ProNet UPDATE - 3

QUARTERLY REPORT OF CODE_ASTER PROFESSIONAL NETWORK

Overview

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?rubrique63

This report is the third issue, after the two one published last year.

Read the previous issues http://www.code-aster.org/spip.php?article890

Summary of ProNet UPDATE 3

Benchmarks Seismic analysis

Project for SME and ETI

Hybrid testing on lattice tower in CANADA

Teachers corner

Congress - Seminar

PHD Thesis

Nonlinear Dynamics Analysis in Theater

Jean-Pierre AUBRY

Composites in LATVIA

Regular and special meetings 2016

- **Salome-Meca and Code_Aster Users Day 2016**
  Thursday **March 17th** at EDF LAB CLAMART
- **10th ProNet meeting** Friday **March 18th** at EDF LAB CLAMART

Meetings next spring

- **Québec user's meeting** in IREQ - VARENNES – Wednesday **8th June**
  contact **Université Sherbrooke** – Sébastien LANGLOIS
- **UK user's meeting** in MANCHESTER Thursday **23th June 2016**
  contact **EDF ENERGY R&D UK Centre** Philippe.Martinuzzi@edfenergy.com

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.

Contact

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

New members

2016

SWITZERLAND

FRANCE

UK

2015

CANADA

FRANCE

STABILIS

GERMANY

LATVIA - LETTONIE

SPAIN

SWITZERLAND

February 2016
67 members
(see last page)

International Benchmarks

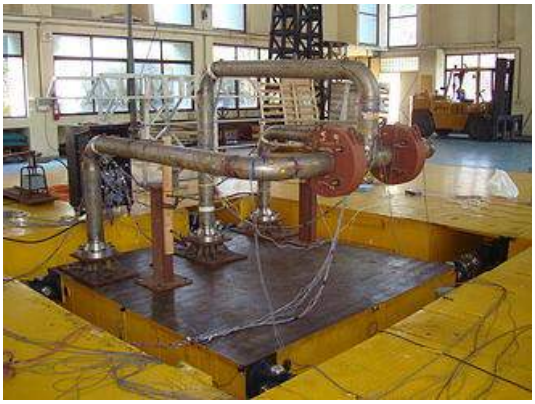
Two international program organized under the auspices of the **OECD - NEA (Nuclear Energy Agency)** with comparison between experimental references and existing design and simulation practices. In both cases EDF, and its partners, contribute to these benchmarks with ***Code_Aster***.

MECOS benchmark

http://www.mecosbenchmark.org/

MECOS (Metallic Component Margins under High Seismic Loads) is organized under an initiative of the WGIAGE (Working Group on Integrity and Ageing of components and structures).

The main objective of the **MECOS** benchmark is to quantify the margins in seismic analysis of piping components for high seismic loads.



The experimental reference case is based on tests recently achieved by BHABHA Atomic Research Centre in India.

The specimen consist of two representative **6" piping systems (stainless steel and carbon steel)**, with lumped masses tested under a sufficiently high **seismic load** (**up to 2.5g zero period acceleration**) to obtain a pipe failure.

Strain gauges on critical locations (elbows, tee) and accelerometers are implemented to document the system behavior during dynamic runs.

The observed failure mode is fatigue-ratcheting in an elbow.

CASH benchmark

http://benchmark-cash.org/

The objective of **CASH** is to evaluate the reliability of predictive analysis tools and methods as well engineering practice know how to assess the seismic capacity of reinforced concrete shear walls to withstand strong earthquakes.

The experimental reference case is based on the "SAFE" reinforced concrete shear wall panels tested at the **ELSA**, EU Joint Research Centre.

These tests were carried out on the main reaction wall using a pseudo-dynamic test program. Each specimen has different natural frequency (4, 8 or 12 Hz)

During the first stage the participants are invited to qualify and calibrate their numerical models based on several experimental loading conditions (static pushover, cyclic and dynamic).

The second stage, to November 2016, the participants would have to assess the capacity of scale 1 shear wall extracted from a real NPP building.

