Project Preparation

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Model

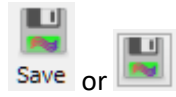The model is a parallel plate transmission line excited with a plane wave (red transmission line port) and terminated with a load port (green transmission line port) matched to the line. The transmission line is partially filled with air and concrete material.
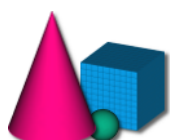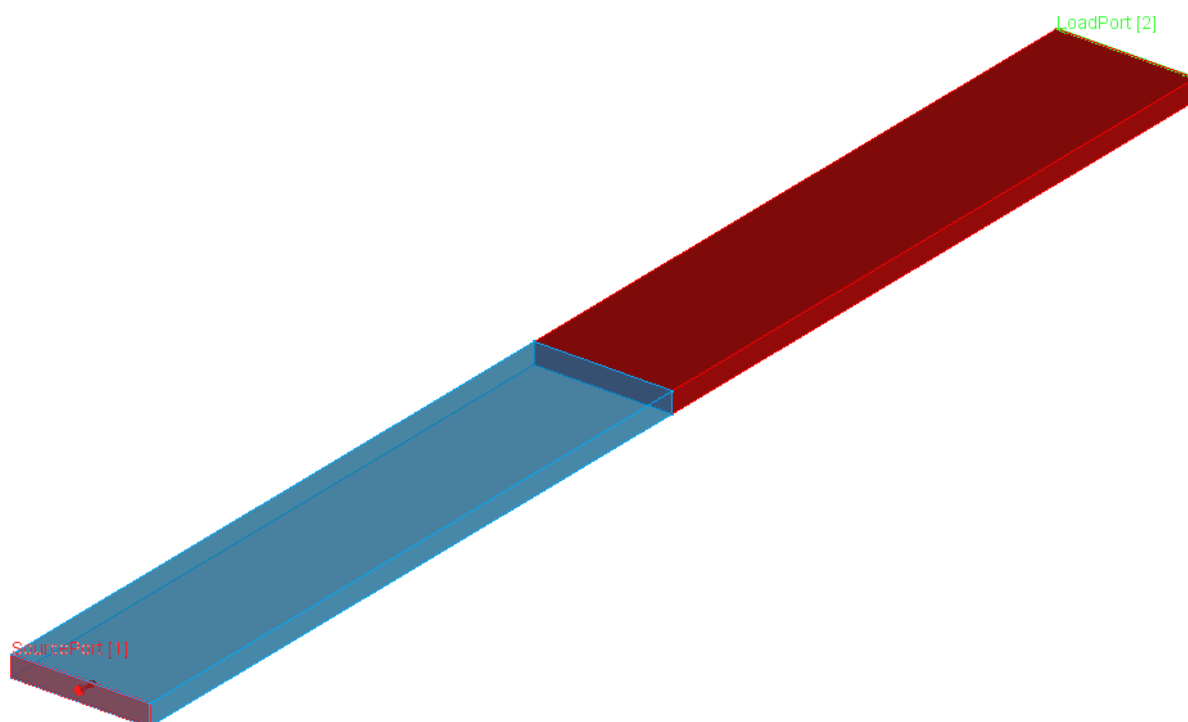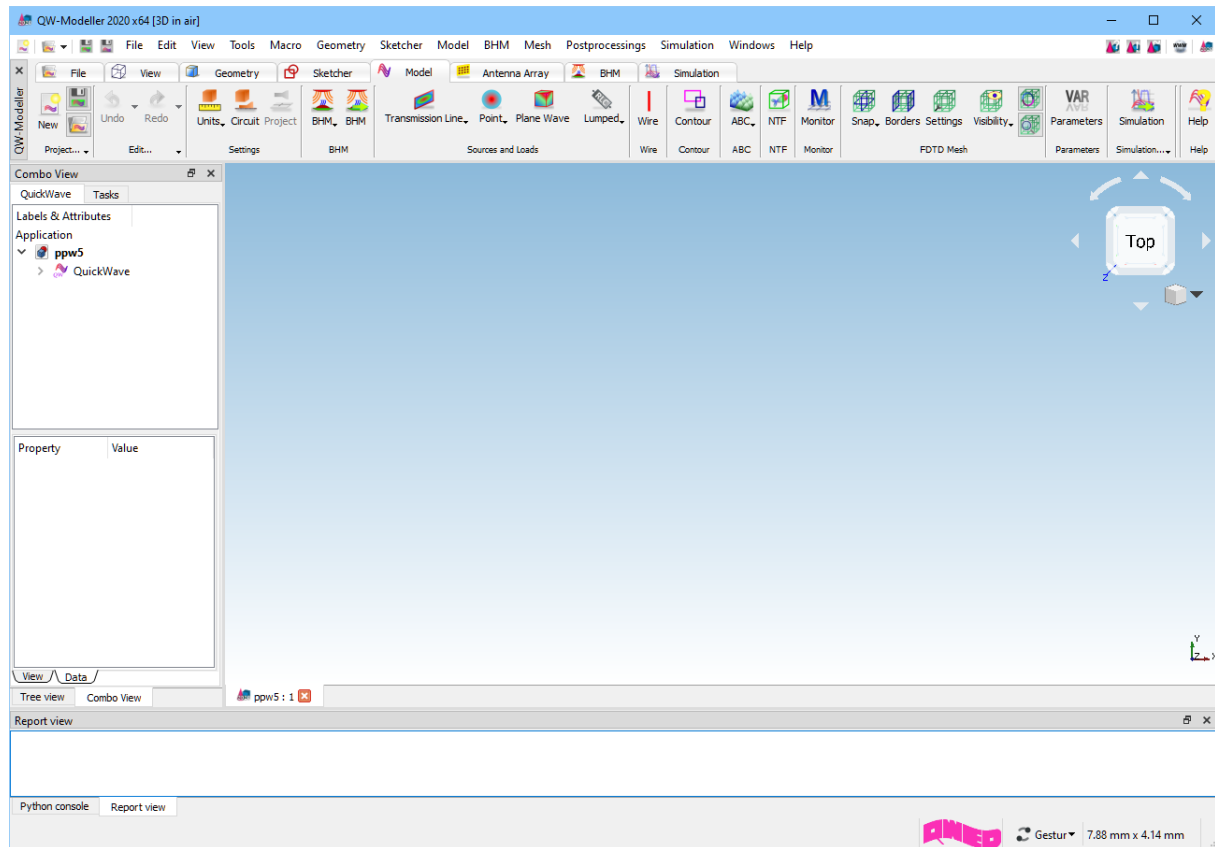
New Project

Having the *QW-Modeller* opened press New button from the Ribbon to create new project. Press

Save or button and save it with the *ppw5.QWpro* name.

Defining the type of the structure and background medium

Having the *QW-Modeller* opened and a new project document created, we can proceed with defining the type of the structure. First of all, we need to specify if we will be dealing with typical three dimensional (*3D*) or maybe periodic three dimensional (*3DP*) structures. The structure type, called also the *circuit type*, is determined in the *Circuit Settings* dialogue available in the *Model* tab, under

