

How to Create a Test Bench

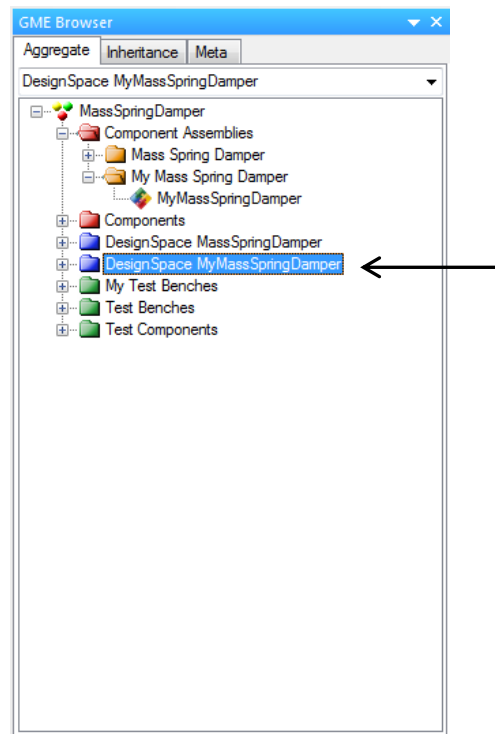
By the end of the How to Create an Assembly Page, a fully functional MassSpringDamper assembly should have been constructed. However, this assembly only contains one of each component and does not take into account the alternative components that could be used for the assembly. When this assembly is tested, the results that are given will only be for one configuration of the assembly. In this tutorial, you will add in alternative components into the model which allow you to test every possible configuration of a model with all the components that you have. To do this, you must first create a “Design Space Assembly”, and then a “Design Space Testbench”.

Step 1: Getting Started

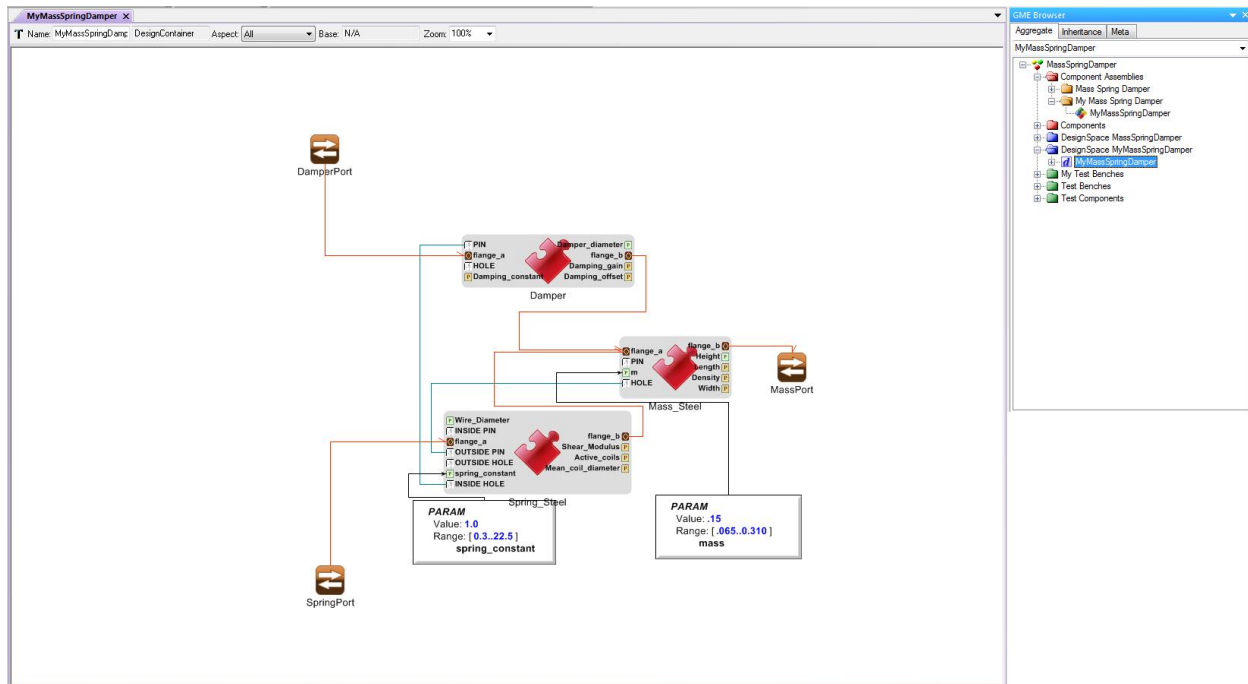
The first step in creating a Design Space Testbench is to make a Design Space Assembly. To do so, open up the assembly you have just created. Once the assembly has been opened and it appears in your editing area, make sure no component in the editing area is selected. After this, click on the “Desert Configuration to ComponentAssembly” button on the tool bar. The button is shown below:



Once you have clicked on this button, a new folder should appear in your GME browser as shown below:

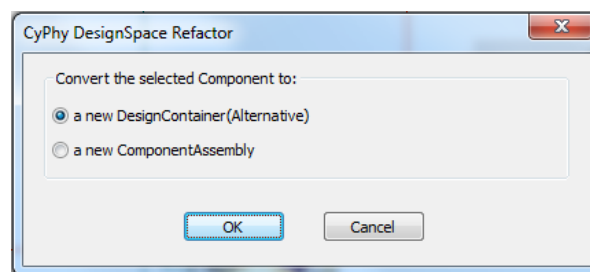


After you have located this folder, open up the folder named “MyMassSpringDamper” under the “DesignSpace MyMassSpringDamper” folder. When you do this, you should see an assembly that looks identical to the assembly you have previously made. Your screen should look as below. Now, you are ready to add alternate components to your assembly.

