

Hardware-in-the-loop Simulation Software – HSS 2.0

User Manual

2019/11/17

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1 Overview

The purpose of this document is to familiarize the user with the operation of the ACTS Hardware-in-the-loop Simulation Software – HSS.

Figure 1 shows the HSS package. By double clicking the icon, HSS will be launched.

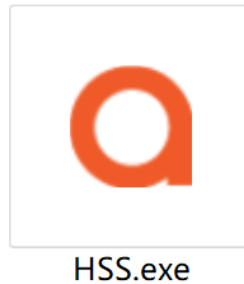


Figure 1 – HSS software icon

2 Copyright Page

Figure 2 shows the ACTS software copyright page.



Figure 2 – ACTS software copyright page

3 Main Functions

HSS is one of the ACTS software series. Its main function is to create numerical models, do analyses and complete the hybrid simulation experiment by standard

network interface with the ACTS ALC software. HSS provides users with a custom numerical analysis interface function.

4 Main Window

Figure 3 shows the Main window, which has both drop-down and tap window.

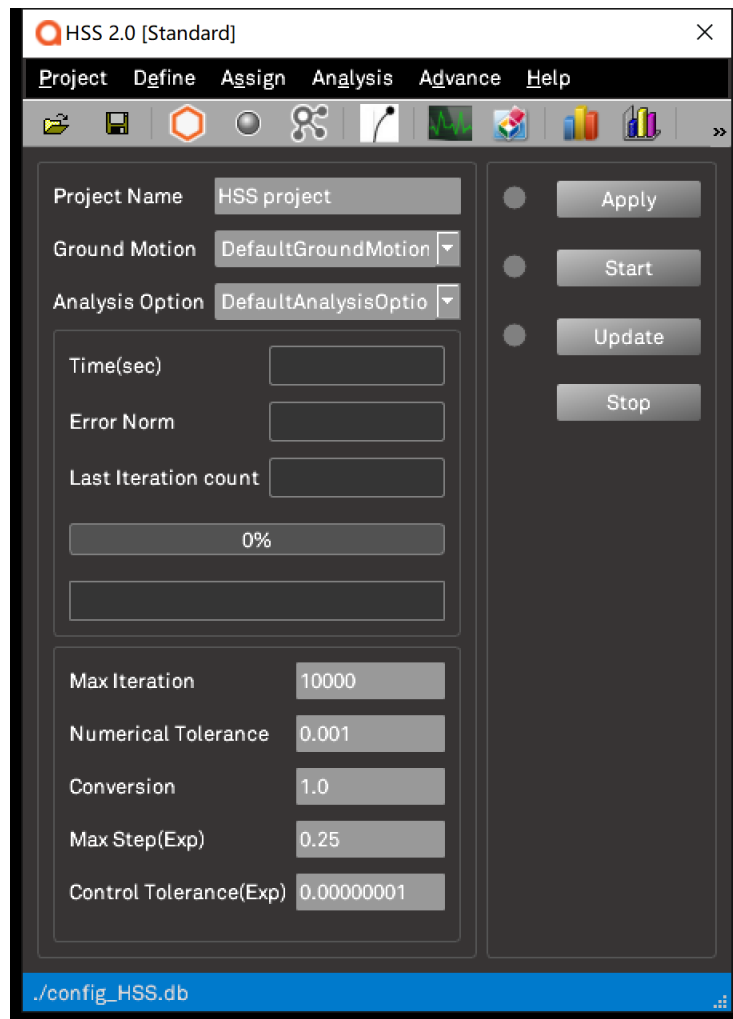


Figure 3 – Main window

4.1 Project Menu

When the main window is first opened, HSS will create a default database (./config_HSS.db) for the user in the current directory. The database contains

various real-time model definitions, and the user can modify, expand and save the database as your own project database.

This section describes the details of the function under “Project” as shown in Figure 4.

