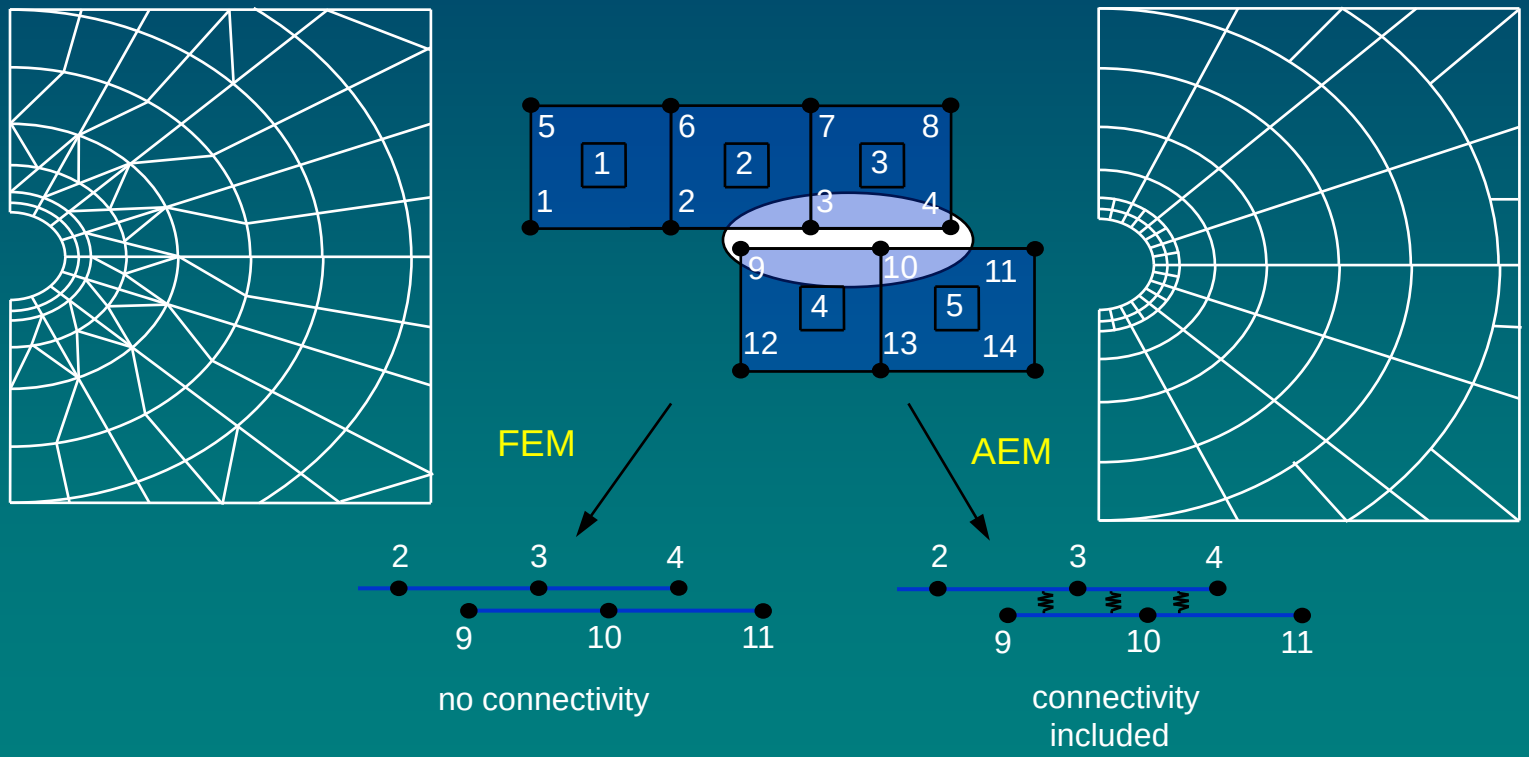




Rotation

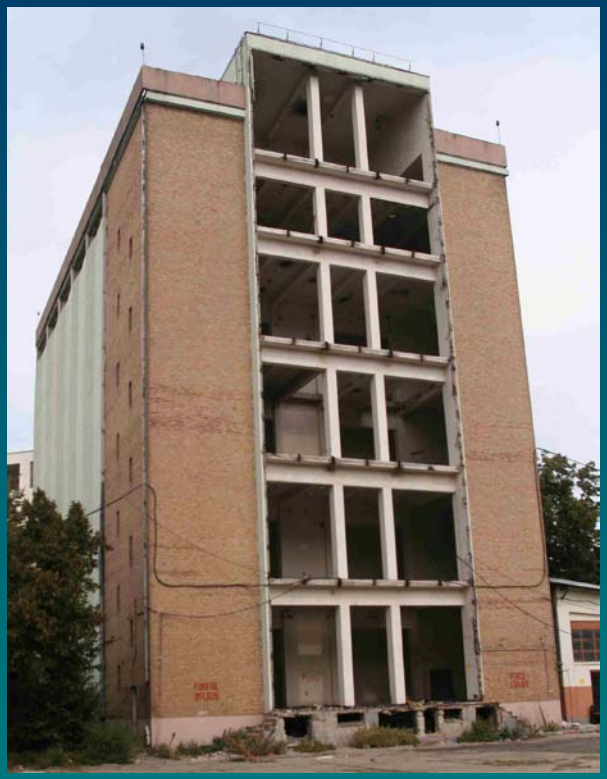
2. Applied Element Method

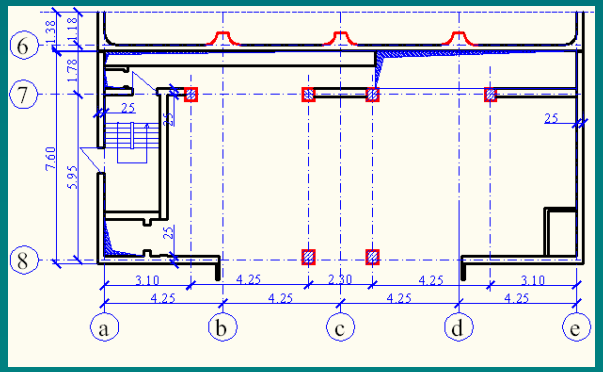
- There is no need for transition elements, it is allowed the partial element connectivity and the springs are generated at interface of elements.