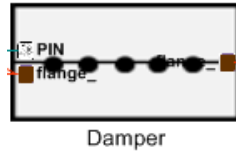


Step 2: Adding Alternate Components

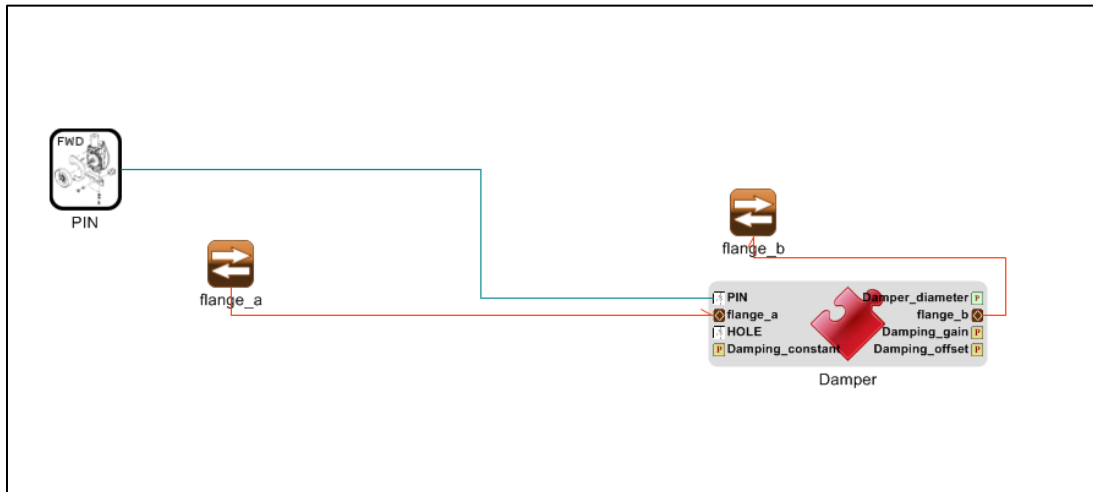
Now with the “DesignSpace MyMassSpringDamper” open, select the damper component in the assembly. To do so, simply click on the damper component once in the editing area. After this, click on the “Desert Configuration to ComponentAssembly” button again. After you click on that button, you should get a pop-up window that looks like this:



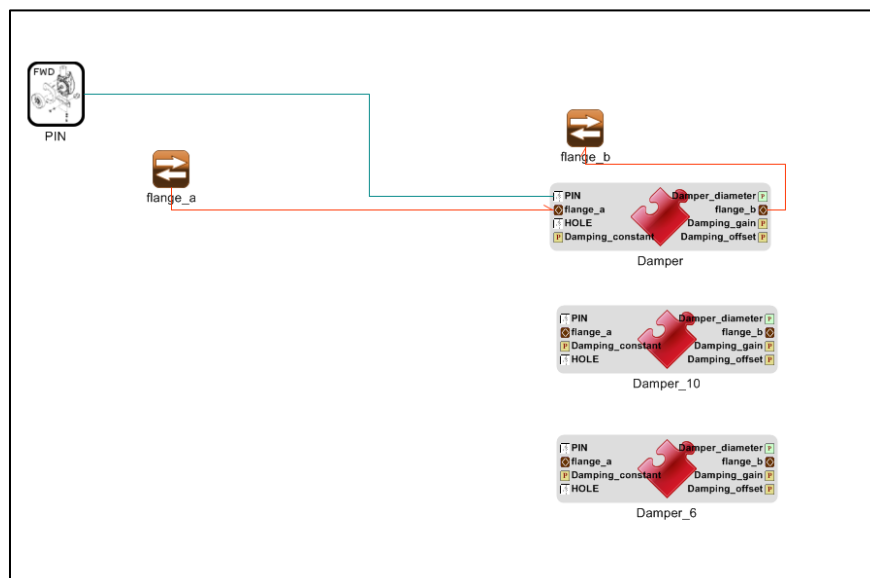
Select the first option, Convert the selected component to “a new DesignContainer(Alternative)”, in this screen, and click OK. After this, the icon for your damper component should look like this:



You have just created a Design Container. Within this container, you can add in all the alternative dampers that you have. To do so, double click on the Design Container you just created. Your editing area should now look as below:

