AD FALCON API Manual

Footing on Soil Modeled by the CASM Elasticity Model

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1.1 Input File Name

fem_casm.txt

1.2 Problem Description

This study investigates the behavior of a rigid strip footing resting on a sand layer modeled using the CASM Elasticity Model. The analysis evaluates soil response and footing pressures. The primary objective is to compare the evolution of the **void ratio** from FEM simulations with a closed-form analytical solution.

1.3 Model Setup

- **Footing Type**: Smooth rigid strip footing
- **Footing Width**: $B = 2m$
- **Material Model**: CASM Elasticity Model
- **Material Properties**:
  - κ: 0.006
  - λ: 0.01
  - **Compression Index (N)**: 1.9
  - **Stress Tolerance (STOL)**: $1.0E - 5$
  - **At-Rest Earth Pressure Coefficient (K_0)**: 0.98
  - **Buoyant Unit Weight (γ')**: $10kN/m^3$

1.4 Initial Stress and Void Ratio Fields

A proper definition of the initial stress and void ratio fields is essential for accurate simulation results. These fields can be established either through direct initialization or by applying body forces.

- The **buoyant unit weight** of the soil is set to $10kN/m^3$ to generate the initial stress distribution.
- The **initial void ratio field** is computed using the relation:

$$e_{in} = N - 1 - (\lambda - \kappa)\ln(400p'_{in} + 10) - \ln p'_{in} \tag{1}$$

  Substituting values:

  - $N = 1.9$
  - $\lambda = 0.01$

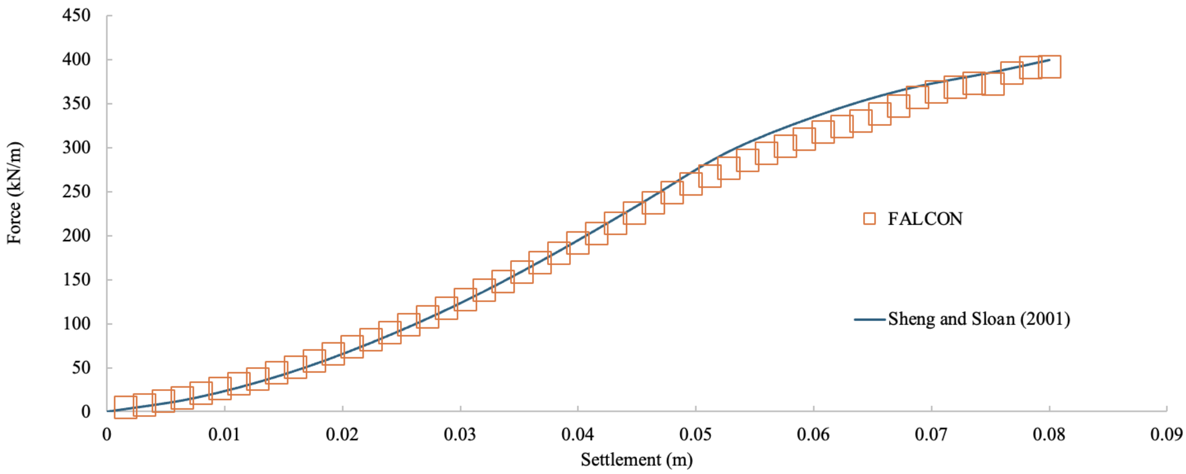

Figure 1: Force vs Displacement

- $\kappa = 0.006$
- At a depth of $5B$ where $p'_{in} = 93.3kPa$, the initial void ratio is computed as **0.83**.

- Once the initial conditions are set, a vertical displacement of 0.075 is imposed on the footing to induce soil failure conditions.

1.5 Finite Element Model

- **Element Type**: 6-noded triangular elements
- **Boundary Conditions**:
  - Bottom boundary fully fixed.
  - Lateral boundaries restrained horizontally.
  - Uniform vertical displacement imposed on the footing.

1.6 Comparison with Sheng and Sloan (2001) Solution

The numerical results obtained from FEM simulations are presented in Figure 1, comparing the evolution of the **void ratio** with the closed-form analytical solution and the numerical solution by **Sheng and Sloan (2001)**.

Reference: Sheng, D. and Sloan, S.W., 2001. Load stepping schemes for critical state models. *International Journal for Numerical Methods in Engineering, 50(1), pp.67-93.*

Figure 1: Force evolution with settlement.