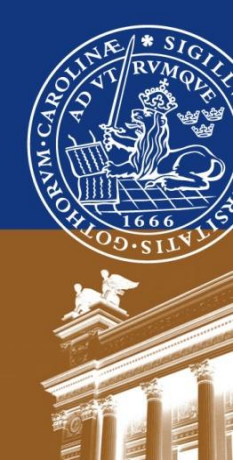


Strukturdynamiska beräkningar, 7.5hp
Structural Dynamic Computing

Per-Erik Austrell

Introductory lecture

Disposition:

- What do we want with the course?
- Some applications
- Course outline and tasks

What do we want with the course?

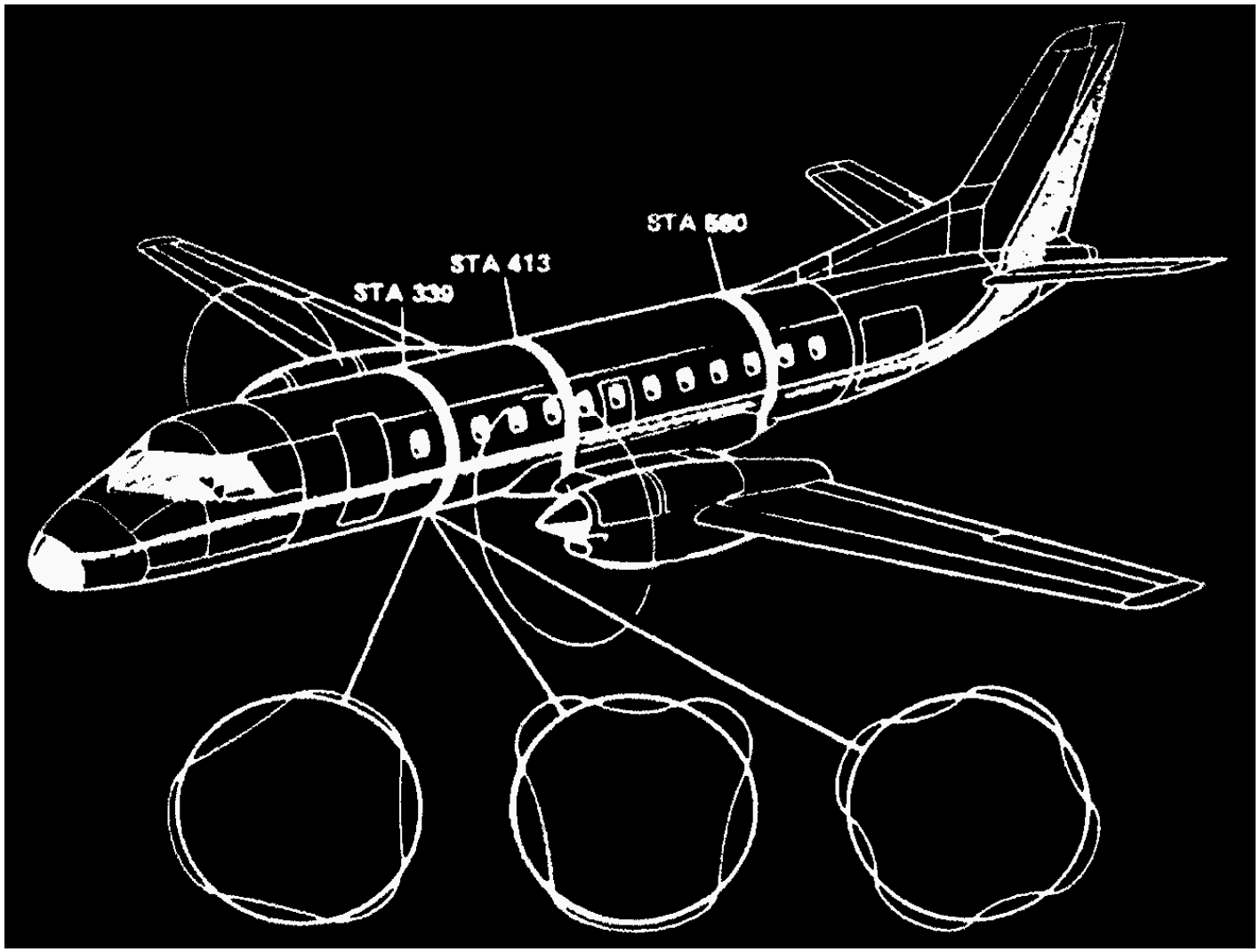
- **Structural dynamics**: theory, mechanics
- **Computations**: numerical methods, software, computers etc
- **Applications**: measurements on real structures, modelling, and simulations
- **Presentation**: writing reports and also orally (project 2)

Some applications

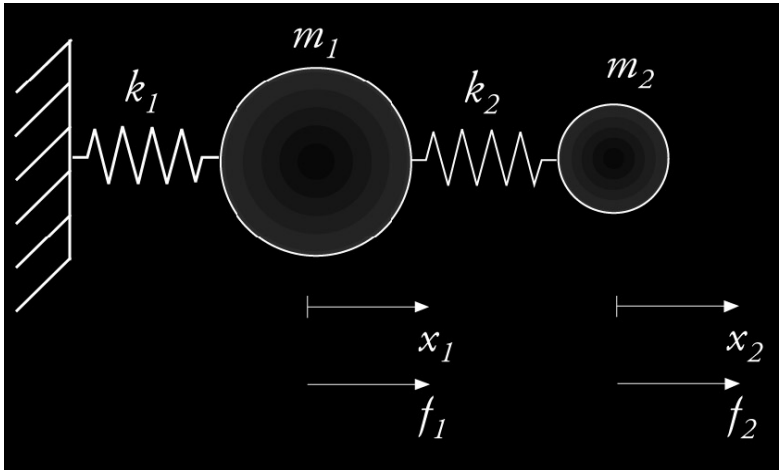
- Sound and vibration damping in an aircraft
- Max IV research facility
- Light weight building vibrations
- Selected PhD works
- Earth-quake engineering

Vibro-acoustics in an aircraft

Vibro-acoustics in an aircraft cont.



