PRONET Update - 18

CODE aster

QUARTERLY REPORT OF CODE aster PROFESSIONAL NETWORK

The new salome_MECA 2021 under LGPL license is available for download.

2021 version integrates
SALOME 9.7.0
CODE_aster 15.4

CODE **aster professional network**
user community of
CODE **aster and salome_meca**

Information content:

- **Open source and ProNet**
- CODE **aster as a research platform**
- CODE **aster as an industrial platform**
- CODE **aster as an educational platform**
- CODE **aster for service providers**

YouTube LinkedIn

Jean-Raymond Lévesque
Sylvie Courtier-Arnoux
Representatives of CODE aster ProNet
contact@code-aster-pronet.org

New members
2021 - 2022

SWEDEN

ENGCAL

ENGCAL engineering calculations

UKRAINE

E.O. Paton Welding Inst

Active members in 23 countries in the world

TRAINING

***Normally several training sessions for* CODE aster *and* salome_meca *are proposed each year,* but in the context of the COVID 19 pandemic, some adaptations were necessary: please contact the different teams directly.**

PHIMECA	Alter Ego	Deltacad
www.phimeca.com/Formations	www.aego.ai/training	www.code-aster-services.org

SimulEase	Fondation dell'ordine degli ingegneri della provincia di Milano	aeroengineering services in Indonesia
contact@simulease.com	info@foim.org	www.services.aeroengineering.co.id [2]

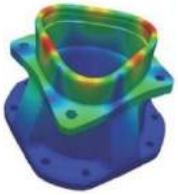
scopeingenieria@gmail.com

A training session was held in China in March 2022. The Civil Engineering session was given by EDF China and his partner YuanSuan in Hangzhou.

Technical Courses
Cursos Técnicos

Modelling, Meshing and Postprocessing with Salome-Meca Course

www.technicalcourses.net



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Engineering simulations with open source codes

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Dr. Franco Concli
Free University of Bozen-Bolzano

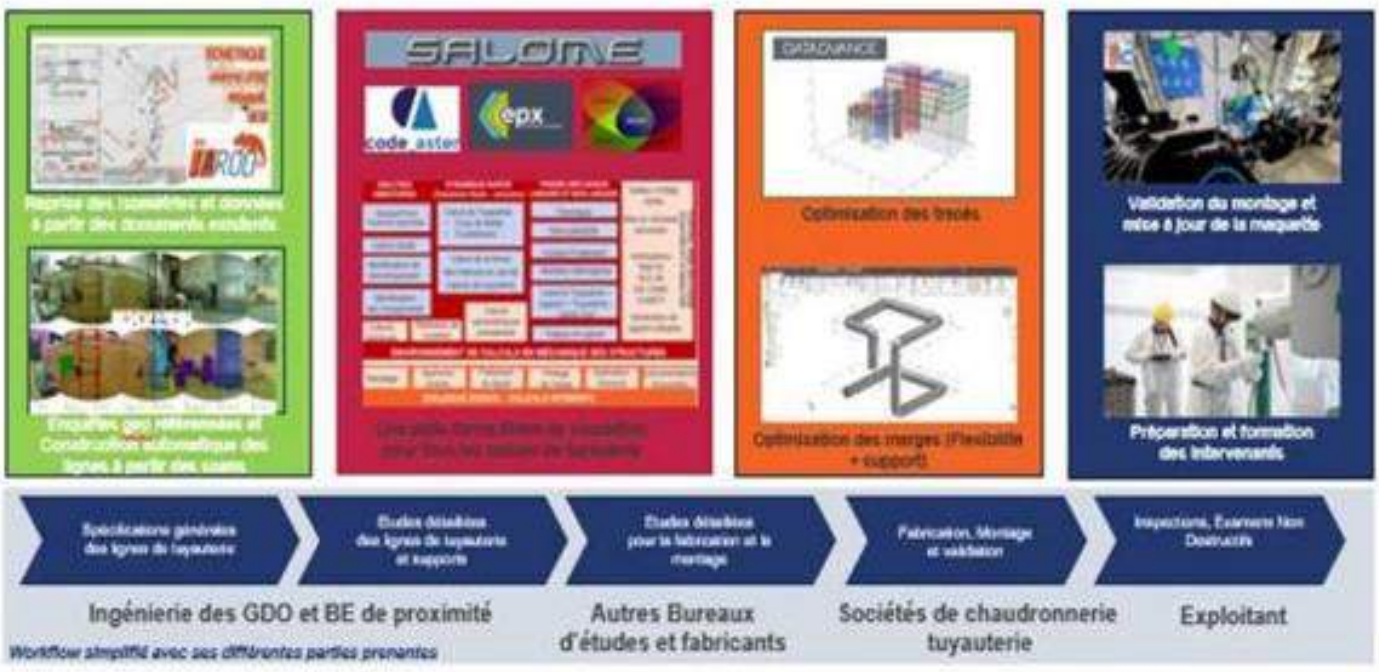
MECANUM a structuring project for the French nuclear industry

