ProNet UPDATE - 7

Code_Aster Professional Network

The *Code_Aster Professional Network* aims to spread and to acknowledge the benefits of *Code_Aster* and Salome-Meca as open-source software.

http://www.code-aster.org/spip.php?rubrique62

This report is the seventh issue, after the first six published since July 2015 ▼

See previous issues

http://www.code-aster.org/spip.php?article890

Summary of ProNet UPDATE 7

Trainings and meetings in the world

Code_Aster supports innovation – CEREMA – *France*

Collaborative work to support development– *Imperial College London – ANDRITZ Hydro*

Applications submitted by members

- **Vibrations analysis of a platform at Hippodrome – *TRACTEBEL Engie – France***
- **Seismic risk assessment of historic masonry – *FIRENZE University – Italy***
- **Non-conventional civil engineering structures – *RIGA University - Latvia***
- **Advanced civil engineering & structural expertise – *NECS – France***

Publications in congress for development and experiment – simulation

Salome-Meca 2017 to be released September 1st

Salome-Meca 2017 will be released on September 1st. It will be available for download on code_aster's website and will bring several improvements including **AsterStudy**.
The revamped GUI for *Code_Aster* (see previous issue) will considerably improve the user experience.
This new Salome-Meca version will also include a major update to *Code_Aster* (13.4) which offers lots of new features.

Dedicated forum for the members

The discussions conducted in the ProNet forum are dedicated to all cooperative exchanges between members of the network, expression of needs, follow-up of developments and all feedbacks.

Code_Aster Open source for sustainable development join the network ProNet

Contact

Jean-Raymond Lévesque – Representative of *Code_Aster ProNet*
contact@code-aster-pronet.org

New members Since 01/2017

ALGERIA

ARGENTINA

FRANCE

GERMANY

TUNISIA

June 2017
81 members
(see last page)

Training and meetings in the world

➡ Quebec user's meeting   Third event

On **May 17th**, the University Sherbrook held a workshop on structures and mechanics of power lines on at **IREQ** (Research Institute HYDRO-QUEBEC), dedicated to users of **Code_Aster** from Universities, Hydro-Quebec and RTE.

Contact sebastien.langlois@usherbrooke.ca

➡ University of Manchester and EDF Energy

On the **13th - 14th - 15th September 2017,** a **free** three day training session for **Code_Aster** will be held in Manchester by **EDF Energy** for introduction to Code_Aster and Salome-Meca, with the **new interface AsterStudy**. The last day will be dedicated to fracture mechanics modelling.

Contact Philippe.Martinuzzi@edfenergy.com

➡ In Germany

Introduction to finite elements analysis with *Code_Aster*

Linear finite elements analysis - Nonlinear contact - Plastic material models - Large deformations. **March 2018 and future dates**

Contact kontakt@vonstein-partner.de

***Code_Aster* group courses with Salome-Meca 2017**

With the re-designed user's interface **AsterStudy**, Salome-Meca provides much more user friendliness and flexibility for example easier visualization, coupling of several analysis steps and much more...
Intro+Contact+Material (09-13 October 2017) Dynamic Analysis (30 Nov - 01 Dec 2017)

Contact http://www.code-aster.de/seminars-and-training.html

### ➡ Numerical simulation and sustainable development in Maghreb with *Code_Aster*

Three meetings were held between **January** and **April 2017** in **Monastir** (**Tunisia**), **Oran** (**Algeria**) and **Meknes** (**Morocco**) for the deployment of **Code_Aster Open source** in universities and engineering schools as help for local industrial development. More information in the next issue on this large program..

Contact contact@code-aster-pronet.org

➡ Argentinean Association for Computational Mechanics (AMCA) and ENIEF Conference

During the last conference **ENIEF 2016** (**Cordoba – Argentina**), November 2016), a user meeting dedicated to **Salome**, ***Code_Aster***, and *Code_Saturne*. was organized and gathered almost 30 participants. Of course the user meeting will be renevedt in the conference of this year (**La Plata, November 2017**)

Contact www.amcaonline.org.ar
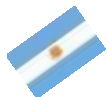
TRAINING

For **2017** several organizations propose **training sessions** for *Code_Aster* and **Salome-Meca** in France and Germany

www.phimeca.com/Formations

www.code-aster-services.org

CEVAA

www.cevaa.com

www.code-aster.de/services

TUTORIALS

The course materials used by EDF for internal teaching are online and written directly in English.

