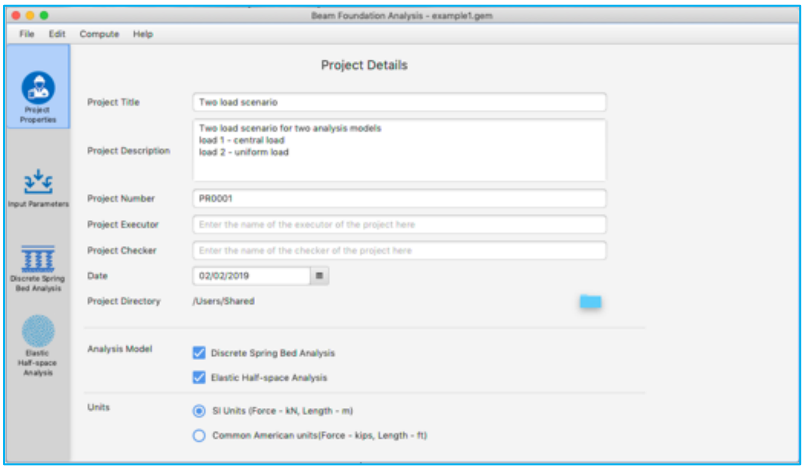
Geotechnical Engineering Modelling Software (GEMS)

BEAM FOUNDATION ANALYSIS



Introduction

Geotechnical engineering analysis is based on modelling the subsoil material and the interacting structure. The modelling parameters which characterise the behaviour of subsoil are obtained from geotechnical investigations.

Geotechnical Engineering Modelling Software Suite (GEMS Suite) deals with finite element analysis of beam foundation, raft foundation, pile foundation & retaining structures.

Beam Foundations

This type of foundation is adopted in the case of combined footing supporting two or more columns. The combined footing is modelled structurally as a beam foundation resting on the soil. The sub soil may be modelled in several ways. Two common models for the subsoil are:

(a) **Discrete spring bed model** using modulus of subgrade reaction (also known as “beams on elastic foundation” or “Winkler beam theory”). The soil parameter used for this analysis is the modulus of subgrade reaction.

(b) **Elastic half–space model** where the subsoil model is replaced by elastic, homogeneous, isotropic semi-infinite continuum. The soil parameters used are elastic modulus and Poisson ratio.

The “Beam Foundations” software consists of two modules incorporating the above two commonly used models of analysis.

Subgrade reaction theory based on discrete spring model

The analysis of the foundation beam is based on the solution of the differential equation

$$EI\frac{d^4y}{dx^4} = -\,\mathrm{ky}$$

where $k = k_s \times B, EI = Flexural\ rigidity\ of\ foundation\ beam,$
$k_s = Modulus\ of\ subgrade\ reaction,\ \ B = width\ of\ foundation\ beam$

The foundation base is assumed to be smooth and the soil pressure is assumed uniform across the width. The solution of this differential equation is complicated and cumbersome except for very simple problems. For practical problems where the loads are in the form of several concentrated loads, moments and UD loads it becomes necessary to resort to numerical solutions.

The software module uses finite element solution of the problem using the exact displacement function and therefore gives exact solution to the problem.

Elastic half-space model

In this approach the subsoil is modelled by a homogeneous, isotropic elastic half-space characterised by an elastic modulus and a Poisson ratio. This model has the merit of accounting for the continuous nature of the soil medium. The discrete spring bed model does not account for the soil continuity. The solution is based on the vertical displacement due to a distributed surface loading on an elastic half-space (given by "Boussinesq"). Again numerical solution of the problem is essential for tackling practical problems as no analytical solution is available for finite beams. The software module for Elastic half-space model is based on finite element formulation assuming a smooth base and uniform soil pressure across the width.