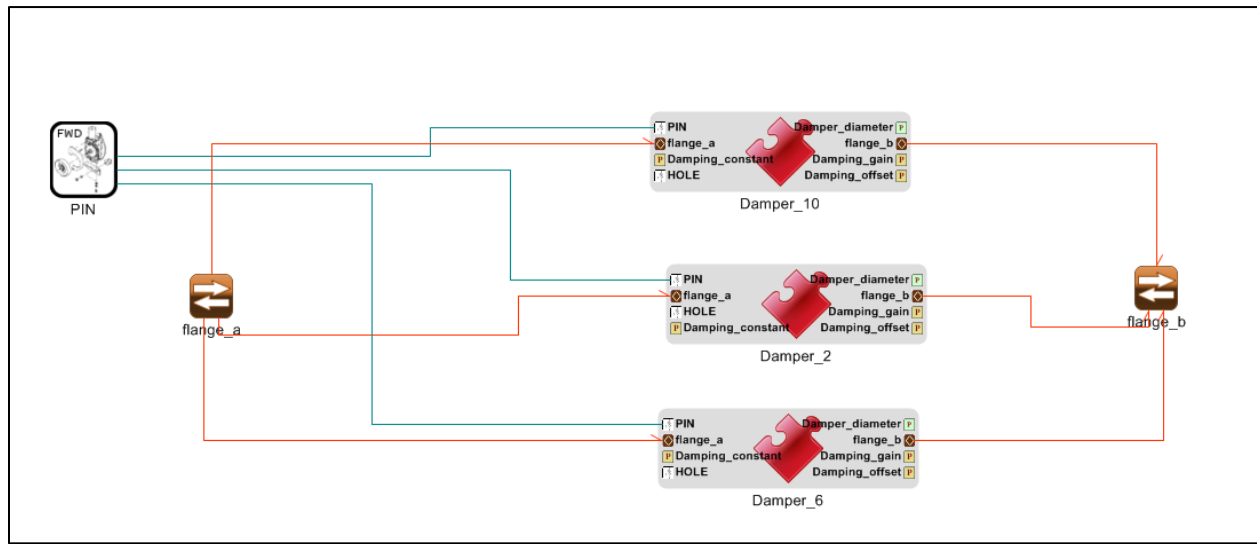


In this screen, you can add in your other alternative components so that your editing area contains 3 different dampers. You can add in these components as described in the assembly tutorial. First, you have to locate the components in the GME Browser. They should be located in the components folder. After locating the desired component, select the component and copy it. Then you would right click on the editing area and choose Paste Special > As a Reference. Do this for both alternative components and your editing area should look something like this:



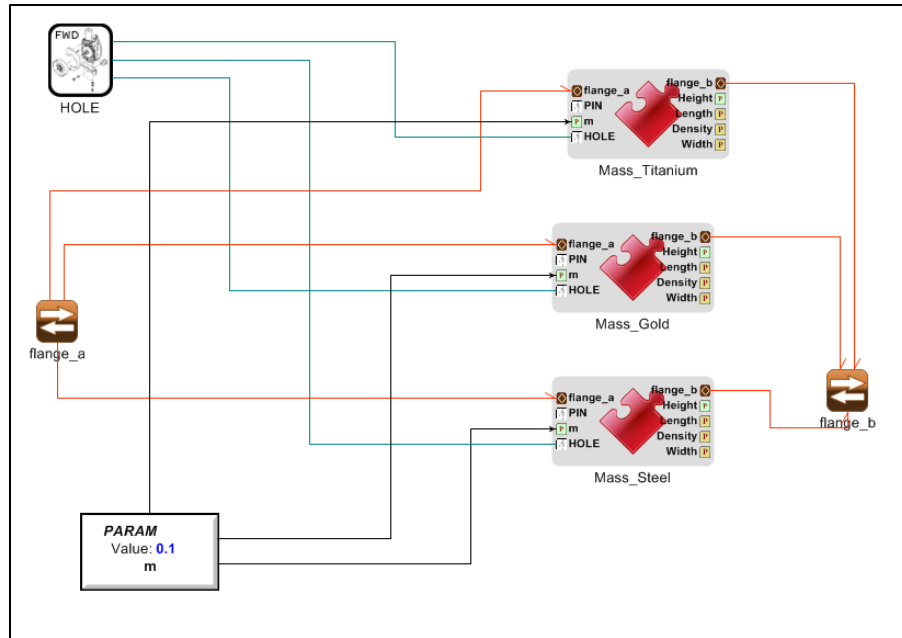
Step 3: Connecting Alternate Components

Now that you have all the alternative components in the editing area, it's time to connect them like the original component. Connections are made in the same way as explained in the assembly tutorial. You must first go into "connect mode" which can be done by selecting that option in the Modebar, or pressing Ctrl+2. After this, just click on the two things you want to connect. For the alternative components, connect them exactly as the original component is connected. When you're done, it should look like the picture below.

