The following tutorial is based on the assumption that the GME tool suite and the META add-on are installed on the user's computer.
The GME tool can be downloaded from: https://forge.isis.vanderbilt.edu/gme/
The META add-on can be downloaded from: http://repo.isis.vanderbilt.edu/META/

Performing Qualitative Analysis with QRM in CyPhy

Purpose: To identify qualitative and symbolic properties of a design with respect to requirements. This tutorial describes a vignette in which the designer runs qualitative verification, which explores a larger design space than the point design, on a Mass Spring Damper configuration against a requirement that the spring force not exceed 17 Newtons. The initial configuration fails to meet the requirement, and QRM uses differential qualitative analysis to suggest parameter changes to the designer. After making changes to the design, a second analyses by QRM results in an abstract design space with successful and violating designs. At this point, the designer should invoke additional analyses, such as simulation and PCC. Future releases of QRM will identify inequalities between parameters that ensure the design meets the requirements as well as other symbolic properties.
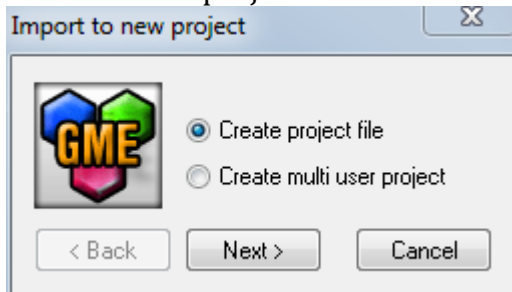
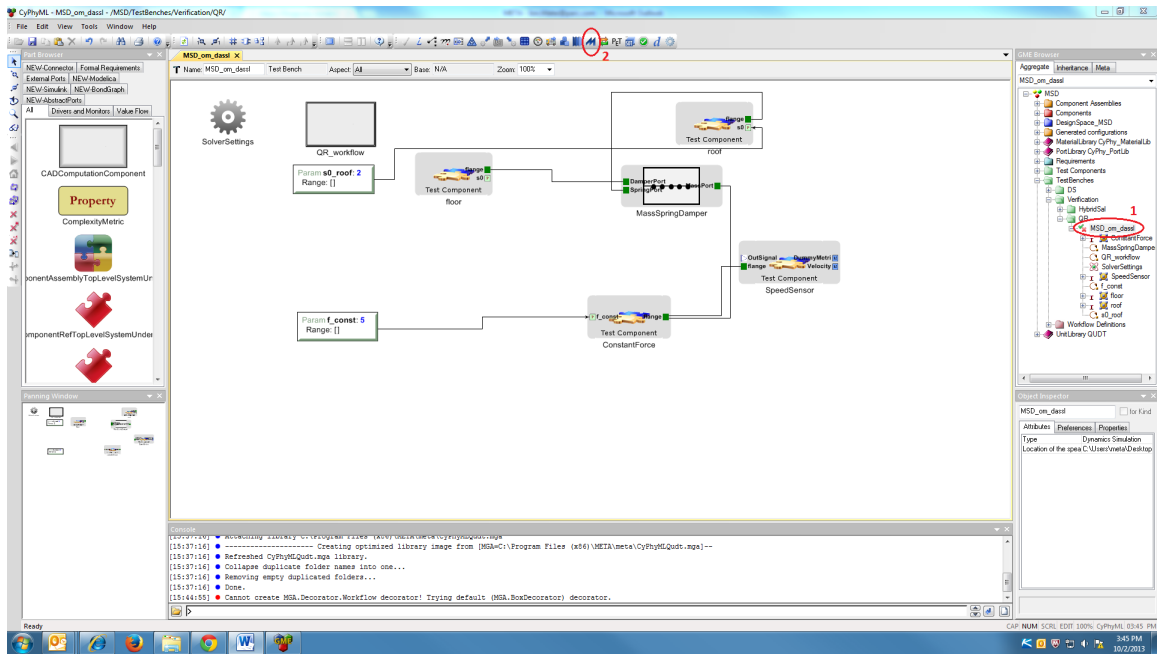**Step 1:**
Open MSD_Big_PARC.xme in CyPhy
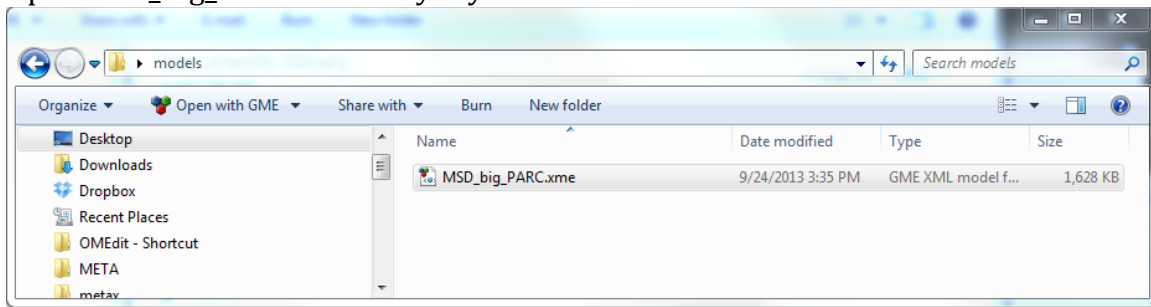
Step 2:
Select "Create project file" and click next. Select the default name and continue.

