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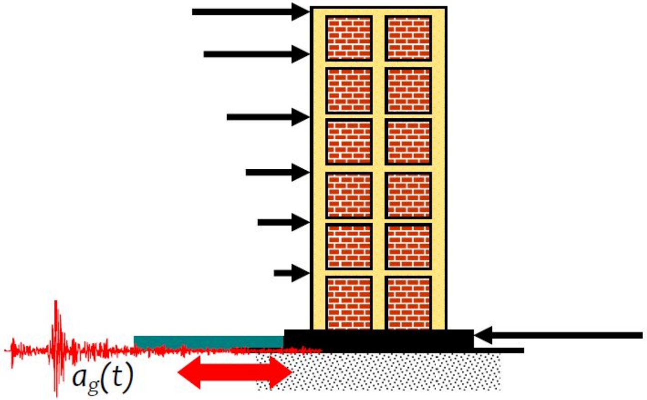
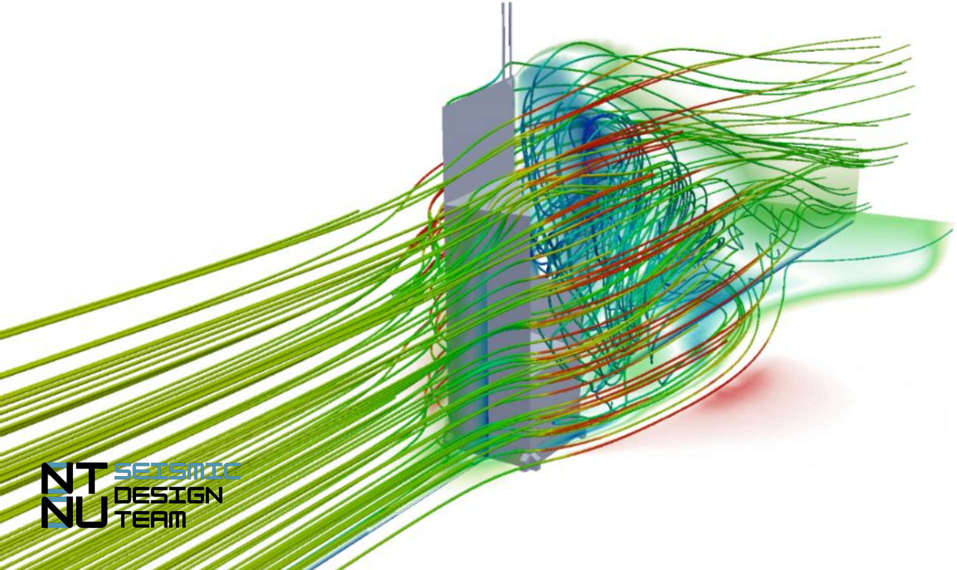
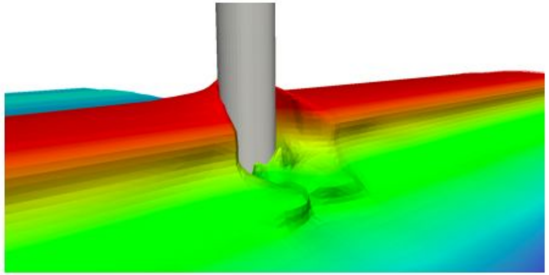
Dynamics Introduction

Dynamic loads

- Earthquake
- Wind
- Wave







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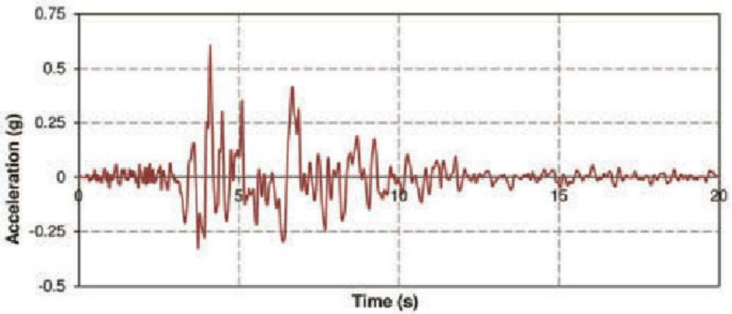
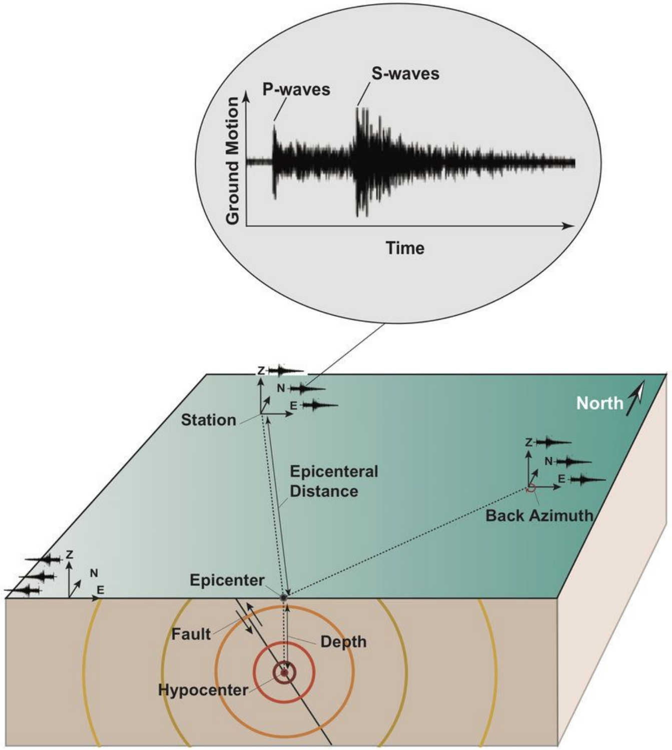
Ground motion