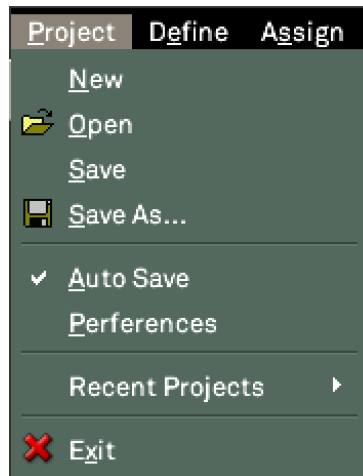


Figure 4 – Drop-down menu of Project

4.1.1 New

By clicking “New” , HSS will start with a blank project.

4.1.2 Open

By clicking “Open” , user can open a previously saved project.

4.1.3 Save

By clicking “Save” , HSS will save all settings to a pre-defined file. If no file has been pre-defined, HSS will consider “Save” as “Save as” .

4.1.4 Save as

By clicking “Save as” , user can choose the file location and name to store the current settings.

4.1.5 Auto Save

HSS will save all settings into the current project file automatically.

4.1.6 Preferences

By clicking “Preferences” , a window as shown in Figure 5 will be opened to allow the user to change font size and background color.

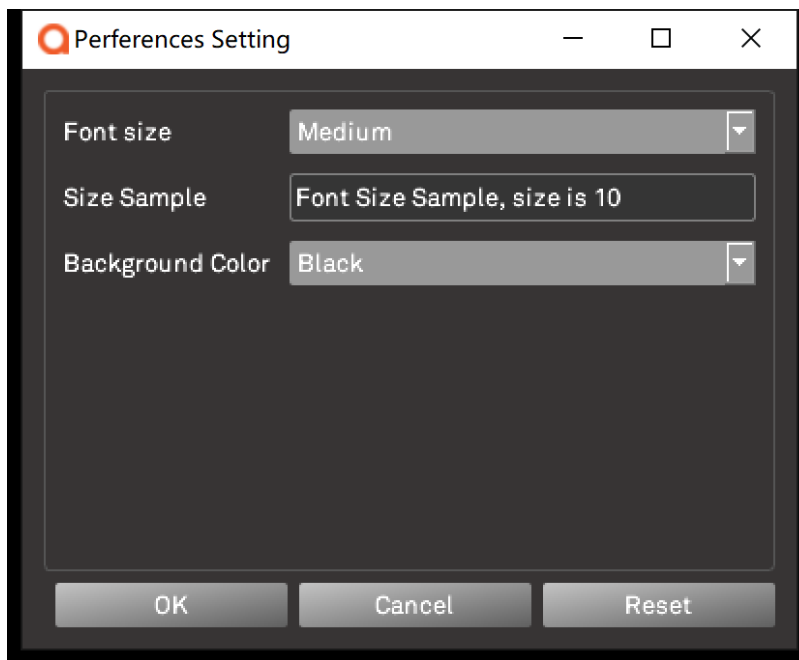


Figure 5 – Preferences Setting window

4.1.6 Recent Projects

“Recent Projects” menu includes sub menu items which keep the recently opened project names; to click the sub item can open them directly.

4.1.7 Exit

By clicking “Exit” , HSS will be closed.

4.2 Define Menu

This section describes the details of the function under “Define” as shown in Figure 6.

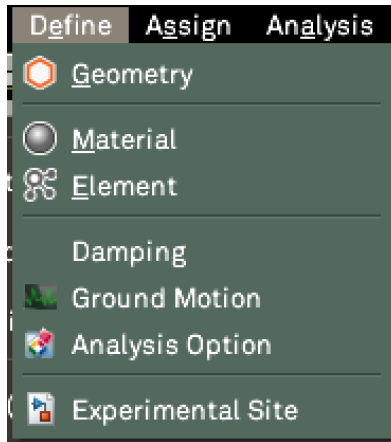


Figure 6 – Drop-down menu of Define

4.2.1 Geometry

By clicking “Geometry”, a window as shown in Figure 7 will be opened, which has both drop-down and tap menus.