Step 3:
In the GME browse window, navigate the tree as follows: MSD->TestBenches->Verification->QR->MSD_om_dassl and double click on (1) MSD_om_dassl. Then, click on the MasterInterpreter icon (2), the blue M.
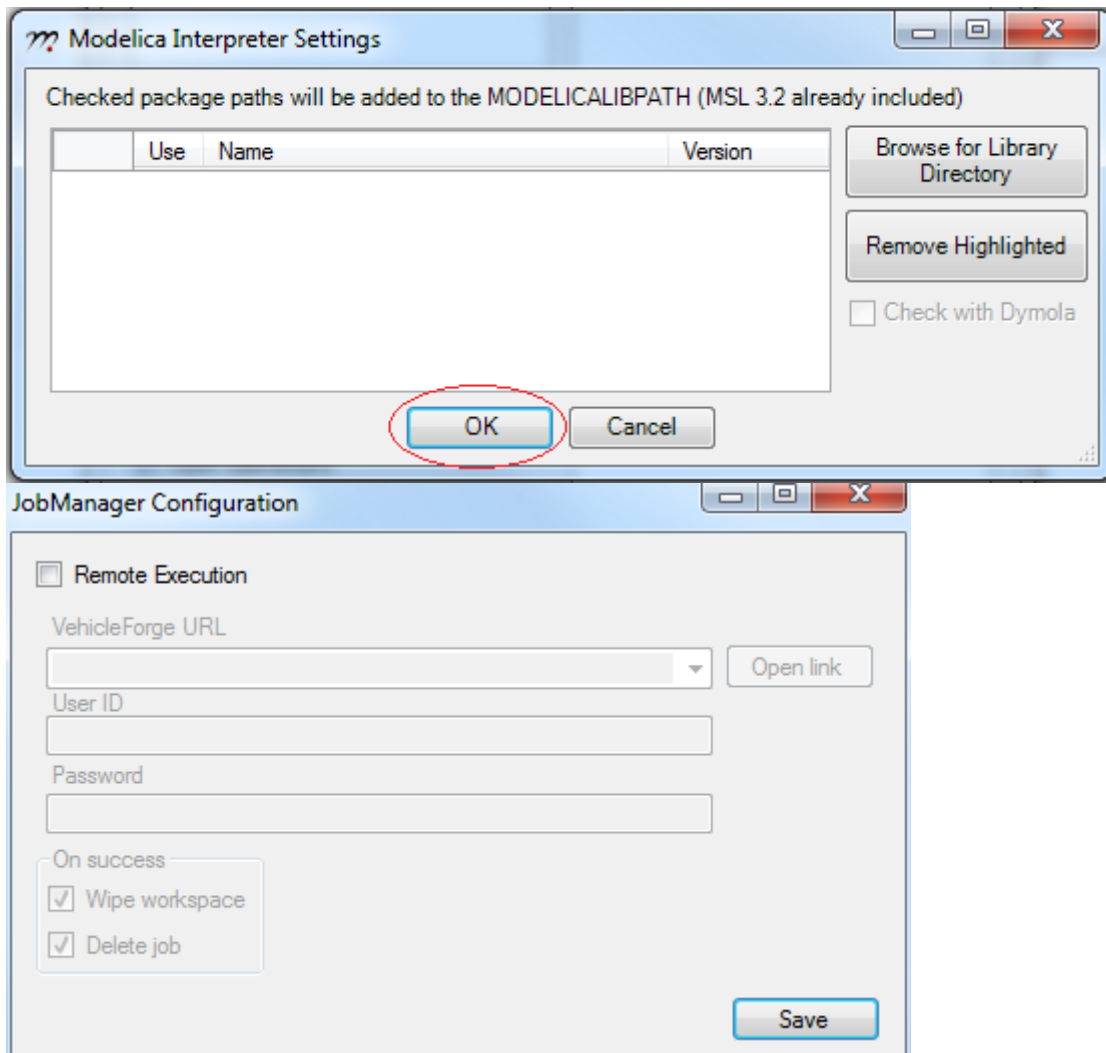
Step 4:
Select the secondconfiguration (MassSpringDamperAuto2cfgs_cfg1), check the "Post to META Job Manager" checkbox, check the "Open dashboard" checkbox to open the dashboard, and select the CyPhy2Modelica_v2 workflow.