alii

EDF, CEA, ORANO FRAMATOME; NAVAL Group – France

All the major clients in the nuclear sector, namely EDF, Framatome, CEA, ORANO and Naval Group, and the Nuclear Valley competitiveness cluster met on January 13,2022 for the launch seminar for the France Relance MECANUM project, a structuring project for the French nuclear industry.

MECANUM aims to design a sovereign digital platform to ensure the success of major mechanical nuclear projects, whether for installations in service or new projects. This platform is based on the development of many innovative technological bricks supporting the performance of the study workflow to be carried out on the **piping lines**



To do this, the MECANUM project has defined 3 major projects:

1. Have quality digital data and maximize its use,
2. Create a complete sovereign, agile and interoperable calculation software chain,
3. Increase test-calculation interaction throughout the installation cycle to enrich and disseminate knowledge on the behavior of structures

The numerous exchanges carried out throughout the seminar were able to confirm:

The convergence of the interests of major donors in the nuclear sector and the high expectations for numerous industrial operations: nuclear fleet in operation at EDF, CEA and ORANO, Naval Group structures in service, Numerous future projects for the design of power plants, -nuclear and aircraft carrier sailors, recycling plants and cycle facilities.

The important base of expertise and know-how of the consortium but also its

- great diversity: the wide spectrum covered in mechanics of structures and materials (calculations of flexibility and support, rapid dynamics, earthquake resistance, fatigue and rupture, ...),
- to the use, acquisition, and processing of large volumes of data to Artificial Intelligence techniques adapted to the rapid digitization of installations
- the optimization of calculations and line layouts.

The common desire to share industrial practices and feedback with the participation of more than 90 people from all walks of life: operators, design engineers and R&D experts.

The wealth of innovations and the complementarity of the software bricks on which the consortium is built: the **Salome_Meca** environment, the **code aster** and **Europlexus** solvers, a first demonstrator of a flexibility calculation tool called Piping Master, the capitalization of material behavior laws through **MFront** and the **CADEEX** (Capitalization of data from the Experience) approach, the many bricks of Artificial Intelligence for data acquisition, automated processing of photos and laser scans, not to mention the optimization of line layouts.

Crowdfunding call for Salome-Meca 2021 and Code_Aster 15.4 on Windows

Contact SIMLEASE – France

Salome-Meca for Windows implementation started on March 2017 with a port of Code_Aster solver first and an integration to the Salome platform then. With dedicated interface AsterStudy, Salome-Meca for Windows has born by the end of 2017 !

Since then, we take care of the maintenance: updates, bug fixes, porting modules, so that the community can always access to the last available version. But due to lack of funds, there was no porting in 2020, although the project was a success with its 10,000 downloads per year.

https://code-aster-windows.com/2021/10/26/crowdfunding-call-for-salome-meca-2021-and-code_aster-15-4-on-windows/

Numerical modeling strategy of cracked reinforced concrete in the context of dimensioning or verification of large civil engineering works

Thesis defense on January 31, 2022 at the LMDC by Daniela VO

Digital services for more sustainable construction

Arnaud Delaplace, Régis Bouchard, Paul O'Hanlon

Holcim Innovation Center – France

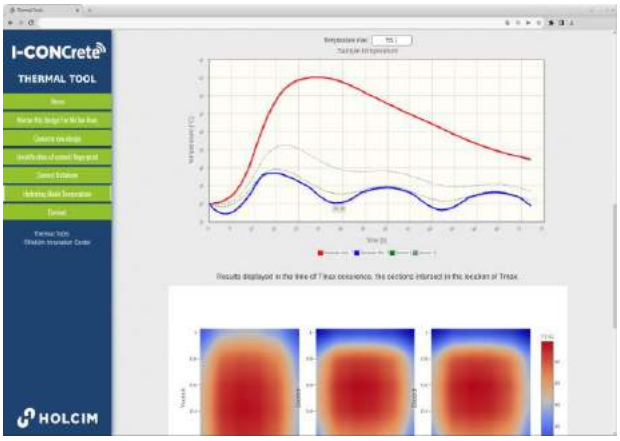
As in many other industries, the construction industry works effortlessly to reduce its carbon footprint, with the end goal to become net zero. Among the numerous solutions that are considered, let's focus on two of them:

- **usage of secondary cementitious materials as a partial substitution of portland cement**: Today this is one of the main levers used to reduce the carbon footprint of concrete. The consequence is that the hydration kinetic of the binder may be delayed, leading to a slower increase of concrete strength. It's important to control and predict this strength development, in order to adapt for example the time of formwork removal.
- **improve the efficiency of the concrete placing**: in many cases, and especially in massive structures, the maximum temperature of concrete reached at early age must be limited to avoid any durability issue. In some projects, unnecessary technical solutions are used (for example using liquid nitrogen or ice to cool down the concrete), even if the maximum temperature reached in the concrete is far from the upper threshold. It leads to excessive energy consumption, and less sustainable construction. It's therefore important to better predict the temperature in concrete at an early age, in order to use only the relevant placement and curing protocols.

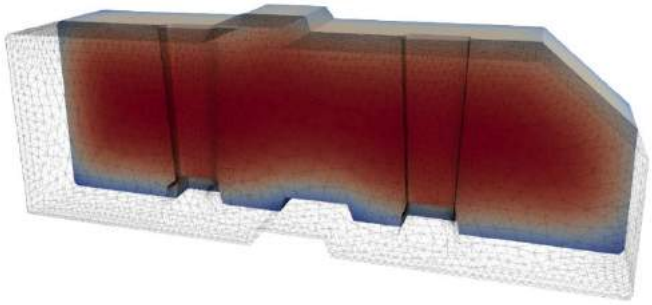
It's quite straightforward to address these two topics: solving the heat equation, using the heat release by the binder as the source term, gives at any time and any points of the structure the hydration degree and the temperature. Then, one can predict for different weather conditions, different types of formworks, different initial temperatures of concrete, the evolution of temperature and strength in realistic conditions.

We have developed a complete package, based on Code_Aster, to solve this physical equation. It's part of the Holcim I-CONCrete brand, covering different digital services. After a characterization of the thermal fingerprint of the binder, the user can connect to a front end (web page), and enter the parameters of the study.

The heat equation is solved in the backend (Code_Aster is hosted on an AWS EC2 server) and the result is displayed on the web page. The coupling between Code_Aster command files and Python allows an easy scripting of the process in the backend, and the user can focus only on the result analysis. Using this service, a better control of the construction process is expected, leading to a significant reduction of its environmental footprint.



user interface of the I-CONCrete thermal web service



example of a temperature map during the hydration of a massive block used in a marine defense project

Stockbridge dampers for extending the fatigue life of a cable at St Nazaire cable stayed bridge

Jacques BERTHELLEMY, Dominique SIEGERT, Édouard BERTON, Pierre QUENTIN

CEREMA– France

Figure 1: Aerial photograph of the entire structure.

The problems of a bridge cable vibrating in the wind are presented in detail. The cause of the ruptures is discussed/investigated in-depth, fatigue cause is proven, and authors provide some monitoring data of this cable during the last years, to show the dominant vibration frequencies to justify the subsequent studies on the dampers which are designed to control high frequency vibrations.

Fatigue cracks led to a replacement alike to the initial in 2000 of cable stay H32, then no solution was found at that time fulfilling every strengthening requirement.

As wires ruptures occurred again in 2017 due to cable flexion at the point where the cable comes ot of the adjustable threaded cylindrical socket. The identification of the most appropriate solution to preserve the structural integrity of the H32 cable is performed using the Cerema's PCP software**.**

Figure 2A - Damage that occurred in 1998
Section of a wire cut by a fatigue crack

The three-dimensional model uses beam elements, considering the catenary effect and the cable bending inertia. Aim is to assess the effects of high frequency vibrations induced by vortex shedding or turbulent wind on the global behavior of the cable.

Modal properties of the cable are evaluated: eigen-frequencies, mode shapes, modal masses and damping. The dynamic analyses show that wind loads which frequency range from 10 Hz to 30 Hz induce the maximal stresses at cable ends.