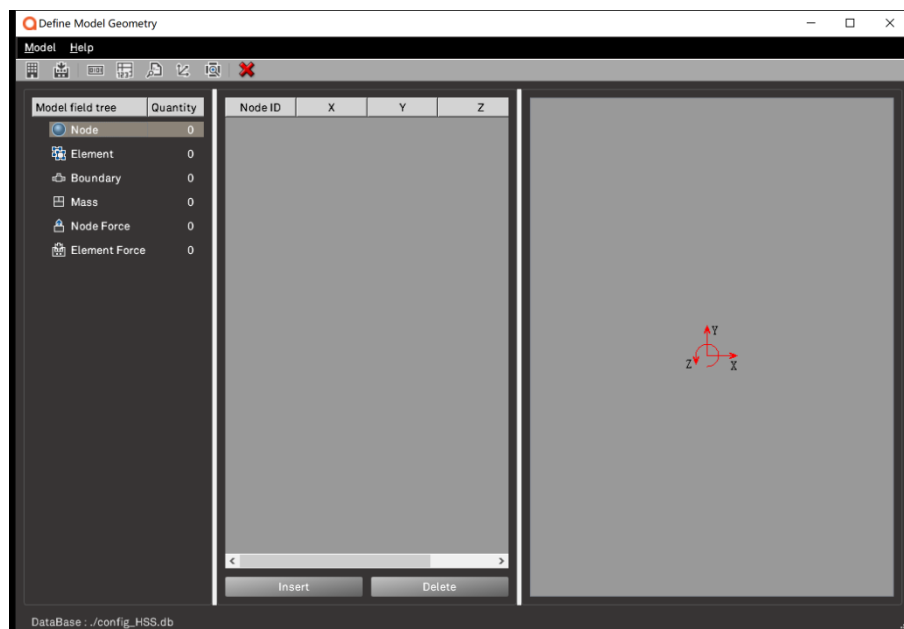


Figure 7 – Define Model Geometry window

4.2.1.1 Model

The detailed functions under “Model” are shown in Figure 8.

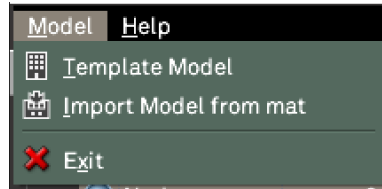


Figure 8 – Drop-down menu of Model

By clicking “Template Model” , a window as shown in Figure 9 will be opened to allow the user to define a template model.



Figure 9 – Define Template Model window

By clicking “Import Model from mat” , user can import a pre-defined model in *.mat format.

By clicking “Exit” , Define Model Geometry window will be closed.

4.2.1.2 Node

By clicking “Node” , a window as shown in Figure 10 will be opened to allow user to insert or delete the coordinates of the nodes.