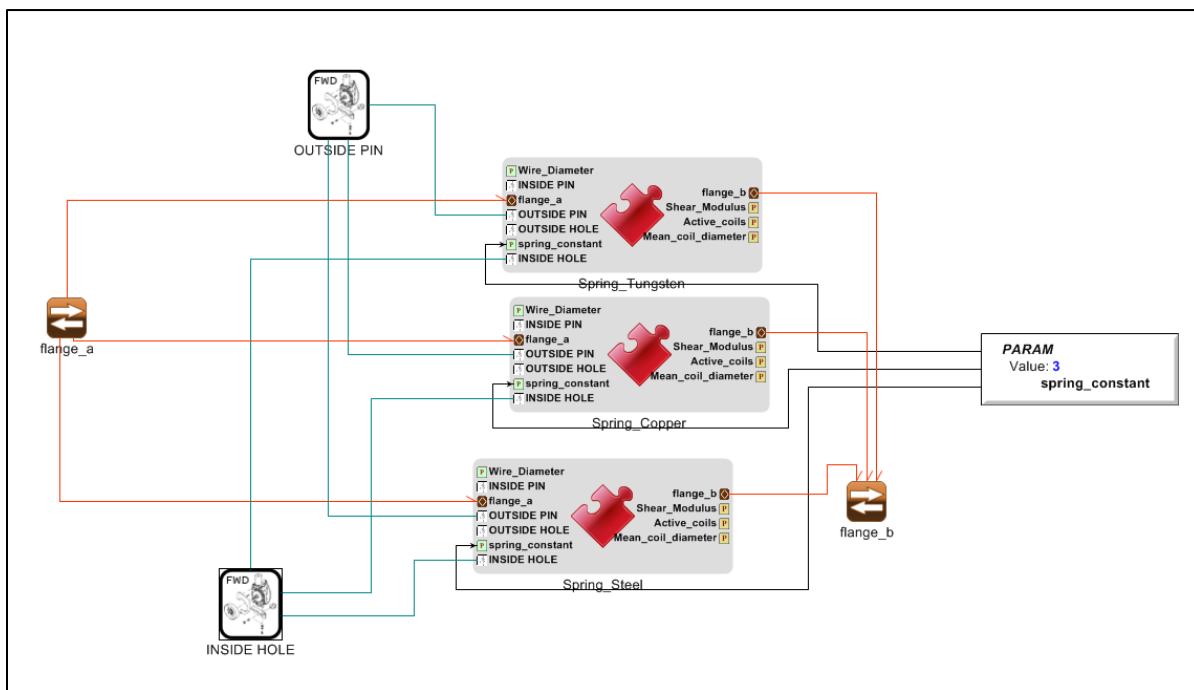


Quick Note: After you have completed making connections, it is best to return to Editing Mode. This ensures that no connections will be made accidentally.

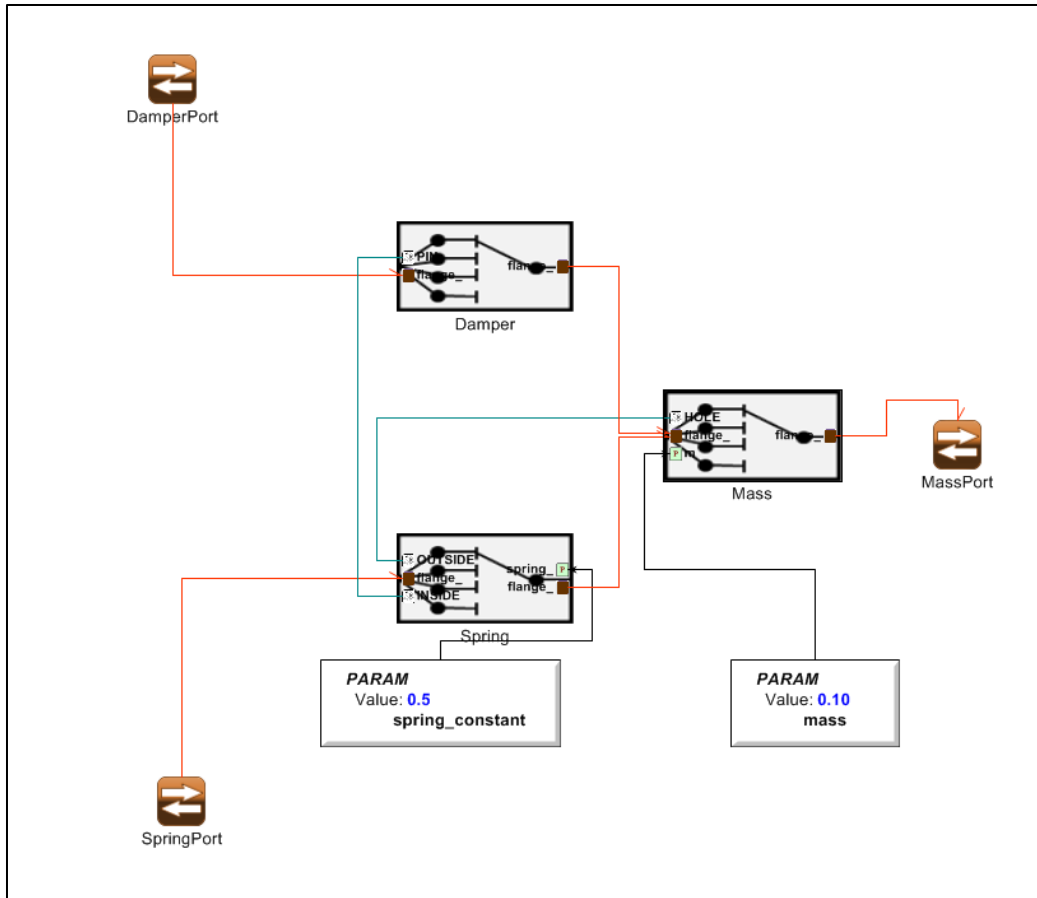
These same steps can be done for the Spring and Mass components. The completed Design Container for Mass components should look as shown below. Make sure that all the connections in your model match the ones in the picture since this is necessary for the model to function properly. Also notice that the range of the parameter has changed. This is so that all the alternative components can be accommodated.