TRAINING

For **2016** several organizations propose **training sessions** for ***Code_Aster*** and **Salome-Meca** in France and Germany

PHIMECA

phimeca.com/Formations

DeltaCAD

www.code-aster-services.org

Tangent'delta

www.tgdelta.com/formation-code-aster

Dr.-Ing. J. Ackva Ingenieurbüro für Mechanik

www.code-aster.de/services

TUTORIALS

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

http://code-aster.org/spip.php?article282

Collaboration between members - Projects

Project CALINCA Champagne – Ardenne – (France)

The objective of project **CALINCA** (Calculation and Engineering in Champagne - Ardenne), carried out by MICADO and its center of R & D DINCCS, is to make a structured offer for access and services to the tools and methodologies of simulation/optimization with high efficiencies for the ETI and SME in the sectors of mechanics and materials forming and their R & D activities.

This project is supported by Champagne-Ardenne region and the European regional development fund.

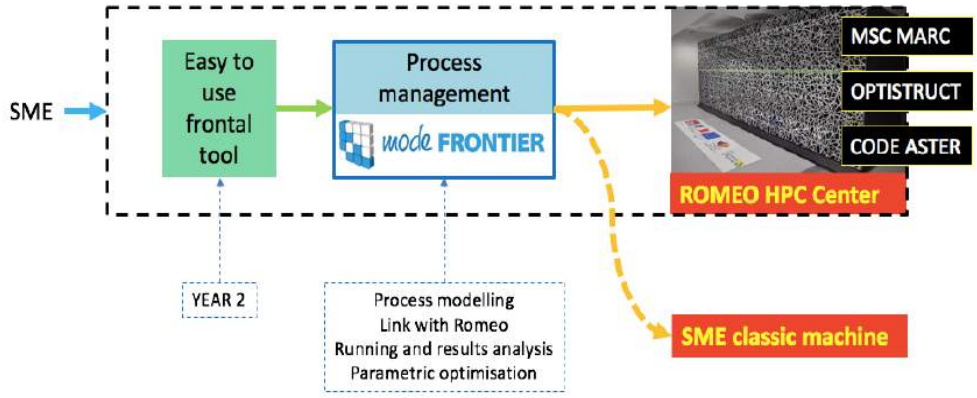
He has, of course, a vocation to get a tool accessible from anywhere … the project is in particular in collaboration with HPC center ROMEO of the REIMS University.

The objective is a tool making to launch the calculations more or less automated according to the level of expert testimony. The first year of the project was devoted to carry out tests starting from SME cases SME.

The simulation process were created with **ModeFrontier** (EnginSoft) which controls at the same time the processes launching and the management of calculations on ROMEO (creation of mesh and command files). The problems related to the adaptation of the CAD models for meshing are solved with **3DEvolution** (Core Technologie).

Several solvers were tested (owners and free). ***Code_Aster*** was used for nonlinear calculations (with or without contact) and to deal with problems of parametric optimization (realized on ModeFrontier) with the calculations carried out in parallel with ***Code_Aster***.

The project enters its second year and the development of the frontal application (portal of access and numerical model of the processes trades). ***Code_Aster*** answers the posed physical problems (many benchmarks was carried out) without problems of licenses. It also arises a great interest for the formation with numerical simulation for SME.



For more information www.afmicado.com and nicolas.gardan@dinccs.com

SALOME MECA DOCUMENTATION

Since the release of **Salome Meca 2015.2** Some documents for Utilization, Validation and Construction of assistant are now freely available

http://code-aster.org/docsmeca

QUALITY ASSURANCE

After the installation of binary package **Salome-Meca** a procedure may be used to **verify the quality** of the versions of Code_Aster packaged with it.

More information may be found in the manual

http://code-aster.org/docsmeca/default/fr/man_sv/sv4/sv4.02.01.pdf

Collaborations between members - PHD THESIS

Modeling the spatial variability of seismic field for studies of soil-structure interaction

Angkeara SVAY's work aims at the development and validation from field measurements of a new parametric coherency function macro command in ***Code_Aster*** for stochastic dynamic response of the structures during an earthquake by taking account the spatial variability of incident seismic ground motion.

Actually his PhD thesis aims to validate the spatial variability modelling with the open source software **SEM3D** based on spectral element method (extension of finite element method with high degree piecewise polynomials as basis functions).