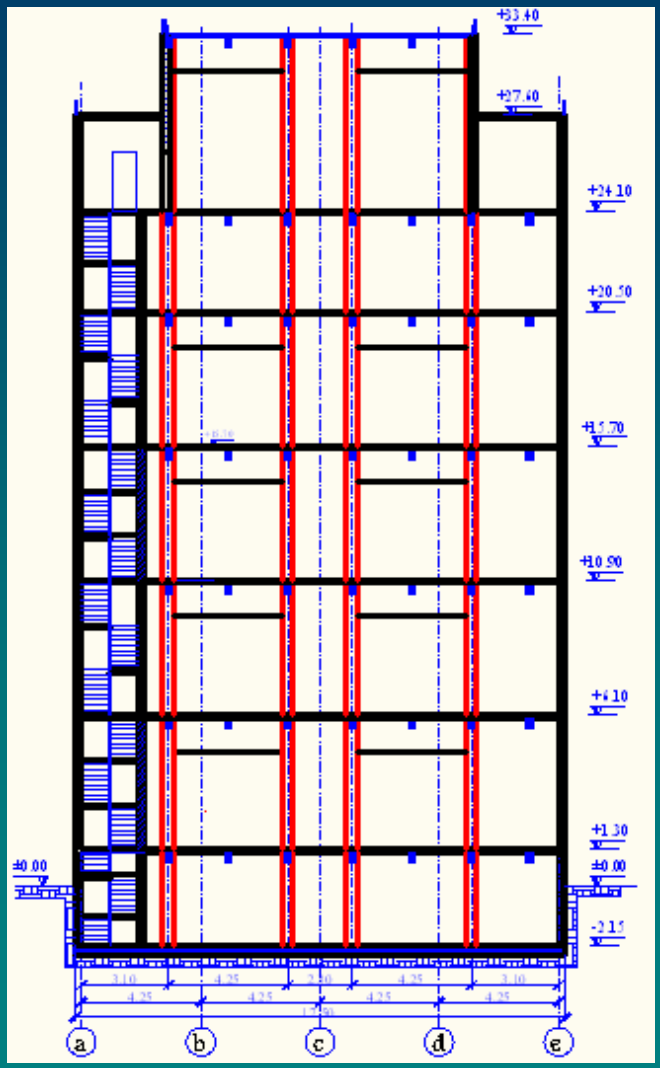


- The using of this modeling method allowed that the initiation and propagation of cracks and the failure of the structure can be studied using only one initial model.

3. Case study – the building







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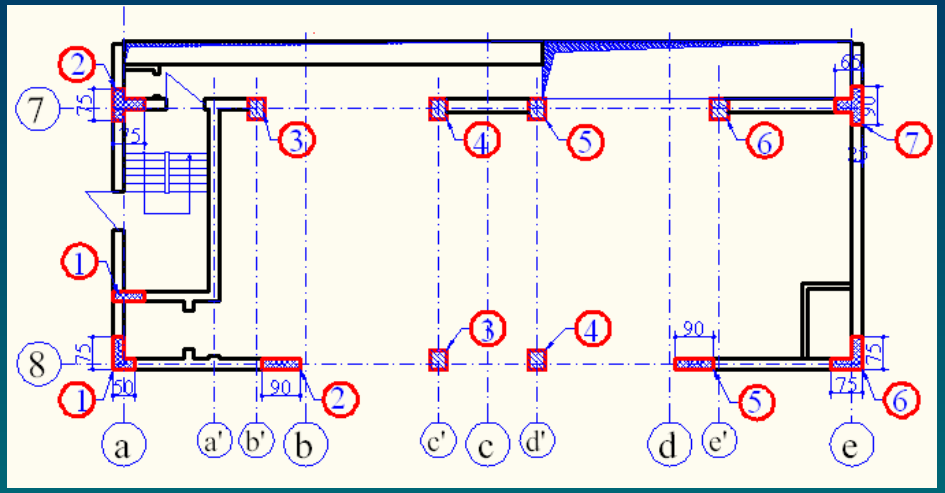
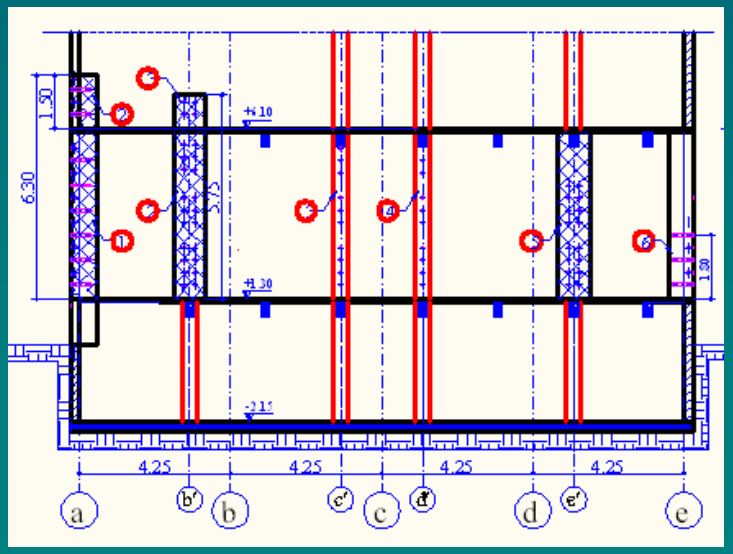
3. Case study – preparatory works