http://code-aster.org/spip.php?rubrique68

Code_Aster supports innovation

Innovation for connector steel – concrete CL

Jacques BERTHELLEMY- CEREMA (ex SETRA)

Cerema

This connector used in steel-concrete assemblies is shaped like a clothoid and is the fruit of an European research program joining multiple partners : Schmitt Stumpf Fruehauf – Cerema - Politechnika Wrocławska - Arcelor Mittal - University of Liege - Bundeswehr University – CTICM France –Technical University Munich.
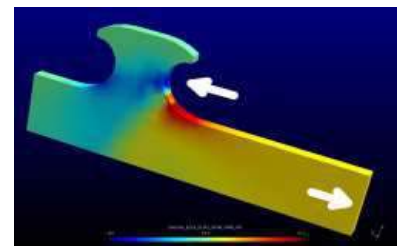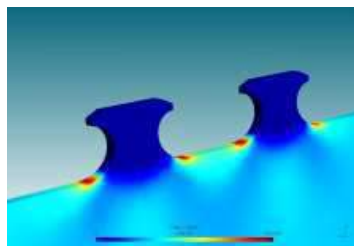
1 – **Experiments**: Resistance, Fire, Effect of the cyclic loads on the concrete and steel, Fatigue

2 – **Simulations** with Code_Aster: **the shape of** clothoid proposed by **Cerema** improves the fatigue behaviour

3 – **Rules of calculation** blind comparison of the outputs of the tests and the simulation results

4 – **Achievements**: bridges in Poland, Romania, Germany (urgent spare bridges for Deutsche Bahn)

5 – **Publications**: Review Metal structure, Stahlbau, congress IABSE, construction steel, …

6 – **Safety regulation**: the Connector CL is recognized equivalent in Germany to the connectors already treated by Eurocodes (dudgeons, connecting angles): **« Zulassung Z-26.4-56 » (2013 May)**

7 – **Possible application for energy**: GE (ex Alstom-Energy) also plans it to anchor turbines of turbo alternator groups

Ancrage de turbine LT75 : glissement de 24 MN
difficultés de mise en oeuvre des goujons
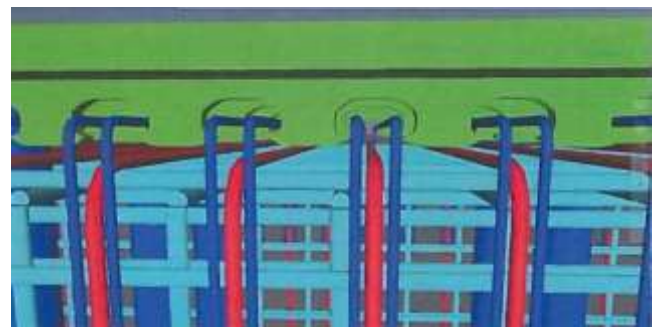
Classical solution with dudgeons very tight

Solution with connector CL : civil engineering simplified

Collaborative work to support development

Collaborative work to support development

Cyclic symmetry for fluid-structure interaction

Loic SALLES - Rami CHAIBI (Imperial College)
Adrien TARUFFI (ANDRITZ Hydro)

The industrial need for ANDRITZ Hydro was the modal analysis of a radial runners (Francis turbine/pump or pump-turbine in water with fluid – structure interaction (FLUIDE formulation (p, rho, phi).

At the beginning *Code_Aster* offered capabilities for cyclic symmetry modal analysis without fluid, but the fluid-structure interaction was not implemented.
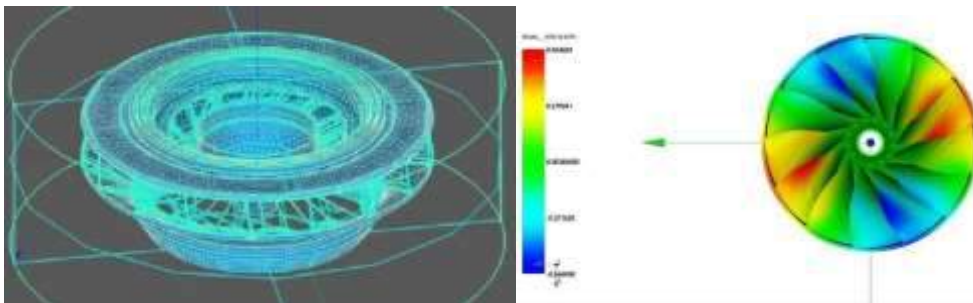

With the assistance of the ProNet Network a relation was built between Loic SALLES and Adrien TARUFFI for the specification of a development. During the six months internship of Rami CHAIBI (Centrale Marseilles) a literature review was conducted to have a better understanding of the theory for modal analysis with FSI and cyclic symmetry. After that he implemented the cyclic symmetry for fluid-structure interaction by extending AFFE_CHAR_MECA/LIAISON_CYCL to the relation for PRES and PHI.