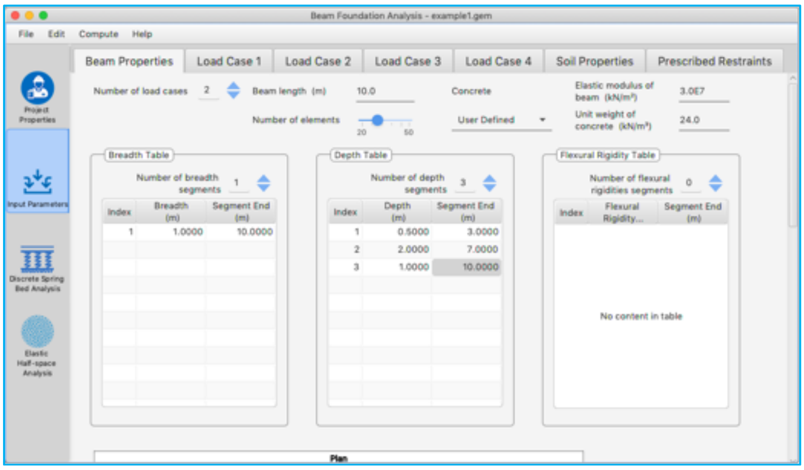


Figure 1. Input Parameters

Results of analyses of both the models complement each other in practical design.

Key Features

- One click computation and analysis for all load cases and models.
- Analysis of the beam foundation using both/either models.
- Multiple load cases could be considered.
- Graphical representation of the Plan and Elevation View of the beam foundation.
- Graphical representation of loading diagrams for each load case.
- Data can be input in either SI units or ‘Commonly used American units’ (*Kips for force and foot for length*).
- Export results to Microsoft Word & Excel
- The loading may consist of several concentrated loads & moments
- Multiple uniformly distributed loads can be specified.
- Self-weight may be included if required.
- Different depths and breadths could be given for the beam. RCC inverted T beam sections and RSJ s could be considered by prescribing EI values directly.
- Vertical displacements, rotations, vertical spring & rotational spring could be prescribed if required.

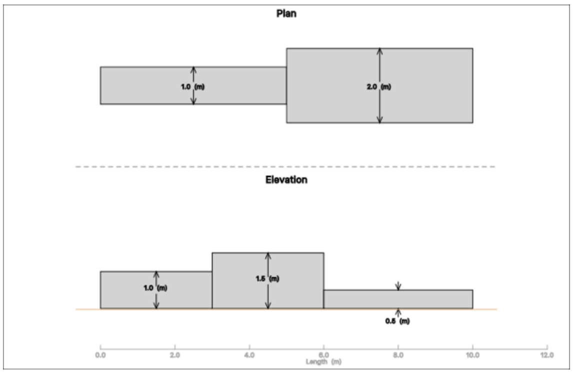


Figure 2 Plan & Elevation View

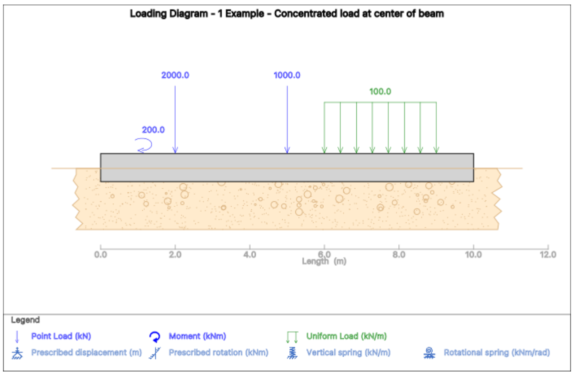


Figure 3 Loading Diagram

Analysis

Results of analysis for subgrade spring model & elastic half-space model are shown in two separate panes for each of the load cases. The analysis consists of –

