SIGMA/W

Stress and Deformation Analysis

SIGMA/W is a powerful finite element software product for modeling stress and deformation in earth and structural materials. SIGMA/W analyses may range from simple linear elastic simulations to soil-structure interaction problems with nonlinear material models.

CONSTRUCTION SEQUENCE

GeoStudio's Analysis Tree models even the most complex construction sequences. Analyses are added to the Tree, forming a Parent-Child relationship in which each new analysis represents a part of the construction sequence.

COUPLED CONSOLIDATION

The coupled stress and pore-water pressure formulation can be used to model construction sequencing involving fill placement, excavation, and soil-structure interaction.

SLOPE/W INTEGRATION

The stresses and/or pore-water pressures from a SIGMA/W analysis can be used directly in SLOPE/W to do a stress-based stability analysis.

STRESS REDISTRIBUTION

Stress redistribution analysis is used to conduct a strength reduction slope stability analysis, model stress transfer onto structures such as pile walls installed within failed slopes, or calculate permanent deformations.

SIGMA/W models a full range of deformation problems

STAGED FILL OR EXCAVATION DESIGN

The rigorous stress-strain formulation of SIGMA/W, and the seamless workflow of GeoStudio, simplifies the analysis of complex staged construction problems involving cut slopes and fill placement. Simulations of this nature are required to simulate the construction of earth and rock fill embankments, tailings dams, railway and roadway cuts, and more. SIGMA/W's coupled stress-strain and water transfer formulation makes it possible to also analyze the simultaneous generation and dissipation of excess pore-water pressures, allowing for the design of sub-surface drainage systems with the software.

STABILITY AND DEFORMATION OF SLOPES

SIGMA/W can be used to model the deformation of natural and cut slopes under a variety of loading conditions resulting from changes to the groundwater flow system, strength loss due to liquefaction during earthquake shaking or strain-softening, and construction activities. SIGMA/W's phi-c reduction technique, referred to as a Stress Redistribution analysis, can be used to simulate deformations resulting from strength loss while also providing information about stability. A stress-based SLOPE/W stability analysis can also be completed to calculate a safety factor from the stress-field simulated by SIGMA/W.

REINFORCEMENT AND SLOPE STABILIZATION

Deep excavations for civil, geotechnical, and mining applications often involve complex soil-structure interaction. The rigorous structural element formulations, combined with a comprehensive material model library, make SIGMA/W the ideal tool for modeling struts, pile and sheet walls, anchorage, tunnel lining, and more. SIGMA/W's Stress Redistribution analysis also makes it possible to simulate load transfers and structural responses for projects involving slope stabilization by means of engineered structures (e.g. soldier pile wall). In all cases, SIGMA/W can be used to ensure that the structures are designed to safely carry the loads and to ensure that overall stability is established with an acceptable margin of safety.

The power of integration

SIGMA/W offers simple but powerful analytical capabilities when used in combination with other GeoStudio products.
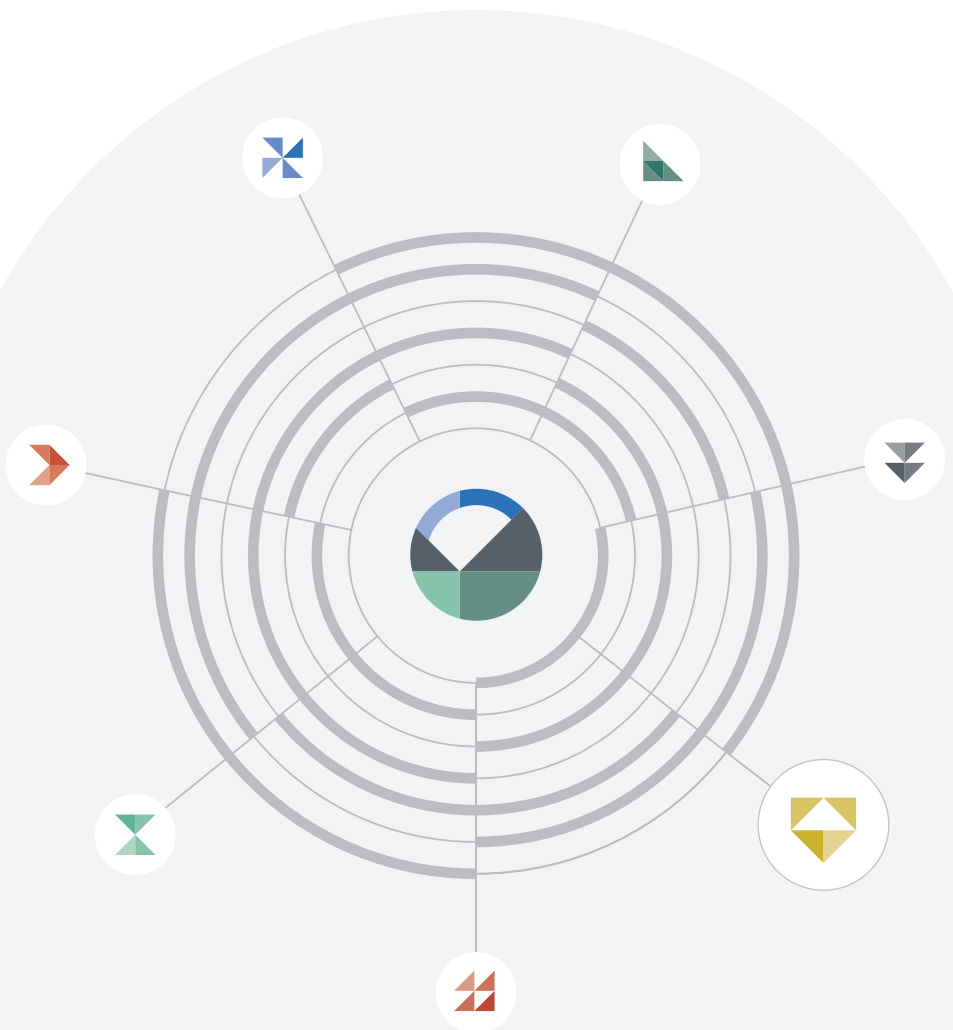
SIGMA/W offers a comprehensive list of features