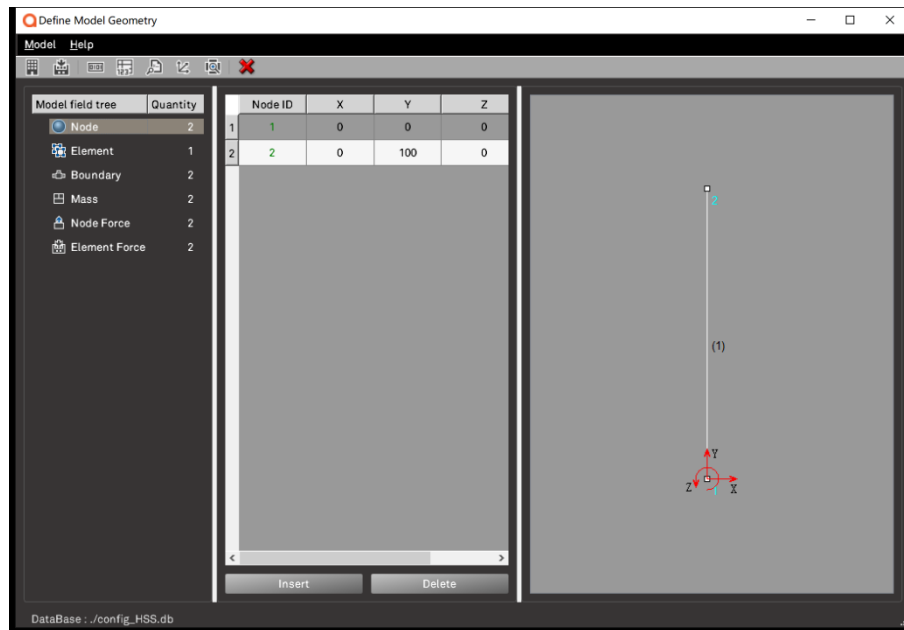


Figure 10 – Node window

4.2.1.3 Element

By clicking “Element” , a window as shown in Figure 11 will be opened to allow user to insert or delete the elements between nodes.

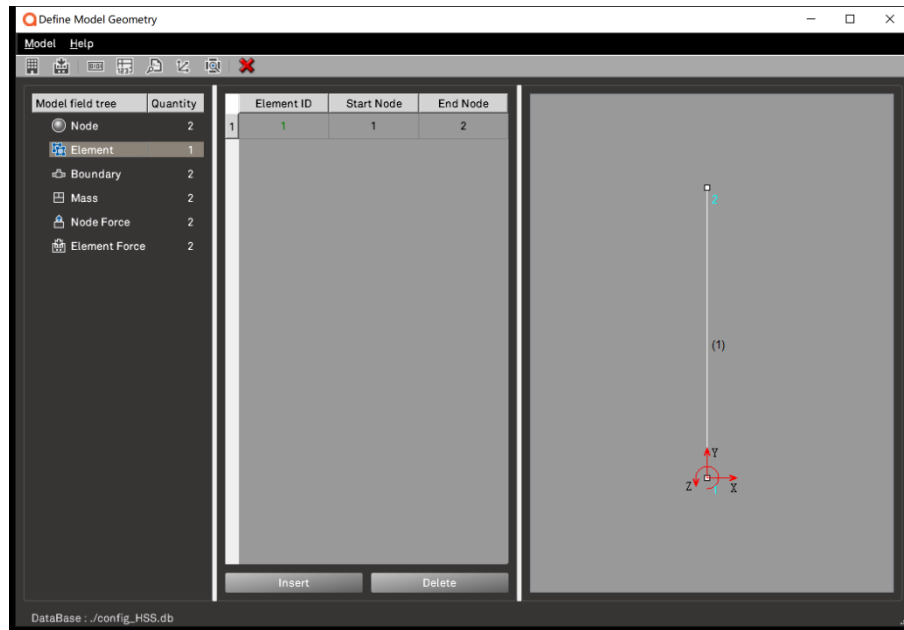


Figure 11 – Element window

4.2.1.4 Boundary

By clicking “Boundary”, a window as shown in Figure 12 will be opened to allow user to define the boundaries of nodes.