The construction of two test cases **fdlv115a and fdlv117a** validate fluid model and fluid-structure interaction

First mode family

ND	whole	cyclic
0	4,1112E+02	4,1112E+02
1	4,0761E+02	4.0761E+02
2	4,8109E+02	4.8109E+02
3	7,6061E+02	7.6061E+02
4	1,2360E+03	1.2360E+03
5	NC	1.8616E+03
6	NC	2.6125E+03
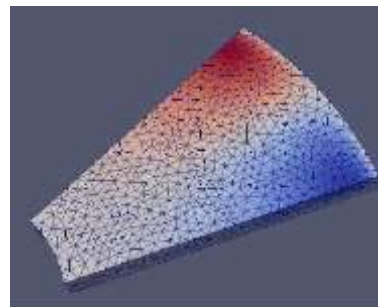
mode nd=6

CPU time and memory

4 cores

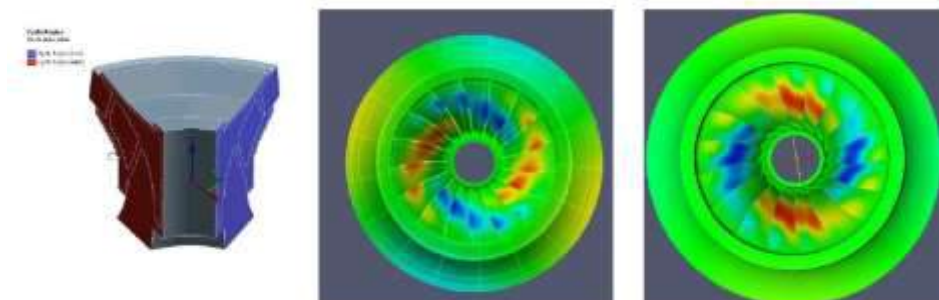**Whole disc** 4131 s – 8200 Mb

Cyclic 288 s – 552 Mb

This work also includes

- Post-processing of complex mode in Paravis
- Forced Response analysis in *Code_Aster*
- Mistuning analysis with *Code_Aster*:

Applications submitted by members

VIBRATIONS ANALYSIS OF THE PLATFORMS OF THE NEW LONGCHAMP TAKING INTO ACCOUNT OF THE EFFECTS INDUCED BY THE SPECTATORS

Andrea CARLETTO - TRACTEBEL ENGIE

The new platforms of the Hippodrome of Longchamp (PARIS – France) proved to be a complex architectural project with the Validation of the criteria of comfort of the platforms:

- Strong architectural constraints,

- Flexible structures with important cantilevers,

- Need to guarantee the comfort of the public during the use of the platforms,

- Development of a method for taking into account the interaction of the sway in the crowd and structure.


The vibrations analysis is conducted with *Code_Aster*: the finite element model is built with SCIA Engineer using the formalism Open BIM.
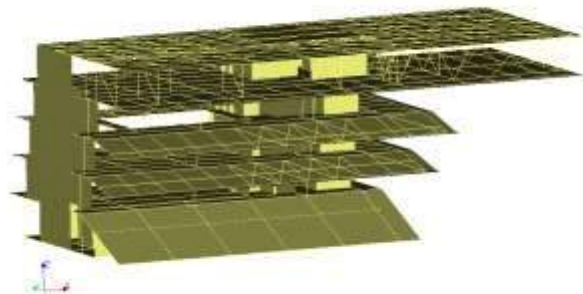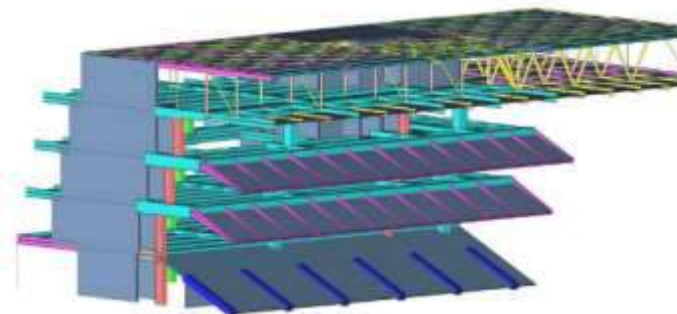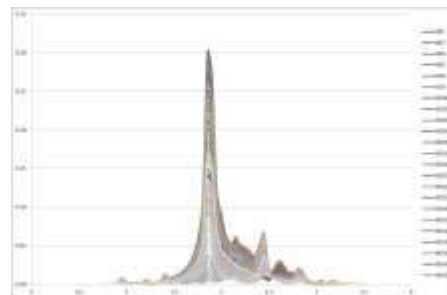

