Wick Drains and Relief Wells

Introduction

This document explains the implementation of wick drain or relief well elements in *RS3* and describes the functionality of each.

Embedded Wick Drain / Relief Well

Both wick drain and relief well are used to assign pore pressure or total head along the coordinates of their geometry. All nodes associated with these boundary conditions would keep these values during simulations. Note that for the **wick drain** condition, if the node has a lower value than the assigned boundary condition, it will automatically ignore the condition.

Both wick drain and relief well are mesh-independent groundwater boundary conditions. To simulate these conditions, RS3 uses embedded elements, which do not conform to the mesh. This simplifies meshing requirements and increases computational speed. Nodes are introduced at the intersections of the embedded elements and tetrahedral elements. The formulation of the embedded element is similar to the original element except that virtual nodes are linked to the parent element as shown in Figure 1.

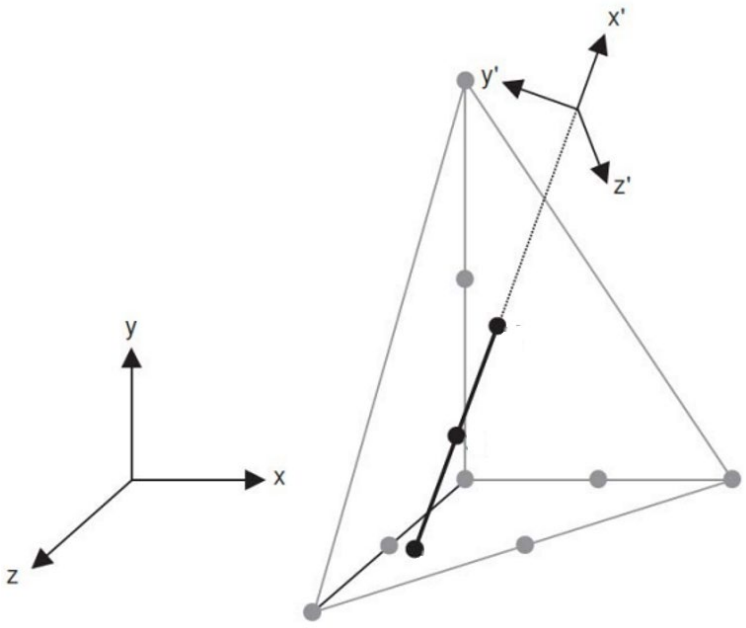

Figure 1 - Geometry of an embedded 1D element.

The derivative matrix (B) of an embedded element is derived from the B^b matrix of the 1D element and the mapping matrix N^{bs} by the relation:

$$B = N^{bs} B^b$$

where B^b is the matrix of the 1D element and N^{bs} is the mapping matrix from the 1D element to the parent element. The mapping matrix is derived from N_i^s by the relation:

$$N_i^{bs} = N_i^s$$

where N_i^s are the shape functions of the parent element at node i.

The permeability matrix of the embedded 1D element (H) is then derived using the following expression:

$$H = \int B^T \mathbf{k}\, B$$

where $\mathbf{k}$ is the permeability of the wick drain/relief well if this value is entered by the user, otherwise, the program uses the permeability of the soil surrounded by the wick drain/relief well.

The permeability matrix can then be calculated numerically using Gauss integration or Lobatto integration scheme.