field computations involving objects of arbitrary shape

FEKO

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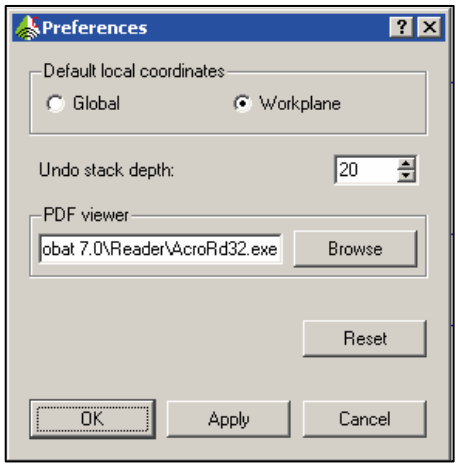
The CADFEKO workplane and what it can do for you

CADFEKO, the CAD geometry interface for FEKO, launched in July 2005 is designed to be a workplane driven CAD GUI. If you are not yet using the workplane, by the end of this article, you will know why it will simplify your geometry creation process and increase your model building efficiency.

If global coordinates are used to construct primitives in CADFEKO, then the orientation of the new entity is fixed. For instance, if geometry is being entered in global coordinates, then a cylinder is defined by a circle in the XY plane, extruded by a height parallel to the z-axis. To re-orientate this cylinder, transforms could be used, but this solution is not the preferred way of doing it. Rather, objects that don't lie in the XY plane should be constructed after repositioning the workplane. This article should be read while following the steps in CADFEKO. A short video clip of this article is also available from the FEKO website (www.feko.info).

To use workplane coordinates in CADFEKO, you need to set the correct option. Open CADFEKO and select Options -> Preferences from the menu structure. Select the *Workplane* option in the *Default local coordinates* group.



To illustrate the use of the workplane, a simple geometric entity will be constructed. It consists of a hollow octagonal prism, 2 units wide at the base, 1 unit wide at the top, and 1 unit high is constructed with a T-shaped slot cut into one of the diagonal faces. All surfaces of the structure are PEC. A drawing diagram of this structure is shown in Figure 1.

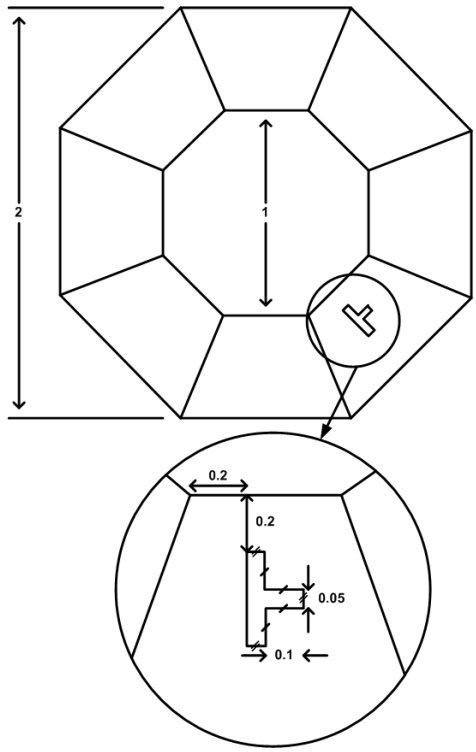


Figure 1: The drawing of the intended octagonal enclosure. The prism is 1 unit high, all walls are PEC and the T shaped slot is cut into one of the faces with dimensions as shown.

Construction strategy

If you open CADFEKO, you will notice that there is no primitive named "octagonal prism with a T-shaped slot cut into one of the diagonal faces". This means that the structure needs to be composed of a number of simpler primitives. The choice of which primitives to use and how to combine them is called the construction strategy.

