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Kobe members:
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Riccardo Corazzi
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code_aster ProNet

UNIVERSITÀ DEGLI STUDI FIRENZE
DICEA
DIPARTIMENTO DI INGEGNERIA CIVILE E AMBIENTALE

Kobe general philosophy/mission:

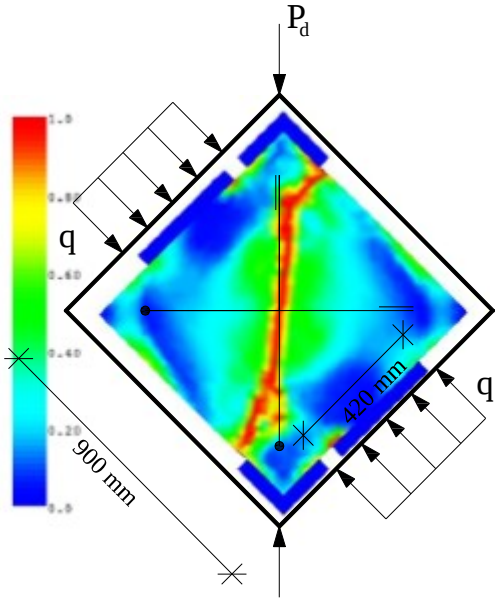
- Numerical approach towards engineering problems;
- Developing and validating methodology in mechanical, dynamic and thermal structural linear and non-linear analyses;
- Developing self-made and directly controlled instruments for the solution of structural problems;
- Employment of open source instruments (code_aster, salome-meca, etc.);
- Interested in developing a wide-spread Italy based network for the usage of code_aster and knowledge exchange.

Research project under development: RiSET project (2016-)

(Coordinator: Prof. Eng. Luca Facchini)

Research project in cooperation with the Department of Civil and Environmental Engineering (DICEA), University of Florence aimed at:

- Employment of existing constitutive laws to reproduce ancient masonry nonlinear behavior;
- Analysis of tower-type masonry structures under seismic loading.



Diagonal test
Damage maps (Mazars' model)

David
Von Mises stresses (gravity loads)

Case study [1602_02], diagonal test on masonry wallettes, and [1602_03], Michelangelo's David:

- Highly detailed mesh (big amount of elements);
- Highly non-linear materials properties (fragile masonry and/or marble);
- Necessity to find a fast way in solving the FE model.

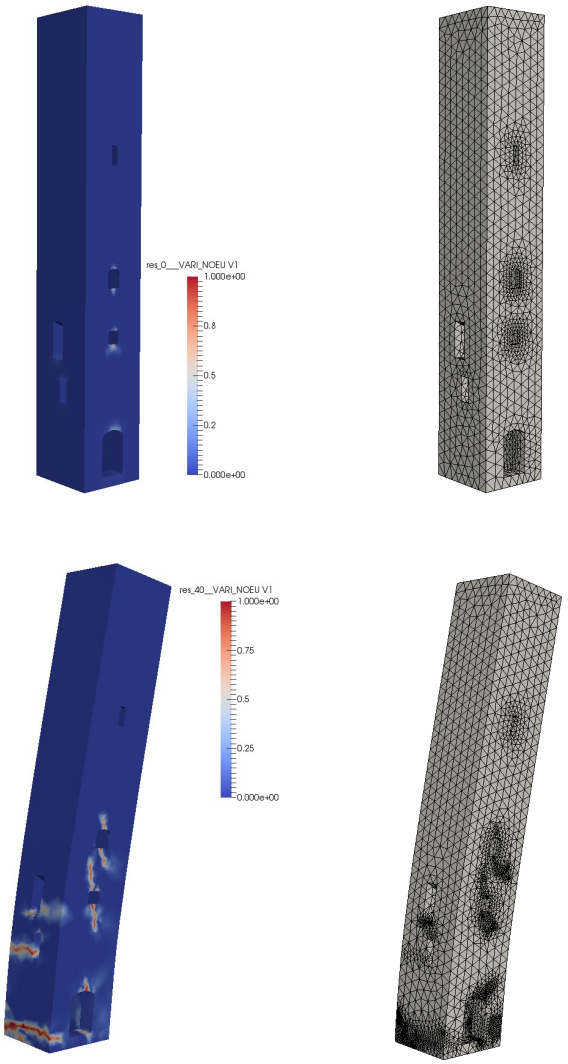
MPI approach (parallel computing):

- Time saving process;
- Opportunity in managing detailed models.

Examples:

David time history dynamic analysis each step:
2,790 s (1 CPU)
1,740 (2x4 CPUs).

Diagonal test static analysis each step:
4.320 s (1 CPU)
3,170 s (2x4 CPUs)
2,450 s (1x8 CPUs)