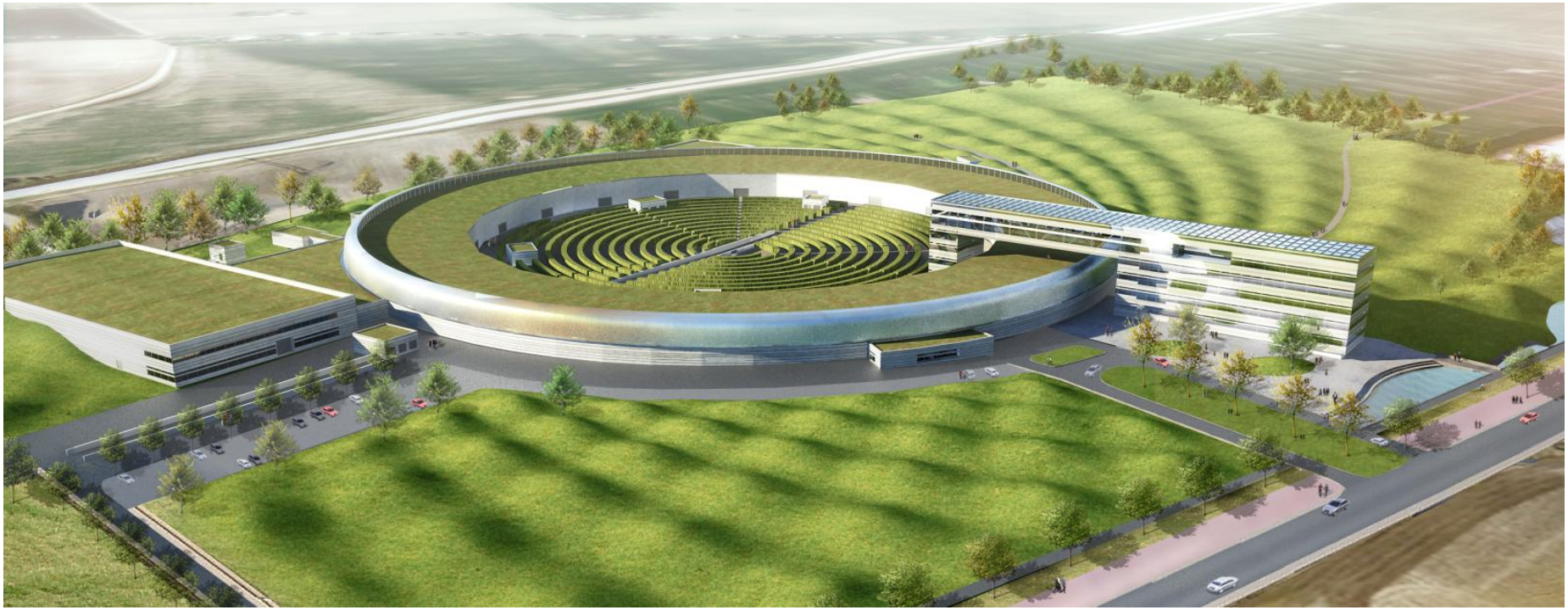
Vibro-acoustics in an aircraft cont.



$$\begin{pmatrix} m_1 & 0 \\ 0 & m_2 \end{pmatrix} \begin{pmatrix} \ddot{x}_1 \\ \ddot{x}_2 \end{pmatrix} + \begin{pmatrix} k_1 + k_2 & -k_2 \\ -k_2 & k_2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} f_1 \\ f_2 \end{pmatrix}$$

MAX IV facility

Synchrotron light research with linear electron injector and storage ring



FE model of the ring

Soil (coarse mesh)
three layers,

D=300 m t=6 m

Concrete (fine mesh)

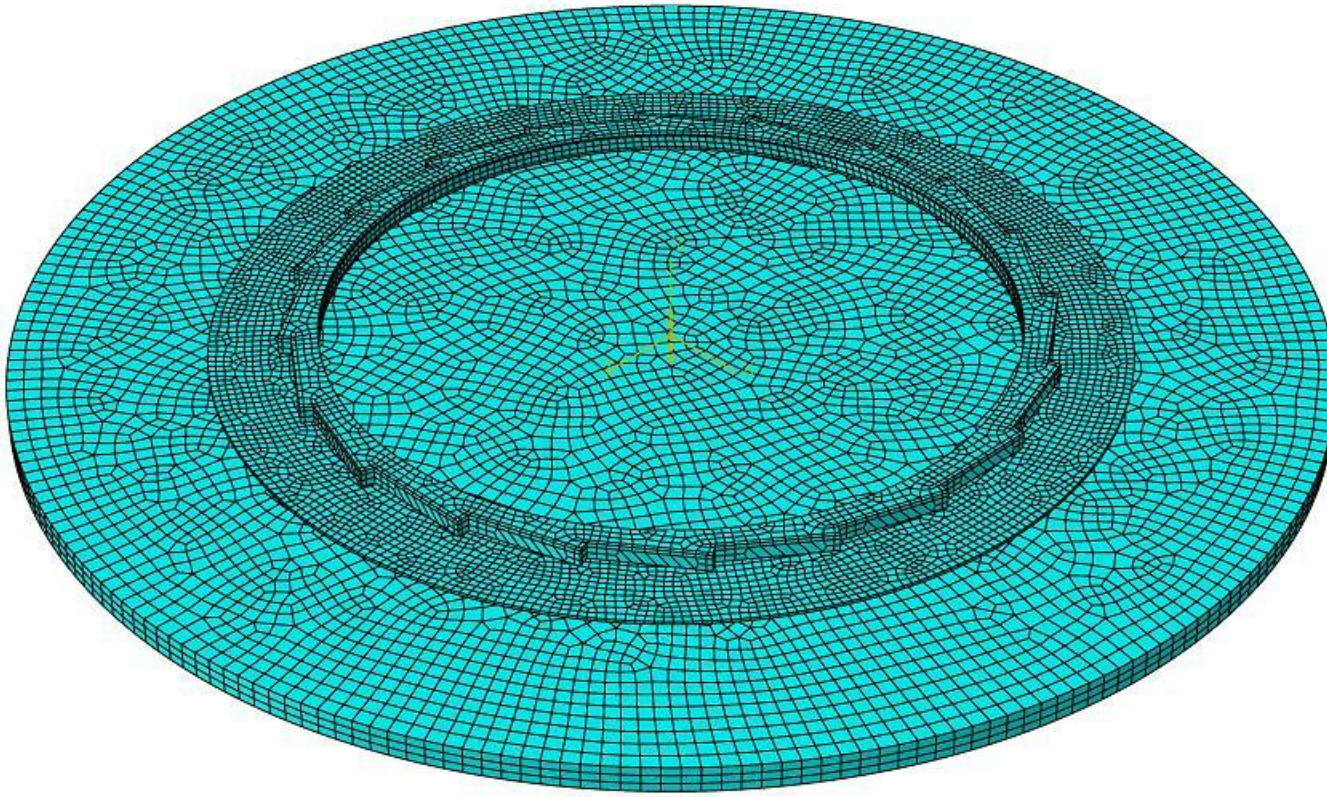
D=210 m d=170 m

Requirements for vertical displacements in the ring:

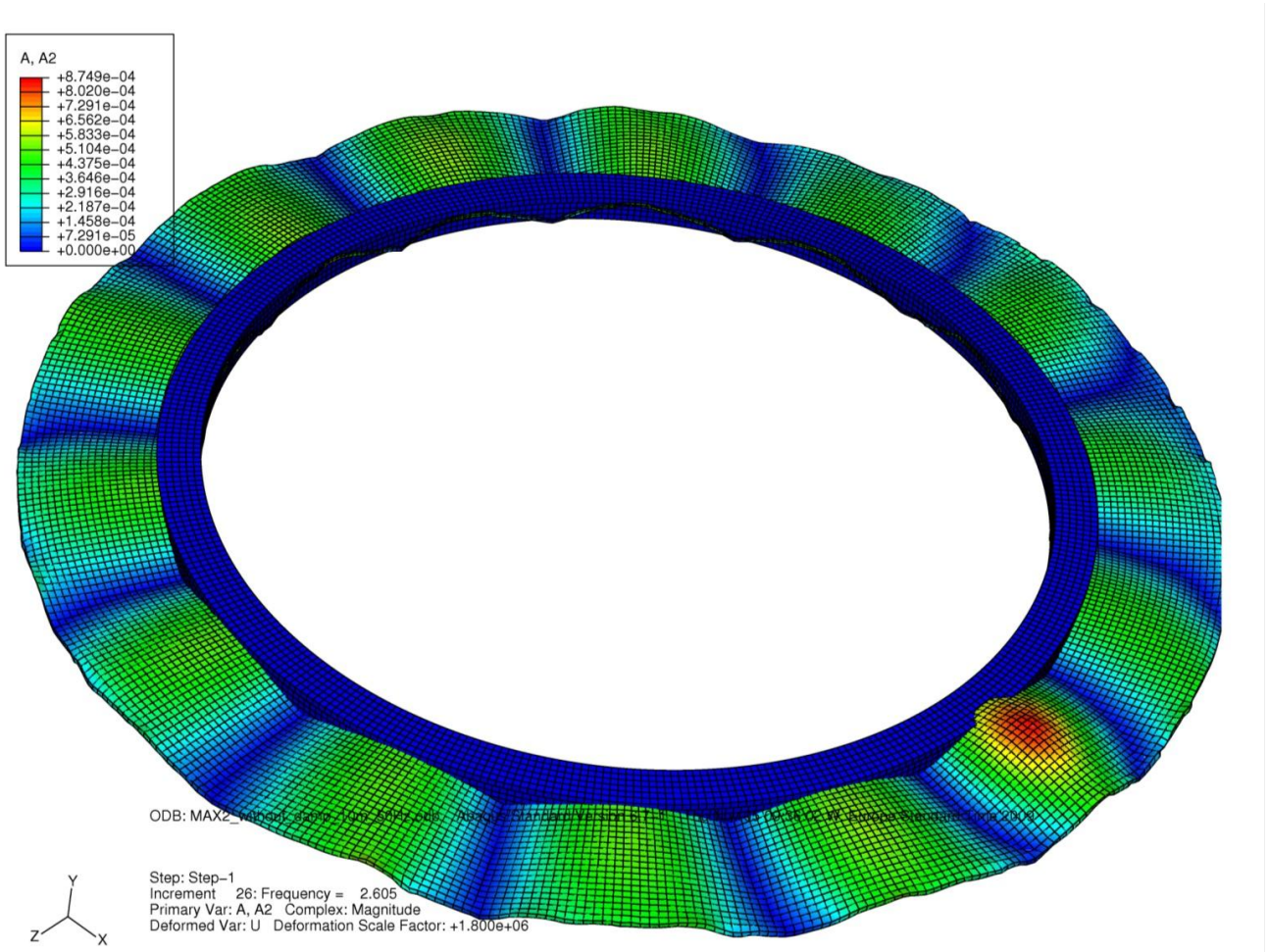
26 nm

How much is 26 nm?

The thickness of a hair divided by 3500 !



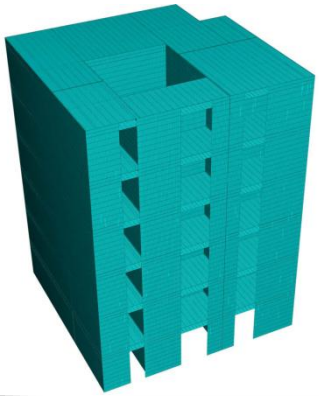
MAX IV steady state dynamics

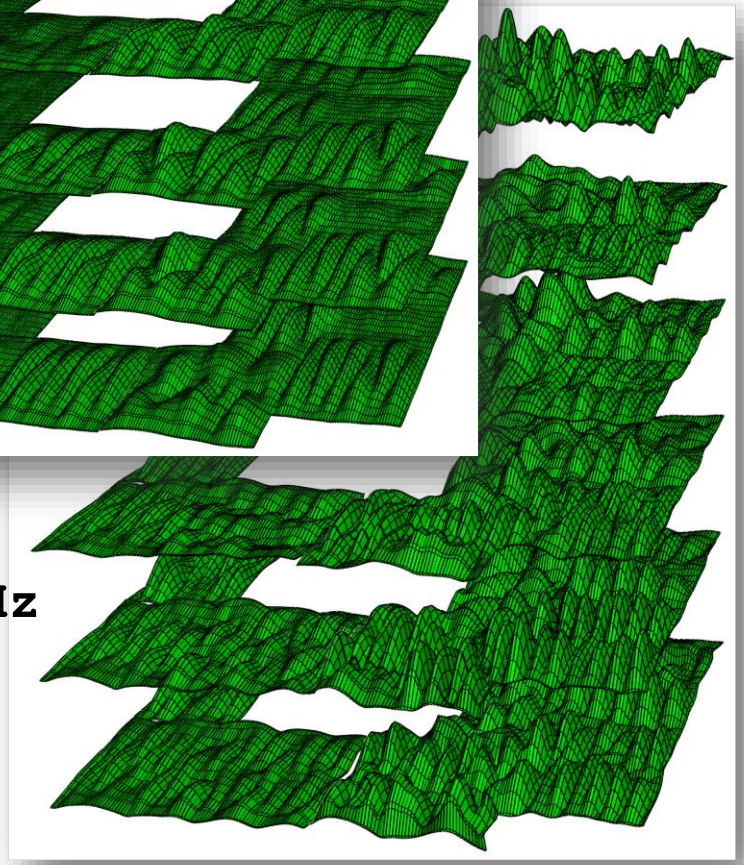


The guest lecture by Peter Persson will give more info about the Max IV design calculations