The Design Container for Spring Components is shown below. The parameter range in here is also changed.



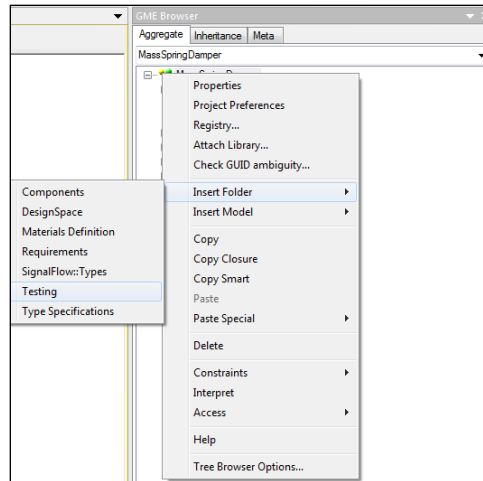
Now that each type of component has its own Design Container, your “MyMassSpringDamper” in the design space folder should look something like this:



With this, you can generate every possible configuration with the components you have. In this case, you have 3 different dampers, 3 masses, and 3 springs which combine to form 27 unique configurations. After this, you can start creating your test bench.

Step 4: Creating the Test Bench

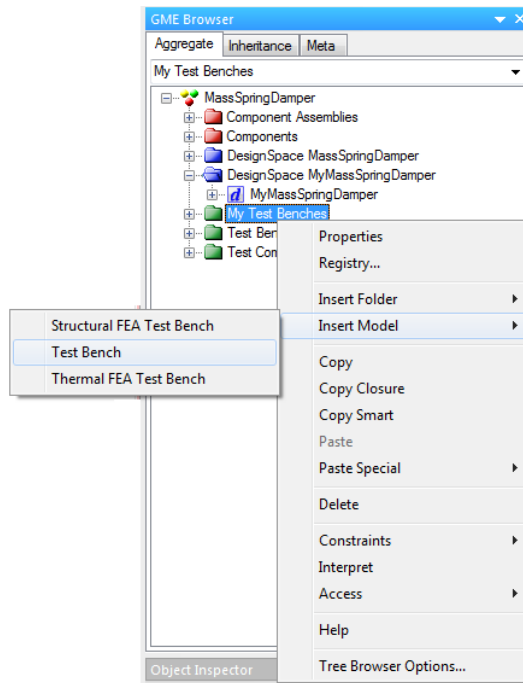
As in constructing an assembly, constructing a test bench first requires creating a folder to house it. This is done by scrolling over the project name in the GME browser window, right clicking, and following the path *Insert Folder > Testing*, as seen below. This creates a folder type which can support test objects, specifically the test bench itself.