The objective is the SSI analysis of facility buildings with *Code_Aster including spatial variability*.

Modeling of soil liquefaction : application to the seismic analysis of the holding dams

Ioanna RAPTI develops a methodology with ***Code_Aster*** to determine the liquefaction induced failure under Hydro Mechanic coupling assumption (**HM**) with the constitutive model of **HUJEUX** (MSSMaT Laboratory, ECP) accounting for rheology of soils under alternate and cyclic loadings, as for seismic situations.

FEM Analysis of effects of mechanical impact parameters on fruit and vegetables characteristics

Emanuele CERRUTO, Claudia AGLIECO, Giuseppe MANETTO
Di3A - University of Catania - Italy
Klaus GOTTSCHALK, Jelena SURDILOVIC, Martin GEYER
Institut für Agrartechnik Potsdam Bornim - Germany

Mechanical harvest and post-harvest handling induce numerous **mechanical impacts on fruit and vegetables**. These impacts may cause severe economic losses.

A miniaturized Acceleration Measuring Unit (AMU) has been recently developed at the **Institut für Agrartechnik, Potsdam-Bornim**: implanted into a real product like a potato tuber, it is able to measure the accelerations into the fruit from an impact.

The PhD Thesis of **Claudia AGLIECO** - **Di3A - University of Catania** represents a first contribution on the study of **dropt test on vegetables** (potato tubers), by means of simulations based on **Salome-Meca** http://hdl.handle.net/10761/1635

Seminar Modelling and Simulation of Materials

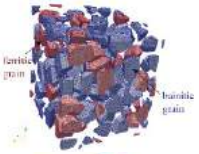
Effect of carbides heterogeneity on the strength for brittle failure of steel 16MND5

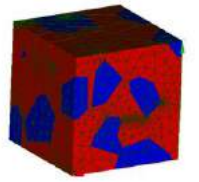
November 2015

Rodrigue DECATOIRE (PHIMECA)
Marc BERVEILLER, Géraut BLATMAN, Félix LATOURTE (EDF R&D)

Reactor PWR vessels are made of ferritic steel 16MnD5. The initial justification of failure risk was defined by conservative rules. The extension of the lifetime requires new methods for evaluation of the risks. Those use the metallurgical observations on information about the carbide grains, potential sites of starting of crack. With prescribe loading, the **failure probability** is estimated with plastic model of **dislocation dynamics for body centered cubic crystals implemented in *Code_Aster*.**

After several test on simplified model, a realistic simulation with 98 grains and 26 617 tetrahedrons (1 day computer time) demonstrate significant impact of carbide distribution on the failure probability





Presentations to congress

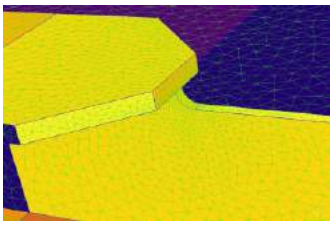
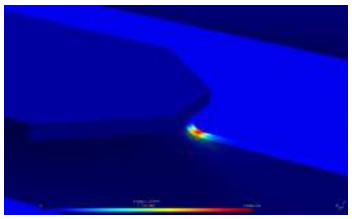
fatigue design2015

Fatigue Design for Durability of bridges and road equipment's

Cerema

November 2015 ***Jacques BERTHELLEMY – CEREMA – SOURDUN – France***

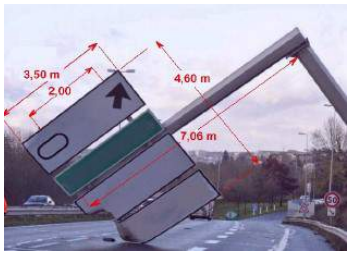
Box girder Bridge - Built at the end of the Eighties (One of the first bridges calculated in fatigue), but with some bad details… … not classified, and thus not calculated.

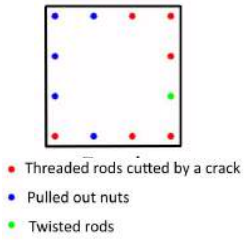




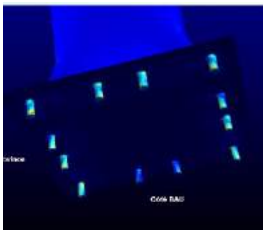
Cracks discovered in 2014: 16 assemblies of this type on the two concerned bridges: 50% of the assemblies are fissured. The class of fatigue is drawn from tests in the Eurocode, but it is also possible to evaluate the class of an unspecified detail by calculation.