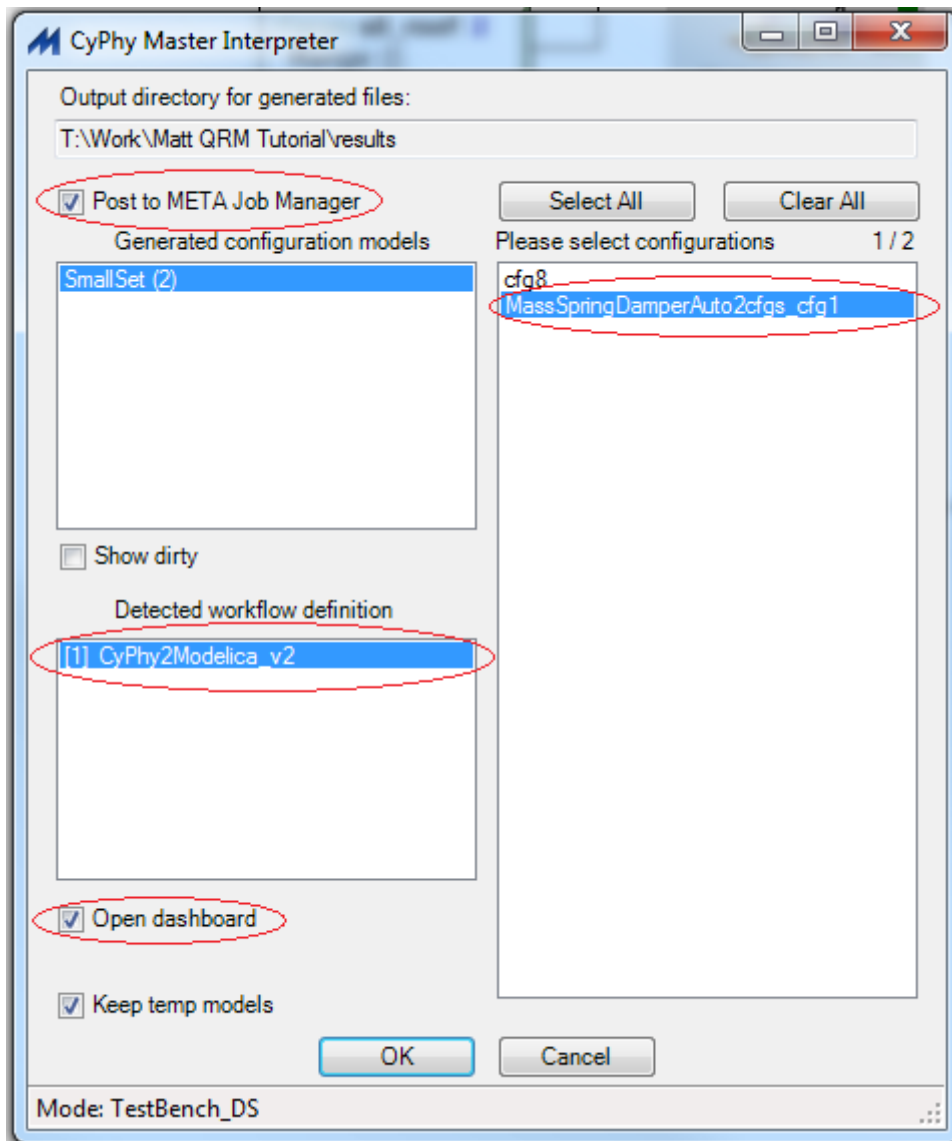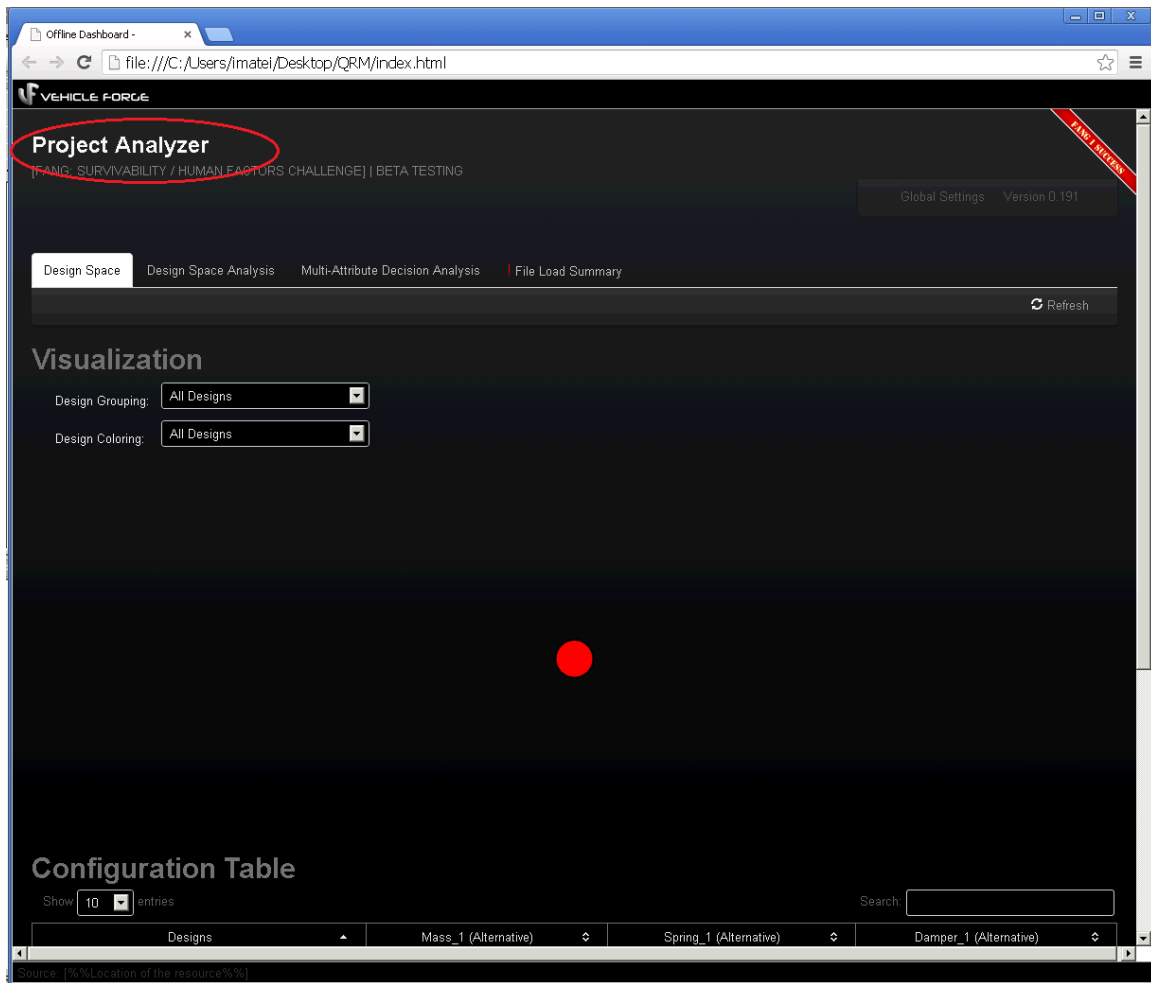
Step 5:
Click "ok" on the screen for additional libraries and a number of windows will open. Navigate to the job Manager window and click save.