the *Circuit* Circuit push button. In case of our parallel plate line we will be analysing typical 3D circuit.
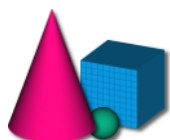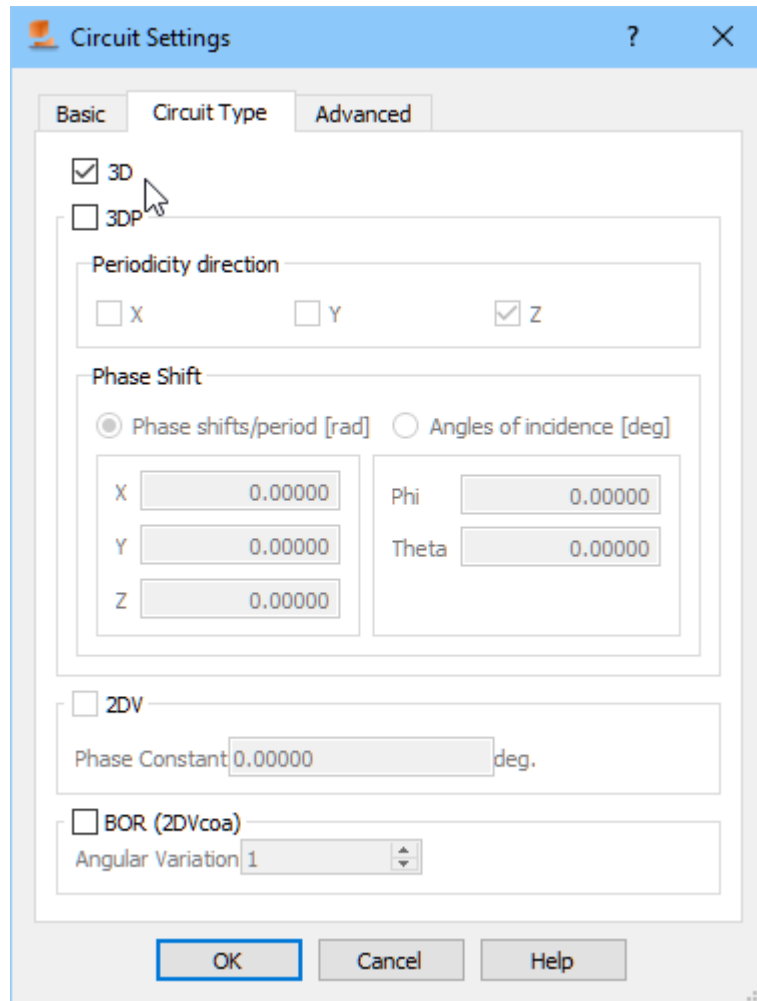
At this stage it is necessary to determine also the background medium for the structure. Since the structure is non-radiating and we are interested only in the fields inside it (it is a closed structure type of problem), we can set the background medium to metal and then draw only the inside of the structure. To set the background medium, we switch to *Basic* tab in the *Circuit Settings* dialogue and choose metal from the *Background Medium* combo box. Please note that there is a choice of only two possible background media, *air* and *metal*.
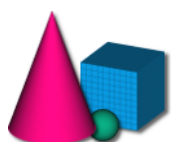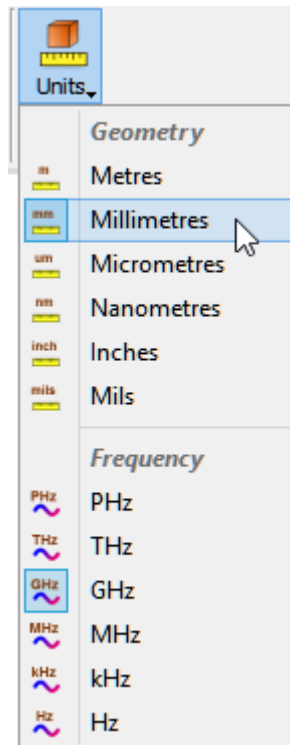
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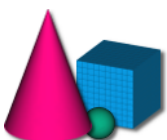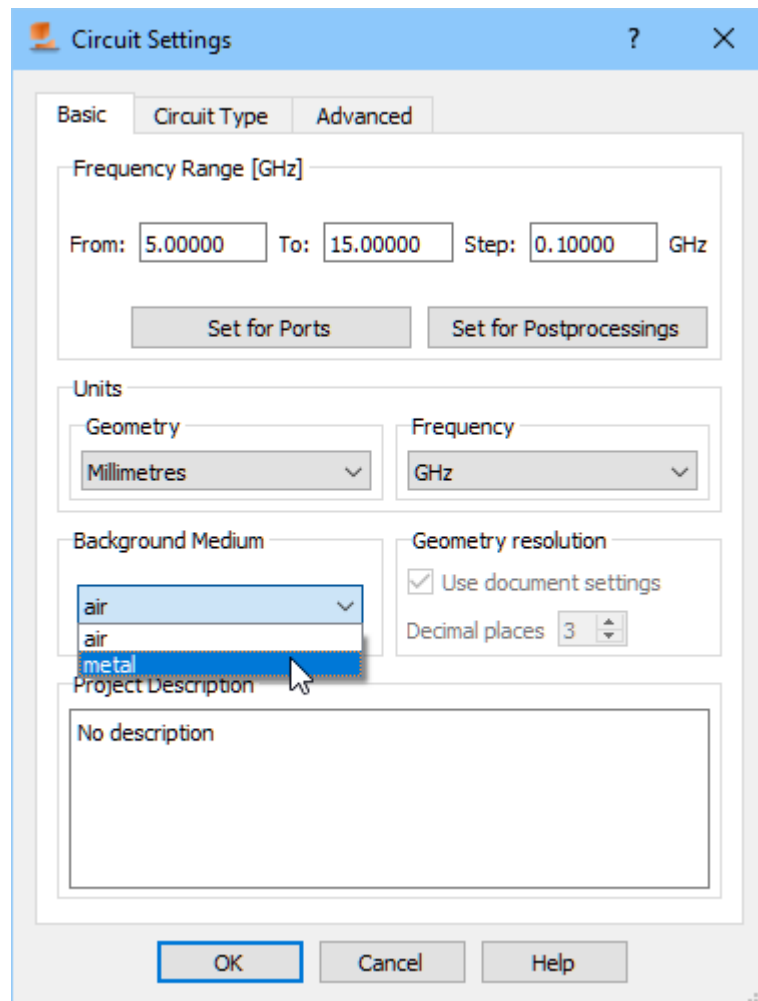
Drawing the structure

At this stage we will be creating the project geometry. First step that needs to be accomplished is choosing the units that will describe the ge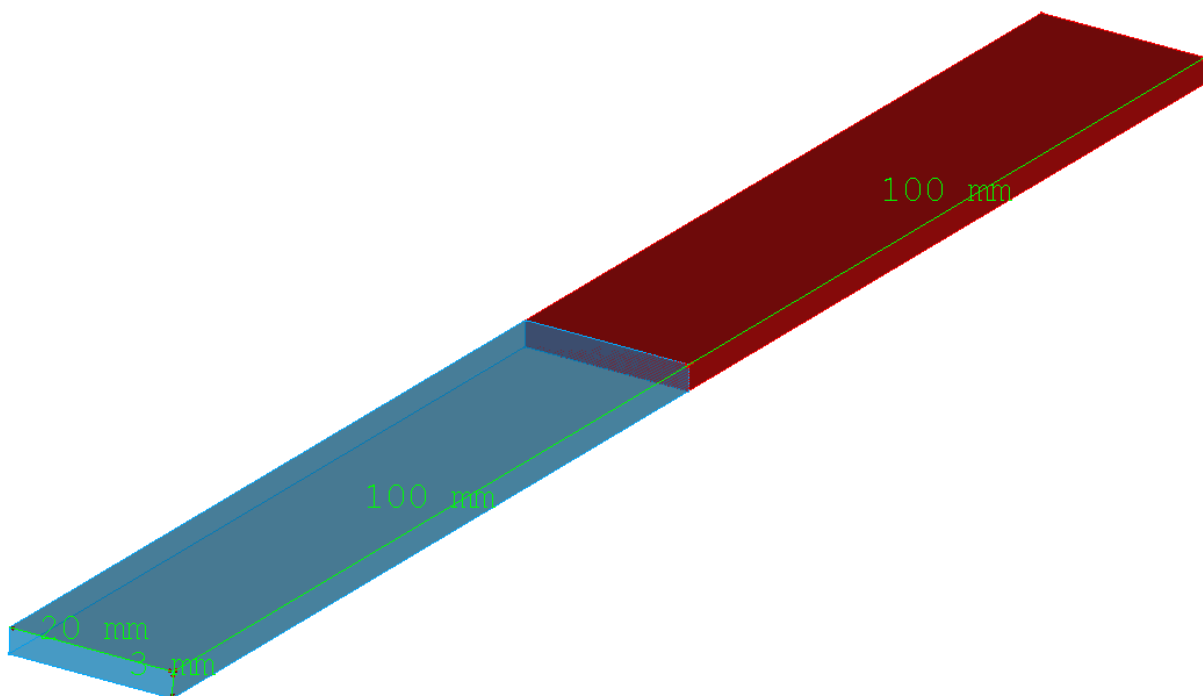ometry. To do that we go to *Model* tab and from *Units* button we choose *Millimetres*. The same can be done in the *Basic* tab in the *Circuit Settings* dialogue.

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The dimensions of the transmission line are as follow:

To draw the structure we go to *Geometry* tab. We start from drawing the transmission line inside. Firstly, the part filled with air is drawn. We need to draw only the inside of the structure (the surrounding medium is metal), thus we start from the air block, which stands for the first part of the