The class of fatigue results directly from the result obtained by ***Code_Aster***, by admitting with the **Eurocode** the assumption of a double logarithmic curve of Wohler.

Cantilever sign bridge - the bearing plate at the foot is deformed and some of the anchor rods are cut. On the cutted threaded anchor rods, the fatigue cracks are all located just under the level where the rods enter the concrete. The modelling with ***Code_Aster*** deliver stresses in all the stems with a **strong correlation with the observed cracks.**





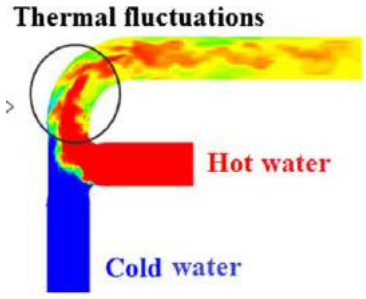
The Critical Plane Orientation under biaxial Fatigue Loading Conditions

EDF ENERGY MaSC MANCHESTER 1824 IMSIA Tsinghua University

November 2015

Bai-Mao LEI, Van-Xuan TRAN, Xiang-Hong HU, Jun GAO

Institute of Nuclear and New Energy Technology, Tsinghua University, Beijing, China,
EDF Energy R&D UK - Modelling and Simulation Centre, Manchester, UK,



For more information
Van-Xuan.Tran@edfenergy.com

The effects of biaxial mean stress on the orientation of the critical plane defined by maximum damage under biaxial tension/compression fatigue loading conditions are investigated by analytical and computational approaches. The analytical solutions of the critical plane orientation using the Matake's and Fatemi–Socie's criteria are first derived and validated by computational results by use of existing functionalities and subroutines of ***Code_Aster***.

A Monte-Carlo study on the cracking directions of the thermal fatigue crazing is conducted in a plate which represents the inner surface of the pipe wall. Finally, the effects of material fatigue properties on the critical plane orientation are discussed.

This work was conducted with support of **EDF R&D** (Said TAHERI) and **Tsinghua University** (Prof. Xin-Xin WU).

Teacher's corner

Teaching platform for mechanical engineering

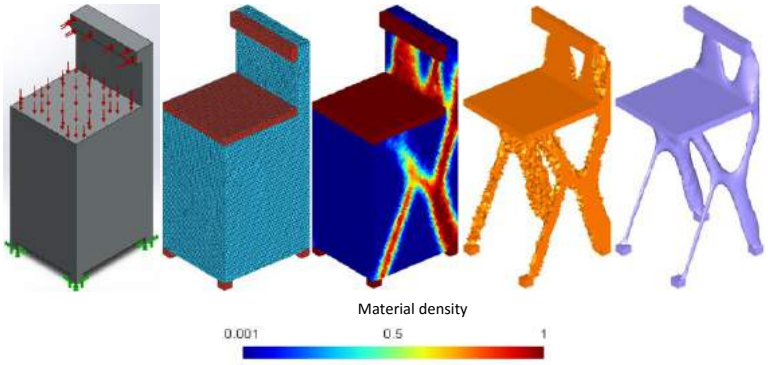
Presented by Vincent FRANCOIS and Jean-Christophe CUILLERE
University Québec at Trois-Rivières - CANADA
ERICCA Team from Department Mechanical Engineering

The **ERICCA** research team (http://www.uqtr.ca/ericca) is working on the integration of FEA and optimization into the CAD process. Our team has been developing numerous tools in a C++ platform since 1990. These tools are aimed at automatically building and solving finite element models from CAD data.

This platform uses **OpenCascade** (http://www.opencascade.com/) as CAD library and **Code_Aster** as FEA solver. Code_Aster is encapsulated inside the platform by using four files: three files for data and one file for results. **GMSH** (http://gmsh.info/) is used as graphics interface for visualizing various FEA and optimization results.

We use linear static analysis in Code_Aster to fully automate **SIMP topology optimisation in 3D**.

