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# TUTORIAL FOR THE EXAMPLE: COLLISION OF VCROSS UNIT IN 3D

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The problem addressed in this example is of direct relevance to the design and application of concrete armour units. The stresses generated when a unit is dropped onto a massive anvil using the contact detection and contact interaction features of FEMDEM provide an informative test case for the numerical methods. The geometry tested is flat-on-flat, a worst case scenario, but it would be possible to set up alternative impact configurations. Figures 1 and 2 illustrate one hypothetical unit which only exists in a virtual sense for the purpose of providing a non-commercial test case. It is termed the Vcross unit and suggest comparing it with a revised bulkier geometry called the VRcross unit treated in another example (\VGW_QMULIC\DEV\Y3D\Examples\VRcross). The engineering significance is discussed in publications.
To run this example double click on RunY3D.bat located in the folders: "\VGW_QMULIC\DEV\Y3D\Examples\\Vcross".

After running the above example, Y3D will produce a series of output files with extension .ym. Double click on ConvertResultsToVTU.bat, these ym files are converted into VTK format files with extension .vtu. These vtu files can be postprocessed using the Mayavi program. Mayavi is Open Source and it has been included in the VGW package. To see more information, please visit Mayavi official website, http://mayavi.sourceforge.net/. The easiest way to start Mayavi is to double click on ViewResultsUsingMayavi.bat files.

**Postprocessing in Mayavi:**

The results are postprocessed using the Mayavi program. To visualize results, several simple operations are described as follows

**Visualizing animations** To visualize animation, just left click "configure data" in top of left panel, a window, "Configure VtkXMLDataReader module" appears. Then click "auto sweep" box, you can watch you results frame by frame.

**Zooming in and out** To zoom in and out of the scene, first you place the mouse pointer inside the right visualization window. To zoom into the scene, you can keep the right mouse button pressed and drag the mouse upwards. To zoom out of the scene, you can keep the right mouse button pressed and drag the mouse downwards.

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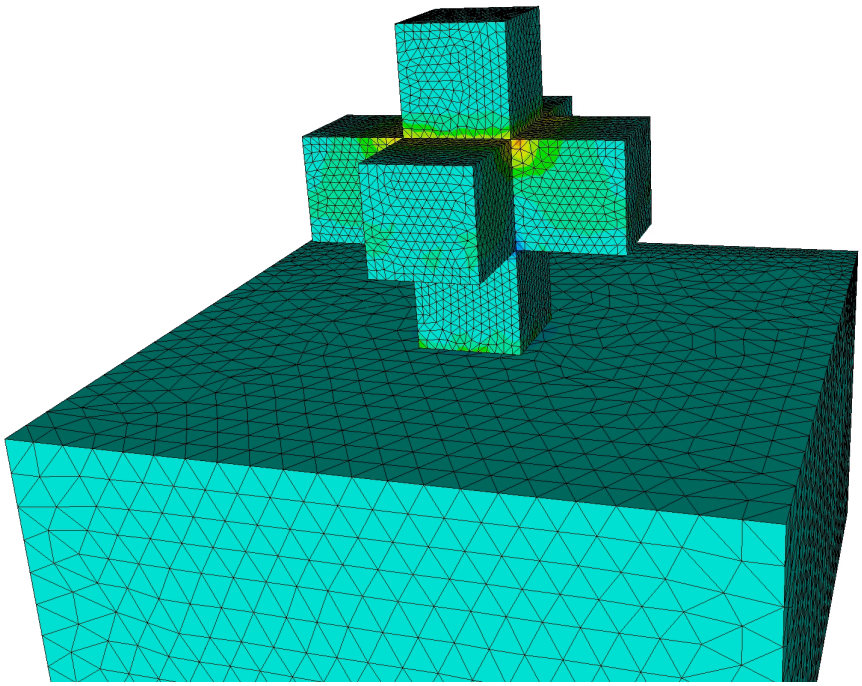

Figure 1 Geometry and mesh used to model impact by drop of concrete unit on massive concrete anvil