transmission line inside. To draw the transmission line we press *Create a Box* button in the *Primitives* section and a dialogue appears.
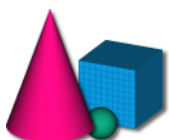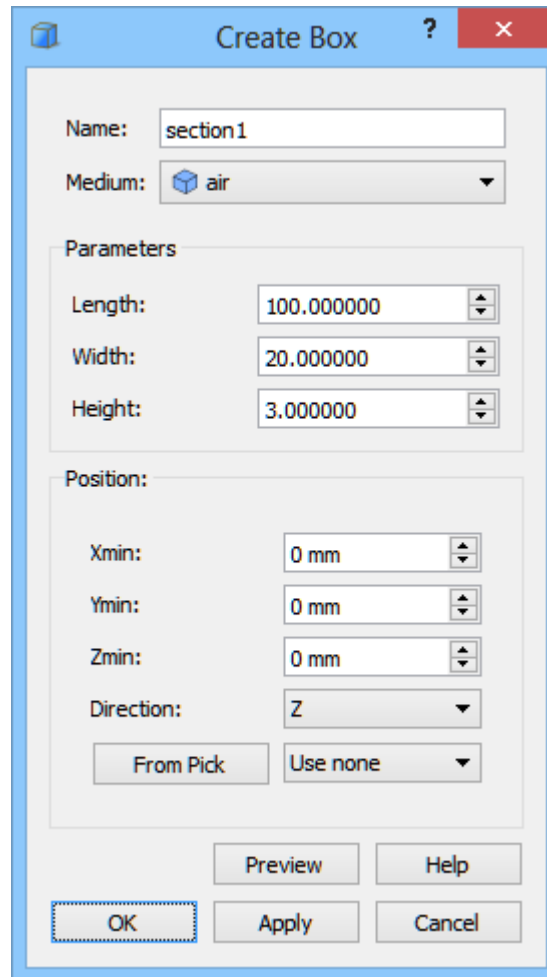
From the *Medium* combo box we choose air. Now we can proceed to setting the dimensions of the air filled part according to the picture above. With *Position* set to (0,0,0) the transmission line will be drawn so that its lower right corner is placed at this coordinates. After pressing *OK* button the air filled part appears in the project.
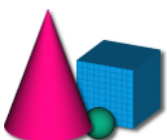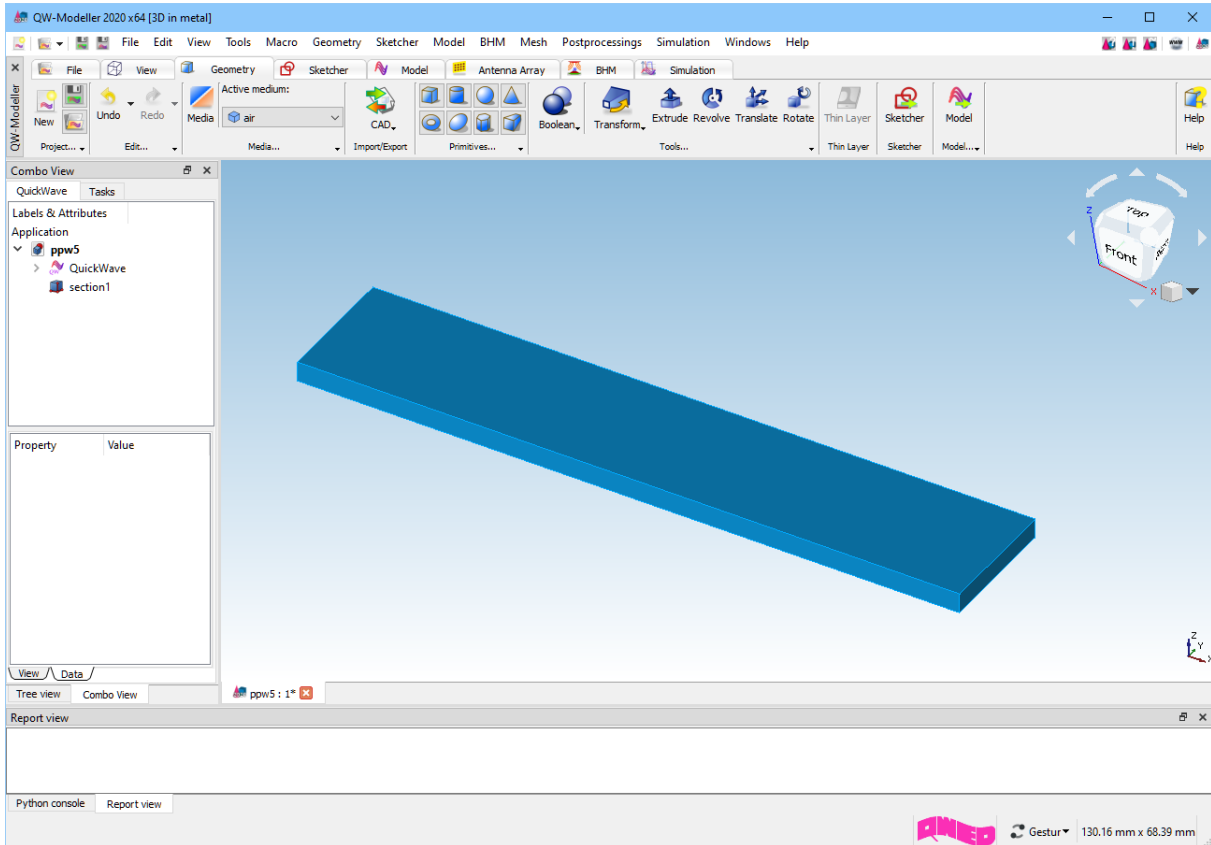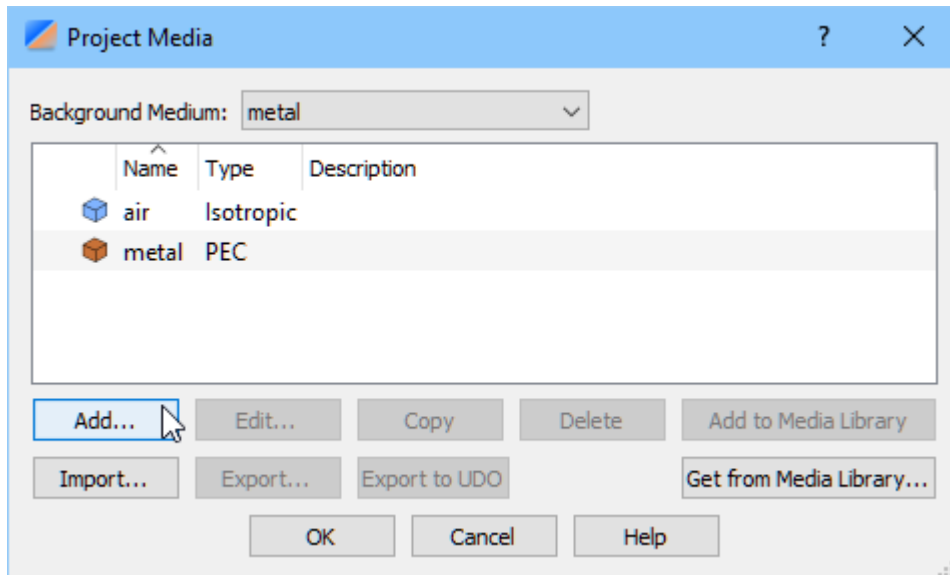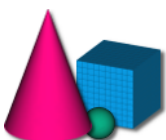
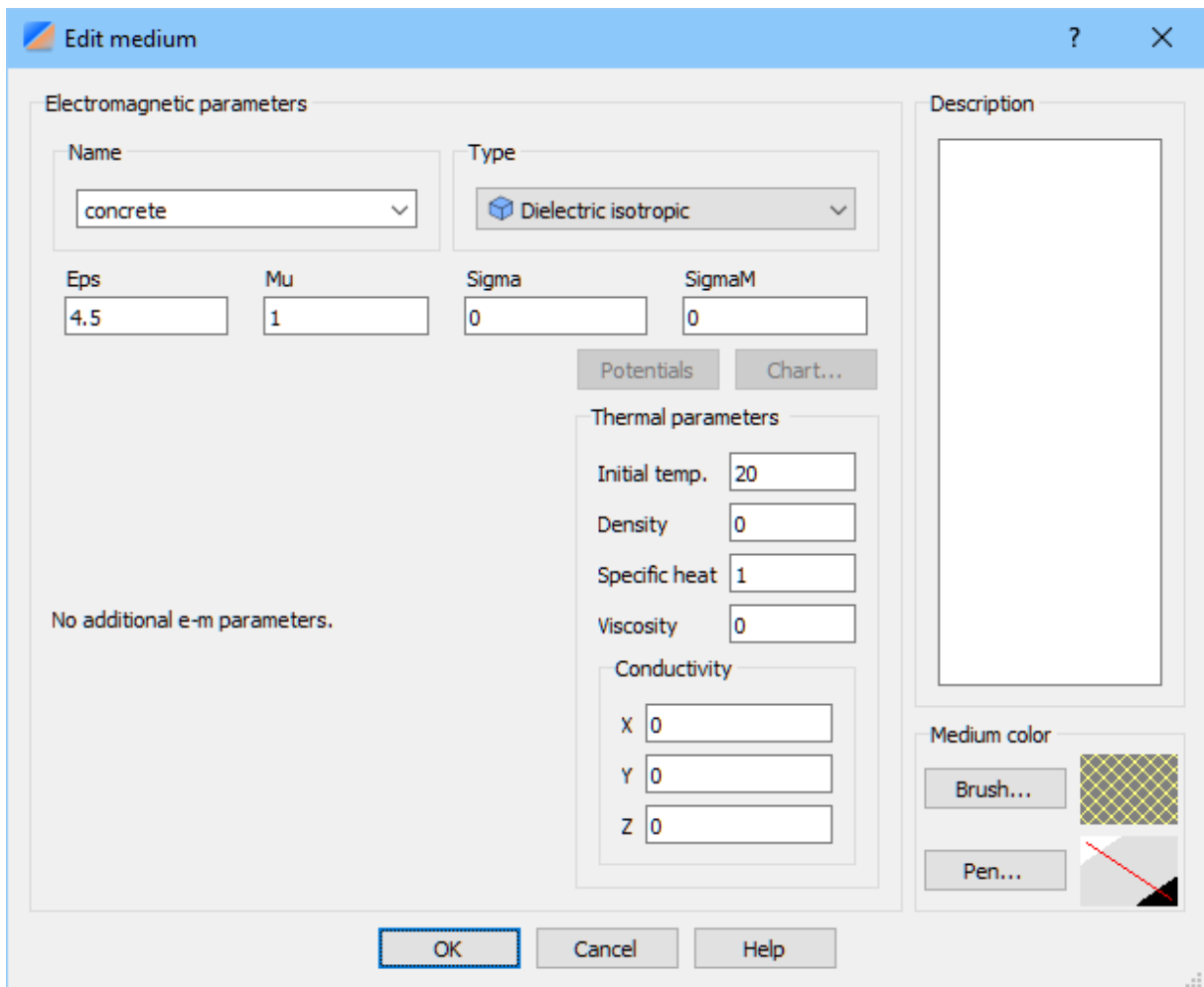Before drawing the concrete filled part it is required to define concrete medium in the project. For that purpose we press *Media* button in the *Geometry* tab and in the appearing *Project Media* dialogue we press *Add* button.