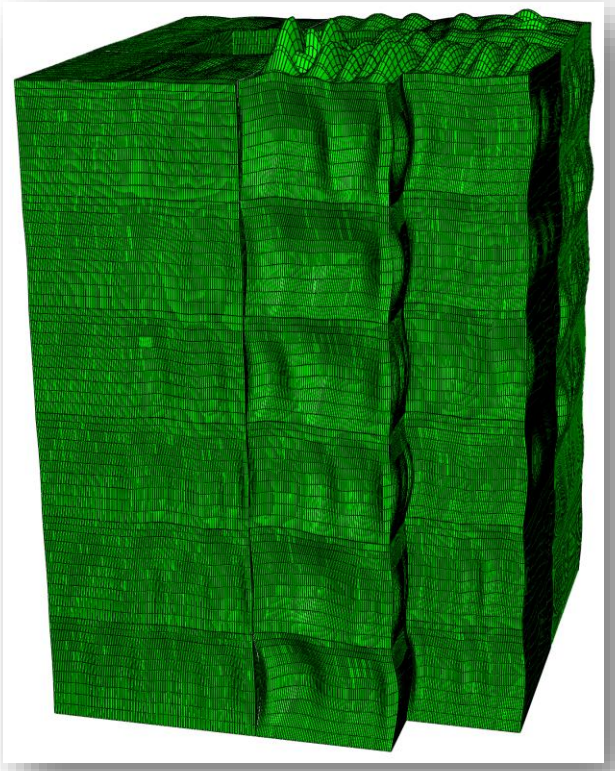
Vibrations in wooden buildings

96 Hz



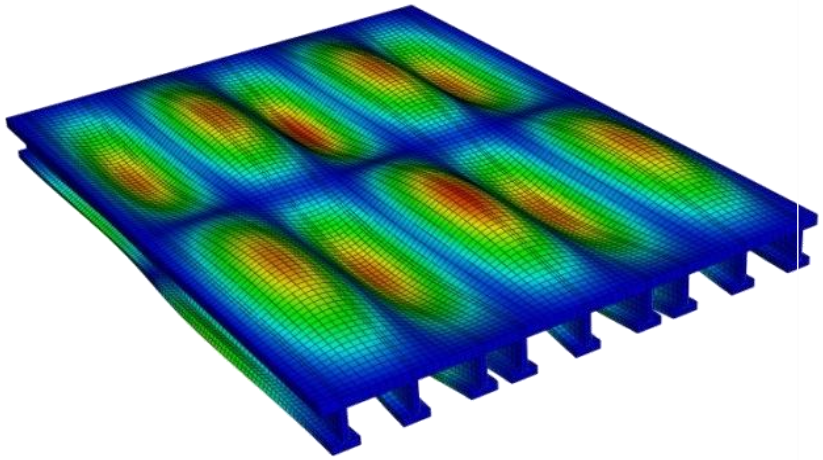


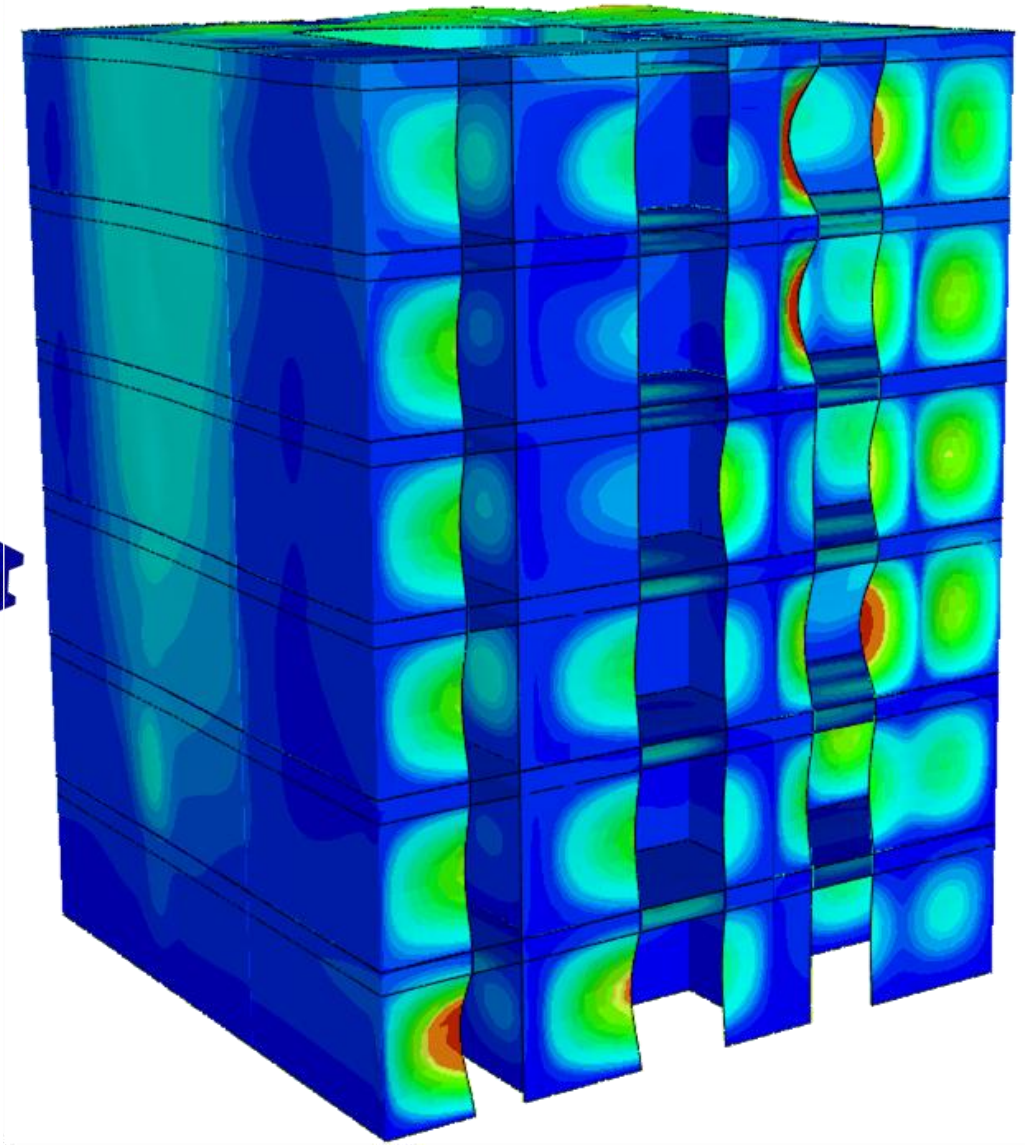
178 Hz



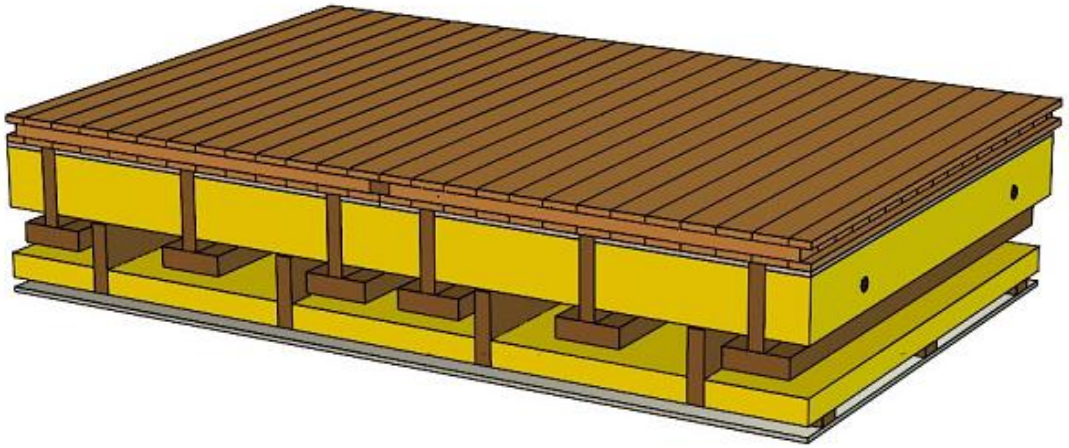
96 Hz