- ✓ Comprehensive incremental stress-strain formulation
- ✓ Rigorous stress-update algorithm for handling non-linear material models
- ✓ Coupled stress and pore-water pressure formulation
- ✓ Straightforward construction sequence simulation

- ✓ Multiple options for insitu stress definition
- ✓ Saturated-unsaturated formulation
- ✓ Comprehensive constitutive model list
- ✓ Estimation routines for typical material properties

- ✓ Complete range of boundary conditions
- ✓ Stress redistribution capabilities
- ✓ Integration with SLOPE/W
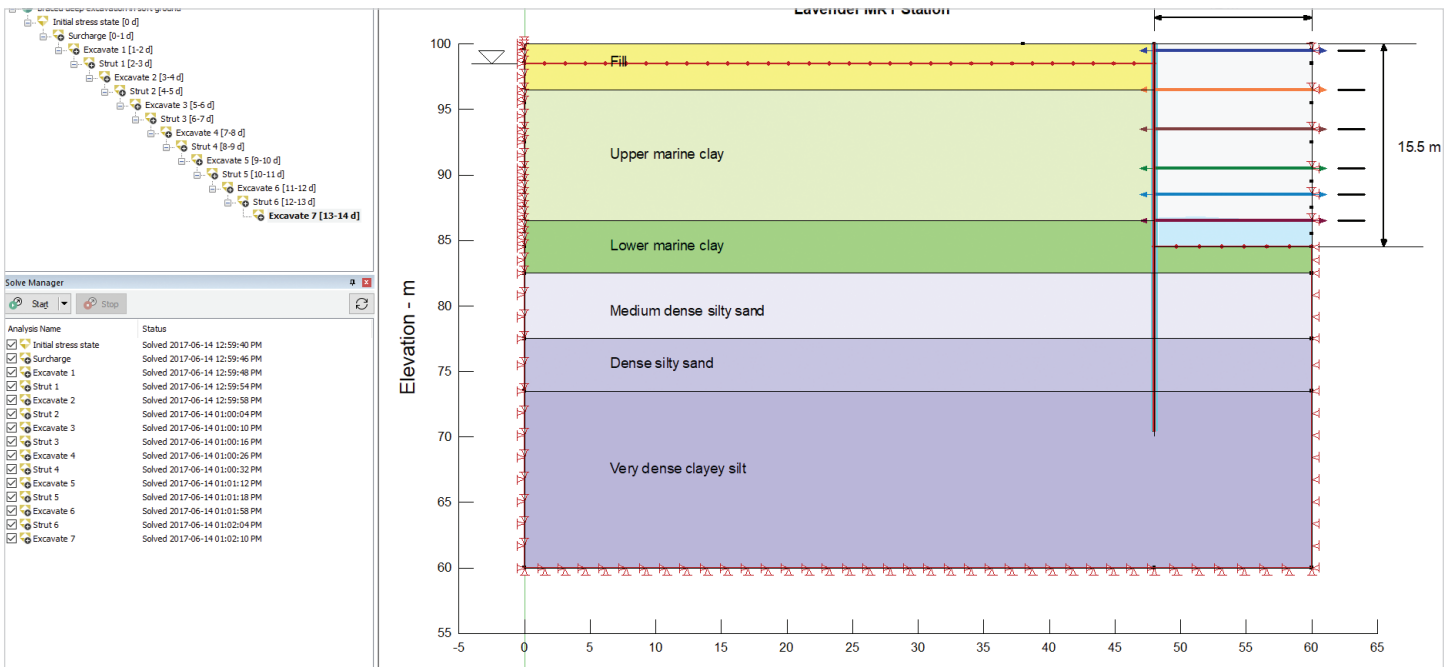
SIGMA/W STRESSES IN SLOPE/W

There are many geotechnical cases where it is desirable to not only perform a deformation analysis, but also to look at stability. In other instances, a SLOPE/W limit equilibrium stability analysis alone is inadequate. For cases like this, the SIGMA/W computed stresses can be used in SLOPE/W to compute the safety factors.

SIGMA/W INTEGRATION WITH SEEP/W

Excess pore-water pressures generated in SIGMA/W by external loads (e.g., fill placement) can be used as initial conditions in a transient SEEP/W analysis. The simulated dissipation rates can be used to develop construction-staging schedules. SEEP/W pore-water pressures can be used by SIGMA/W to simulate in situ effective stresses.

SIGMA/W STRESSES IN QUAKE/W

Establishing insitu static stresses can be done simplistically in QUAKE/W. Alternatively, you can use the load sequencing and non-linear constitutive soil models in SIGMA/W to improve the estimation of the static stress conditions, and then use them as the initial static stresses in a QUAKE/W dynamic analysis.

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