To reduce these bending stresses, the use of Stockbridge dampers is investigated to increase the damping in the frequency range of the excitation. The design parameters of a Stockbridge damper implemented on the cable, geometry, mass and stiffness distributions, are derived from a simplified model.

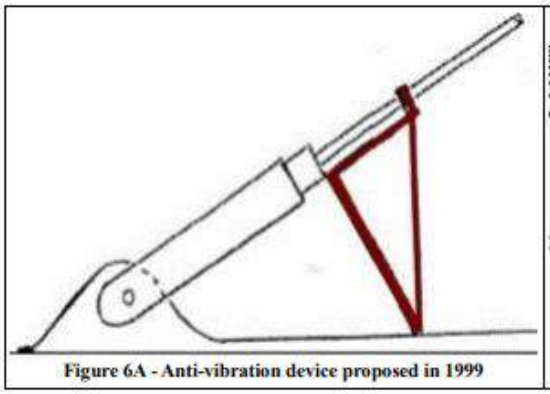


Figure 6A - Anti-vibration device proposed in 1999

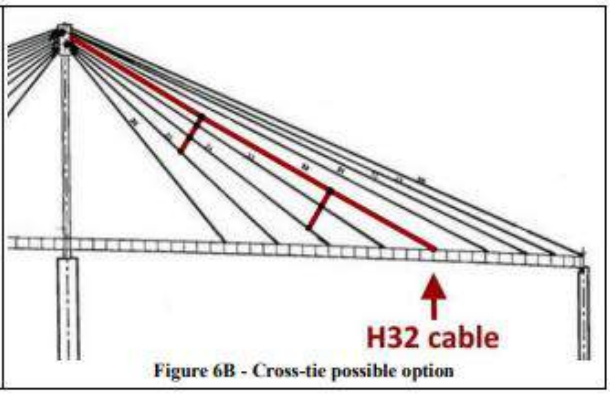
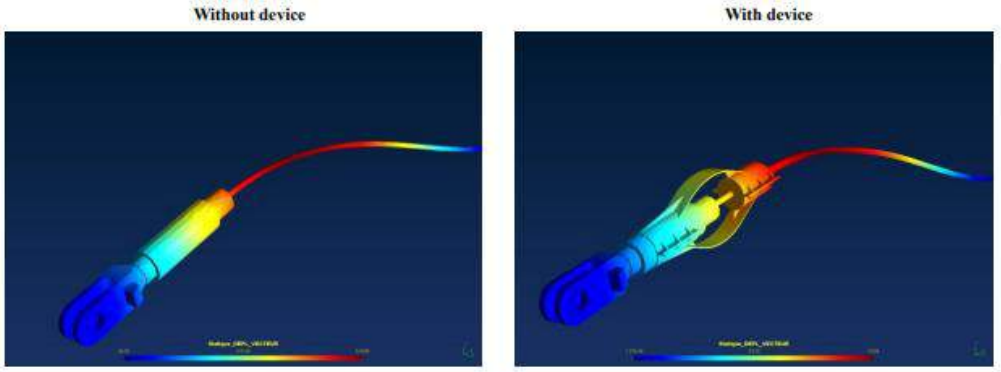