The Institution of Structural Engineers (ISE) in UK defines dynamic performance requirements for permanent grandstands subject to crowd action, with the definition of the harmonic loading and the function of synchronization.

In the *Code_Aster* the "equivalent spectator" is represented by a Kelvin – Voigt model.
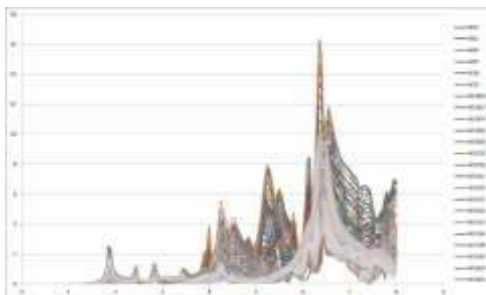
Module of rough harmonic acceleration

Accelerations balanced with application function of synchronization

Accelerations are reduced by the use of granted dynamic shock absorbers placed in the floors.

Applications submitted by members

### A numerical study on seismic risk assessment of historic masonry towers: a case study in San Gimignano

Gianni Bartoli - • **Michele Betti - Andrea Vignoli**

The research project RiSEM (Seismic Risk of Monumental Buildings), presents the seismic assessment of historic masonry towers according to the Italian ''Guidelines for the assessment and mitigation of the seismic risk of the cultural heritage''.

A relevant case study in the ''Town of Fine Towers'', **San Gimignano** (Italy) is the analyses performed on the Coppi-Campatelli tower for evaluation of the seismic vulnerability of this building.
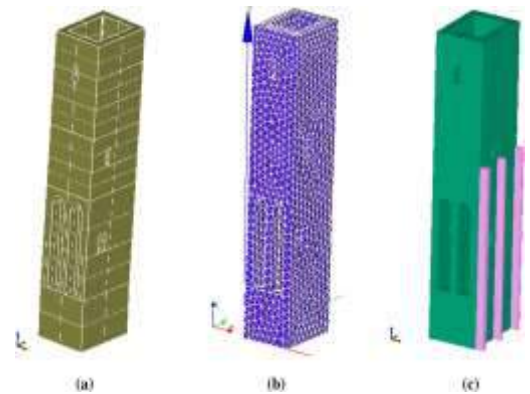
Mechanical characterization of the materials: two different masonry walls typologies were taken into account. The first was Uncut Stone Masonry with facing walls of limited thickness and infill core, referred in the following as USM. The second was the scheme of Dressed Rectangular Stone masonry (DRS).

Seismic risk assessment

      LV1 analysis (seismic assessment by means of equivalent static analysis)
      LV2 analysis (kinematic linear analysis) - Analysed collapse mechanisms
      LV3 analysis (global structural analysis)

The numerical analyses were performed using *Code Aster which* has a wide library of non-linear material models, and the masonry non-linear behaviour was reproduced by the continuum damage model introduced by **Mazars.**
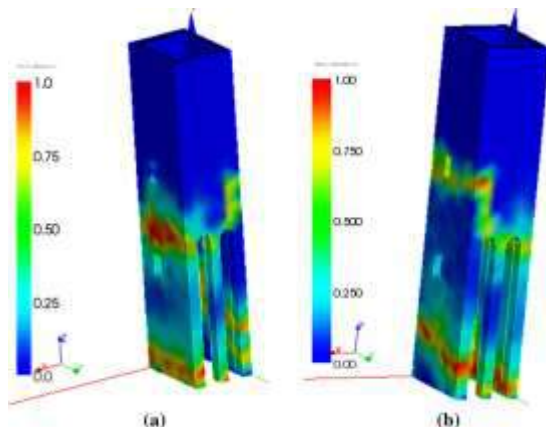
Isolated tower. Damage maps (D = model damage variable; blue D = 0, undamaged material; red D = 1, damaged material)

Analysed collapse mechanisms

Only a clear understanding of the structural behaviour based on a comparative approach can ensure the definition of reliable strengthening interventions, thus reducing the extent of the remedial measures.