- The movement of an earthquake
- Acceleration against time
- Dependent on distance from epicenter

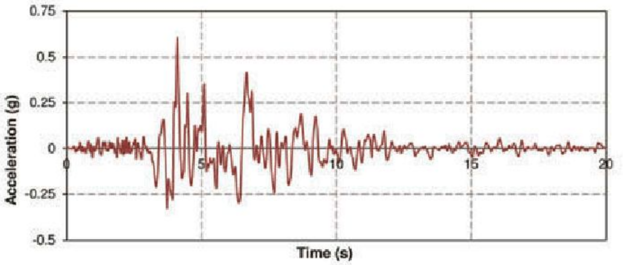


(a) Northridge-01 (1086) record

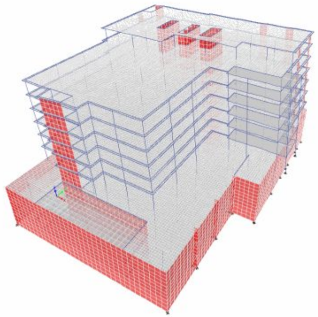


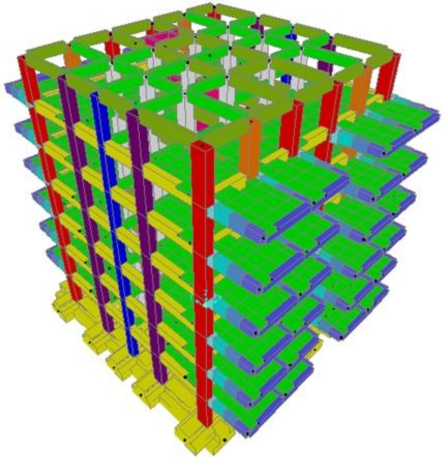
Response history analysis

- Input ground motion
- Gives a acceleration as a function of time
- Acceleration => Displacement, stress, shear, moment + others (All as function of time)
- Most accurate method to measure response

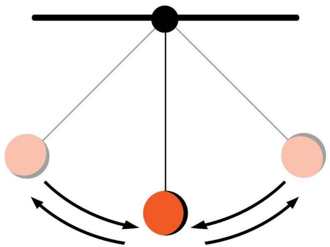


(a) Northridge-01 (1086) record





Important terms



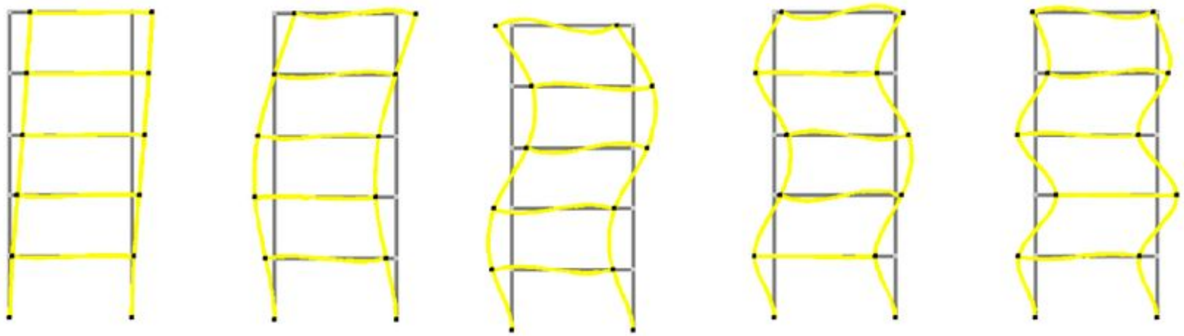
Period (T): Time for one oscillation

Natural Frequency (ω): How many oscillations per second, ω =

Roof Drift:

A Structure can have multiple Periods with one corresponding: frequency and mode.
However, the 1st period/mode is usually the most critical