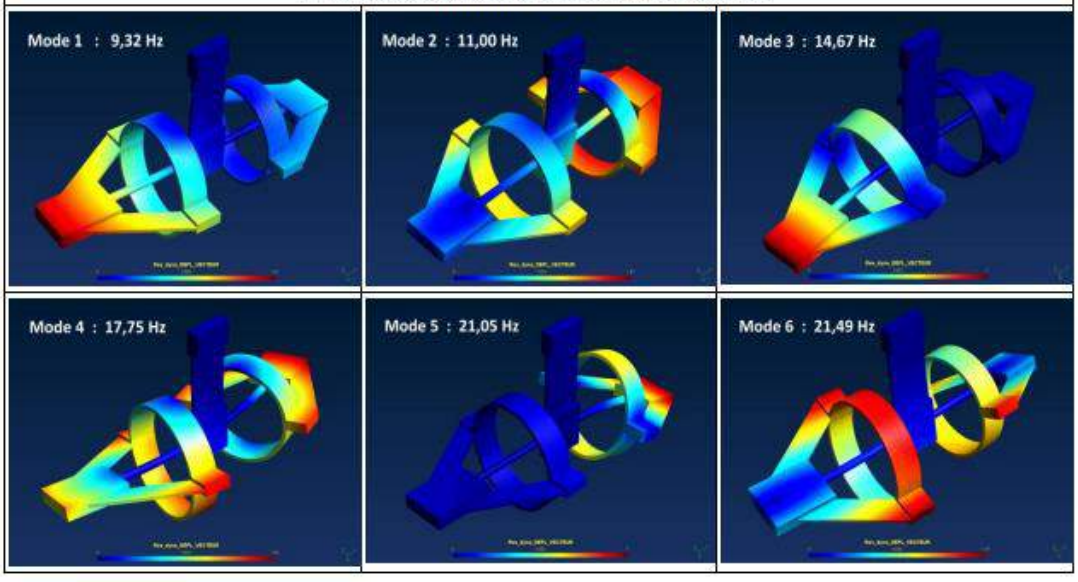
Figure 6B - Cross-tie possible option



Modal properties of the cable are evaluated, i.e., eigenfrequencies, mode shapes, modal masses, and damping. The dynamic analyses show that wind loads which frequency range from 10 Hz to 35 Hz induce maximum normal stresses at the cable ends.

In addition, numerical simulations with a more detailed finite element model carried out with Code_Aster software were carried out to get more precisely the relevant resonant frequencies of the damper. Additional protection device is studied to optionally complete the control system and avoid cable flexion near the socket at the cable ends

Table 4
Modes 1 to 6 of the martyr cable Stockbridge prototype
Frequency map obtained by the Code_Aster model:



Software development for calculation of pipeline with erosion/corrosion defect, using Code_Aster

Nick ANANCHENKO, Oleh MAKHNENKO

E. O. Paton Electric Welding Institute – Mathematical Modeling Department –Ukraine

E. O. Paton Electric Welding Institute is research institution, doing research on welding processes.

Established in 1934 Institute is experienced in research of welding process and developing of new welding technologies, such as: welding in space, underwater welding; welding application in civil industry: welded Paton Bridge; development of welding machinery for manufacturing industry. Department of Mathematical Modeling is scientific unit of institute founded in 1972.

It specializes in research of welding process and stress state of welded constructions, using numerical methods.

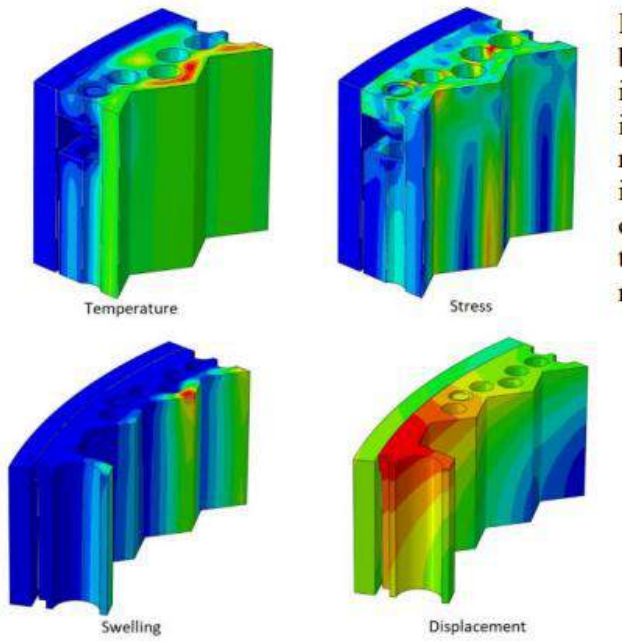
Department developed technology of structural repairs of nuclear power plant components with welding, defining resource of welded nuclear power plants components, and developed welding software.

Nowadays department doing research of defects in a pipeline, developing pipeline repair technology with welding, doing research on nuclear reactor swelling and irradiation.

We discovered advantages of free software Code_Aster at 2020, and planning to use it on our further projects.

We developed software, using available Code_Aster source code, for solving most resent industry problems.

See example of Pipe Module to define limit state plastic stresses in a pipeline, subjected to erosion/corrosion wear.



Developed module (using Code_Aster source code) for defining limit state stresses in pipe with erosion/corrosion defect.

Residual strength of pipelines can be defined from these stresses.

Irradiation swelling of reactor's baffle. Using models of irradiation swelling and irradiation creep; cumulative radiation dose, temperature, irradiation creep and stress state of baffle obtained.