3. Case study – explosion steps

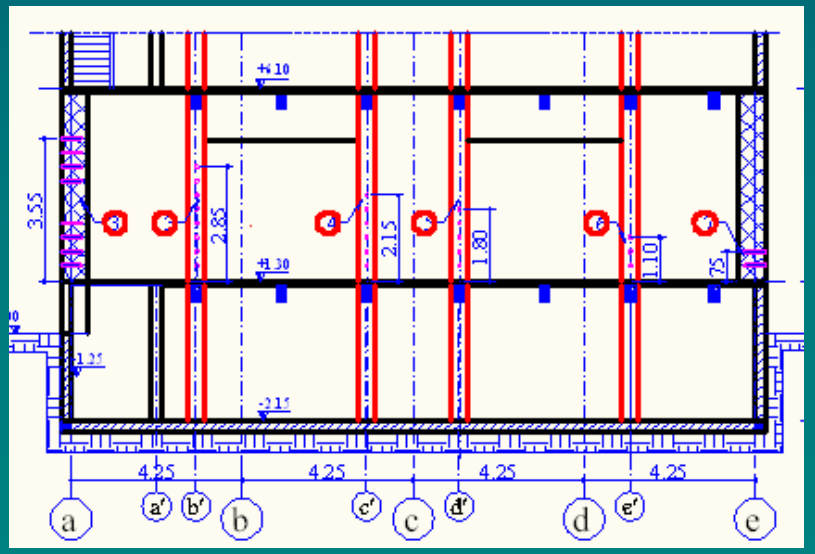


Plan of the explosion steps

Explosion steps in axis 8



Explosion steps in axix 7



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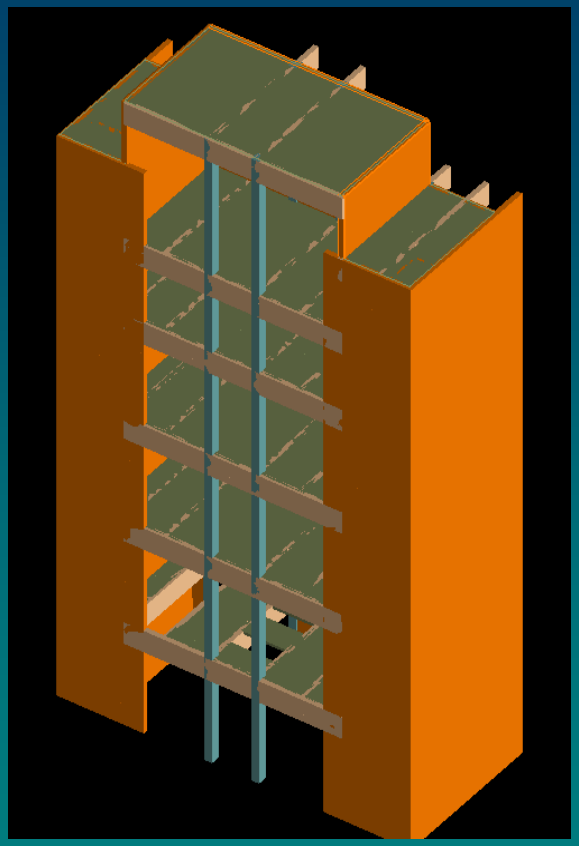
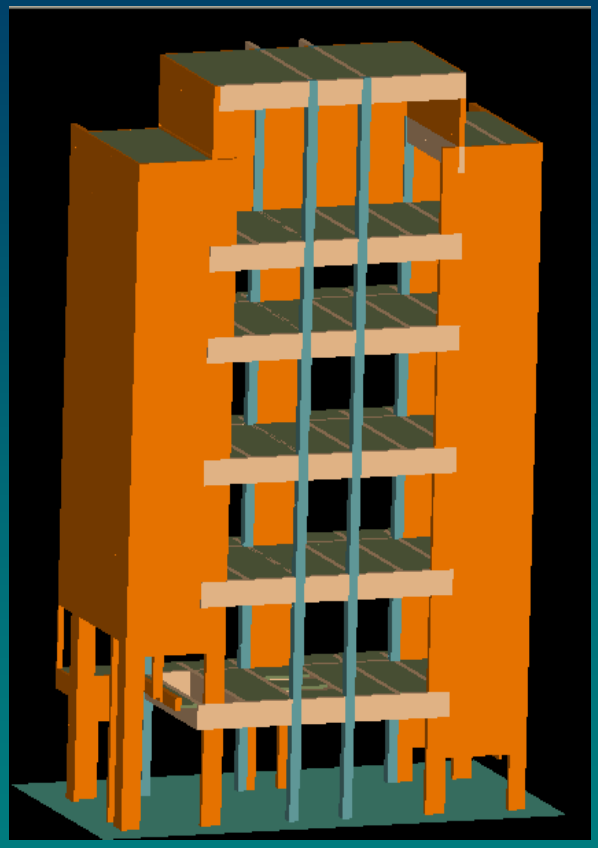
3. **Case study** – geometrical modelling