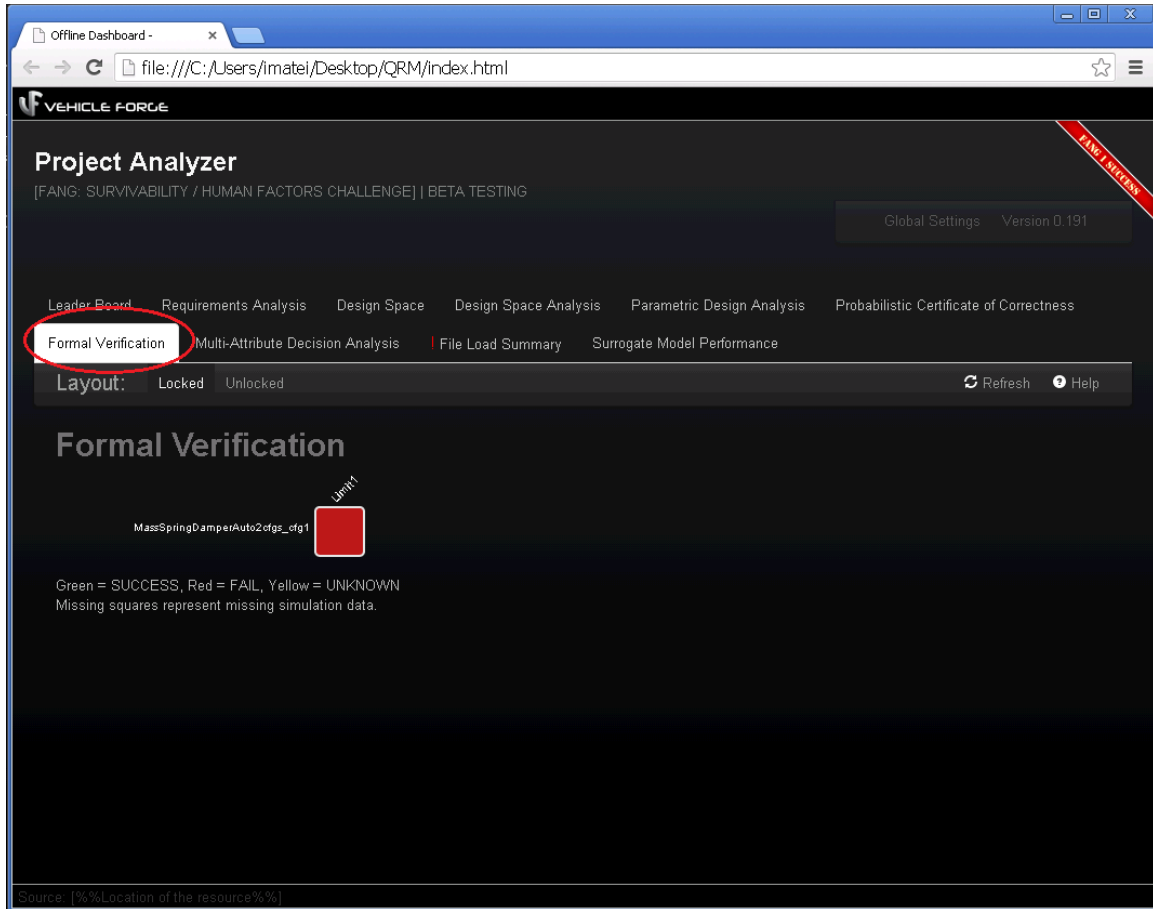
Step 6:
Next, select the browser window that opened named the Offline Dashboard (requires chrome as default browser and started with --allow-file-access-from-files flag). Next ctrl+click on Project Analyzer.