The basic principle is optimizing material distribution through several updates of a density field performed via FEA simulations



We use linear static analysis for automating the **shape optimisation of shell structures** (bicycle frames for example). In this case, we use shell elements.

Recently, we started using linear and non-linear static analysis for **modeling and simulating the microstructures of heterogeneous materials**.

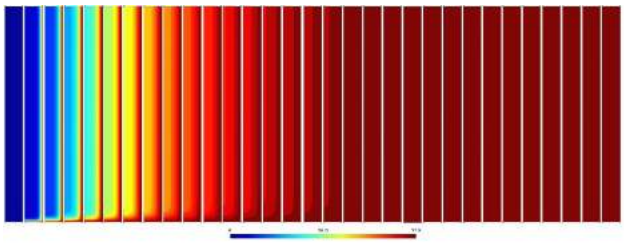
We also use thermal transient analysis for simulating **moisture adsorption in natural fibers composite materials**

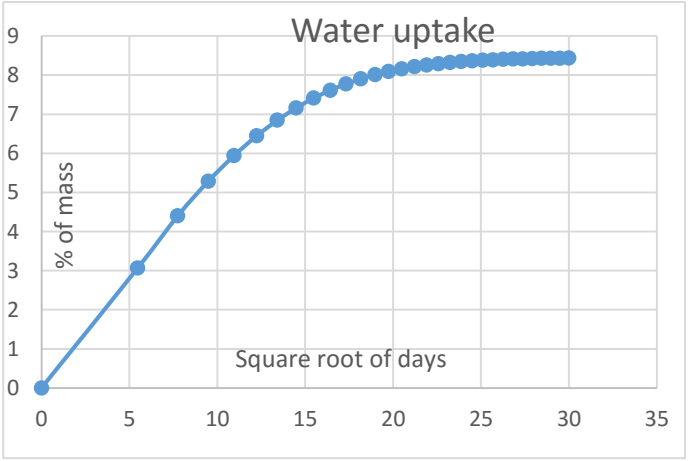
This work is based on a thermal diffusion analogy.

The result below shows moisture diffusion across a quarter section of a polypropylene (PP)/hemp composite sample.

The evolution of moisture concentration versus time is shown for a specimen that has been immersed in water at 20°C for 900 days

As shown, these FEA simulations allow computing water uptake in specimens along immersion (as function of the square root of time).





Applications submitted by members

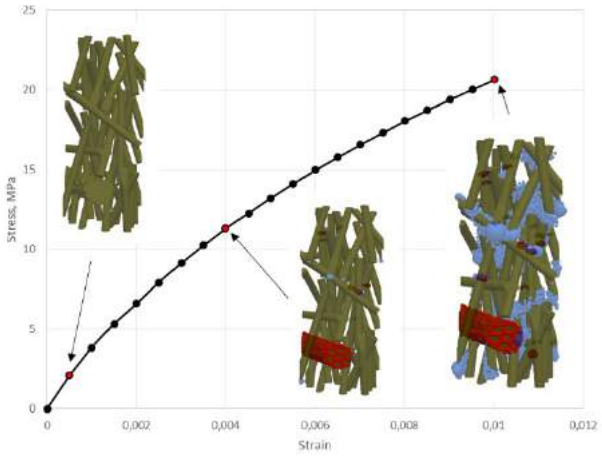
Numerical modeling of flax short fiber reinforced and flax fibre fabric reinforced polymer composites

January 2016

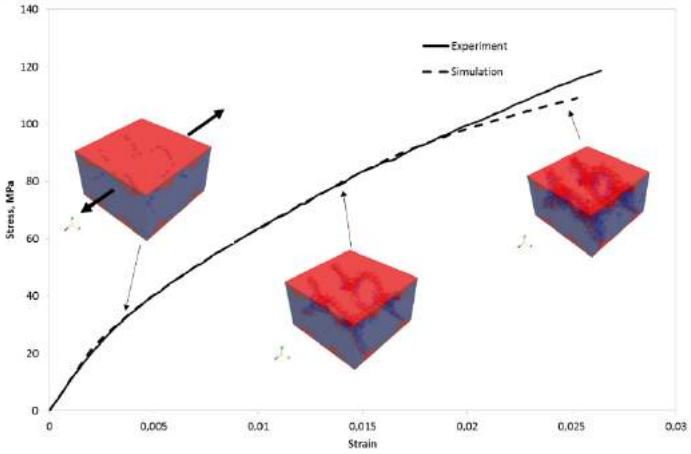
Janis SLISERIS- Riga Technical University, Latvia,
Libo YAN, Bohumil KASAL- Braunschweig University of Technology, Germany