Most critical



Mode 1	Mode 2	Mode 3	Mode 4	Mode 5
$T_1=T_{max}$	T_2	T_3	T_4	$T_n=T_{min}$

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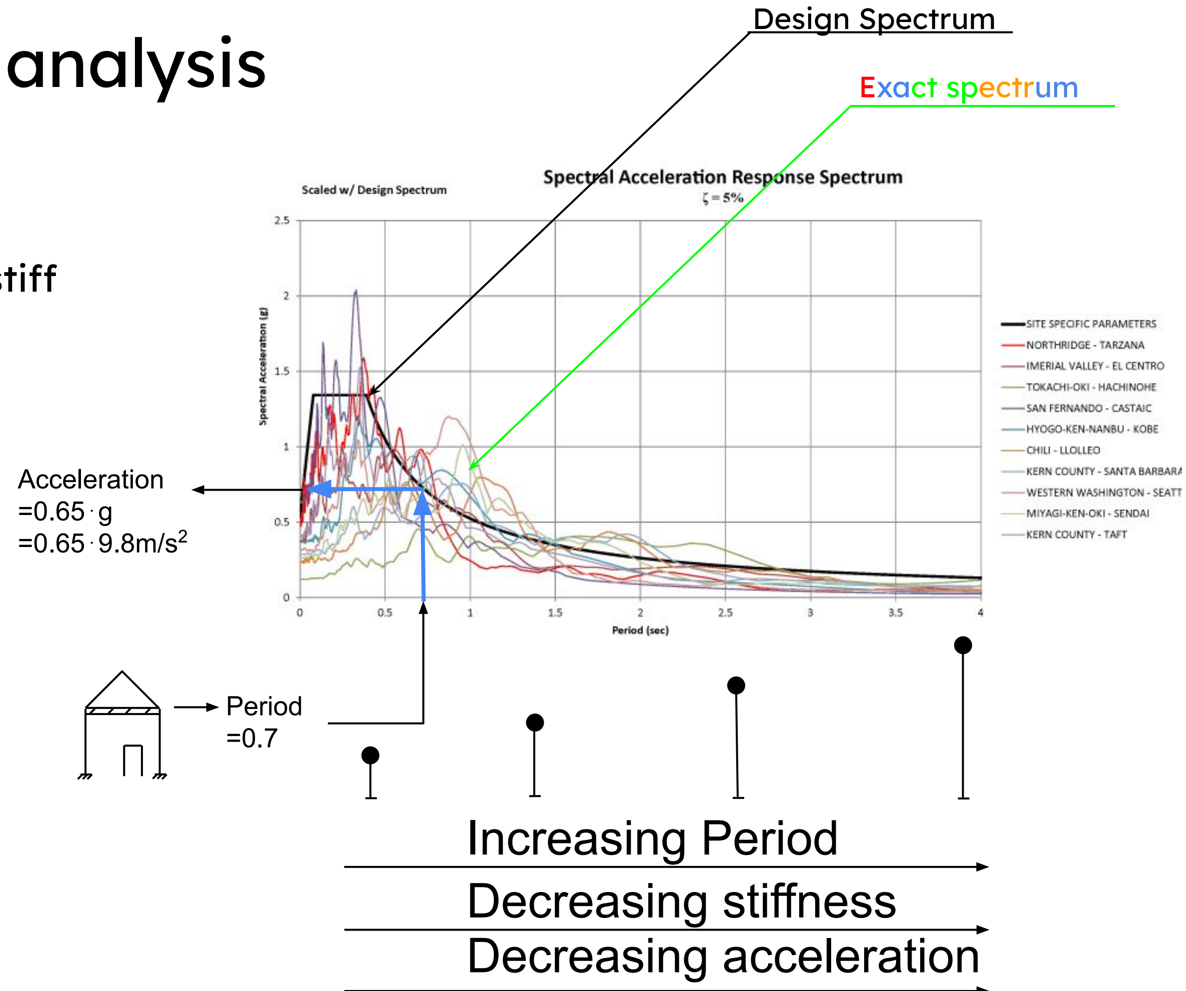
Response spectrum analysis

- Gives the peak acceleration for different periods.
  - The period represents how stiff the structure is
- Peak acceleration => Peak: Displacement, stress, shear and moment.



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Design process

Stiffness +Mass → Period / Natural frequency → Modes or Mode shapes

\+ Ground motion

→ Stress & capacity / Displacements

SAP2000 or konstruksjonsdynamikk 1

- Input ground motion to get the stresses on the structure

Design considerations:

- Insert braces, trusses and shear walls will "take up" horizontal forces, without these, columns and beams will break in shear or moment
- Make it torsionally resistant => Symmetrical
- Have uniform stiffness along the tower. A sudden change in stiffness will cause high stresses