Based on these results, service life of reactor can be defined

Services and Declaration of Interest

Mickael HELIN

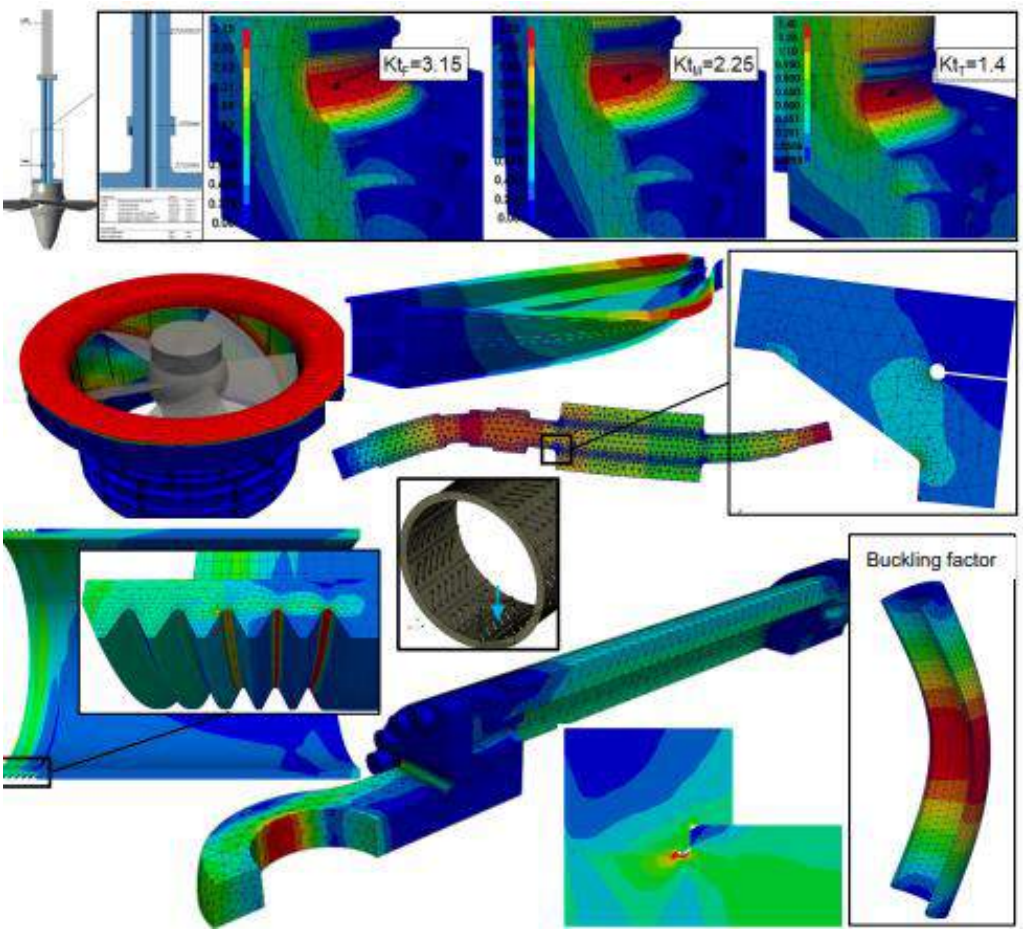
ENGCAL Engineering calculation –Sweden

ENGCAL is a technical consultant with broad experience from mechanical design calculations in the fields of, Automotive, Pulp and Paper, Hydro Turbines, Hydro Generators and more.

The company support clients with static, dynamic and thermos-mechanical calculations to improve and verify their products or to investigate and understand failures. Assessments in terms of static strength, fatigue strength, fracture mechanics, stability or vibrations are carried out according to applicable guidelines or codes as for example FKM Guideline, EN13445, 13155, 1993/EC, IIW, ASME pressure vessel code, VDI2230, NGTR etc.

Experience with commercial programs such as Abaqus, Ansys, MSC/NASTRAN, Ideas, Femlab, Altair Hypermesh, Hyperstudy, exist but since 2008 Code_Aster is the primary solver for mechanical simulations.

Code_Aster and Salome platform have a wide-ranging functionally and cover the whole process from CAD geometry and mechanical simulations to the postprocessing of results. With python scripting user specific calculations can be achieved and efficiently automated.

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