CUSTOMER SUPPORT NOTE

Using background grids

Note Number: **CSN/LUSAS/1007**

This support note is issued as a guideline only.

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1. Introduction

This support note describes how to use a background grid to control the mesh discretisation over a surface. This is normally used with irregular surfaces which require more dense areas of elements in some parts of the model.

2. Description

2.1 General

Background grids define a network of points which control the mesh spacing and enclose the surface to be meshed. The points have an element size associated with them by assigning point mesh datasets to the points forming the background grid. Mesh spacing at points inside the grid (forming the surface) is then interpolated between those specified for the background grid.

A background grid is composed of tetrahedral "shapes" which completely surround the surface to be meshed. The number of shapes in each of the X, Y and Z directions is specified from the background grid dialog.

2.2 Planar surface example

A mesh discretisation may be required for a planar surface such as that below, where the discretisation in the top left-hand corner is fine and that in the bottom right-hand corner is coarser:
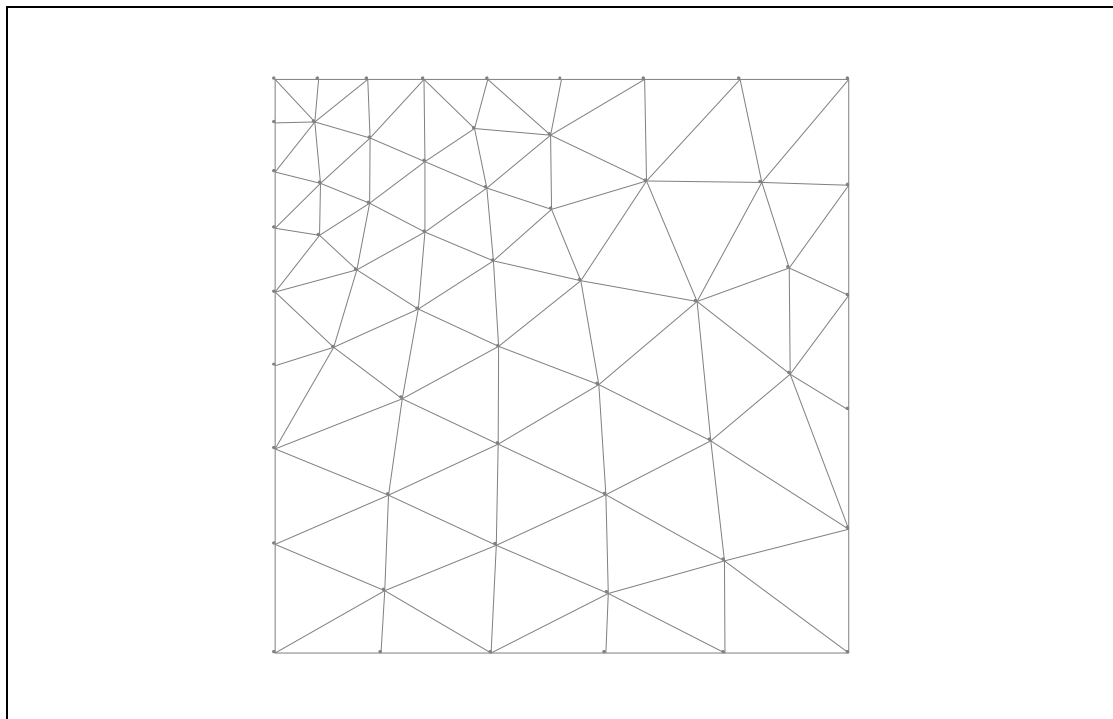

Figure 1: Required mesh discretisation

It has been assumed that a planar surface has been created in the XY plane of length and width 10m.