In the *Edit Medium* dialogue we set the medium name to "concrete" and its relative permittivity to 4.5. Pressing *OK* button introduces the concrete medium to the project.

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Edit medium   ?   ✕

Electromagnetic parameters   Description

Name   Type

concrete   ⌄   🔷 Dielectric isotropic   ⌄

Eps   Mu   Sigma   SigmaM
4.5   1   0   0

                              Potentials   Chart...

                              Thermal parameters

                              Initial temp.   20

                              Density   0

                              Specific heat   1

No additional e-m parameters. Viscosity   0

                              Conductivity

                                X 0

                                Y 0   Medium color

                                Z 0   Brush...

                                              Pen...

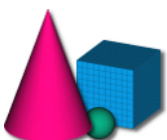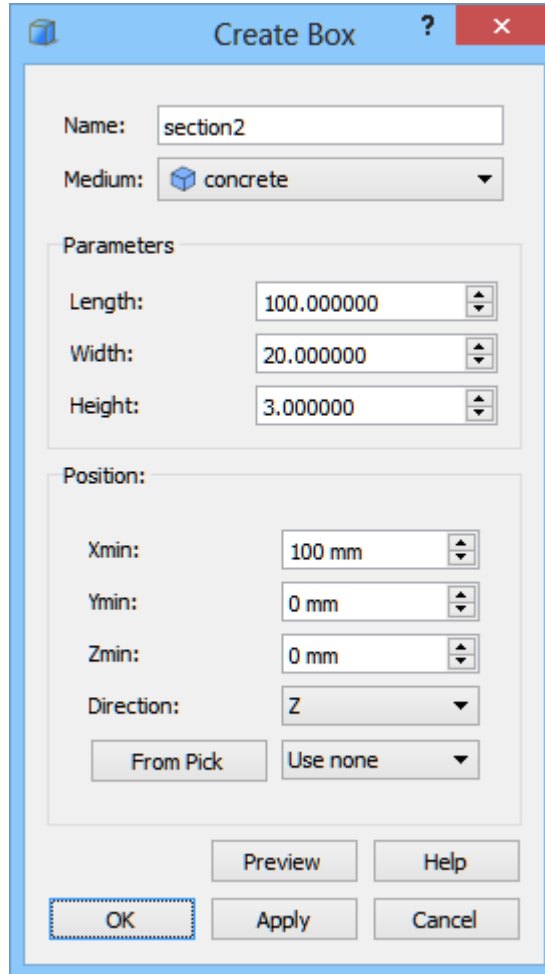   OK   Cancel   Help

We now proceed to drawing the concrete filled part of the transmission line. We press *Create a Box* button in the *Primitives* section and a dialogue appears.

The name of this part is set to "section2" and its medium is chosen to be *concrete*. The dimensions of this part are the same as in the case of air filled section. The concrete filled part is placed behind the *section1* thus its position in X direction is set to 100 mm. After pressing *OK* button the concrete filled part of the transmission line appears in the project.
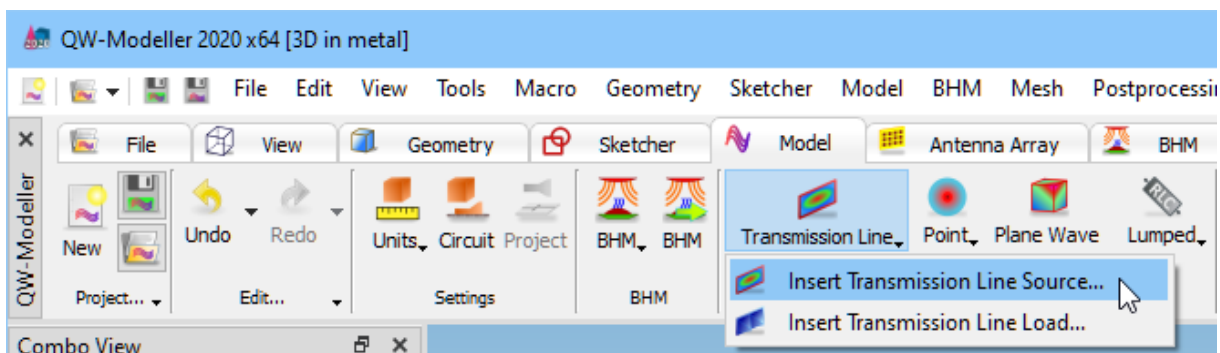
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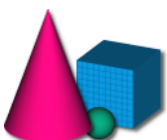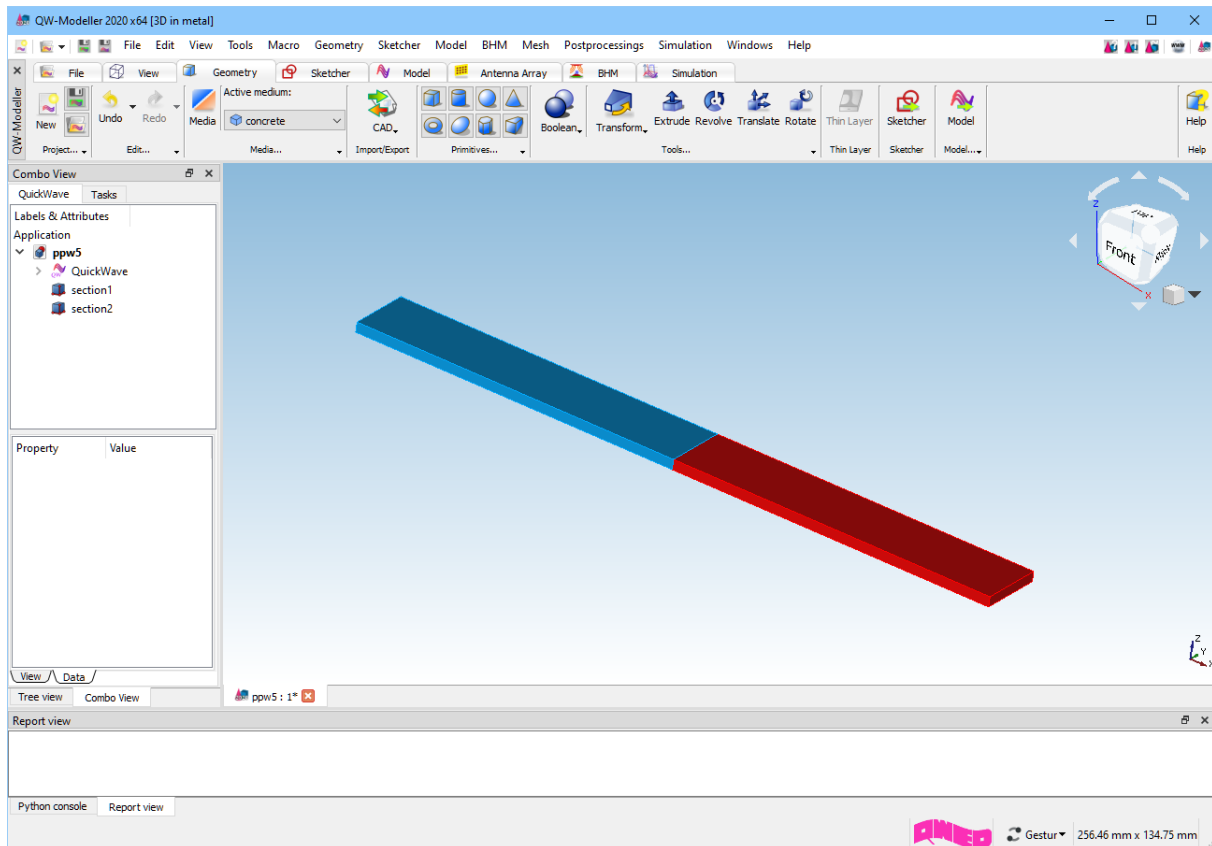
Drawing the ports

