PLAXIS

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DYNAMICS MODULE

Soil and structures are often not only subjected to static loads due to construction in and on the ground surface but also to dynamic loads. If the loads are powerful, like for example earthquakes, they may cause severe damages. Vibrations may occur either man-made or natural. In urban areas, vibrations can be generated due to pile driving, vehicle movement, heavy machinery or train travel. The source of natural vibrations in the subsoil is earthquakes. With the Dynamics module PLAXIS 2D and 3D are extended with capabilities to analyse the effects of vibrations in the soil.

Low frequency vibrations can normally be calculated with a pseudo-static analysis, which is offered in the default PLAXIS program, however for more advanced seismic analysis the Dynamics module is necessary. The effects of vibrations have to be calculated with a dynamics analysis when the frequency of the dynamic load is in the order or higher than the natural frequency of the medium. PLAXIS helps users to perform dynamic analyses in a user friendly, efficient and accurate way.

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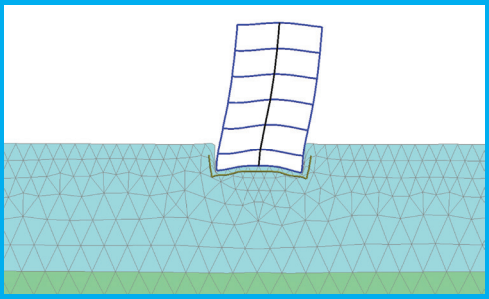

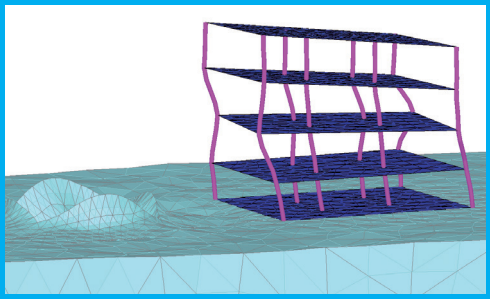

Dynamic analysis in PLAXIS

With the Dynamics module users have extra options in the software to deal with various sources of vibrations and their effect on the soil, structures and the soil-structure interaction. Existing projects can easily be extended by simply adding dynamic calculation phases within the standard workflow of the PLAXIS software.

Initially the Linear Elastic model can be utilised for the simulation of dynamic effects, but in principle any of the available soil models in PLAXIS can be used. All the material models contain extra parameters, which allow damping due to material and/or geometry to be taken into account. Material models especially useful in dynamic analysis are for example the UBC Sand model in order to predict liquefaction. This model can calculate the excess pore pressure build-up during dynamic excitation. For materials other than liquefaction susceptible sand, the Hardening soil model with small strain stiffness generally offers a good choice

In modelling the dynamic response of a soil structure the inertia of the subsoil and the time dependency of the load are considered. The time dependent behaviour of the load can be assigned through harmonic, linear or table multipliers. Especially the table input allows user to import real earthquakes signals, so that they can perform meaningful seismic design, of for example jetties or foundations. Dynamic multipliers can be assigned independently in the x- and y-directions in PLAXIS 2D and the x-, y- and z- direction in PLAXIS 3D.

Dynamic analysis in some cases also requires some special boundary conditions. For the benefit of 1D site response analysis, the tied degrees of freedom boundary conditions are available in PLAXIS 2D. To reduce spurious reflections of waves reaching the model boundaries, free-field and compliant base boundaries can be selected.

Automatic determination of the minimum mesh element size is performed, which ensures the smallest wavelengths can be captured in the model. In addition users have the option to automatically generate a regular mesh, which performs better for dynamic analyses. For calculations users can choose between a lumped mass matrix or a consistent mass matrix, while the first reduces the calculation time somewhat, the latter one leads to more accurate results.

The PLAXIS Output program is enhanced with various new plot types to display contours and vectors of accelerations, velocities, structural forces envelopes and much more. For curves, options exist to plot Pseudo Spectral Acceleration, relative displacements and there are possibility to switch between time or frequency representations, allowing users to determine the natural frequency of structural elements in the model.

Applications

- Site response analysis
- Seismic design of jetties, quays, walls, building foundations
- Earthquake simulation
- Embankment stability under dynamic loading due to high speed trains or car traffic
- Pile driving & wave propagation to adjacent structures
- Liquefaction analysis to predict the safety of critical infrastructure like levees or large dams under earthquake loading
- Racking of tunnel lining

Request a free demo

To learn more about PLAXIS and to download a free demo version, visit **www.plaxis.com/demo**.

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