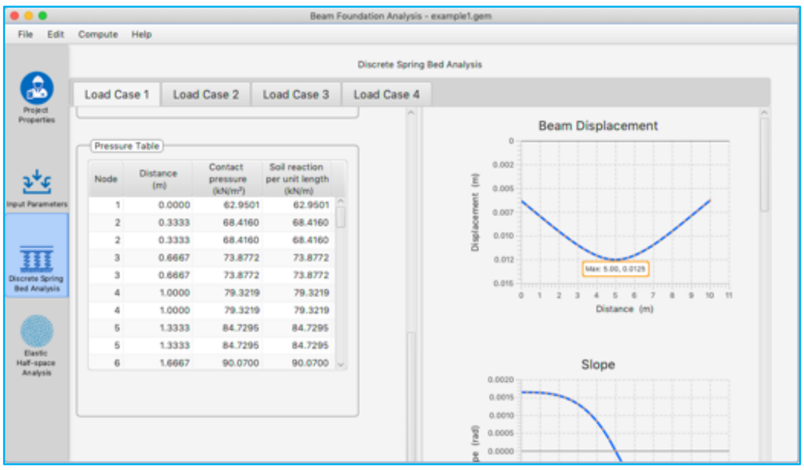
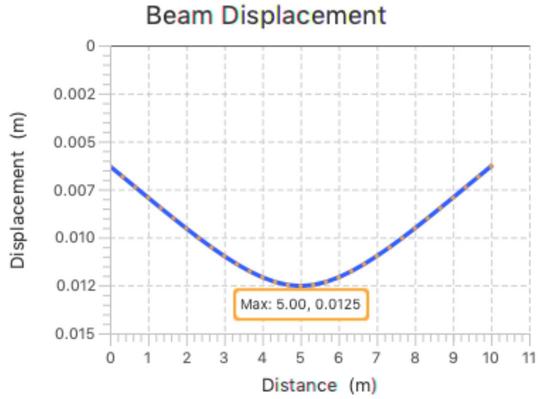
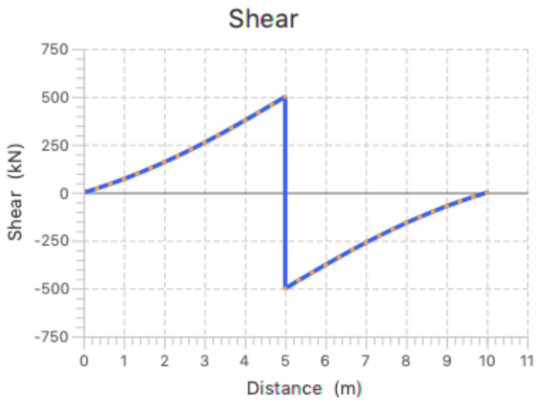


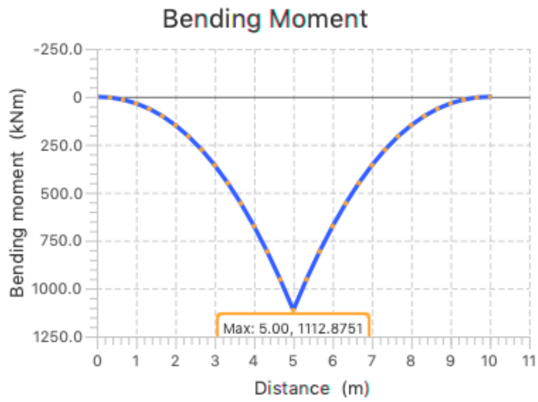
Figure 4 Analysis Pane

- Tabulated values of displacements and rotations along the length of the beam and graphical representations of them.

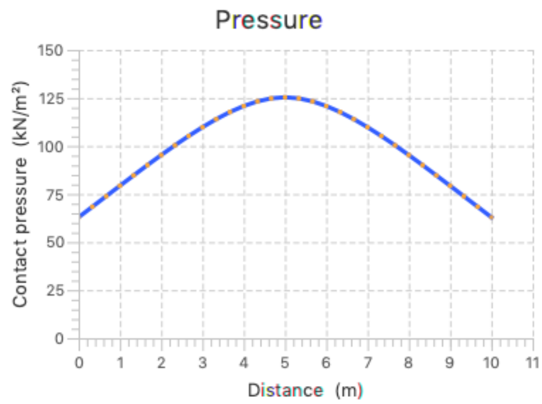


- The Bending moment and shear force values along the beam and bending moment and shear force diagrams.





- Values of soil reaction per unit length of the beam & soil pressure along the beam.



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