In this step we need to draw and define the ports. In this case we need to define two ports, input and output with TEM mode excitation.
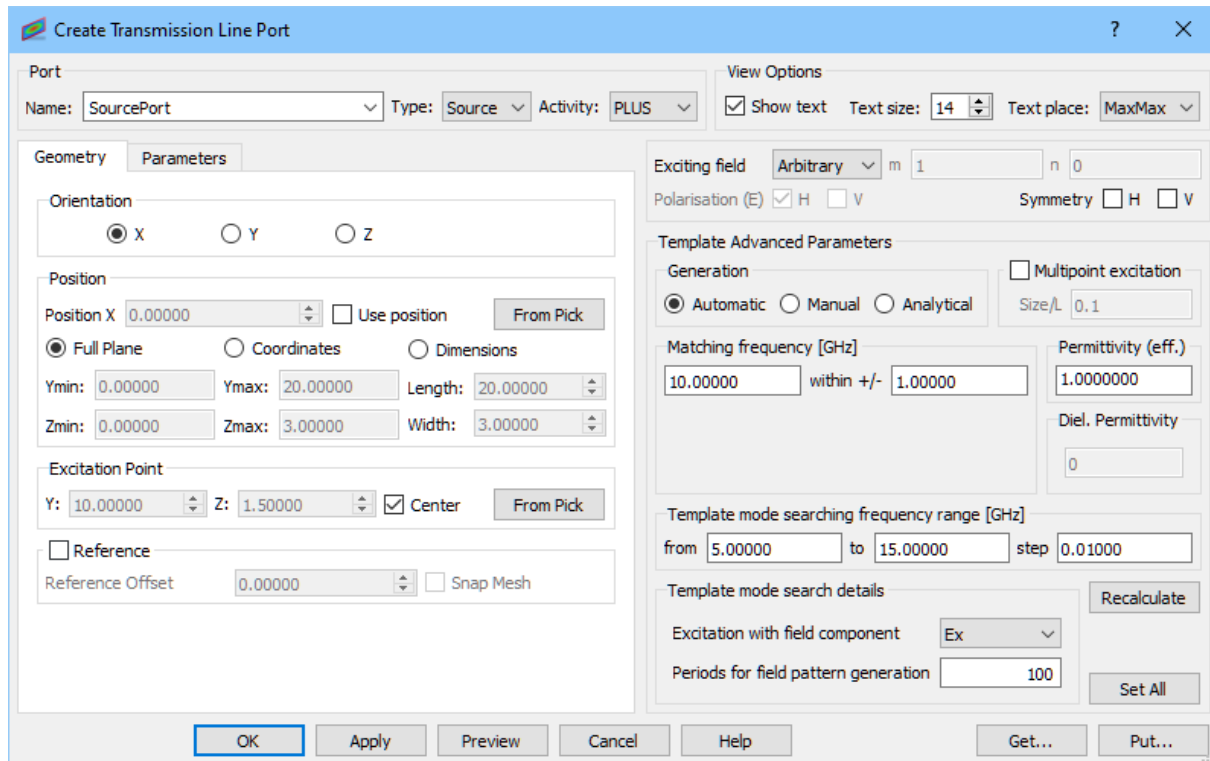
To define the ports we need to go to *Model* tab. As a first one, we will define the transmission line input port. For that purpose we press *Transmission Line* commands button and choose *Insert Transmission Line Source* command.
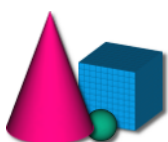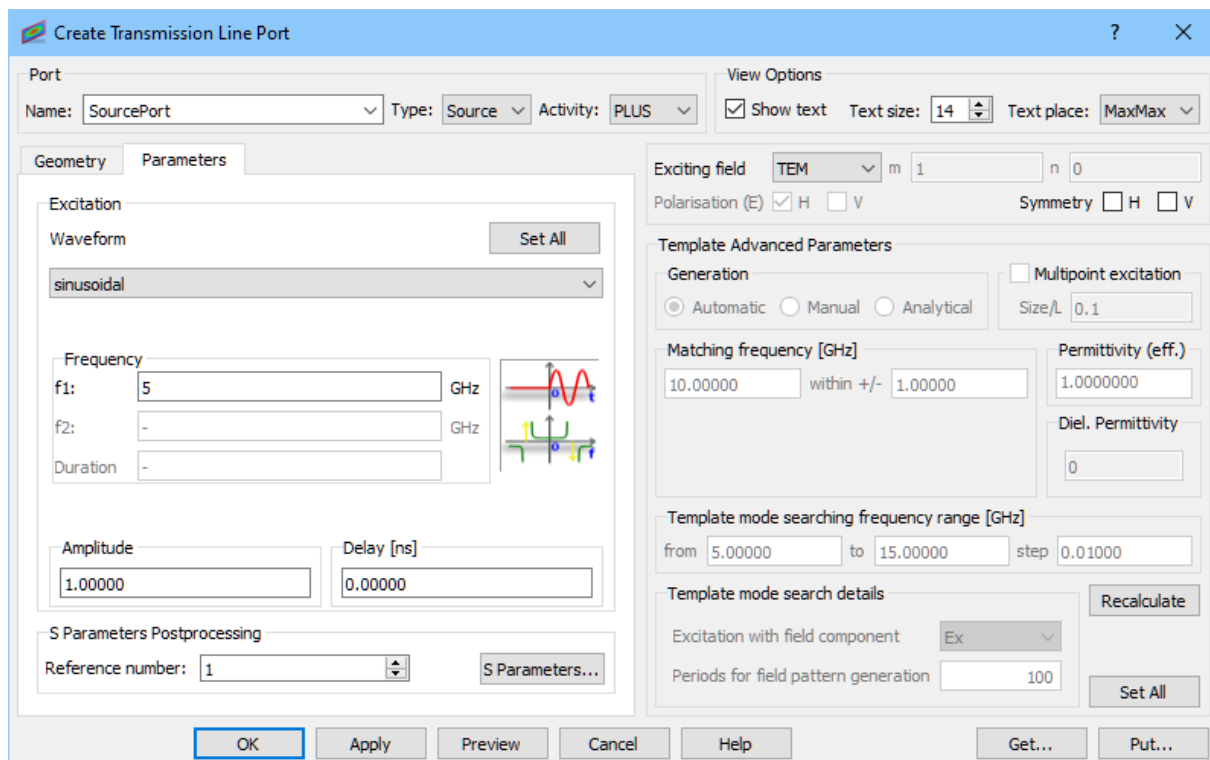

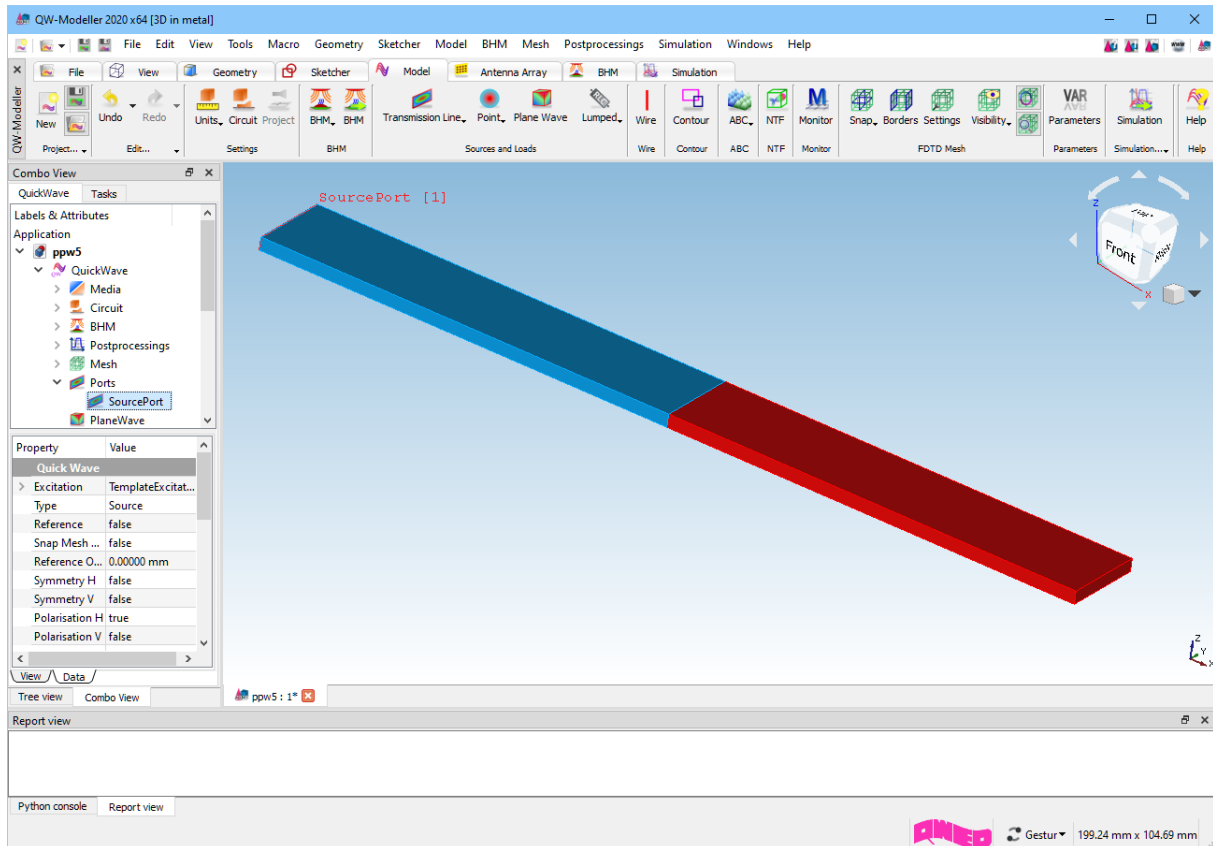The following dialogue will appear.