Geometrical model



Geometrical model with "preparatory works"

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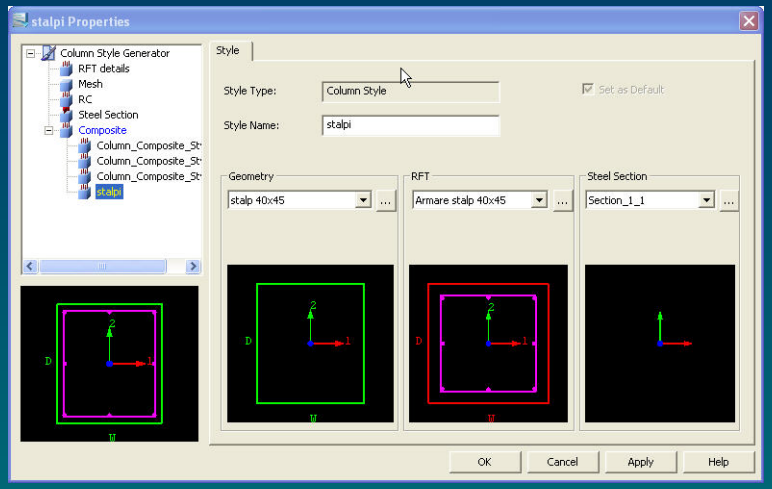
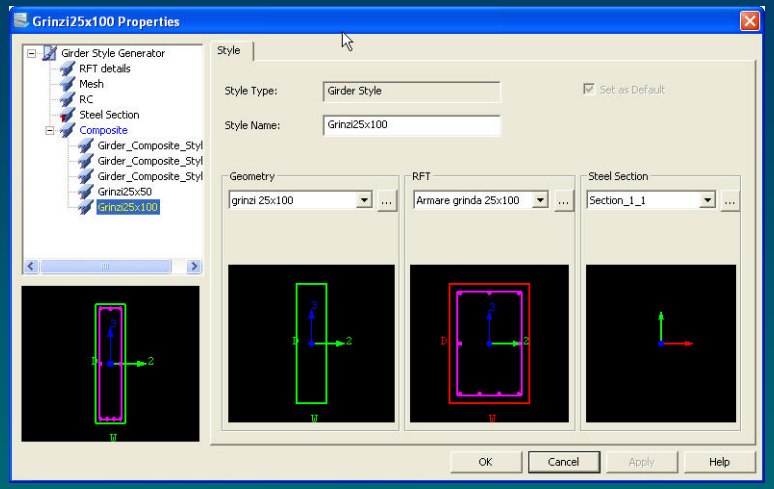
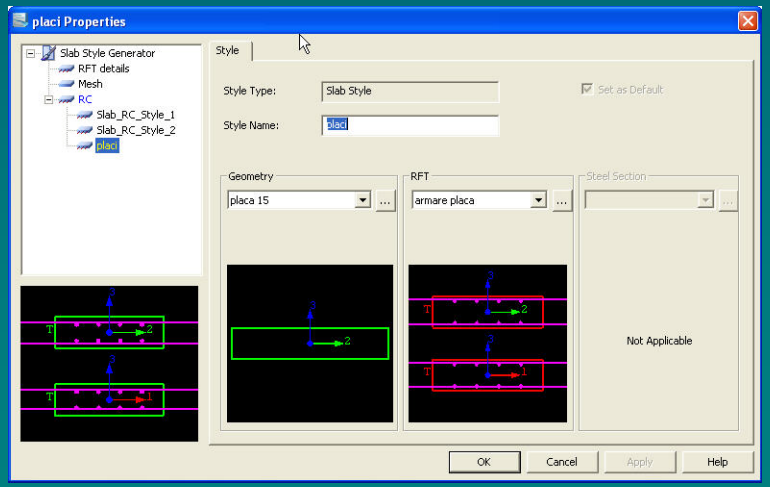
3. Case study - geometrical modelling