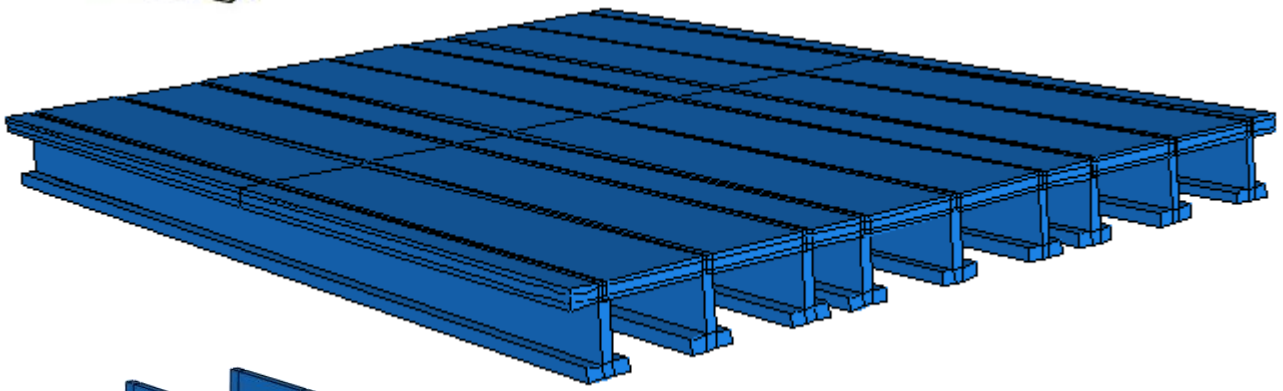
Vibrations in a seven-storey building

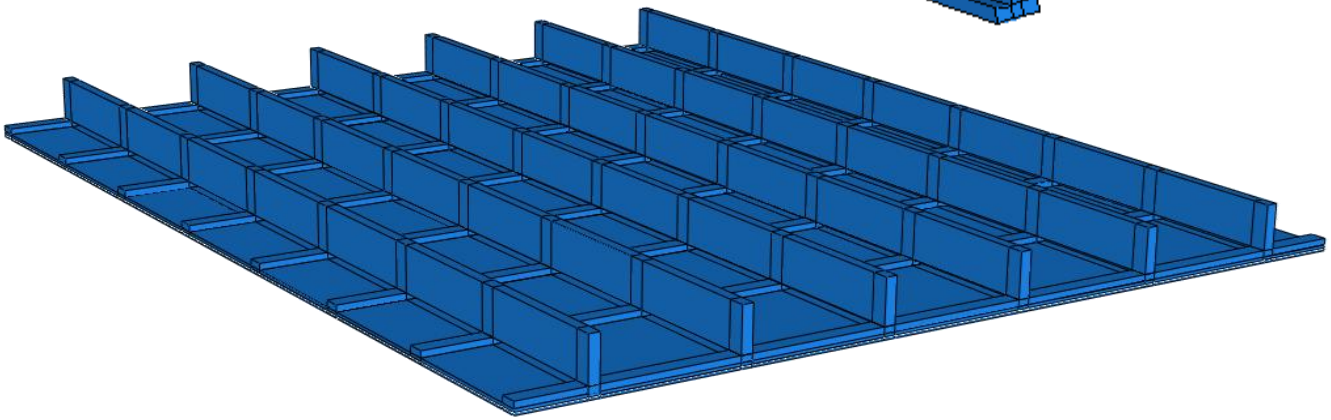




Wooden floor/roof

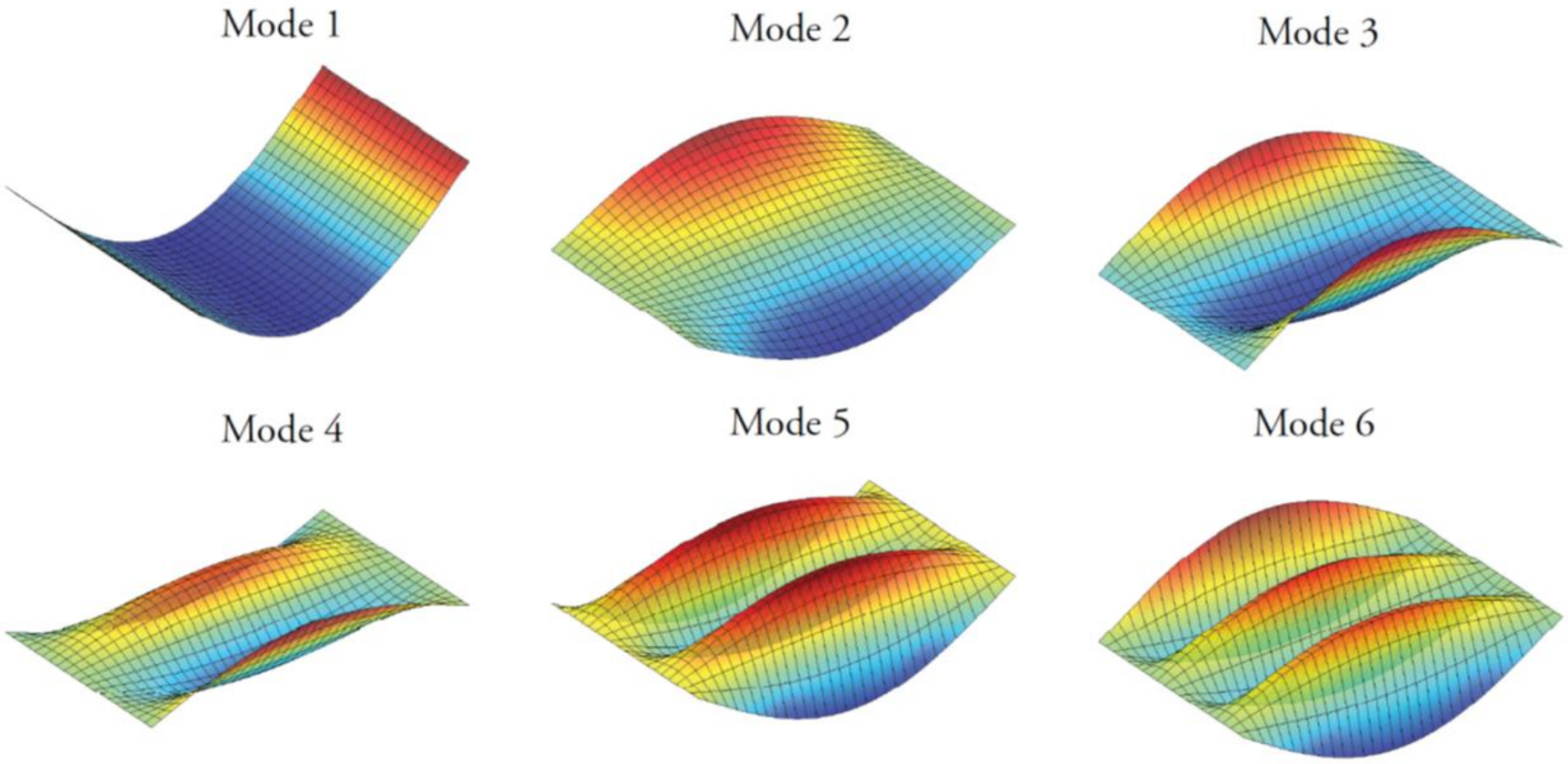


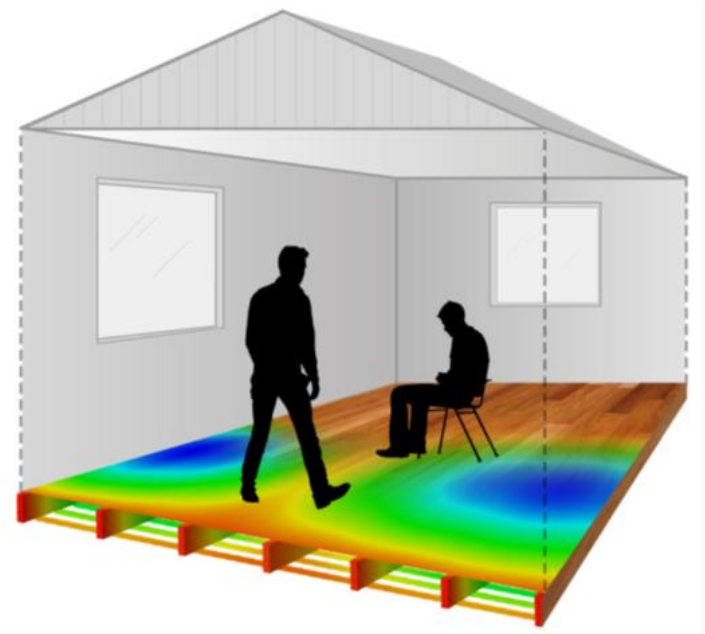




Wooden floor/roof cont.