Applications submitted by members

Code_Aster and non-conventional civil engineering structures: Estimation of strength of existing steel-timber arch support joint

Jānis ŠLISERIS - Riga Technical University, Latvia

The estimation of load bearing capacity of existing building that had problems in operation was made using Salome-Meca 2015 environment.

Structure consists of timber arch and steel tension elements. Timber arch is joined with steel using steel plates and ten steel bolts. This structural solution is non-conventional and therefore an accurate simulation is necessary to estimate the load transfer mechanisms from timber to steel.

The interested timber-steel support joint is modelled using 3D continuum based finite elements. In order to accurately apply load on the support joint without making full 3D simulation, the rest of structure was modelled using beam type finite elements. The connection of beam-solid finite elements was created using "LIAISON_ELEM". Structural steel S275 parts were modelled using Von-Mises isotropic plasticity model from *Code_Aster* material library and timber was modelled using orthotropic elastic material.
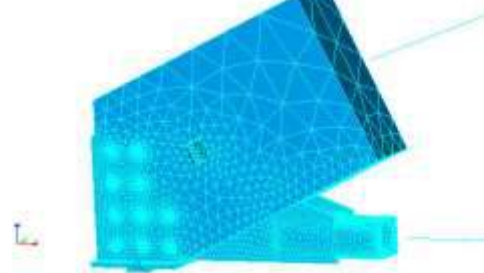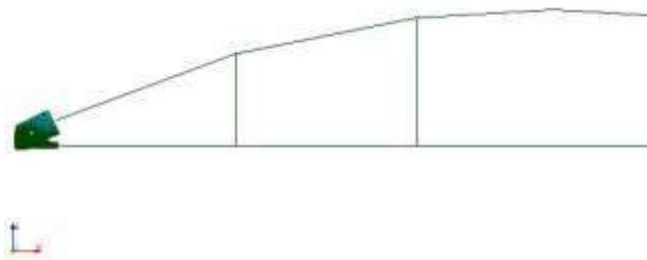
Structural forces in each steel bolt was obtained using post-processing Paravis module that is integrated in Salome-Meca.

In appropriate cross sections of each bolt the variable integration filter was applied. The same method was used to calculate the horizontal and vertical forces on supporting steel plates. Non-linear plastic deformations caused a significant force redistribution in the support joint. Two components of structural forces were calculated and the resultant force and its orientation angle with respect to wood fibers was obtained.