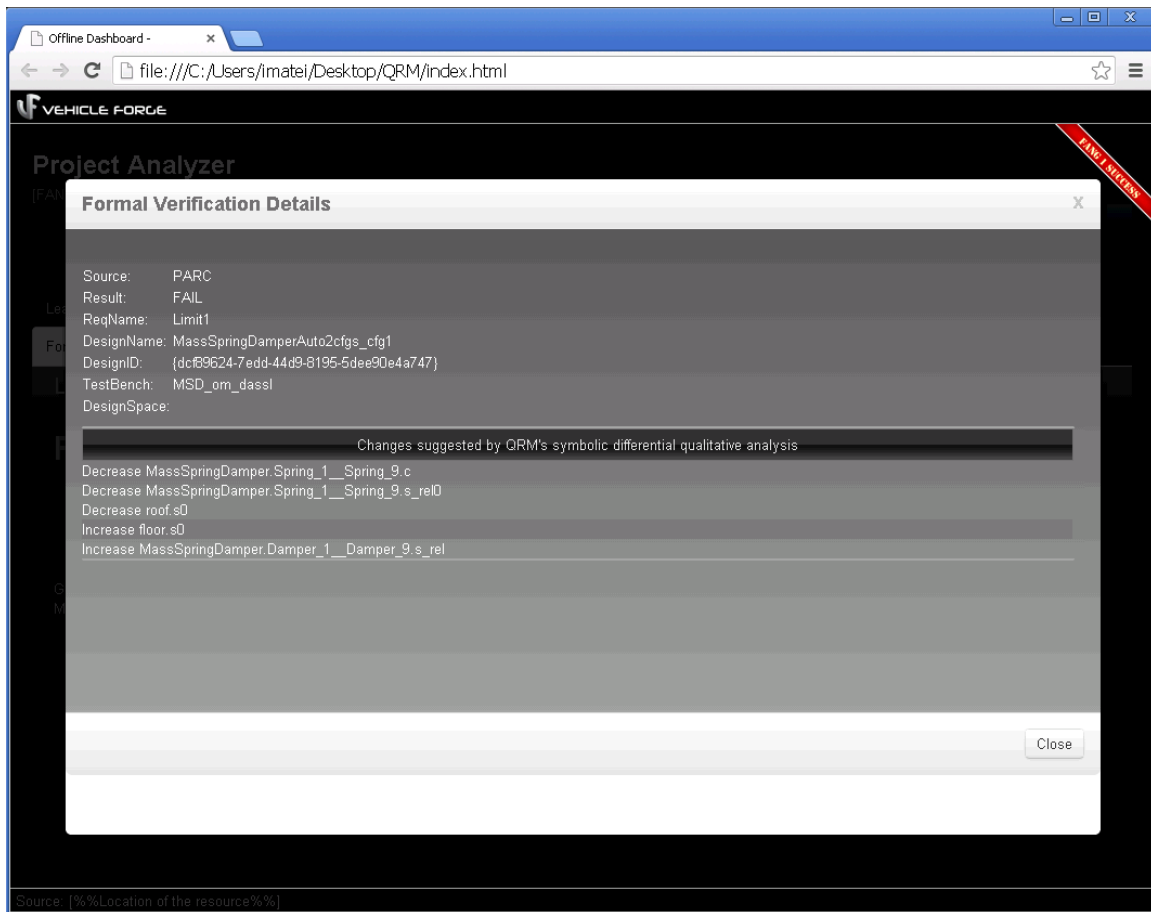
Step 7:
Select the "Formal Verification" tab, and you will see that the configuration failed the requirement, as indicated by the red color.

Clicking on the red square will display the results of differential qualitative analyses, shown below. This pane includes the list of parameter changes to meet the requirements.

Step 8:
Return to GME. In the GME Browser navigate to the configuration as follows MSD->Generated configurations->MassSpringDamperAuto2cfgs->Configurations (2-22-2013 15:36:19)->MassSpringDamperAuto2cfgs_cfg1 and double click (1). Then double click on the spring component (2)