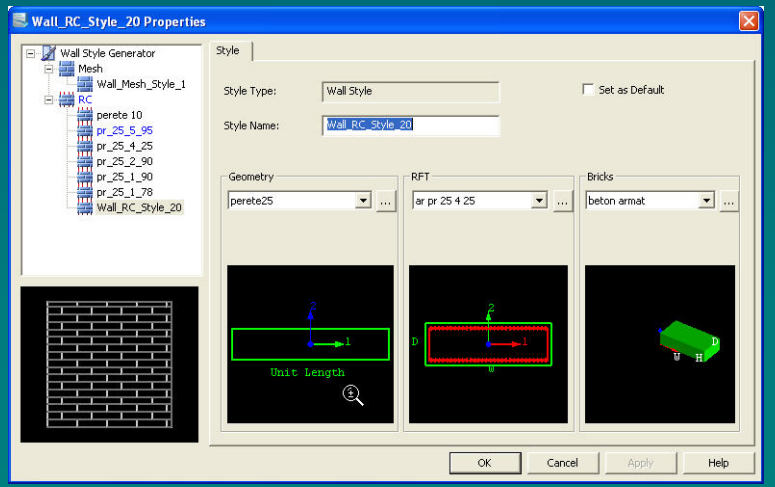
Modelling of Columns



Modelling of Girders



Modelling of slabs



Modelling of walls

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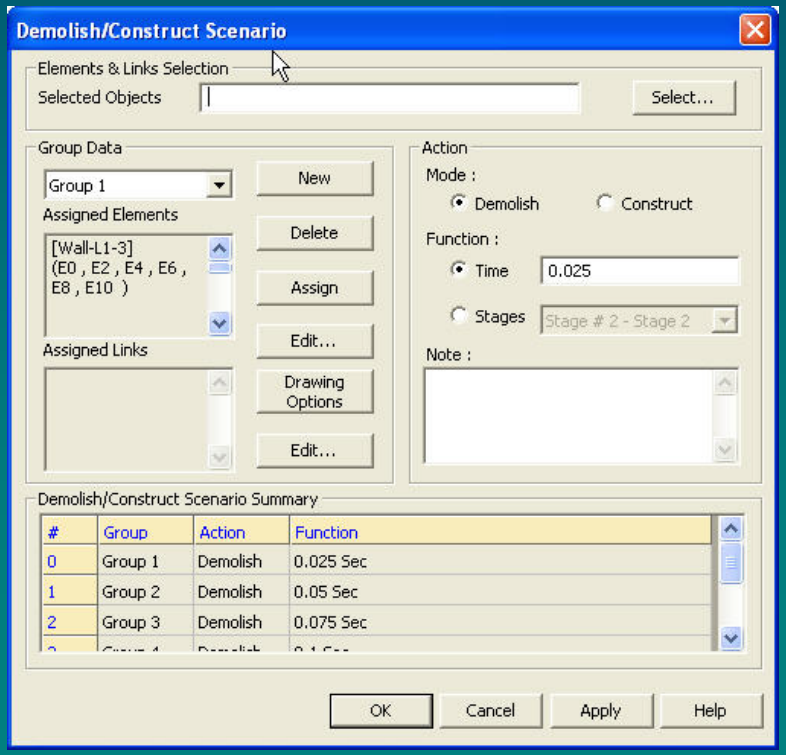