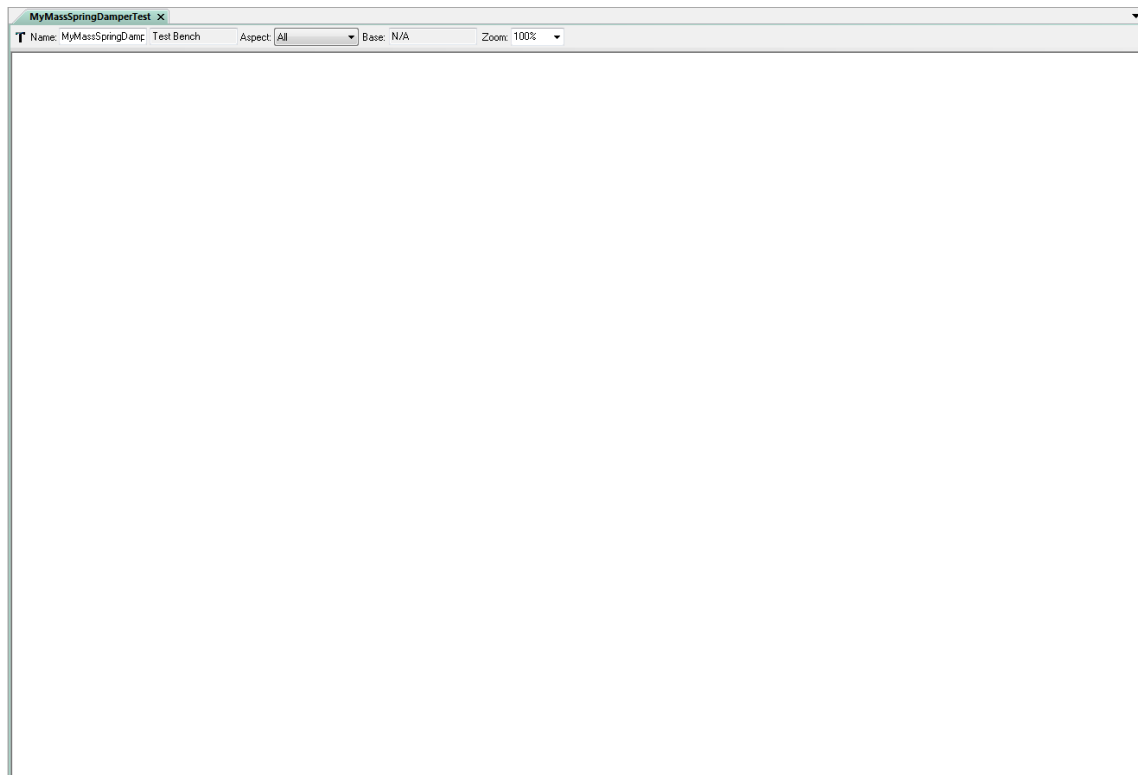
Once inserted, you can name the folder “My Test Benches”. To do so, first ensure that edit mode is enabled (which is most easily accomplished by pressing Ctrl+1). After this is done, select and left-click the name of the Testing Folder that was just created.

Step 5: Insert Test Bench

Similar to the steps for inserting an assembly, inserting a test bench into GME requires right clicking on the just created testing folder, and following the extension Insert Model > Test Bench. This results in a test bench object being created, which will be able to hold the system under test and the parts needed to interact with it. This model can be renamed by highlighting, and then specifically selecting the title with the left mouse button. In this case, the name will be “MyMassSpringDamperTest”. The top of the next page shows an image of where to access the test bench insert function on the right-button menu.



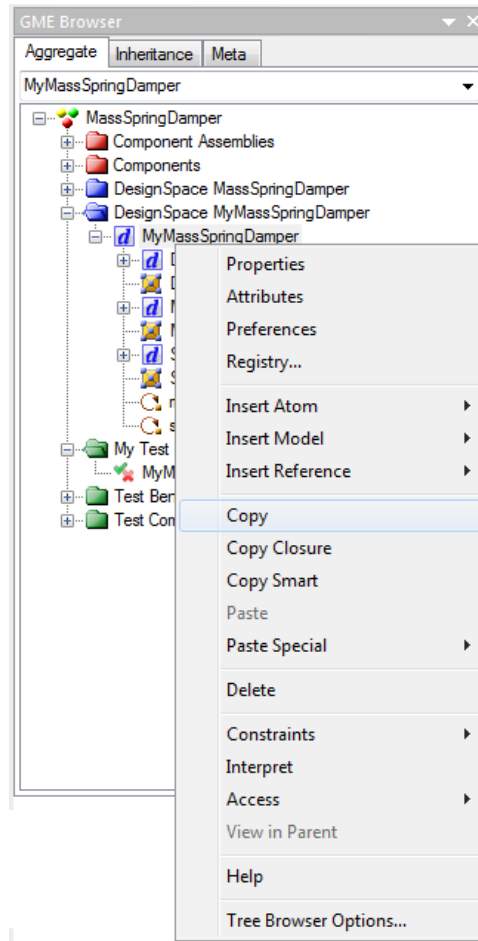
To open the test bench, double click on the newly created test bench object in the GME window. This will open up the initially blank test bench seen below.



Step 6: Import Object Under Test

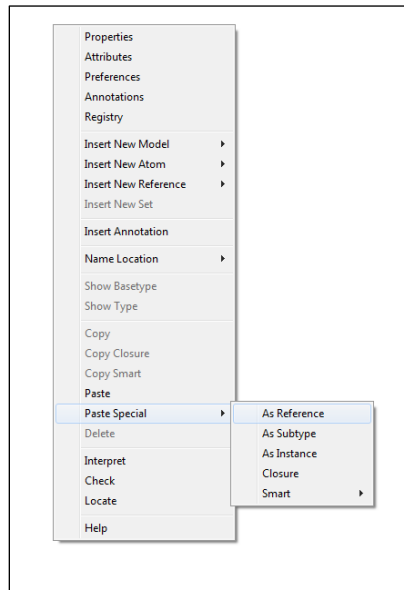
The object under test is the principle assembly from which data will be gathered. A simple three step process is all that is necessary to import it.

