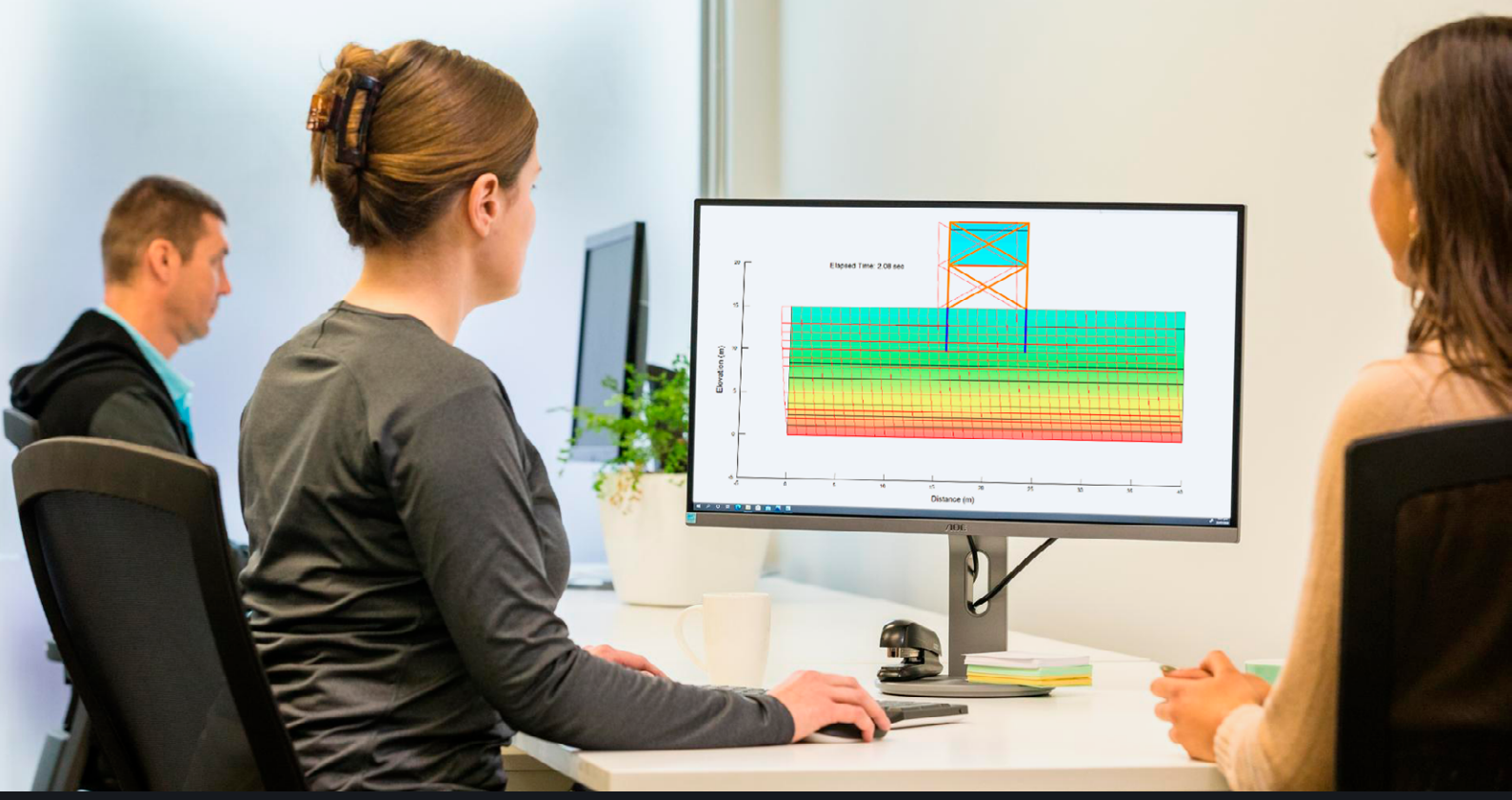
SEEQUENT

QUAKE/W

Dynamic Earthquake Analysis

GeoStudio



QUAKE/W is a powerful finite element software product for modeling earthquake liquefaction and dynamic loading. QUAKE/W determines the motion and excess pore-water pressures that arise due to earthquake shaking, blasts, or sudden impact loads.