Those forces were used using Eurocode design standard to estimate load bearing capacity of this support joint. Results showed that steel bolts are very unequally loaded. Resulting force on each steel bolt had a specific orientation angle with respect to wood fibers.
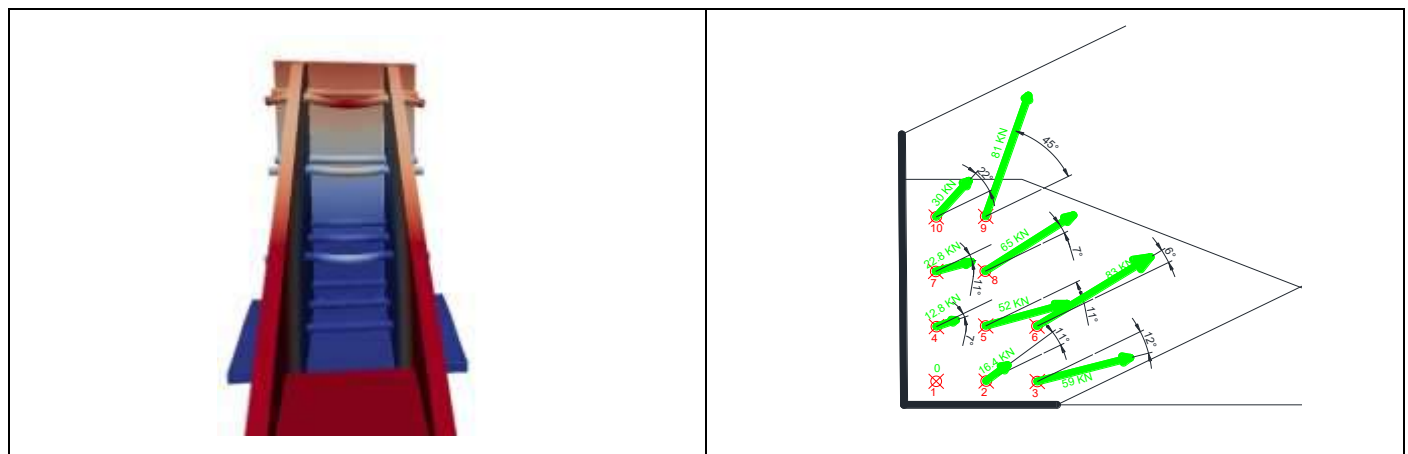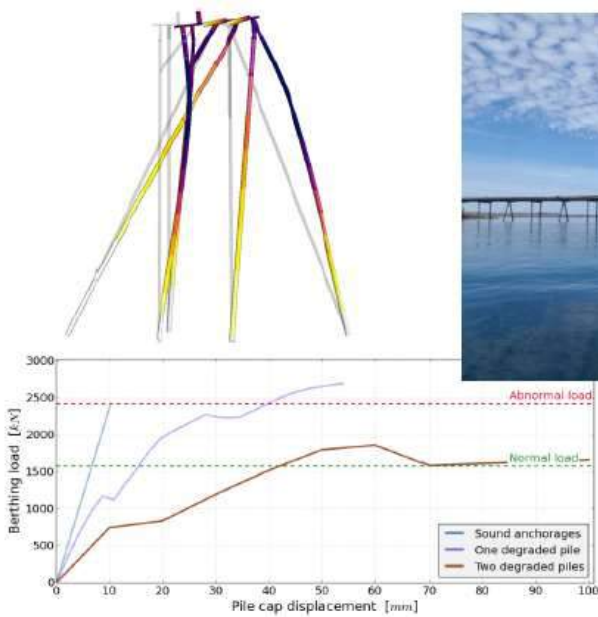
Applications submitted by members

SIXENCE - NECS has been using, since several years, *Code_Aster* **for advanced civil engineering & structural expertise**

Shahrokh GHAVAMIAN - Véronique LE CORVEC - SIXENCE NECS

RIO TINTO - Australia

Dolphin stability assessment

Capacity evaluation for various degradation scenarios using nonlinear FE analyses.

CEA - Atomic Energy Center – France

Seismic behavior of a Basis Nuclear Installation

Justification of the seismic behaviour by nonlinear transient dynamic analysis :

- Seismic movements
- Plastic behaviour of reinforcements
- Cracking of concrete
- Plastic behaviour of soil
- Decohesion and slipping of the foundations
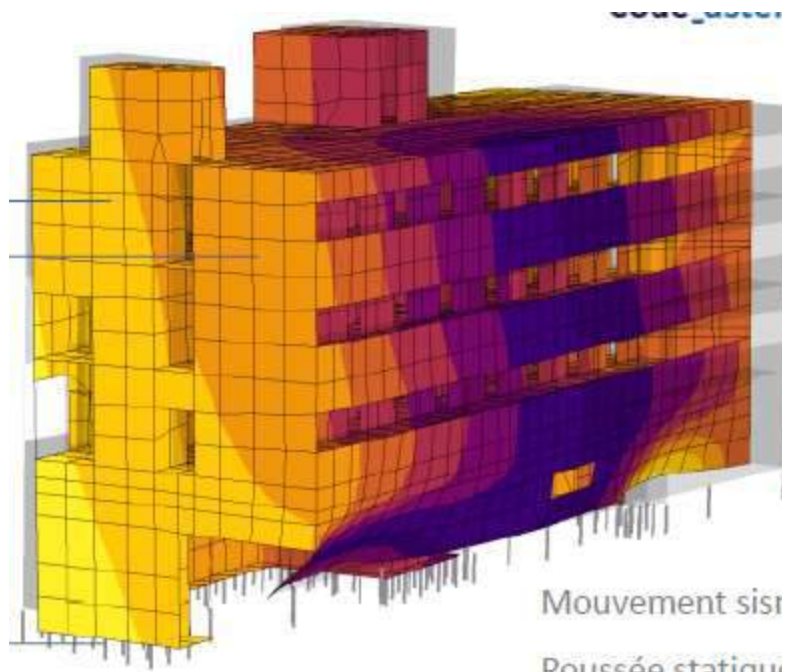
Thirteenth national conference in numerical simulation of structures – May 15th – 19th – GIENS - France