Step 6.1: Copy the Design Space Assembly

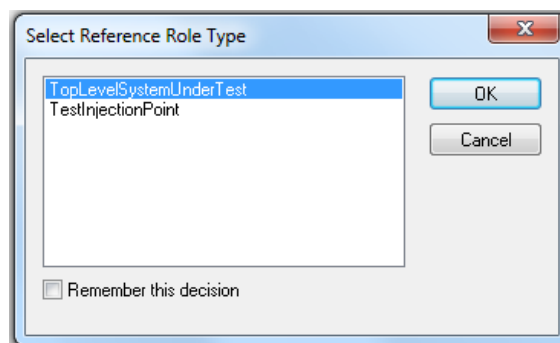


Go to the GME Browser window and copy the Design Space assembly you have just created. Be sure that an object type, not a folder type, is selected before moving on to the next step.

Step 6.2: Paste the Design Space Assembly in the Test Bench



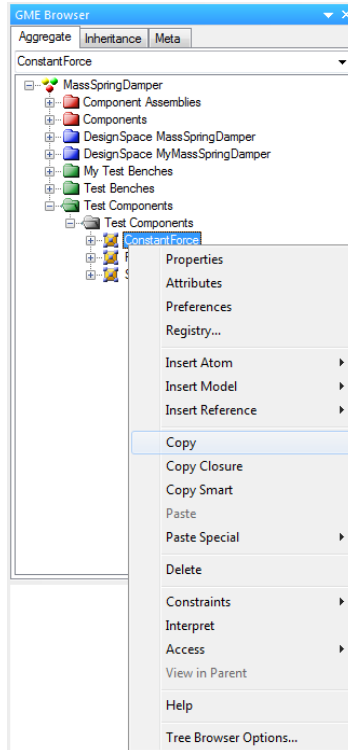
Right click on the workspace of the test bench and follow the extension Paste Special > As Reference. This will cause a “Select Reference Role Type” menu to pop up asking what type of object you are attempting to paste. The correct option for this is to choose “TopLevelSystemUnderTest” and then to select OK, as seen in the image on the next page.



With this, the central object for the test bench will have been imported. All that remains is to populate the test bench with other test components needed for testing.

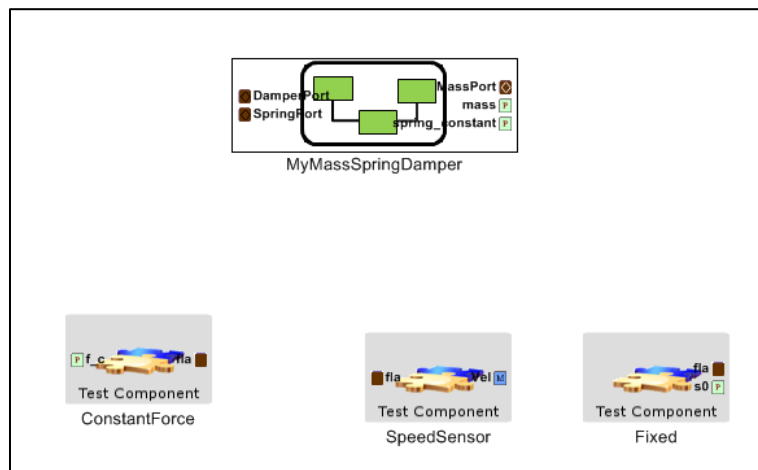
Step 7: Import Other Test Components

Importing test components is very similar to the process of importing the assembly in Step 6. To find test components, simply search under the test components folder, expand the folder beneath that one, and select a test component to insert as shown below.



First copy the test component you need, and then right-click on the workspace of the test bench and follow the extension Paste Special > As an Instance. This time, choose “TopLevelSystemUnderTest” again, and do this for all three test components.

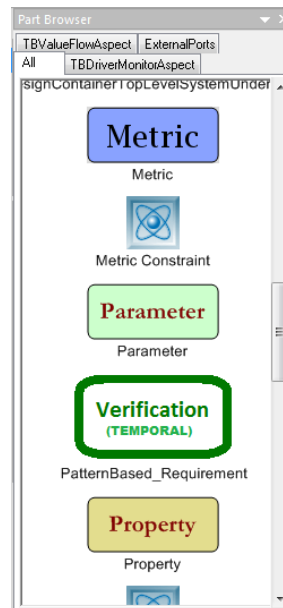
For this exercise, one instance of the ConstantForce, Fixed, and SpeedSensor test components will be needed. Once each of them has been imported, the screen should look like this.



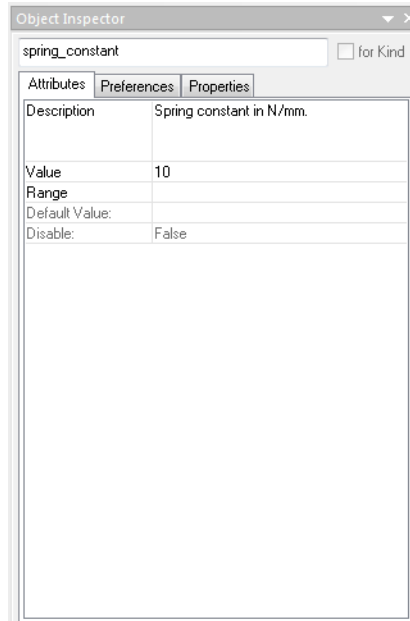
Quick Note: It is very important that the test components are copied into the test bench **As an Instance**. However, your “MyMassSpringDamper” Design Space assembly should be copied **As a Reference**.