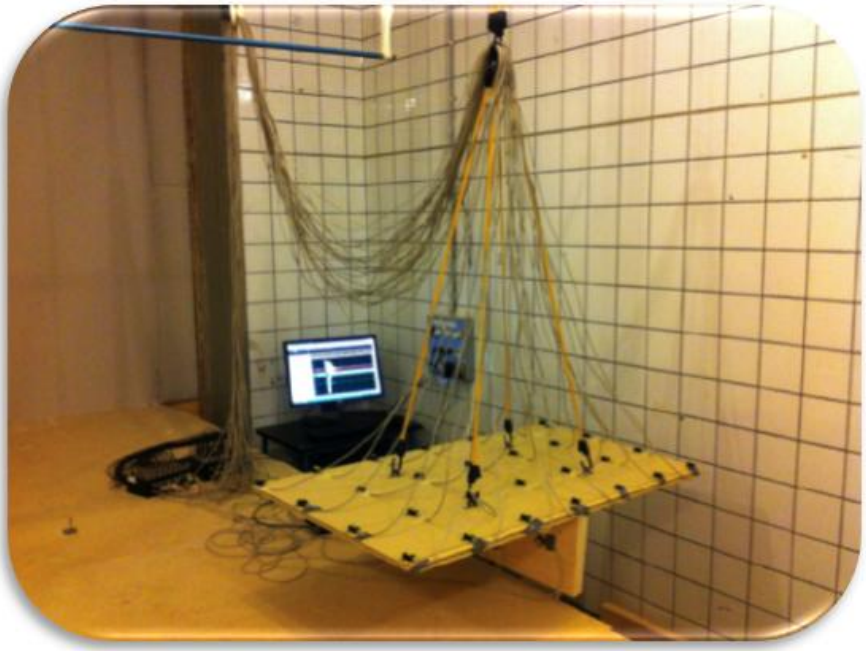
At particular frequencies (resonance) the basic modes of vibration can be seen:

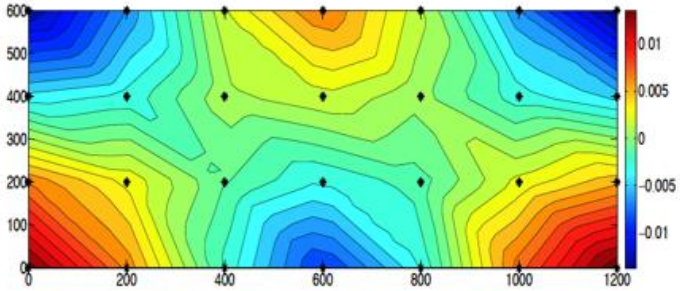




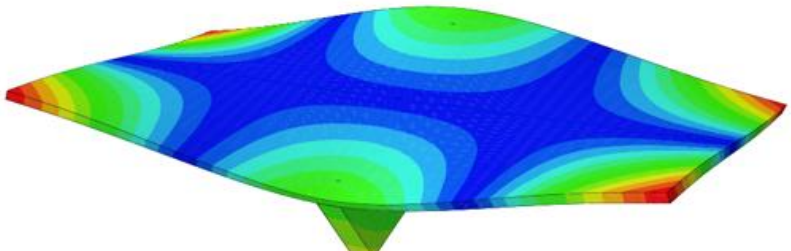
Juan Negreira PhD work

Measurements and simulations of sound and vibration transmission in light weight buildings



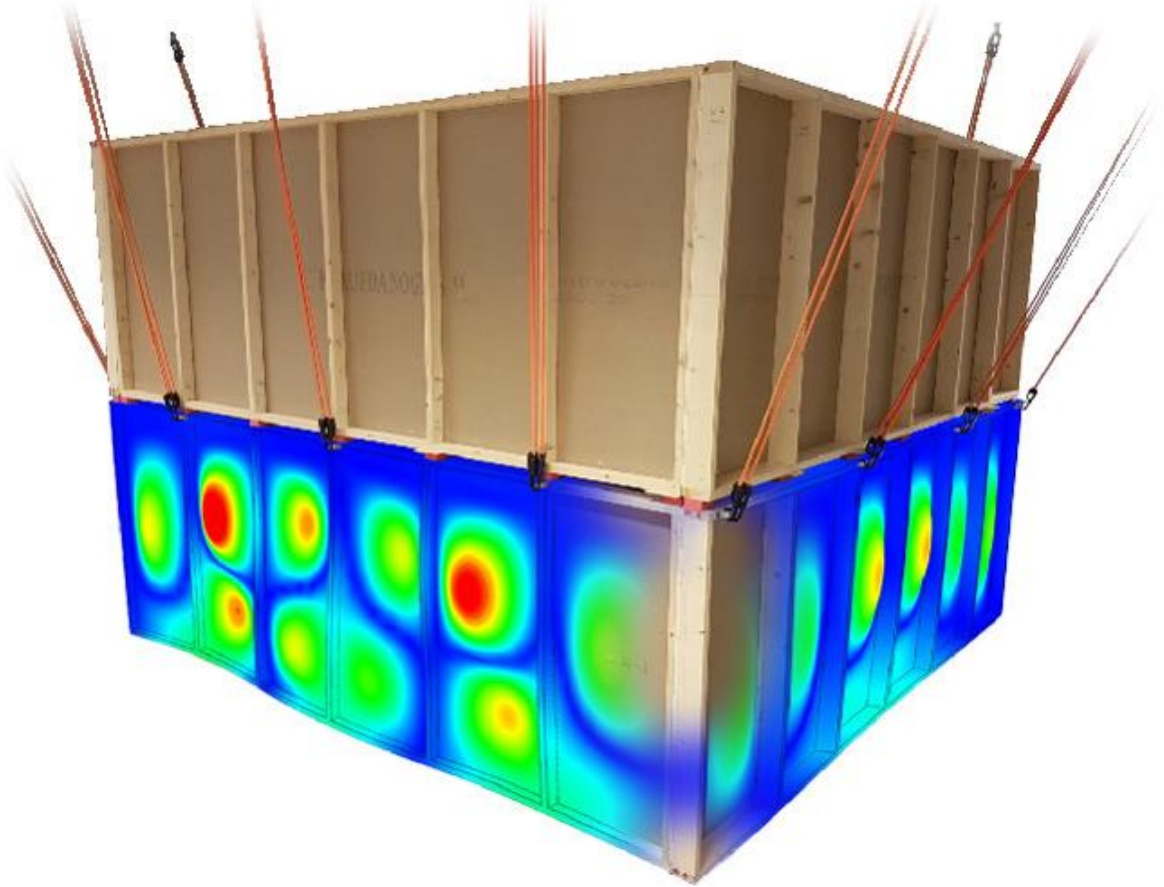


T-junction



Ola Flodén PhD work

Measurements and modelling on a scale model of a wooden house module:



Ola is now at Volvo Cars and will be giving a guest lecture in the course

Vedad Alic PhD work

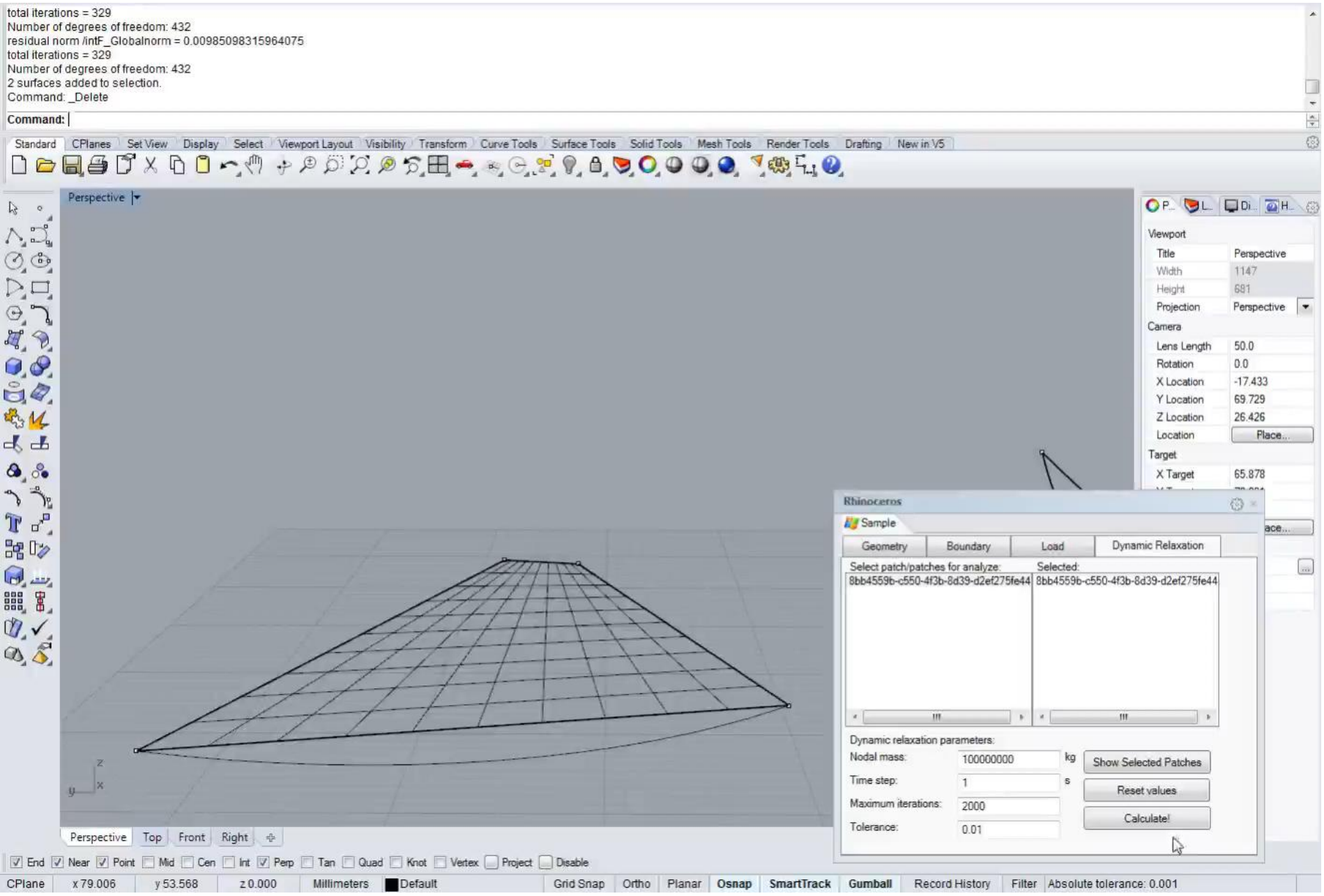
Connection between architecture and dynamics

British Museum Great Court
C. Williams / Foster+partners

National Maritime Museum
Ney + partners

Savill Building
Glen Howells / Buro Happold / C. Williams

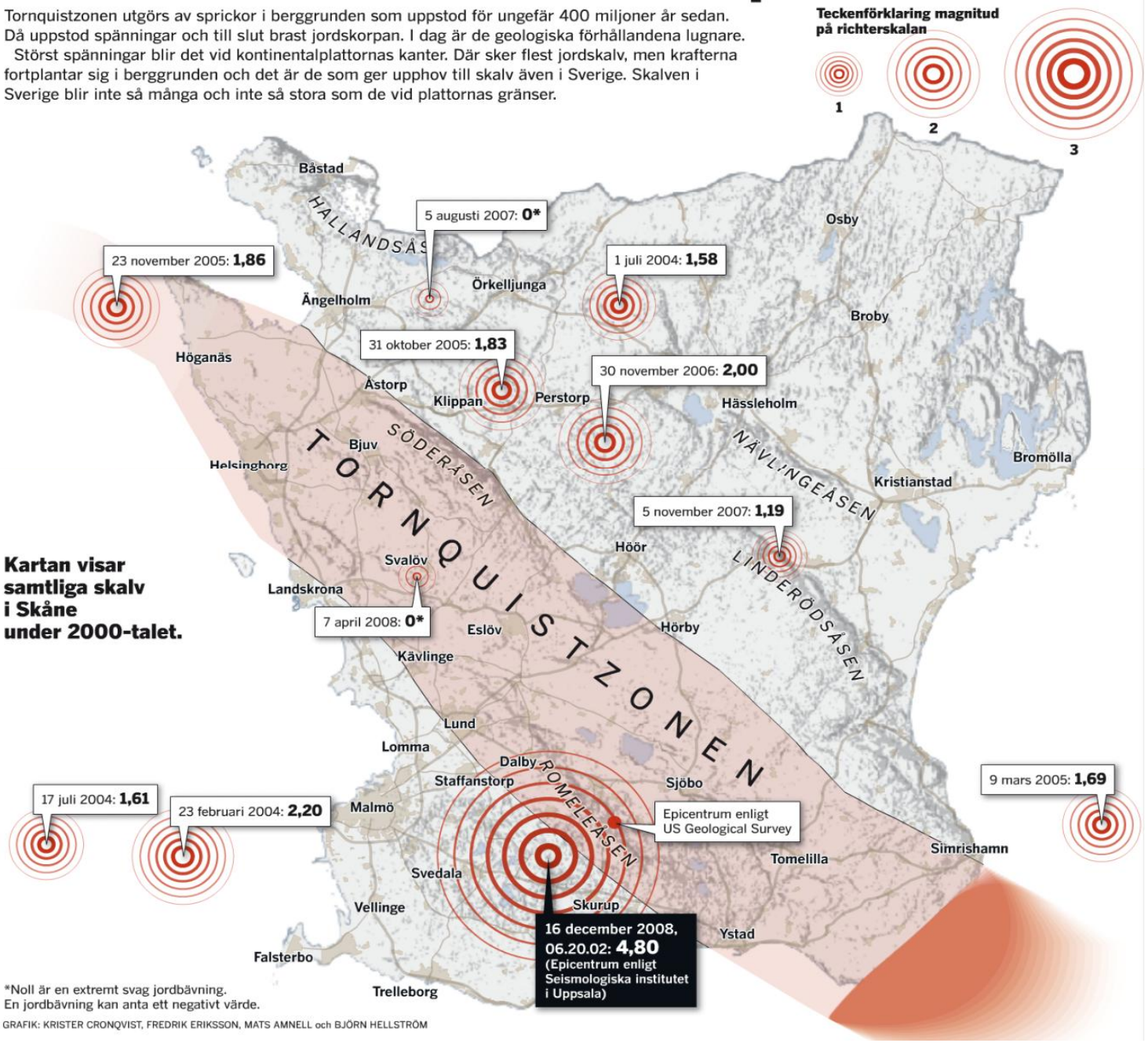
Program development for finding shape of membranes by dynamic relaxation:



Jordskalvet skedde nära Tornquistzonen

Tornquistzonen utgörs av sprickor i berggrunden som uppstod för ungefär 400 miljoner år sedan. Då uppstod spänningar och till slut brast jordskorpan. I dag är de geologiska förhållandena lugnare.