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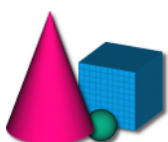
We set the name of the port to *SourcePort*. The default *Type*, *Activity* and *Orientation* of the port are properly set for this case. *Full Plane* option sets the port dimensions equal to the bounding dimensions of the entire project in the directions perpendicular to the port orientation what is suitable in this case. We uncheck the *Reference* option – it is not necessary since we do not calculate S-Parameters.
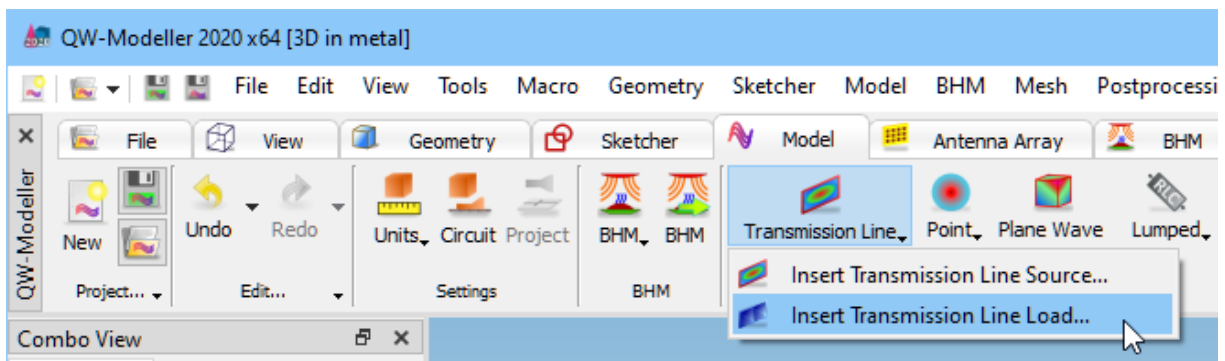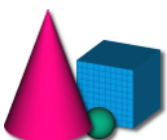
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In the *Parameters* tab we set sinusoidal excitation at 5GHz. We excite the structure with a fundamental TEM mode. Pressing *OK* button accepts the settings.
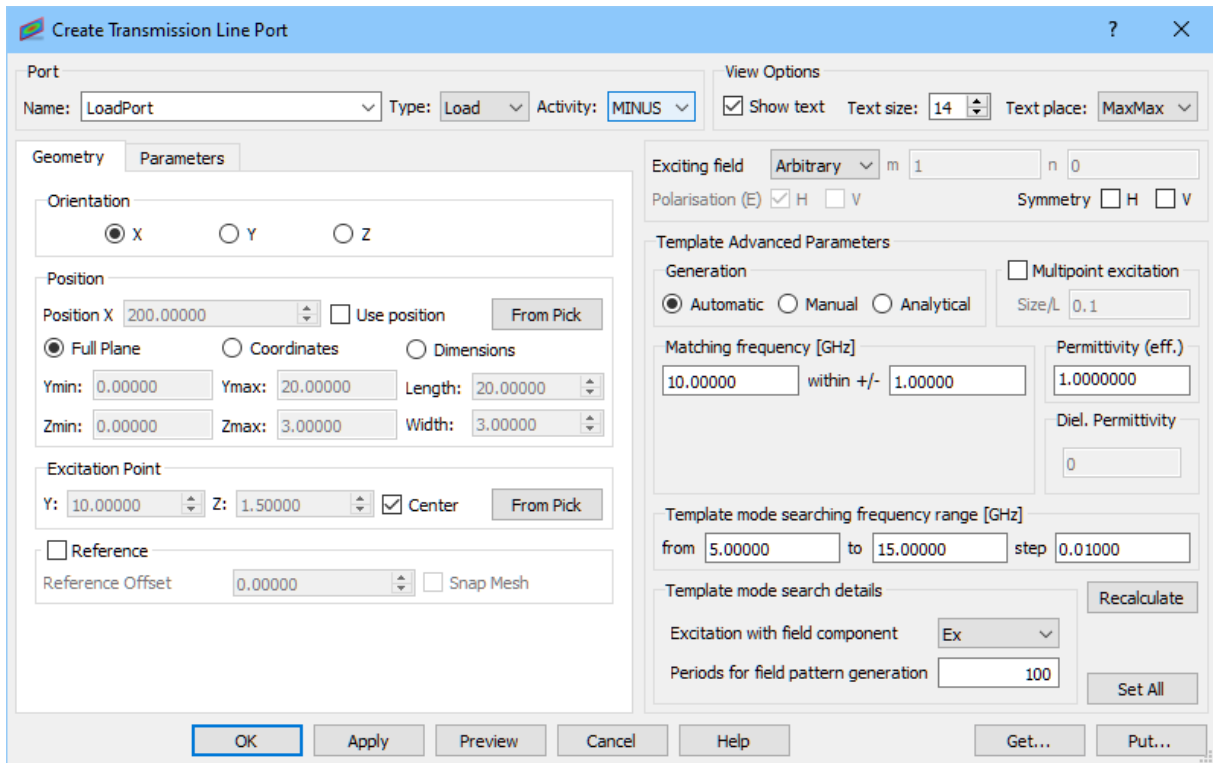

Now press *Transmission Line* commands button and choose *Insert Transmission Line Load* command.



The following dialogue will appear.