2.2.1 Defining the background grid

The first stage is to define the background grid using the menu command **Utilities > Background grids…** In this simple example a single background grid element will be used in each of the X, Y and Z directions by entering 1, 1 and 1 in each of the relevant boxes within the dialog. A suitable name should be given to the background grid being used. Pressing OK will then result in a background grid comprised of four tetrahedra being displayed in the graphics pane as shown in Figure 2. The "Background Grids" layer will appear in the layers tab and the background grid details will be contained within a Utilities dataset.
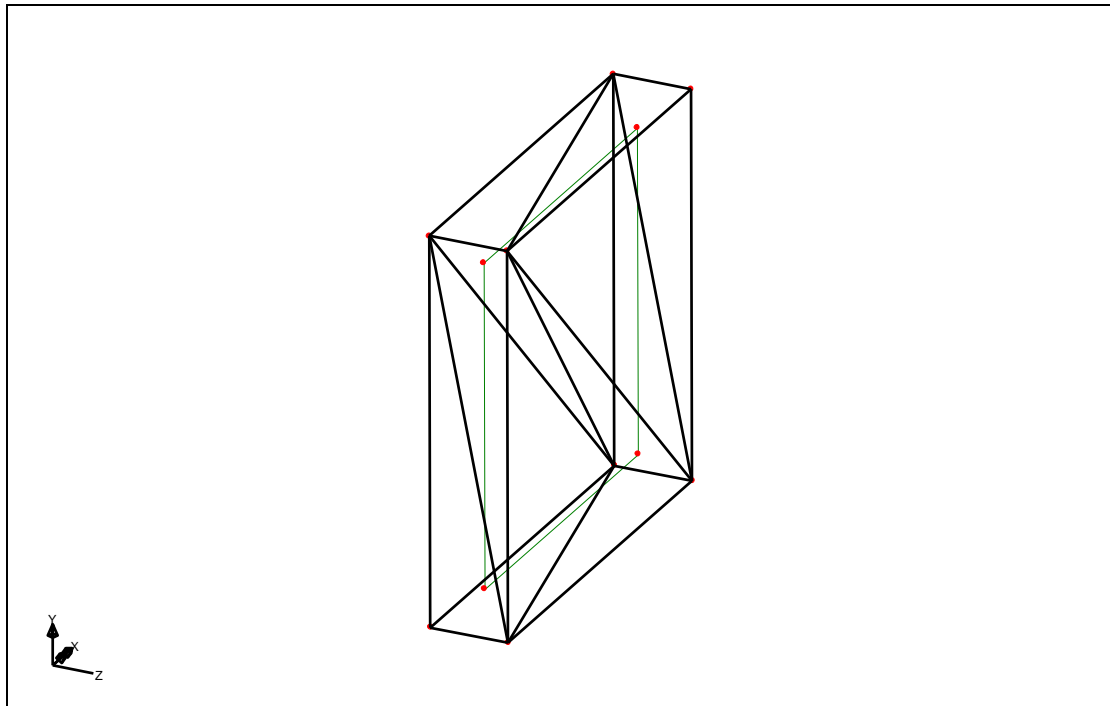

Figure 2: Model surface enclosed by the Background Grid

2.2.2 Defining/assigning point meshes to the background grid points

The spacings of the points on the grid are specified using point mesh datasets (a point mesh dataset has a box in the form for an "element size"). This spacing parameter controls the length of an element side at that point in space if the stretching parameters are used with their default settings. The stretching parameters control the element distortion in the directions specified by the stretching vectors.

A mesh size of 0.5 is required at the top-left corner and therefore a point mesh dataset is defined with an element size of 0.5. The point mesh dataset should be assigned to the two points forming the top-left corner of the background grid. A mesh size of 2.0 is required at the top-right and bottom-left corners of the background grid and therefore a point mesh dataset is defined with an element size of 2.0 and assigned to the relevant four points. Finally a point mesh dataset is defined with an element size of 2.5 and assigned to the two points forming the bottom-right corner of the background grid.

The default stretching parameters and stretching vectors should be used for all point mesh datasets in this simple example. These parameters can stretch the lengths of the elements in two different directions. For example if the following data was used:

1st stretching parameter = 1

1st stretching vector = [1 0 0]

2nd stretching parameter = 2

2nd stretching vector = [0 1 0]

The above would lead to a mesh in which the elements were twice as long in the y direction as in the x direction.

2.2.3 Defining and assigning the surface mesh

A triangular surface mesh is then defined and assigned to the model surface by highlighting the surface and dragging the mesh attribute onto the graphics pane in the normal way (note that an irregular mesh must be specified for background grids to work). A dialog box will then appear regarding whether the mesh spacing should be specified using the mesh dataset in question or from the background grid defined. If the background grid method is chosen the mesh discretisation shown in Figure 1 will be created.