Organized by CNRS IMSIA, CEA, EDF, ONERA, University Paris-Saclay, École Polytechnique, ENSTA ParisTech this conference was the opportunity to present several applications of developments and new features in Code_Aster

Application of the reduced basis method for vibroacoustic of structures immersed with uncertain parameters

> C. Leblond, M. Abbas, J. Vernet-Castex, S. Prigent, J.-F. Sigrist

A finite elements method "Local Average Contact" for friction

> M. Abbas, G. Drouet, P. Hild, N. Pignet (EDF R&D - IMT Toulouse – IMSIA Paris-Saclay)

A simplified method for the restoration of work hardening used in the numerical simulation of welding

> S. Hendili, L. Le Gratiet, M. Abbas, E. Lorentz (EDF R&D – IMSIA Paris-Saclay)

Operators of impedance in Soil - Structure Interaction: accelerated by a fast-multipole boundary

> Z. Adnani, S. Chailla, M. Bonnet, A. Nieto Ferro, N. Greffet (ENSTA Paristech, Université Paris-Saclay, EDF R&D)

Hyper reduction of mechanical models for the simplified prediction of the welding residual stresses

> T. Dinh Trong, D. Ryckelynck, S. Hendili, M. Abbas (EDF-R&D - MINES ParisTech, PSL Research University - IMSIA Paris-Saclay)

Limited memory preconditioners for non-symmetric systems

> Sylvain Mercier, Serge Gratton, Nicolas Tardieu, Xavier Vasseur (IMSIA Paris-Saclay - INPT Toulouse - ISAE-SUPAERO Toulouse)

Gp method: an energy approach of the prediction of cleavage

> S. Jules, S. Geniaut, G. Debruyne (EDF R&D)

Correlation simulation – experiments in dynamics of the structures: free-free simple system with the assembly bolted in its industrial environment (Project FLED SICODYN 2012-2016)

> S. Audebert (EDF-R&D - IMSIA Paris-Saclay)

Modern building Materials, Structures and Techniques MBMST 2016 – VILNIUS - Slavia

Deformation process numerical analysis of T-stub flanges with pre-loaded bolts

Jānis Šliseris, Līga Gaile, Leonīds Pakrastiņš - Institute of Structural Engineering and Reconstruction, Riga Technical University

A numerical analysis and experimental validation of T-stub steel joint with pre-loaded bolts is done. Design codes have a very imprecise analysis methodology that might not take into account the actual behavior of this joint. The calculations are done with state-of the-art open source software Code_Aster by taking into account large strains, nonlinear plasticity and contact mechanics. Experimental validation of truss T-stub joint's ultimate load and displacements shows good agreement with numerical simulation results.
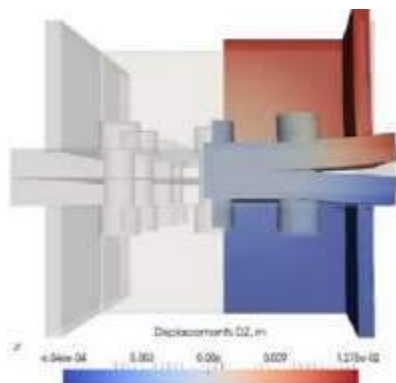
| Simulation | Experiments |

ProNet UPDATE - 7

QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK

Industrial and research centers, services providers and teachers are welcome

81 members - 18 countries

Italy	France	France	Switzerland	France	Spain	France
Switzerland	France	France	Argentina	Switzerland	France	France
France	UK	France	France	France	France	Czech Republic
Germany	France	Canada	Spain	France	France	Germany
France	UK	France	Germany	Germany	Korea	Italy
France	Algeria	France	France	France	UK	France
France	Poland	Switzerland	France	France	Switzerland	Germany
France	France	Spain	France	France	Japan	
France	Poland	France	Germany	Poland	France	France
Germany	Switzerland	Germany	Canada	Germany	Mexico	China
Italy	France	Canada	Latvia	Germany	Germany	Chile
Algeria	Tunisia	Tunisia	Tunisia	Tunisia		