The first step would be the construction of the prism. One method would be to create each face separately using the polygon primitive. Another method would be to create the top and bottom faces, copy the edges to the geometry tree and then use the *loft* opera-

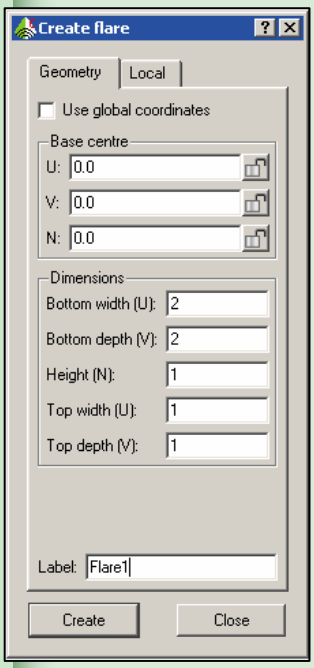
The CADFEKO workplane and what it can do for you.... continued

tion to create the remaining faces. After either of theses strategies, the *union* operation must be used to ensure mesh connectivity.

The strategy that will be illustrated in this article, is to create two square pyramids (using the *flare* primitive), one rotated 45 degrees with respect to the other, and the common volume between these two structures used to define the octagonal pyramid. To make the prism a hollow PEC structure, the properties of the interior region are changed to be the same as the external region (free space).

The slot is then added by drawing a polygon that defines the surface of the slot and subtracting it from the rest of the prism.

Creating the first flare

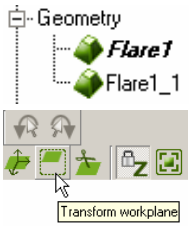


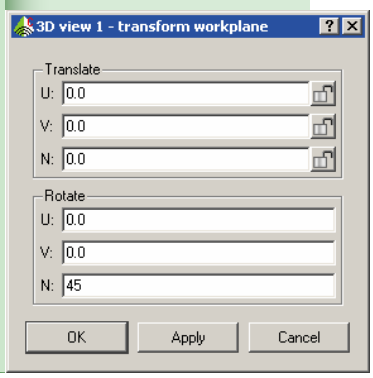
Open a blank CADFEKO model, ensuring that the preferences are properly set to use the local coordinate system. Press the 'Flare' button on the geometry creation toolbar to create the flare, entering values as shown here on the left.

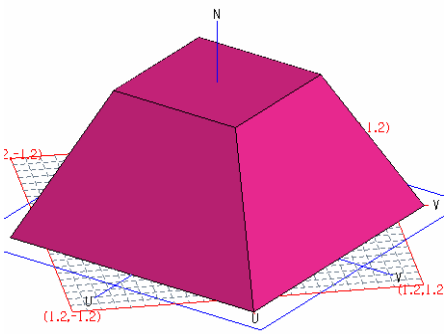
Creating the second flare

A number of techniques can be used to create the second flare. In this case the second flare is made by copying the first and changing its orientation, for the purposes of demonstrating the local coordinates of each primitive.

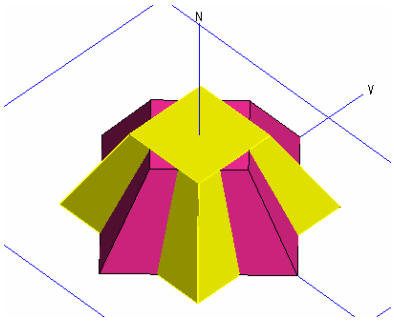
Select the first flare (you can select it in the tree or in the 3D view), and press *Ctrl-K*. Another Flare primitive is shown in the tree. The current workplane must be rotated by 45° around the N axis. To transform the workplane, select the transform workplane tool from the 3D view toolbar. Enter 45 into the Rotate group next to the entry for the N axis. The workplane will move in the 3D view.





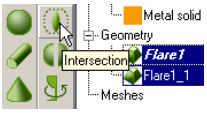


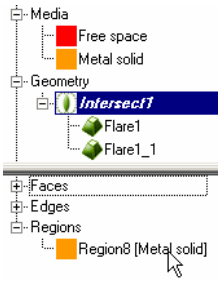
To align the second flare with this workplane, select the flare, and edit its properties. On the *properties* dialog, select the *Local* tab. This dialog sets up the local coordinate for each primitive. Press the *Set to workplane* button to align the primitive's coordinate system to the workplane. A wireframe of the modified primitive will be shown in the 3D view while the properties are edited. After accepting the changes, the two overlapping flares are now visible in the 3D view.



