CUSTOMER SUPPORT NOTE

Geotechnical Capabilities

Note Number:	**CSN/LUSAS/1010**

This support note is issued as a guideline only.

LUSAS

Forge House, 66 High Street, Kingston upon Thames, Surrey, KT1 1HN, UK
Tel: +44 (0)20 8541 1999 Fax: +44 (0)20 8549 9399
Email: info@lusas.com www.lusas.com

Rev: 18-Jul-03

Table of Contents

1. Introduction

LUSAS has a number of facilities which may be used in a geotechnical analysis. This document provides a brief discussion regarding a few of the more directly relevant facilities that may be of interest. A nonlinear license is required to carry out nonlinear geotechnical modelling.

2. Specific features

2.1 Types of analysis

In general a geotechnical analysis will be carried out in one of four ways:

- Total stress analysis modelling short-term behaviour
- Effective stress analysis modelling short term behaviour and the prediction of generated excess pore water pressures
- Effective stress analysis modelling long-term behaviour
- Consolidation analysis modelling the change in effective stresses with time due to pore water pressure dissipation

2.2 Soil-structure interaction

Geotechnical engineering, soil-structure interaction analyses can be carried out in both plane strain and 3D. Slidelines can be used to represent a concrete/soil interface and can include a frictional coefficient. The sliding and separation of a soil against a structure can be modelled using slidelines.

2.3 In situ stresses

In situ stresses (effective or total) can be set up in the very first loadcase to model the initial condition using variations. In situ vertical stresses should balance with gravitational body forces and horizontal stresses can be related to vertical stresses via the coefficient of earth pressure at rest.

2.4 Staged construction

LUSAS supports an activation/deactivation or “birth-and-death” facility that enables the addition and removal of parts of the model during an analysis to simulate excavation and construction.

2.5 Pore water pressures

Two-phase, high order, 2D and 3D continuum elements are available which can be used to model the change in pore pressure over time in a consolidation analysis or to calculate the short-term changes in pore pressure arising from excess pore pressures generated during the construction process. These elements have both displacement and pressure degrees of freedom which are fully coupled. The transient process of consolidation is achieved by carrying out a transient analysis in which a variable time-stepping scheme is adopted. Consolidation type problems can be used in conjunction with the birth and death facility enabling problems involving long-term excavation and construction in clays to be carried out. The entire construction sequence can be modelled as various time-stepping load increments and the final load-case will be of a sufficient time interval to allow pore pressures to come to equilibrium representing the long-term situation.

2.6 Material models

Material models that can be used for use in geotechnical engineering problems are as follows:

- **Tresca**: Used to represent the ductile behaviour of materials which exhibit little volumetric strain (eg metals or undrained behaviour of soils). Incorporates isotropic hardening.
- **Mohr-Coulomb**: The non-associated Mohr-Coulomb model can be used to represent dilatant frictional materials which exhibit increasing shear strength with increasing confining stress (eg granular materials such as rock or soil). The model incorporates isotropic hardening and dilatancy.
- **Drucker-Prager**: Used to represent the ductile behaviour of materials which exhibit volumetric plastic strain. Also incorporates isotropic hardening.
- **Concrete Cracking and Crushing model**: A multiple non-orthogonal cracking concrete material model has been implemented in LUSAS for plane stress, plane strain, axisymmetric and 3D solid analyses. This model may be used to represent the nonlinear material effects associated with the cracking and crushing of concrete.