2.3 Curved surface example

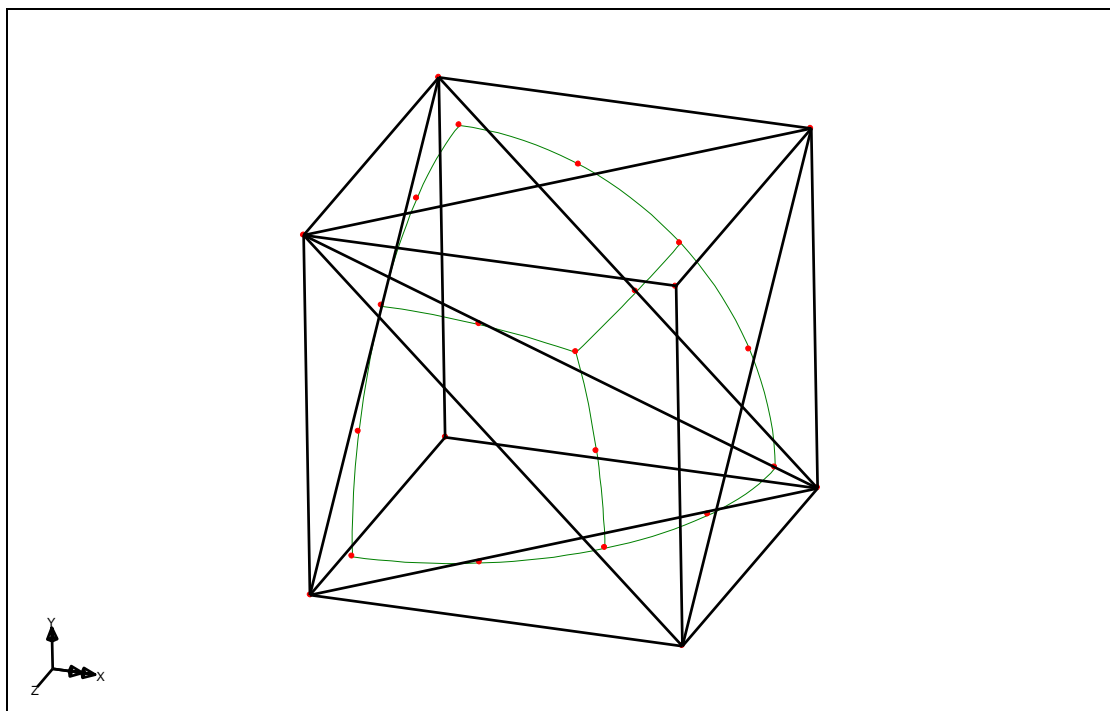The background grid technique can be applied to curved surfaces as well as planar surfaces.

Figure 3: Background grid used with 3 curved surfaces

Figure 3 shows a background grid surrounding three curved surfaces. Assigning point mesh datasets of differing divisions to the relevant points of the background grid and then meshing the surfaces with shells can produce a mesh such as that shown in Figure 4.
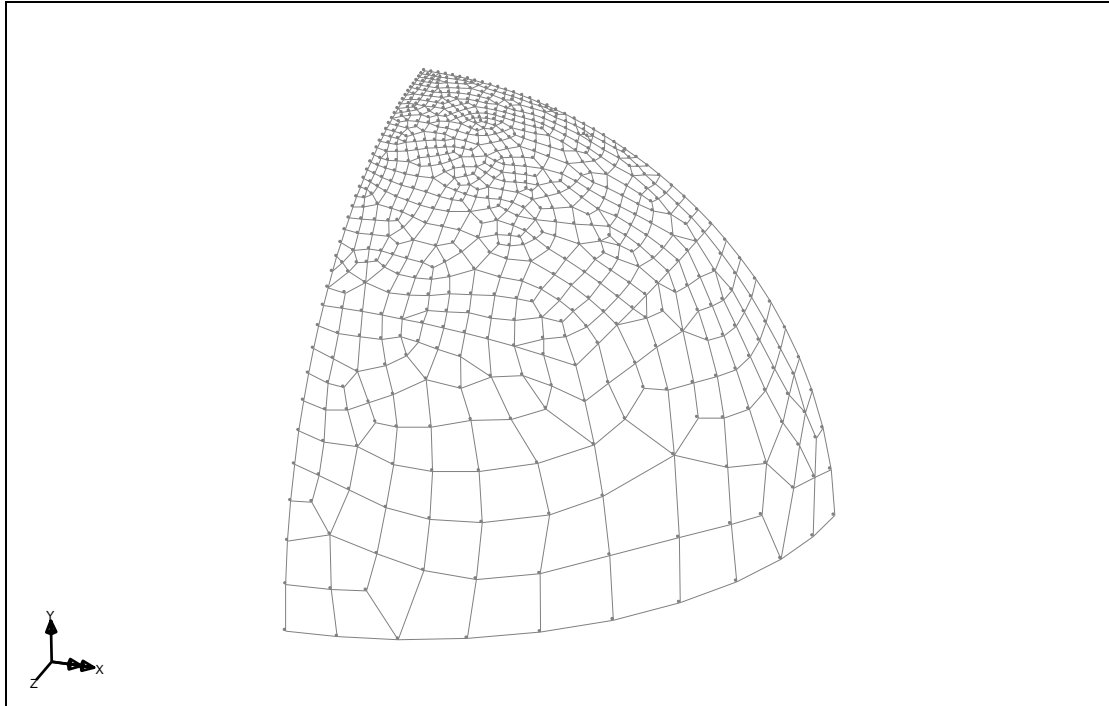

Figure 4: Curved surfaces meshed using the background grid