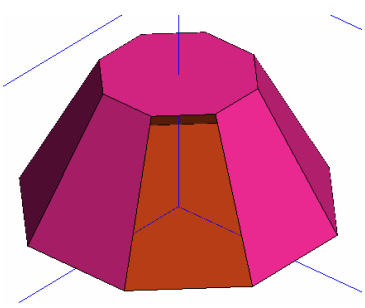
Creating the octagonal prism

The octagonal prism is now the volume which is common to both flares. Select both flares and use the *intersect* operator to obtain the octagonal pyramid. In this example, the octagonal pyramid is a hollow enclosure, not a solid. By default, all regions in CADFEKO are solid metal. To change the properties of the interior region, select the prism, expand the *Regions* branch in the detail tree, right click the region and select *Properties*. From the medium type dialog, select *Free Space* and press *OK*.





The prism is now filled with the external medium. All the faces are thin PEC surfaces. You can see this by deleting one of the faces. Switch to face selection mode, select a face, and press the delete key. You will be able to see inside the prism. Press *Ctrl-Z* to undo the face deletion.



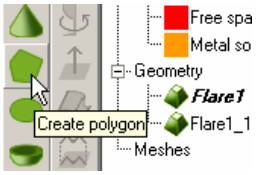
Creating the slot

The slot is a regular T shape, all dimensions having a common factor of 0.05. The slot is the absence of metal conductor in the specified shape. There are two ways to draw this slot – either by drawing the surrounding plate, or by drawing the slot and subtracting it from an existing surface. In this example, the second method is used.

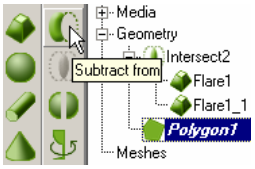
The easiest way to draw the slot is by setting the grid size to 0.05 and entering the coordinates using the mouse in the 3D view. Note that the grid doesn't lie along the intended plane for the slot. To use the workplane grid, the workplane first needs to be transformed to the correct position.

The points that are on the surface of the prism are going to be used to set the workplane. Set the snapping to geometry points (by right clicking in the 3D view). Press F9 to open the workplane edit dialog. Choose the correct face for the slot and position the workplane by selecting the top left side point of the face for the origin, top right corner of the same face for the U vector and bottom left of the same face for the V vector. From the preview screen, you should see that the workplane is now aligned with the face (you can rotate and zoom in the 3D view as normal when the workplane dialog is open). Change the grid spacing field to be 0.05 in both the u and v directions and press *OK* to accept the new workplane. Turn on the grid so that it can be used for the rest of the entry.

Select the *Polygon* primitive and change the snap mode to *grid*. Draw the slot by selecting appropriate grid points in the 3D view. Note the green preview of the polygon while entering vertices, and that CADFEKO automatically adds new vertex points while clicking.



After closing the polygon dialog, the slot should still be selected - if not, select it. Then press the *subtract from* operator, and select the prism as the object to subtract from. The structure is now complete and ready for meshing.

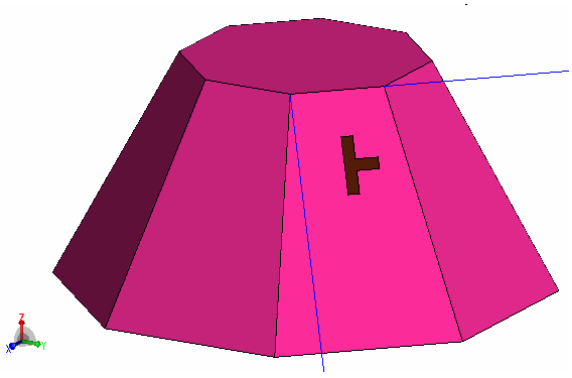


Discussion

In this article a structure has been drawn using workplanes. This structure would be more difficult to draw using any method that didn't involve workplanes.