In this study, numerical methods to generate and simulate mechanical properties of flax short fiber reinforced- and flax fabric reinforced-polymer composites are proposed and fully done within **Salome-Meca 2015 environment**. The microstructures of short flax fibres with different fibre length-to-diameter ratios and flax/epoxy fabric are generated by python script for Salome-Meca geometry and mesh module, taking fiber defects (e.g. kink band) and fiber bundles into account.

Finite element simulation are done with ***Code_Aster*** solver **STAT_NON_LINE**. A brittle material law ENDO_FRAGILE for fiber defects and interfacial zones of fiber bundles is proposed. Flax short fibre / polypropylene and flax fabric/epoxy composites are modeled by a non-linear plasticity model VMIS_ISOT_TRAC considering an isotropic hardening law and non-local continuum damage mechanics. This study shows that the simulation can capture the main damage mechanisms of the composites such as fiber breakage initiated at the fiber defects, damage of polymer matrix and the fibre debonding at fibre / matrix interface accurately.



Microstructure failure mechanisms at different stress-strain states in the tensile response of short flax/PP composite. The red color is fiber and fiber bundle damage and the blue color indicates plastic deformation growth



Experimental and simulated tensile stress-strain curves of flax fabric/epoxy composites

FE model of lax epoxy composite

Results are published in:

Janis SLISERIS, Libo YAN, Bohumil KASAL - ***Numerical modelling of flax short fibre reinforced and flax fibre fabric reinforced polymer composites****, Composites Part B: Engineering, Volume 89, 15 March 2016, Pages 143-154.*

janis.sliseris@rtu.lv

Applications submitted by members

Hybrid testing on transmission lattice tower

February 2016 ***Alex LOIGNON, Sébastien LANGLOIS – SHERBROOKE University – MONTREAL- Canada***

The analysis of transmission line steel lattice towers is usually performed with linear numerical methods. However, the actual behaviour of bolted lattice towers is complex and most power utilities perform full-scale tests for the qualification of new steel lattice transmission tower designs. The objective of this research project is to develop a hybrid testing method for the evaluation of the failure mode and capacity of lattice towers.

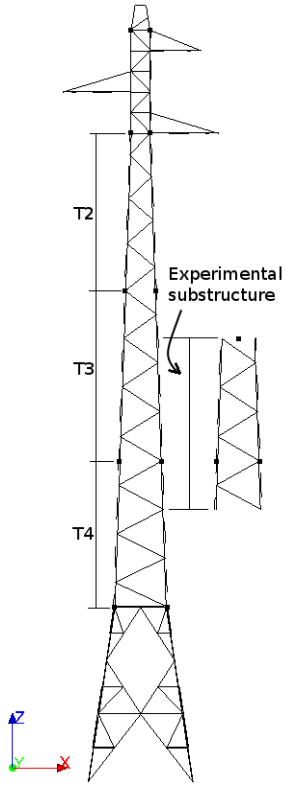


Figure 2: Lattice tower studied : identification of an experimental substructure

To identify the experimental substructure, a beam model was built in ***Code_Aster*** and a linear elastic buckling analysis was performed while including connection eccentricity and rotational stiffness. The results for the elastic buckling analysis is combined with the elasto-plastic buckling curve of transmission line **standard ASCE10-97** to predict failure modes and capacity for the studied tower. The analysis is repeated with an isolated section of the tower, verifying that the model on this section allows to obtain the same failure mode and capacity (figure 1). This procedure identifies the experimental substructure (figure 2) that will be tested at the laboratory (figure 3) in a hybrid simulation.

During the hybrid simulation, ***Code_Aster*** is also used to build matrices and to implement the explicit integration scheme that will solve the equation of motion. Code_Aster needs to be linked to the MTS hydraulic actuator control system at the laboratory via a National Instrument acquisition and control system that manages the hybrid simulation.

