

Seismic characterization of equipment

Seismic behavior qualification method



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Many components and systems must be validated, with even increased reliability, in order to meet post-Fukushima stability requirements for equipment in the energy sector, operating in potential seismic conditions.

The qualification method combines simulation with seismic testing and involves analyzing the dynamic behavior of equipment or a structure in case of an earthquake by carrying out tests on a bi-axial seismic table. This approach is particularly suitable for nuclear powerplants, oil & gas sites, railway and aeronautic sectors.

Scope

► An earthquake is characterized by multi-axial low-frequency loads, with a relatively short duration (a few dozen seconds). The excitation amplitude depends on the geographic location and position of the equipment (directly connected to the ground or fitted to another equipment). The severity level depends on the seismic class and the acceptance criteria in terms of acceptable malfunctions. Many components and systems must now be validated, with even increased reliability, in seismic conditions to meet post-Fukushima stability requirements for equipment in the energy sector.

How it works

► Equipment and structures are qualified based on experimental or numerical methods or even a combination of both. Tests are carried out on a bi-axial seismic table according to load specifications (coming from standards, customer reference documents, etc.). This test bench is the result of cooperation between Cetim and FCBA and comprises a bi-axial seismic table powered by two electrohydraulic actuators (100 kN along vertical axis and 70 kN along horizontal axis). The equipment to be tested is fixed on the seismic table using specific tooling designed for the test. Suitable instrumentation (acceleration, displacement, stresses, etc.) can be used in order to improve the interpretation of the dynamic behavior of the equipment and to provide input data for simulation process.

The following methods are used for qualification based on simulation:

- applying construction codes formulas,
- equivalent static analysis,
- spectral analysis,
- non-linear time dynamic analysis.

The method to be applied is selected depending on the equipment and also the reference used.

Simulation results are enhanced by updating simulation based on experimental data. The design of the equipment is then optimized using iterative simulations if necessary.

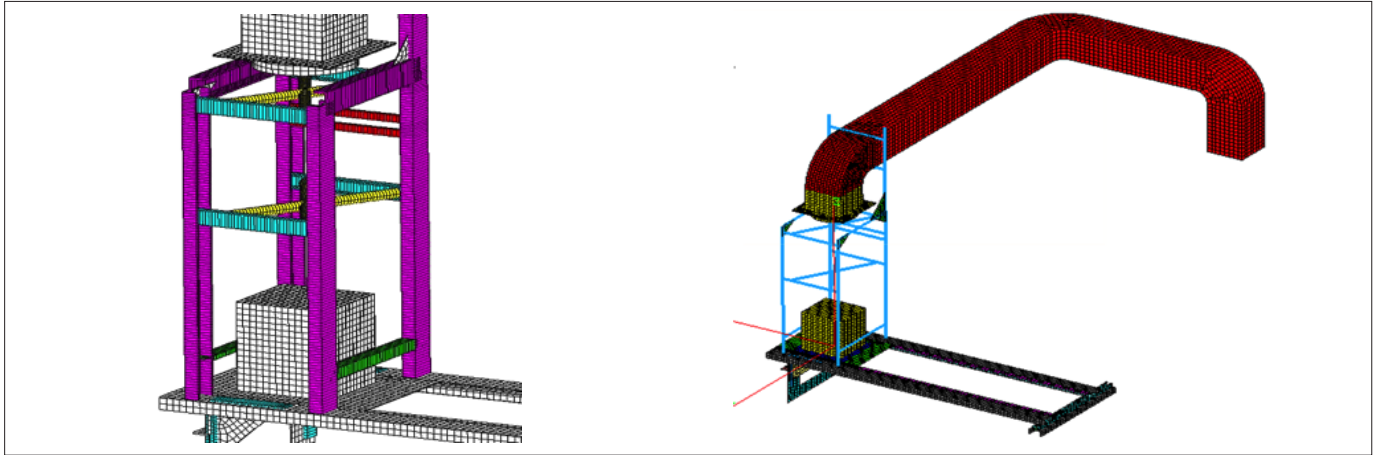
The tests and calculations carried out can therefore be used to design and qualify equipment or a structure for seismic conditions, improving the reliability and more generally improving future facilities.

Technology

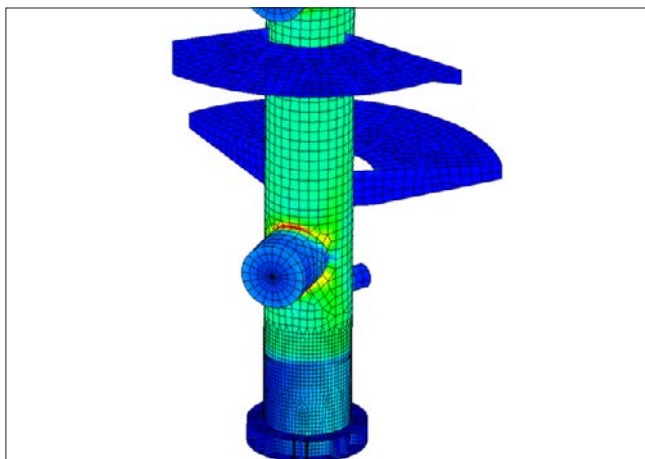
► Tests are carried out on a bi-axial seismic table with the following characteristics:

- frequency range up to 100 Hz,
- X/Z acceleration up to 5 g,
- tested equipment weight up to 2 t,
- table dimensions: 2 x 2 m,
- multi-physic instrumentation.

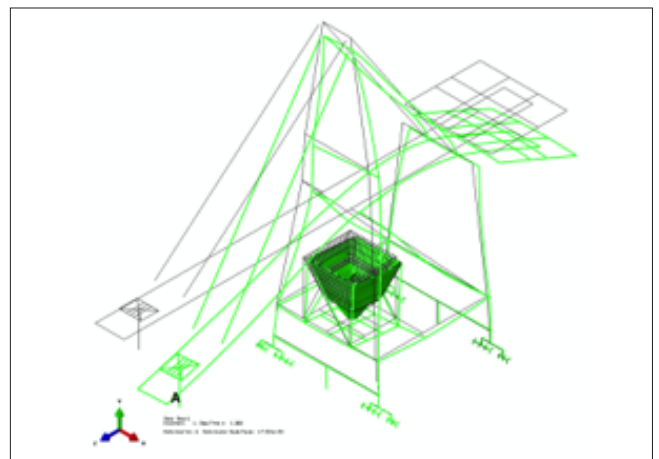
A few examples of applications with illustrations



Seismic qualification of a heating system



Earthquake design simulation for industrial structures, industrial equipment and pressurized equipment



Simulation example (crane)

- Seismic simulation and test bench
- A multi-disciplinary team with a technical referent in charge of the project
- A combined simulation/test-based approach
- A well-known seismic expertise

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Question & Answer Service

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