In general all structures should be created in their intended positions by creating them using workplanes. Workplanes are also very handy ways of entering new geometry onto an oblique surface in a FEKO model, by using the points of the oblique face to enter the location and orientation of the new workplane. This was done in this example to create the slot.

If one wants to make the location and orientation of the workplane parametric, named points should be used to define the workplane. This hasn't been shown in this article, so please ask your local FEKO support if you encounter any difficulties in this regard.



7th Annual German user meeting

This year about 45 customers attended the 7th annual German FEKO user meeting on 26 October in Stuttgart, Germany. During the meeting, FEKO users contributed presentations on how FEKO is used in their companies. Contributions included the modelling of aeroplanes, dipole antenna optimisation using OPTFEKO and obstruction detection on railroads for collision avoidance with stationary vehicles.

EMSS contributed to the meeting by presenting the details on many aspects of FEKO, focussing on CADFEKO. A general discussion, including a discussion of wish-list requests, concluded the meeting.

Figure 2: Dr. Ulrich Jakobus (Technical Director EMSS-S.A.) presenting the MoM/FEM hybrid technology to the users at the meet-

News and Events

Student competition winner 2005

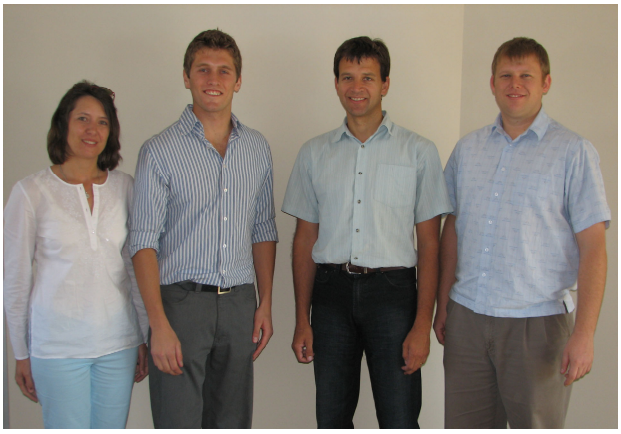
"The student competition 2005 was the toughest yet." says Sam Clarke of EMSS. In fact the competition was so steep that consolation prizes were awarded for the first time in the history of the competition.

The winning entry was from the University of Stellenbosch, South Africa. The winner is Mr. S.J. Marais, a Masters degree student, who entered his work on aperture fed microstrip antennas. He has already received his prize, an Intel Pentium-M 1.5GHz laptop.

The first of the consolation prizes goes to Rosa Mateos Navarro, from Université Catholique de Louvain, for her work on modeling of a PMC structure in FEKO. The second goes to Amit Kumar Mishra, from the University of Edinburgh, for his work on using FEKO to generate a database of Synthetic Aperture Radar (SAR) signatures for a variety of targets.

Both Rosa and Amit submitted documents of their work, which can be downloaded from the FEKO website (www.feko.info). SJ's entry is available from his website http://students.ee.sun.ac.za/~sjmarais.

Thank you to all participants, we hope to have a great competition in 2006!



Madelein O'Brien, SJ Marais, Gronum Smith and Sam Clarke at the handing over of the prize for the student competition.

Short course Feedback

FEKO Suite 5.0 presented a significant change in the way that FEKO is used. Consequently, a significant number of short courses have been hosted since this release. Great feedback has been received from users regarding how the short course has contributed to their FEKO experience. If you haven't been to a FEKO Suite 5 short course yet, you should contact your distributor and find out when another will be held in your region!

Upcoming exhibitions

Dec 4—7	Asia-Pacific Microwave Conf, Suzhou, China
Dec 6—9	Asia-Pacific Symp on EMC, Taipei, Taiwan.
Jan 17-19	MTT radio & Wireless, San Diego, California