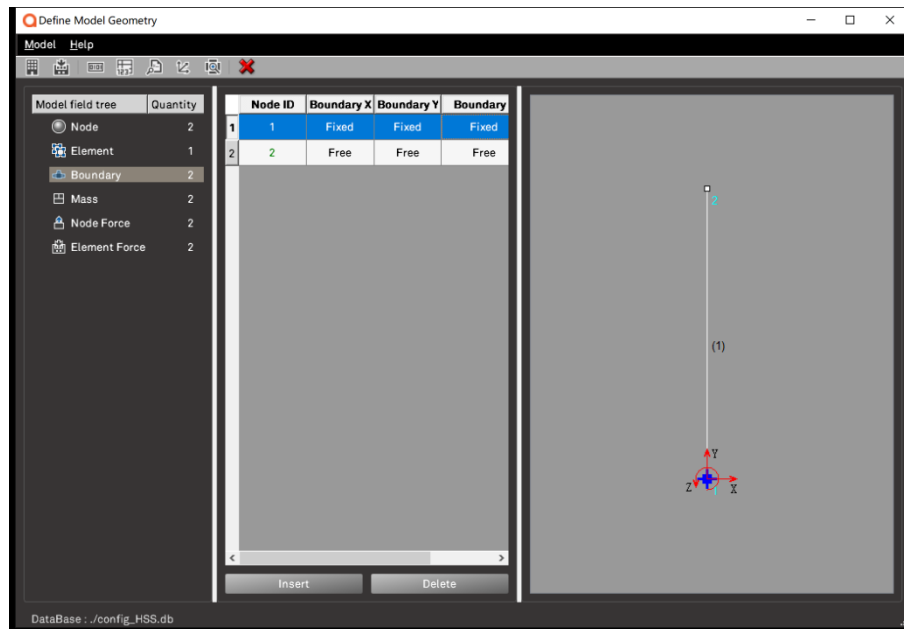


Figure 12 – Boundary window

4.2.1.5 Mass

By clicking “Mass” , a window as shown in Figure 13 will be opened to allow user to assign mass of node.

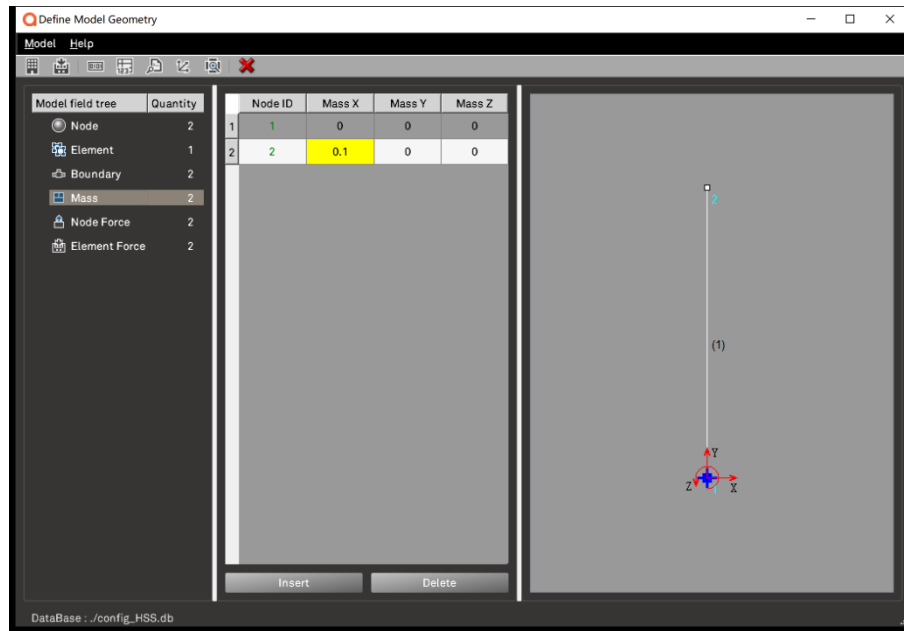


Figure 13 – Mass window

4.2.1.6 Node Force

By clicking “Node Force” , a window as shown in Figure 14 will be opened to allow user to assign force on node.