Störst spänningar blir det vid kontinentalplattornas kanter. Där sker flest jordskalv, men krafterna fortplantar sig i berggrunden och det är de som ger upphov till skalv även i Sverige. Skalven i Sverige blir inte så många och inte så stora som de vid plattornas gränser.

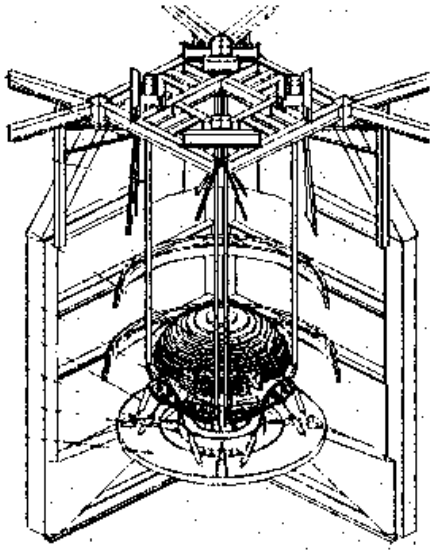


Kartan visar samtliga skalv i Skåne under 2000-talet.

*Noll är en extremt svag jordbävning. En jordbävning kan anta ett negativt värde.

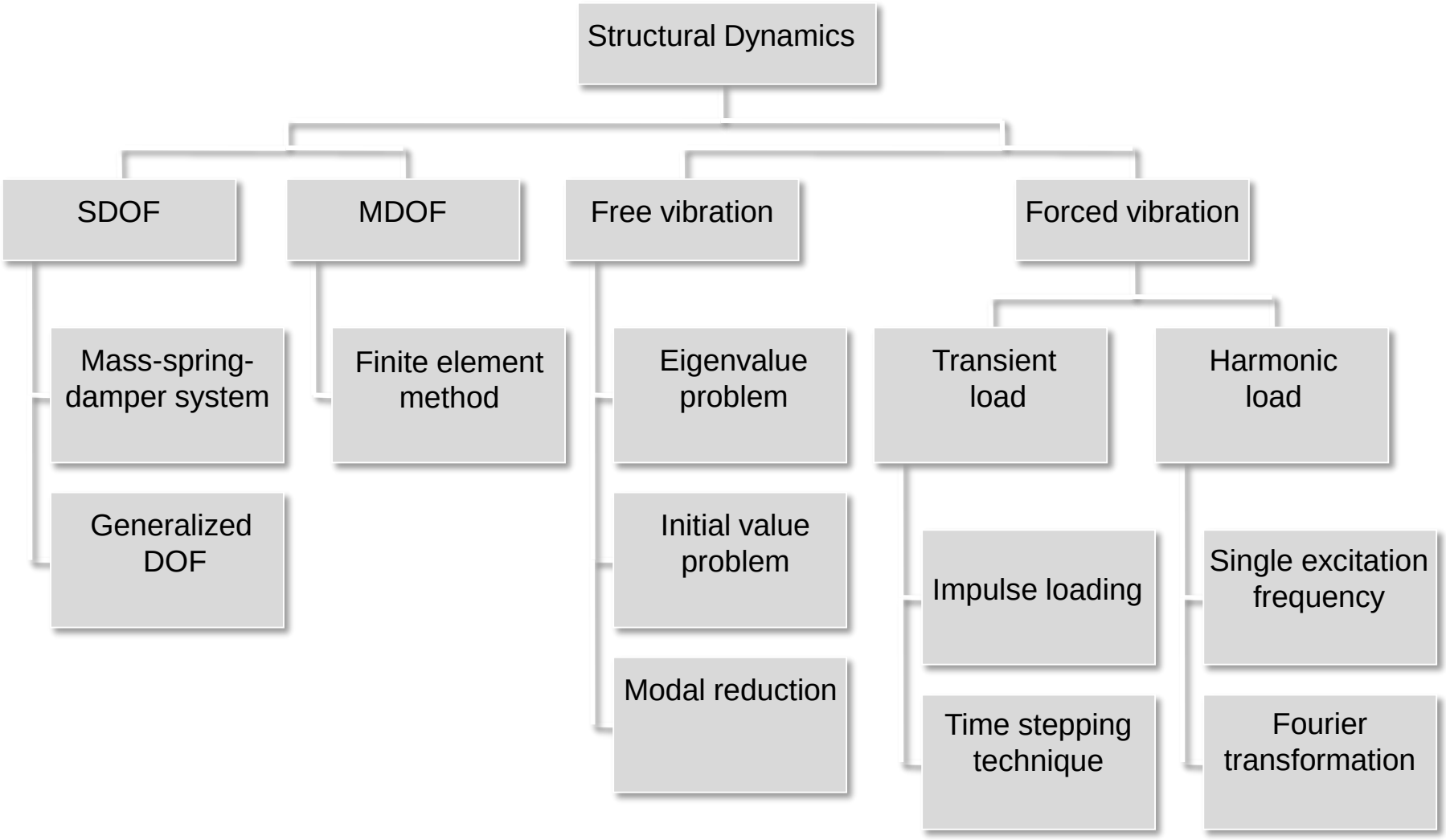
GRAFIK: KRISTER CRONQVIST, FREDRIK ERIKSSON, MATS AMNELL och BJÖRN HELLSTRÖM

Taipei 101- tuned pendulum



Course outline and tasks

Theory contents in the course



Course overview

- Theory lectures
- Guest lecture
- Home assignments
- A short theory exam
- Laboratory data
- Project 1: Multi storey frame - report
- Introduction to Abaqus
- Project 2: Impuls loaded structure – report and oral presentation

Teachers and responsibilities

- Per-Erik Austrell - Course coordinator, theory lectures, homework, and examination
- Anders Sjöström - Laboratory and measurements
- Jens Malmborg - Consulting on Abaqus in Project 2
- Kent Persson - Abaqus finite element task and examination in Project 2

Points and grading

Weight of different course tasks:

- Home assignments 5/60
- Project task 1 15/60
- Theory exam 20/60
- Project task 2 20/60

P1 and P2; report, presentation, and grading applies to groups of 3 persons.

Grades; 3: min 30p, 4: min 40p, 5: min 50p

Website:

www.byggmek.lth.se/utbildning/kurser