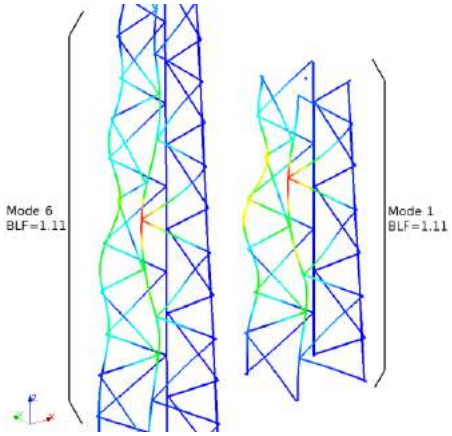


Figure 1: Identification of buckling modes in the complete and the identified substructure

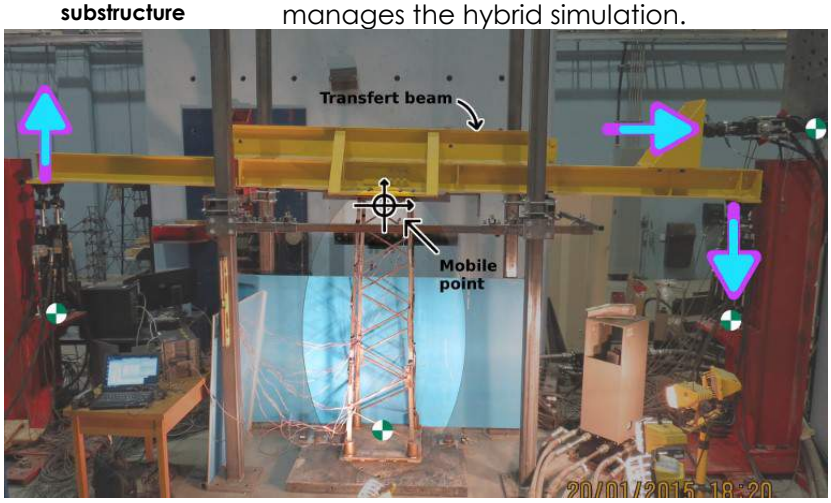


Figure 3: Experimental setup for hybrid tests.

Hybrid simulations were conducted on two sections of a reduced-scale (1:4) version of an existing transmission tower and compared successfully to results from experimental tests on the complete tower.

Applications submitted by members

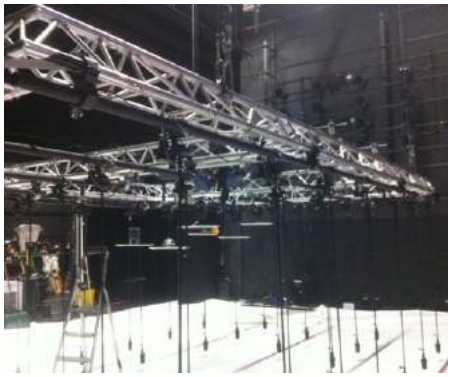
UND - a nonlinear dynamics analysis in theater with *Code_Aster*

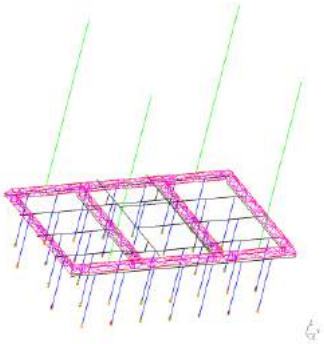
November 2015

Jean-Pierre AUBRY – France

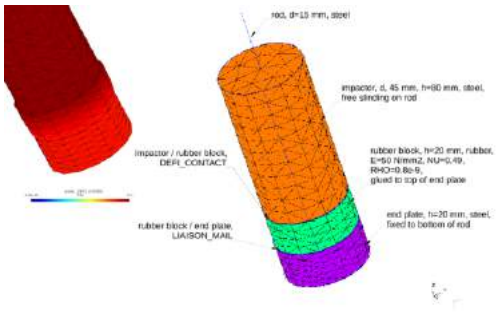
UND is a monologue written by Howard BARKER translated in French by Vanasay KHAMPHOMMALA produced by Jacques VINCEY (Centre Dramatique Regional de Tours) the scenography is by Mathieu LORRY-DUPUY.