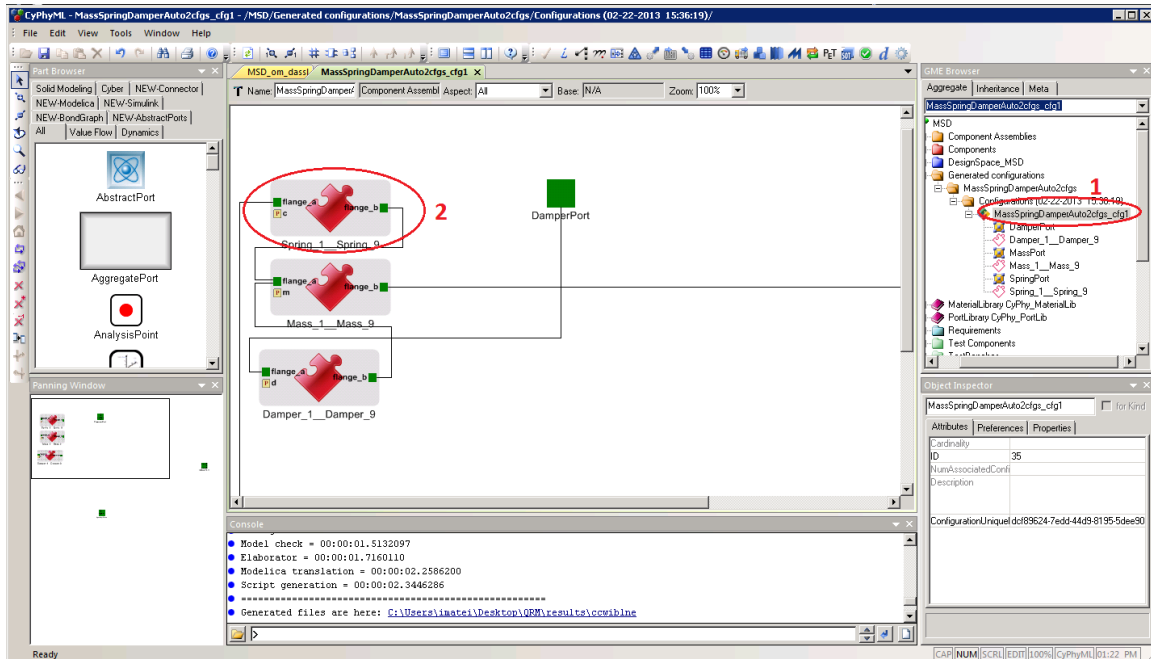
Step 9:
Change the spring constant from 9 to 3 by double clicking on the Prop item, and then return to the testbench named MSD_om_dassl.
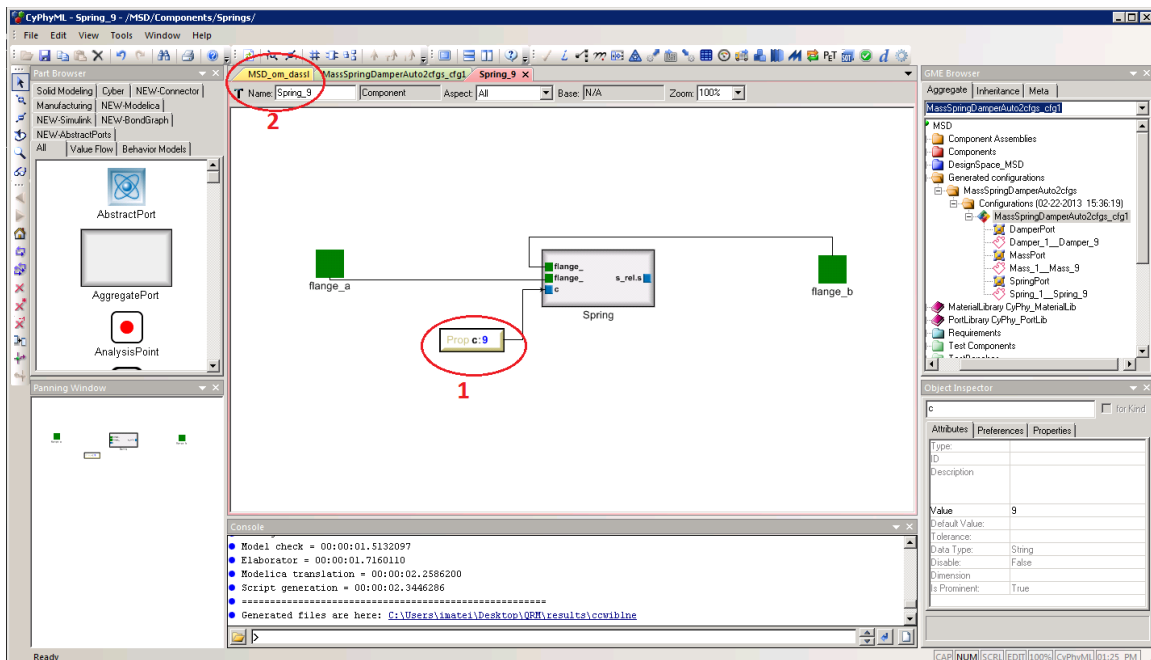
Step 10:
Repeat steps 4 and 5 to execute the analysis again.

Step 11:

Return to the dashboard and check the analysis. You should find qualitatively the requirement is unknown ('yellow') meaning that these parameters may meet the requirements and further analyses should be considered for this point design.