We set the name of the port to *LoadPort*. The default *Type* and *Orientation* of the port are properly set for this case. We should change *Activity* to MINUS (please note that when *Full Plane* option is checked, port will change its position to the opposite side of the project). We uncheck the *Reference* option – it is not necessary since we do not calculate S-Parameters.
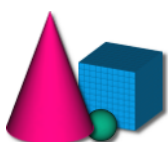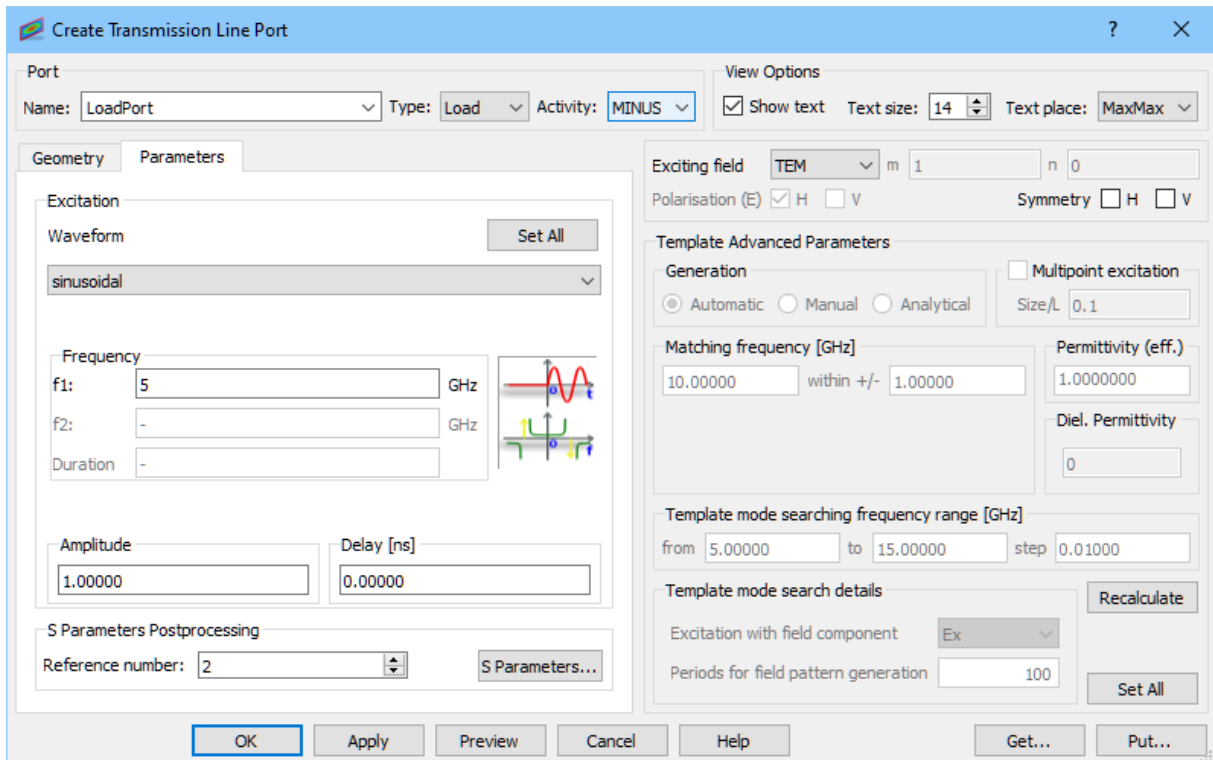
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In the *Parameters* tab we set sinusoidal excitation at 5GHz. We excite the structure with a fundamental TEM mode Pressing *OK* button accepts the settings.
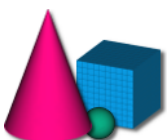
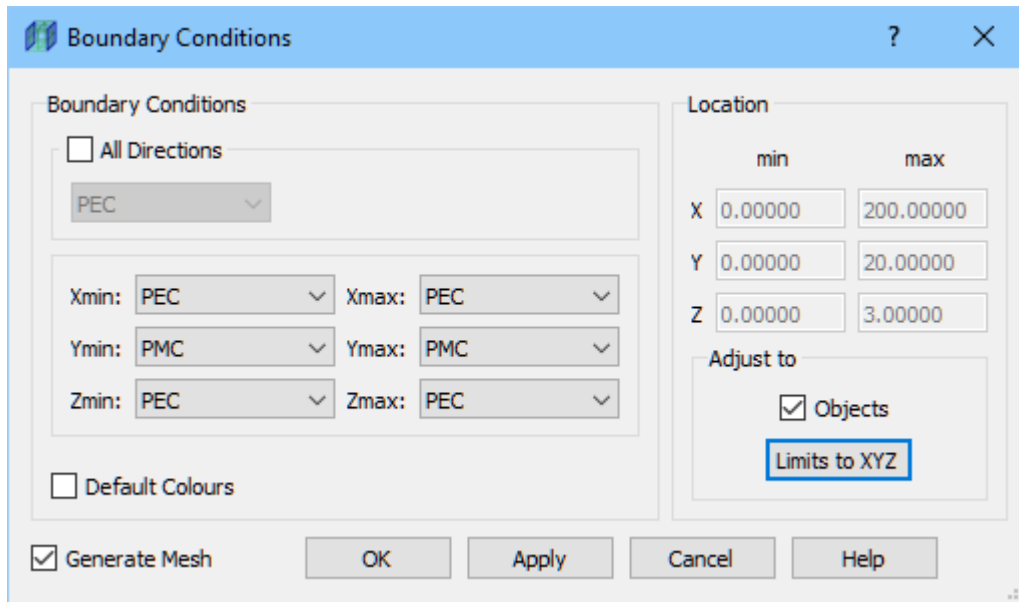The *LoadPort* can be also set by creating a copy of *SourcePort* and changing its parameters.
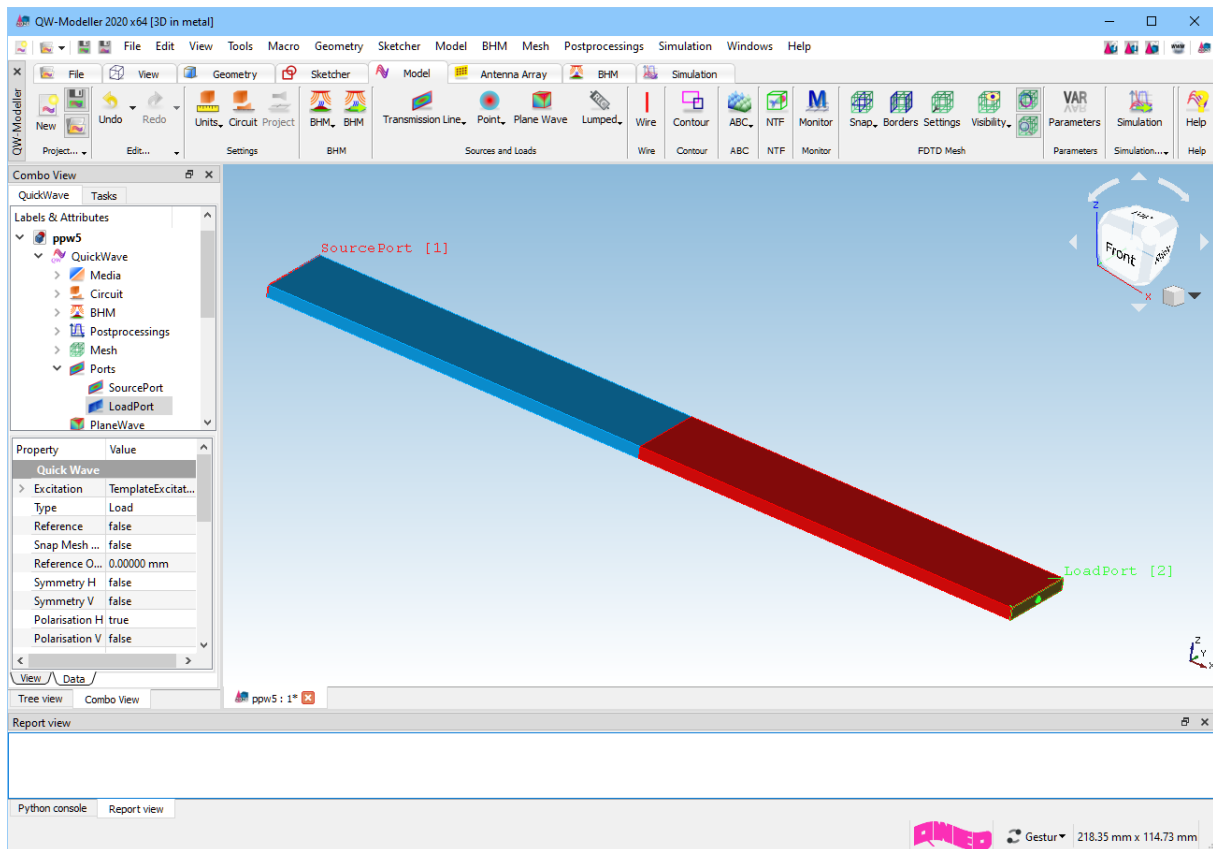
Setting boundary conditions

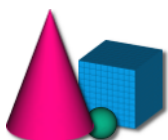In the *Model* tab we press the *Borders* button. The *Boundary Conditions* dialogue will appear.