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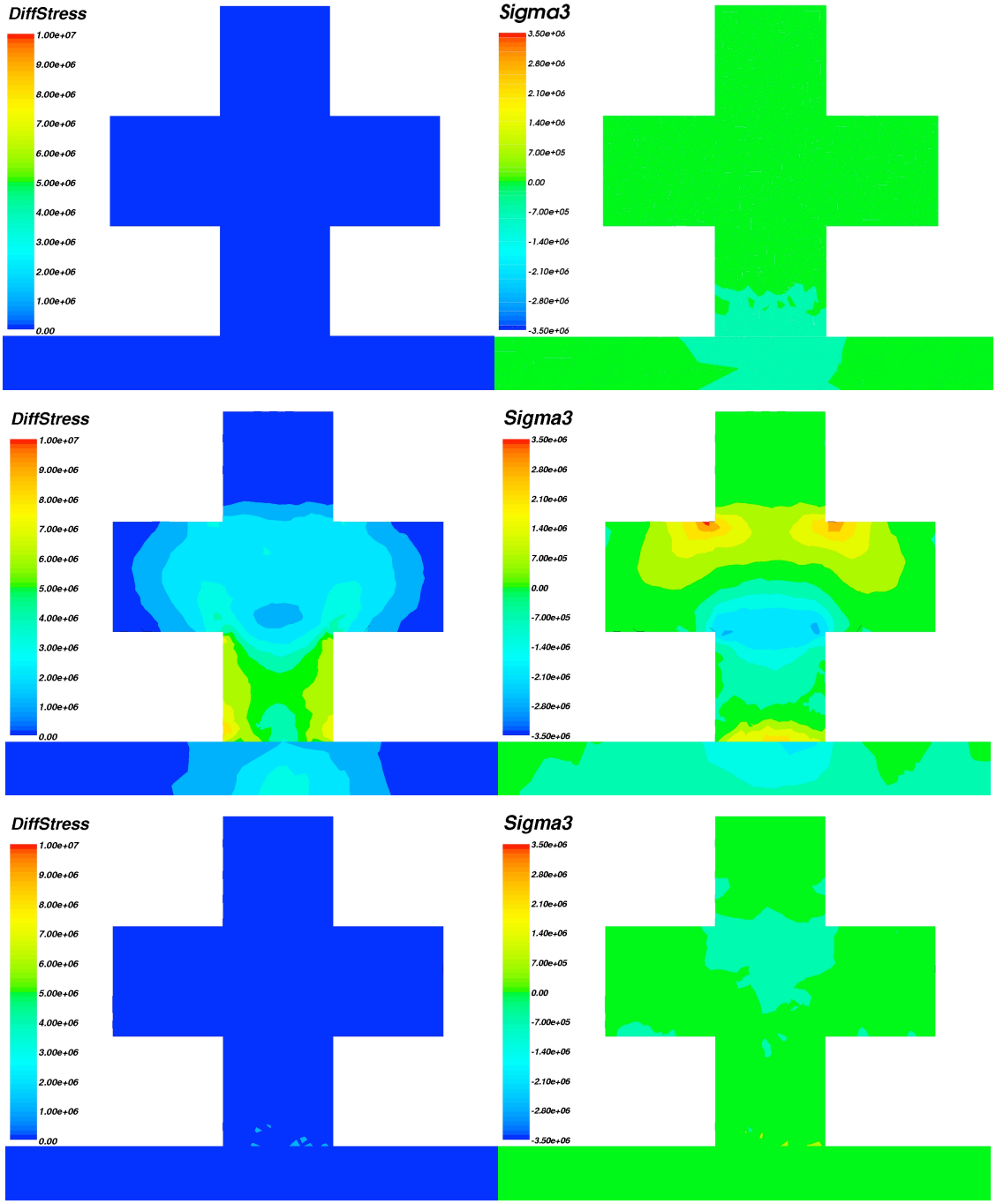


Figure 2. Vcross unit of 14 $m^3$ volume and height of 3.78 m. Simulation results are for a vertical impact of the unit striking normal to a massive anvil at 0.5 $ms^{-1}$ using FEMDEM. (a) just after the impact; (b) instant when highest stresses are developed; (c) instant just before unit bounces up and leaves the anvil. The values in (a), (b) and (c) show the differential stress ($\sigma_1$-$\sigma_3$) with a scale from 0 to 10 MPa and (d) (e) (f) show least principal stress ($\sigma_3$) with tensile stress positive on a scale from -3.5 MPa to +3.5 MPa. Maximum differential stress (MPa), maximum tensile stress (MPa), time after impact (milliseconds) are: (a) 0.96, 0.00, 2.0; (b) 8.77, 3.89, 4.6; (c) 1.49, 1.02, 6.7.