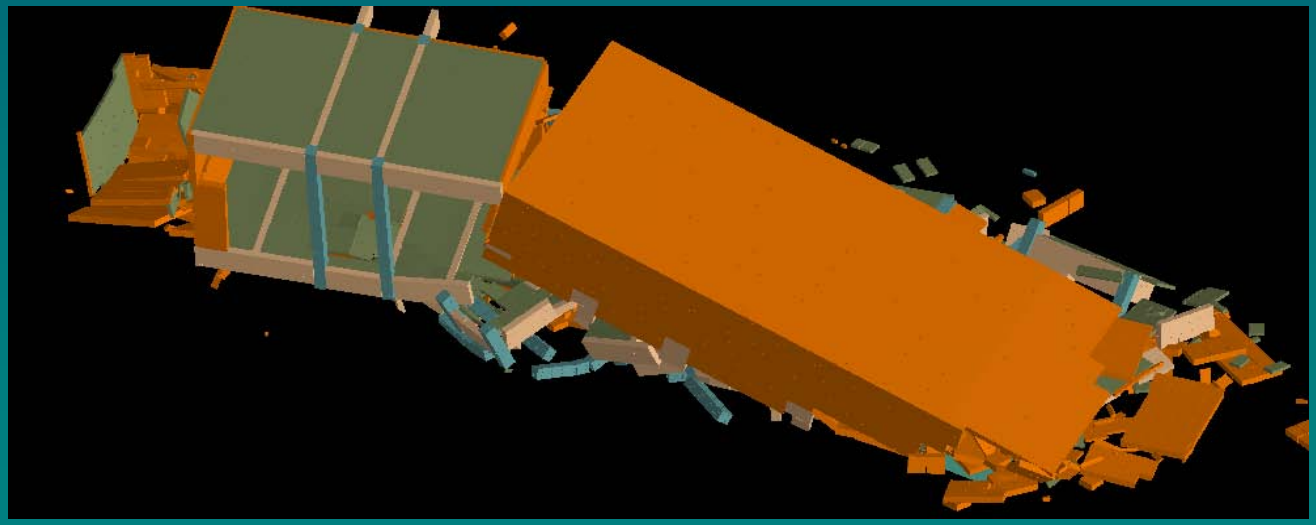
3. Case study – demolition scenario

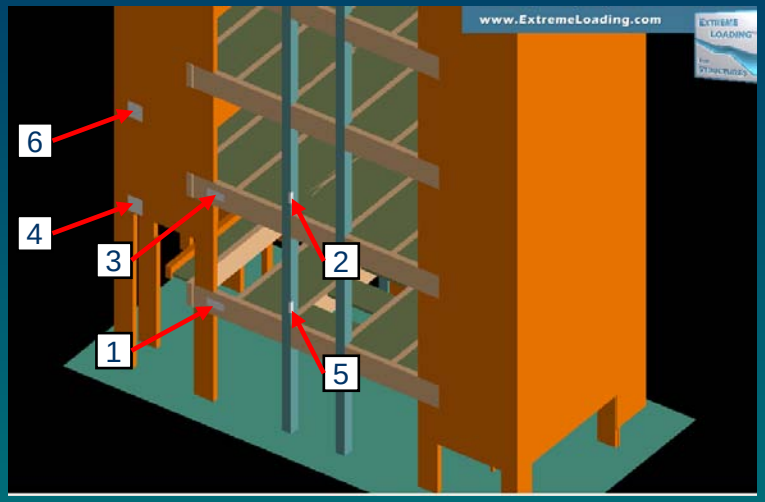
- Step 1
- Step 2
- Step 3
- Step 4
- Step 5
- Step 6
- Step 7