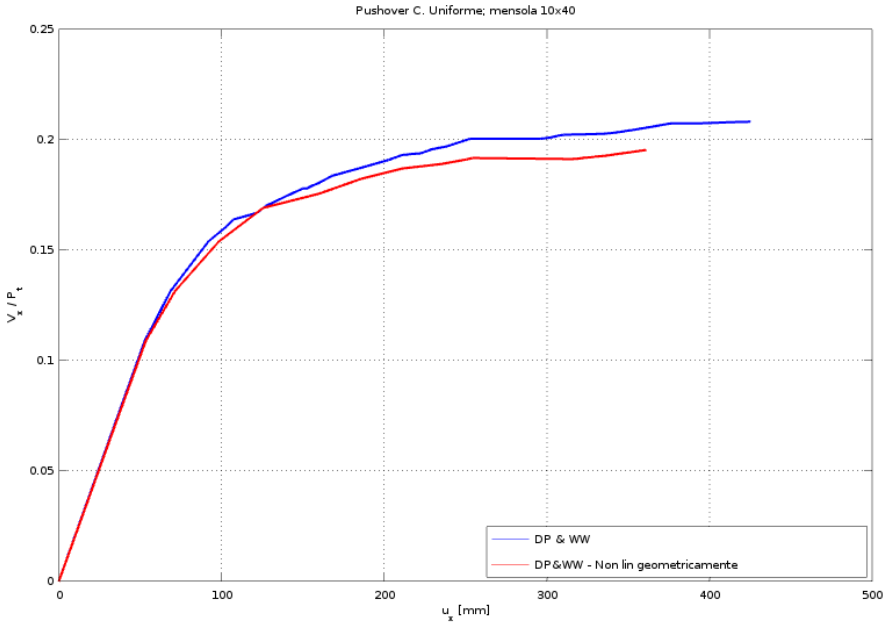


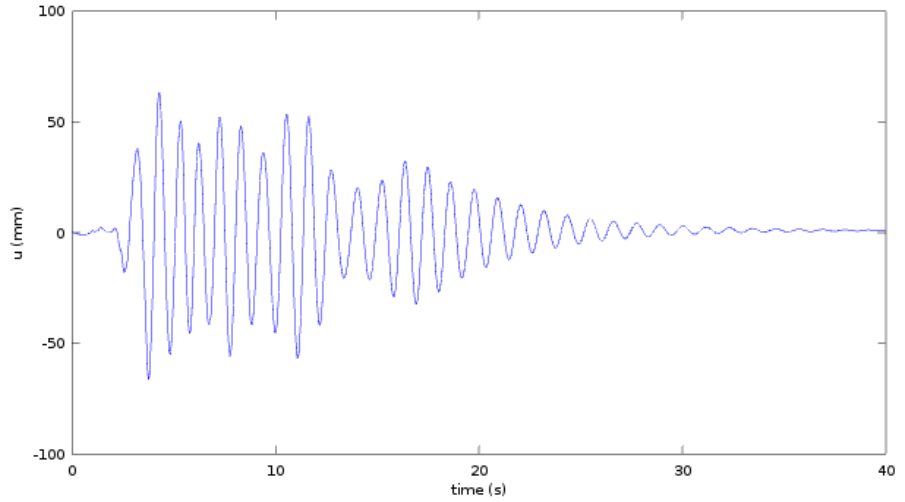
Case study [1602_05], Salvucci Tower in San Gimignano (Tuscany, Italy):

- Highly non-linear properties of materials (fragile masonry with damaging behaviour modelled through the Mazars constitutive law);
- Mesh dependant propagation of damage.

Mesh refinement for each calculation step triggered by the amount of damage level (both in compression and tension).

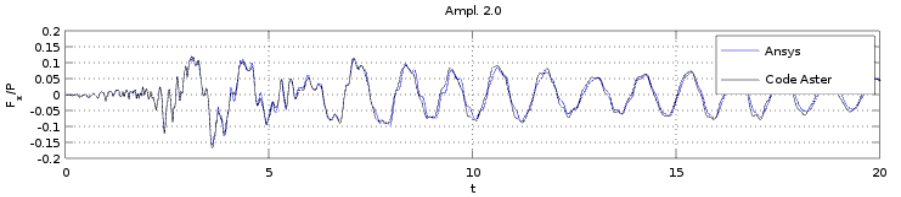
[Special thanks to Gerald Nicolas of EDF, who helped us in developing the comm file].

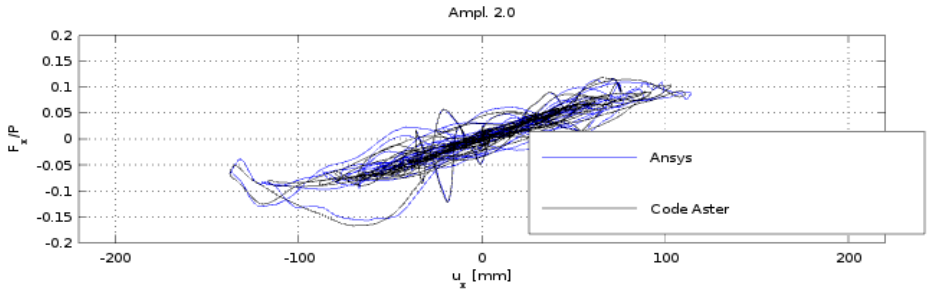




Further development:

- Exploitation of existing constitutive laws in masonry behaviour modelling;
- Interest in developing a suitable constitutive law for masonry material;
- Development of solid and confident pushover (static non-linear) analyses for masonry structures;
- Non-linear time history analyses for masonry structures.





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Publications (Code_Aster related):

- Bartoli G., Betti M., Vignoli A. (2016). *A numerical study on seismic risk assessment of historic masonry towers*. *Bulletin of Earthquake Engineering*. doi: 10.1007/s10518-016-9892-9.
- Betti M., Bartoli G., Corazzi R., Kovačević V. (2015). *Engineer Education and Research With Code Aster*. Proceedings of WEEF (World Engineering Education Forum. Engineering Education for a Resilient Society), Firenze, Italy, 20-24 September 2015. Special Session: «OPENSOURCE AS A VECTOR FOR ENGINEERING EDUCATION» (Session Chairs: Jean-Raymond Levesque, Code_Aster ProNet, France and Michele Betti, University of Florence, Italy).
- Betti M., Bartoli G., Corazzi R., Kovačević V. (2012). *Strumenti Open Source per l'ingegneria strutturale. Modellazione meccanica non lineare di edifici in muratura*. Bollettino degli Ingegneri, Collegio Ingegneri della Toscana, LX (12), pp. 3-15.