Dynamic Stress Analysis

QUAKE/W models dynamic stresses arising from earthquake shaking or dynamic point forces from a blast or sudden impact. QUAKE/W simulates the impact of these stresses on earth structures.

Earthquake Records

Earthquake time history records can be imported and scaled for a dynamic analysis. Modify the peak acceleration and duration to ensure the values used in the QUAKE/W analysis represent site-specific conditions.

Newmark Analysis

The QUAKE/W computed dynamic forces can be used in SLOPE/W to compute yield accelerations and potential permanent deformations for each trial slip surface.

Excess Pore Pressure

Excess pore-water pressures computed by QUAKE/W together with the initial static pore-water pressures can be used in SLOPE/W to examine the effect of the elevated pore-water pressures on stability.

QUAKE/W results in SLOPE/W

Earthquake shaking of ground structures creates inertial forces and excess pore-water pressures that may affect the structure's stability. The dynamic stress conditions and pore-water pressures generated by QUAKE/W can be used in SLOPE/W to assess stability and deformation following an earthquake.

QUAKE/w results in SEEP/W

The excess pore-water pressures generated during an earthquake may dissipate quickly or gradually depending on the soil properties. The pore-water pressure results from a QUAKE/W analysis can be inputted into SEEP/W to investigate excess pore-water pressure dissipation over time.

SIGMA/W stresses in QUAKE/W

Establishing *in situ* static stresses can be done simplistically in QUAKE/W. For more complex systems, the static stress conditions may be simulated in SIGMA/W with the load sequencing and non-linear constitutive soil models, for example, and then imported into QUAKE/W as the initial conditions.

QUAKE/W models liquefaction and dynamic loading

Ground response analysis

QUAKE/W can simulate ground motions to evaluate dynamic stresses and strains in earth and retaining structures. This allows for assessment of liquefaction hazards and the dynamic-induced forces that can lead to instability. The dynamic stress-strain analyses can be driven by an earthquake acceleration history or by static/dynamic loads on the ground surface (e.g. blast vibration). Earthquake time-history files can be imported directly into GeoStudio and scaled to different peak accelerations for rapid sensitivity analyses. Alternatively, acceleration, velocity, or displacement data can be pasted directly into user defined spline functions. Soil and rock stress-strain responses can be represented by linear, non-linear, or equivalent linear constitutive models and retaining structures by specially formulated structural elements.

Liquefaction assessment

Excess pore-water pressures during an earthquake can lead to liquefaction and subsequent large-scale deformations or global failure. QUAKE/W simulates excess pore-water pressure generation using classical cyclic stress ratio and pore-water pressure relationships or by a functional relationship between volumetric straining (and therefore pore-water pressure response) to cyclic number. Liquefaction zones are identified by tracking stress paths relative to the collapse surface or by reducing effective confining stress. Liquefied zones are shown at each time step to better simulate deformations and assess stability.

Stability and deformation analysis

Integration with SLOPE/W allows the factor of safety to be assessed at every dynamic analysis step using limit equilibrium or stress-based analyses. Liquefied zones identified by QUAKE/W can be assigned a steady-state strength to include the effects of strength loss. To calculate irrecoverable plastic deformation (e.g. settlement of a dam crest), use SLOPE/W with the simulated ground accelerations in a Newmark Deformation analysis. Alternatively, use SIGMA/W to compute permanent deformation by redistributing stresses within liquefied zones and other over-stressed areas. This allows for assessment of failure mechanisms and overtopping in earth structures or, when combined with structural elements, assessment of bending moments and shear stresses within retaining structures.

GeoStudio

QUAKE/W offers a comprehensive list of features

- Comprehensive dynamic stress strain formulation
- Estimation routines for typical material properties
- Comprehensive constitutive model list
- Simulation of liquefaction potential via collapse surface definition
- Straightforward import functionality for earthquake records
- Integration with SLOPE/W for Newmark analysis
- Integration with SLOPE/W for modeling effect of excess pore-water pressures
- Integration with SLOPE/W for modeling liquefaction zones
- Integration with SEEP/W for modeling dissipation of excess pore-water pressures
- Integration with SIGMA/W for modeling post-earthquake deformation

SEEQUENT

A better understanding of the earth creates a better world for all

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