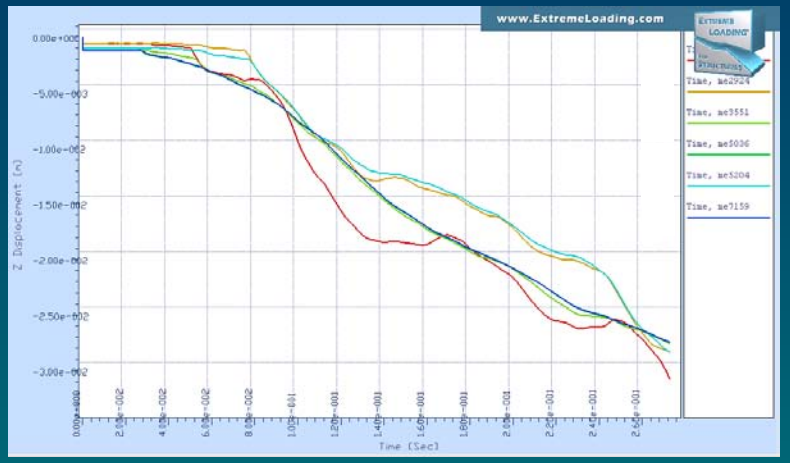
3. Case study - comparision



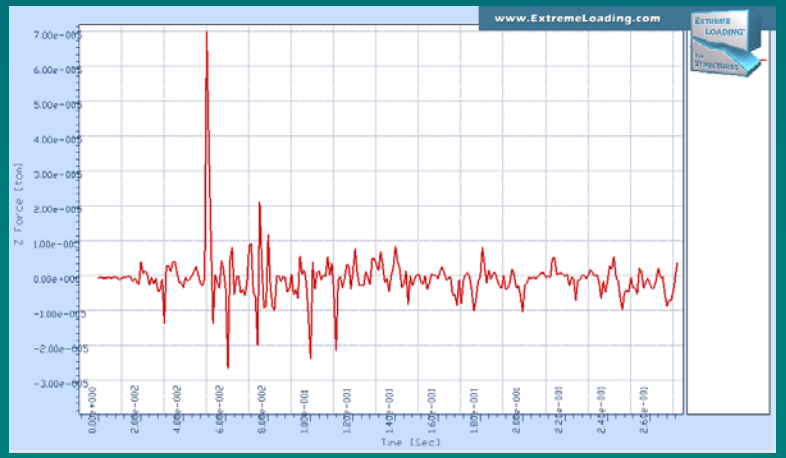
3. Case study - results



Points where were determined displacements and vertical forces were



Displacements corresponding to points indicated in left part



Variation of vertical force corresponding to point 1

4. Conclusions

- *Applied Element Method" combines features of Finite Element Method and Discrete Element Method, having as main advantage the possibility to describe the behavior of structure beginning with loadings application, initiation and propagation of cracks, elements separation until total collapse of the structure.*
- *It can be seen that points where occurs accentuated changing in downgrade corresponds to moment of explosions and thus to the moment of support elements destruction.*
- *It is shown that the joints above one of the removed columns in two different floors moved almost identically, with the floor above having slightly smaller displacement.*
- *The results show a good correlation between numerical simulation and real demolition of the structure.*

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