UND, starring by Natalie DESSAY, feature a lone character on the stage, above 68 slabs of ice are slowly melting, drops of water hitting the floor, one ice slab falling on the floor from time to time. At the finale all the ice slabs are **impacted by an electromagnetic triggered device** and fall on the floor at the same time.





Model, general view



Model details around impact system

The 34 rods hang from an 8 x 4 meter aluminum frame truss, built from standard parts, which is held from the theater roof by 4 lifting chain, 5.5 meter long.

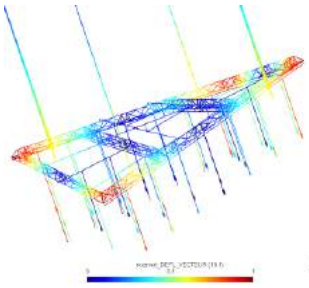
The ice slabs hang at the bottom end of 1.7 meter long rods, an impacting mass, 1 kilogram, held at the top of each rod is released, hits the top the slab, breaking or detaching it, and afterward, hits the bottom end plate of the rod.

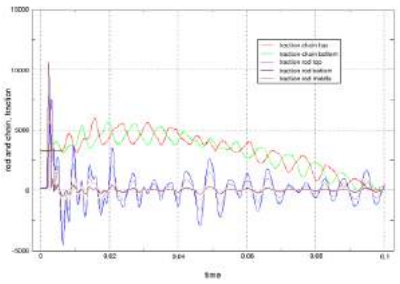
Geometry is made with a **Gmsh** script, it contains 315 groups due to the 34 fall systems with surfaces for contact.

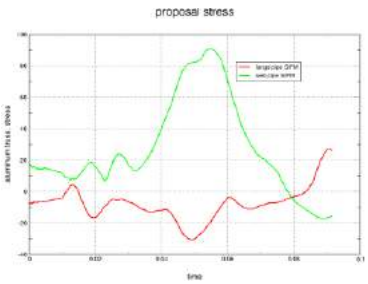
In command files many arguments are built **using Python loops**, with this the command files are kept under 1200 lines (with one keyword per line).

The question is the structural integrity of the whole setup under the rather large shocks loads generated by the impacts and evaluate the dynamic part of stresses.

For **nonlinear analysis** a first **STAT NON LINE** gives the initial state due to gravity loading. Impacting blocks are given a 5.78 m/s initial velocity, corresponding to 1.7 m fall. Five **DYNA NON LINE** with varying Contact conditions, are performed one after the other to gain some CPU time. Ice weight is manually released after the shock.







Many things could be improved in this study (discussion during ProNet meeting). And in the finale: it was a headache but I had a lot of fun at doing it!

67 members in 13 countries

AIRBUS GROUP	ALNEOS	ANDRITZ Hydro	B.Ing Ingénierie-Etudes-Calculs EF	BC BISCARRI CONSULTORIA	BOUYGUES ILE-DE-FRANCE	CAE Linux
France	France	Switzerland	France	Spain	France	Switzerland
Cerema	coperion K-TRON	CRIHAN	CSUC	DeltaCAD	Centre R&D de DINCCS micado	EC2 MODÉLISATION
France	Switzerland	France	Spain	France	France	France
EDF ENERGY	EDF	EGCEM	egis industries	FEMCA	Geo Ressources	Hydro Québec
UK	France	France	France	Czech	France	Canada
Idra simulation	ifp Energies nouvelles	INERIS	IMG	IMSIA		INGÉROP
Spain	France	France	Germany	France	Germany	France
KiSTi www.kisti.re.kr	LA MACHINE COMPAGNIE	LafargeHolcim	LaMCoS UMR 5259	Logilab	MaSC MANCHESTER 1824	necs Numerical Engineering & Consulting Services
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SIMSCALE	STABILIS	Tangent'delta	TECSIMAT Technology Simulation Material	TRACTEBEL ENGIE	Valeo	Verite Inc. Professional CAE company
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Industrial and research centers, services providers and teachers are welcome