Step 8: Adding Parameters, Properties, and Metric

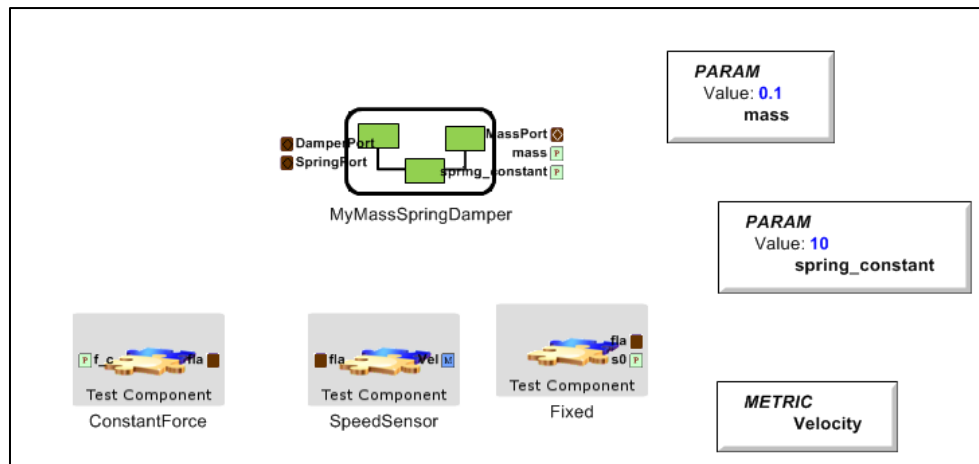
Note: though all of the **components** may be present, the test bench is not ready to be assembled. Looking at the ports, there is one metric port (indicated by a blue “M”) and quite a few parameter ports (indicated by a green “P”) that lack inputs. Since this is a test bench, there will not be any output ports. Thus, if these parameters or metrics are not already defined, they must be defined here. Looking at the f_const and the s0 ports, neither of these require inputs, leaving only the mass and spring constant ports to be defined, as well as the metric port for the speed sensor. The parts which can designate these values can be found under the “all” view in the Part Browser about halfway down the menu, as seen below.



We will require two parameters for the spring constant and mass and one metric part for the speed sensor. [A metric part is a part used to designate a particular aspect of an object’s output as the subject of data collection.] Simply dragging and dropping the appropriate icons into the work space is the simplest way to add them to the test bench, and they can be renamed just like any other object. Furthermore, it is possible to define the specifics of the parts, as well as their names, in the Object Inspector menu (as seen below).



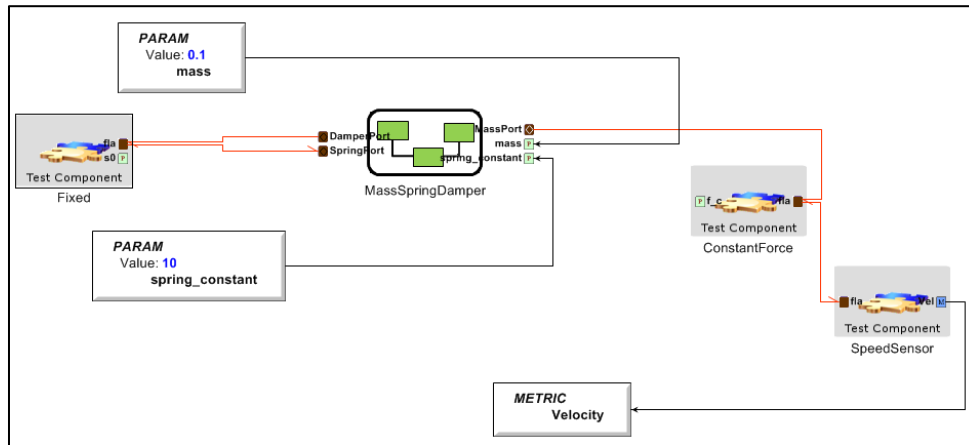
When all the necessary parts have been added, the test bench should look like the image below Pay special attention to ensure that the parameter values are correct.



Step 9: Drawing the Connections

Now that all of the components and parts have been gathered, it is time to connect them into one functioning system. The parameters are, of course, assigned to their respectively named ports, while the metric is applied to the speed sensor. The Fixed object is used to indicate two objects that are fixed in relation to each other and a moving frame, which in this system describes the damper and spring components. Thus, a connection is drawn to the same port of the fixed object from both the damper and spring ports on the system block. Finally, the mass is the portion of the system to which the force is applied meaning that the translational ports for the two should be connected.

Referring back to the prior section for creating an assembly, connecting the parts of a test bench is exactly the same. Simply switch from edit to connect mode (Ctrl+2) and draw the connections between the correct ports to complete the test bench, which when finished should look like the image below.



The system under test now possesses all of the external factors required to simulate a real-world test of the system. However, GME cannot process the test bench within its own bounds, so it must export the test elsewhere. This topic will be covered in more depth in tutorial 3.