In the *Boundary conditions* frame we uncheck the *All* directions check box and we set *Perfect Magnetic Conductor* (*PMC*) for *Ymin* and *Ymax* positions and *Perfect Electric Conductor* (*PEC*) for the rest and press *Apply*. Please note that boundary conditions' indicators are visible when *Boundary Conditions* dialogue is opened or when visibility for *Computational Borders* is enabled. We will make
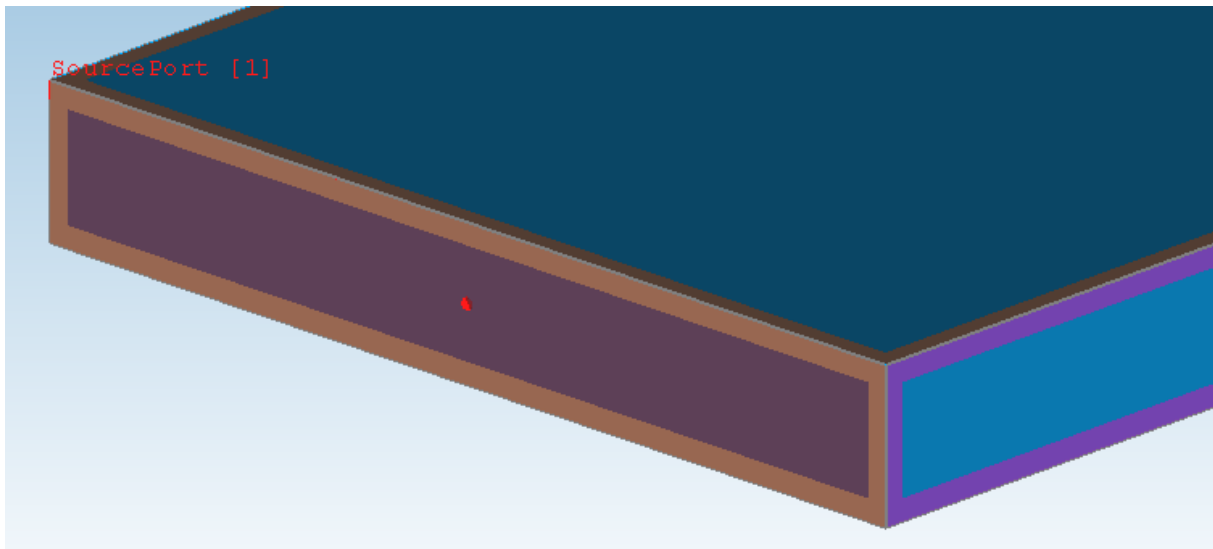
Boundary Conditions indicators visible using *Visibility* Visibility▾ button.
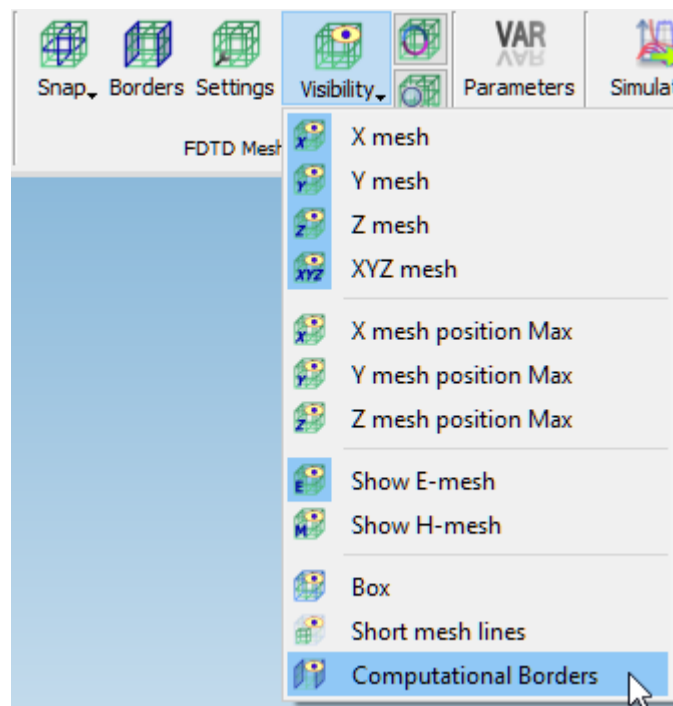
After zooming the display, we can observe that violet colour indicates *PMC* boundary conditions and brown colour indicates PEC boundary conditions.
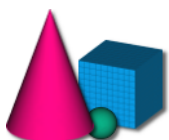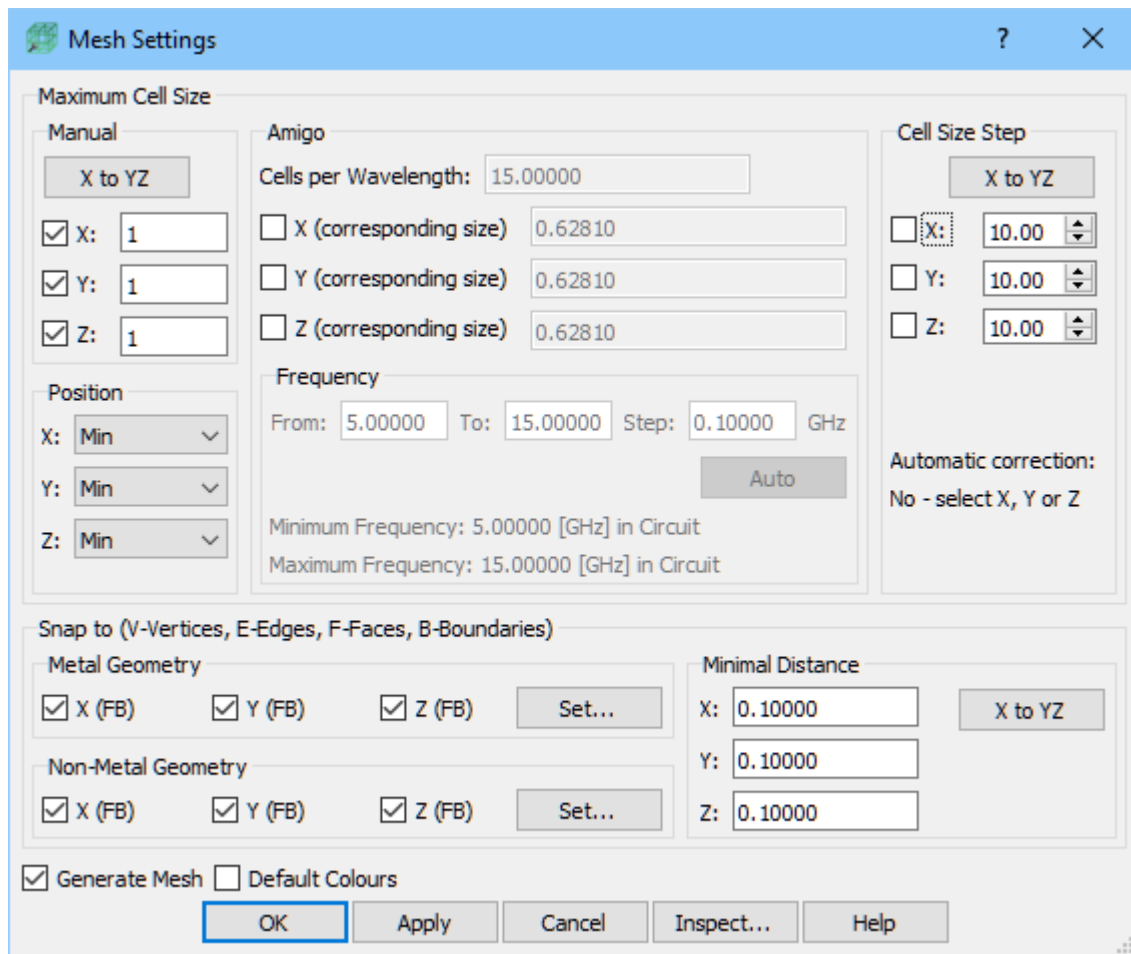
Setting up the mesh

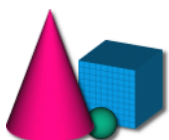Having the structure's geometry and the ports defined we can now set up the mesh. To do that, in

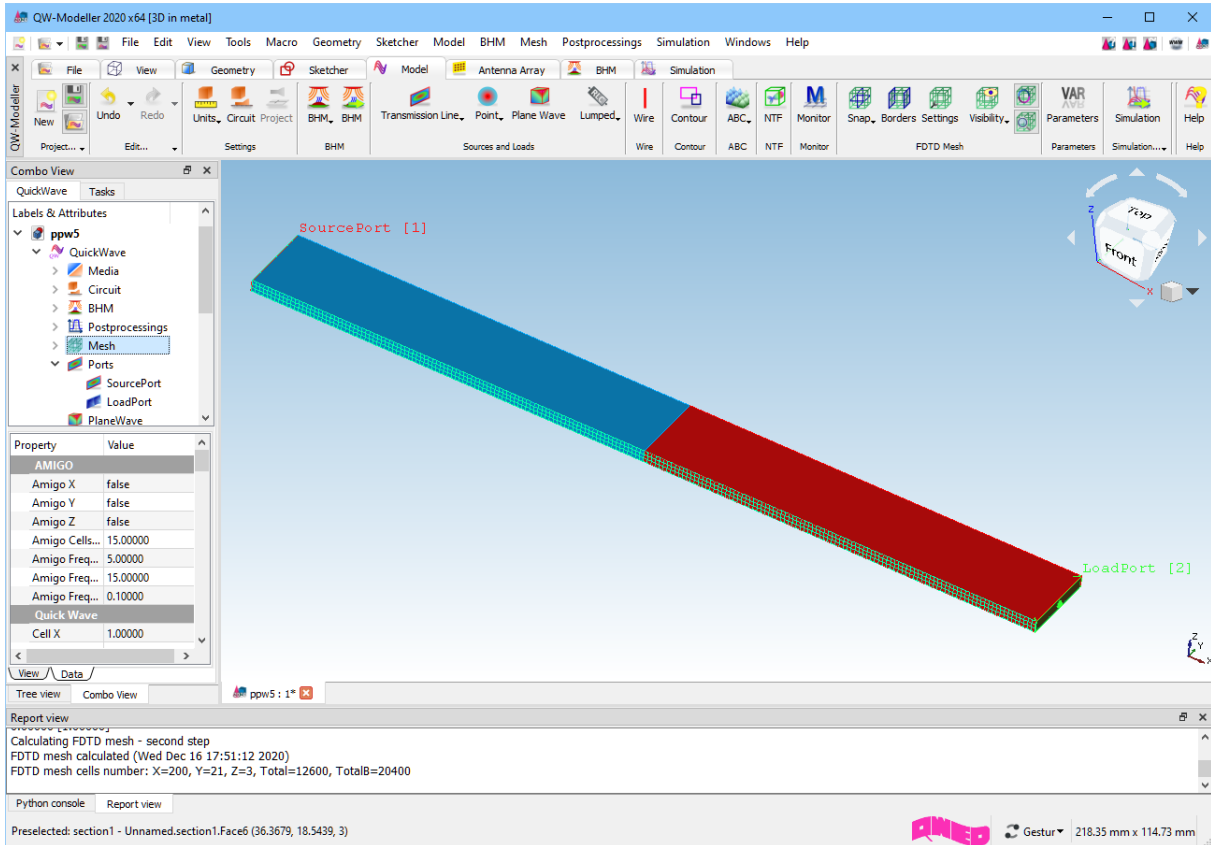*Model* tab we press the *Settings* Settings button. The following dialogue will appear.

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We set 1mm cell sizes in X, Y and Z direction. The meshing will be enforced in the entire project space.

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Exporting the project and running the simulation

The project is ready and we can run the simulation. For that purpose we switch to *Simulation* tab and

we press *Start* Start button from the *Export* section. The *QW-Simulator* is run and the simulation starts automatically. For a detailed description of *QW-Simulator* functionalities please refer to *QW-Simulator* manual.