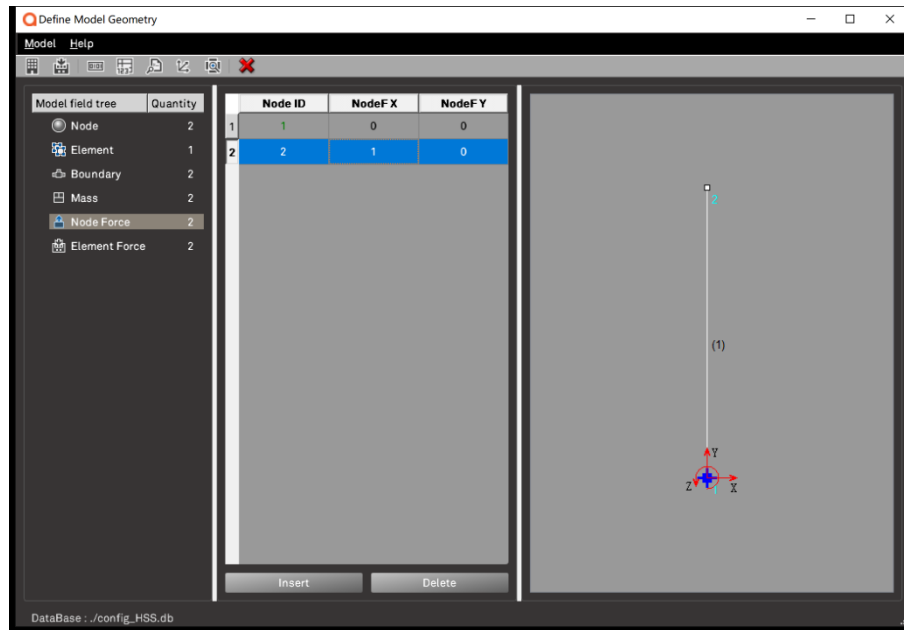


Figure 14 – Node Force window

4.2.2 Material

By clicking “Material” , a window as shown in Figure 15 will be opened to allow user to define material type. HSS has three defined material types: Bi-linear default, Bi-linear Hysteretic default and Elastic default. User can also add other material type to HSS, which will be described in section 4.5.

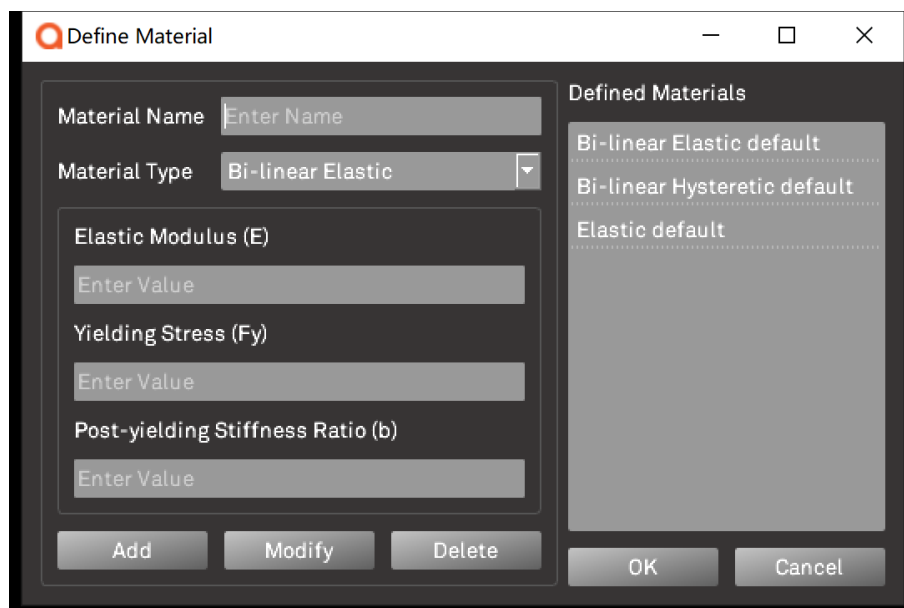


Figure 15 – Define Material window

4.2.3 Element

By clicking “Element” , a window as shown in Figure 16 will be opened to allow user to define element type. HSS has three defined element types: Elastic Beam-column default, Truss default and Zero-length default.

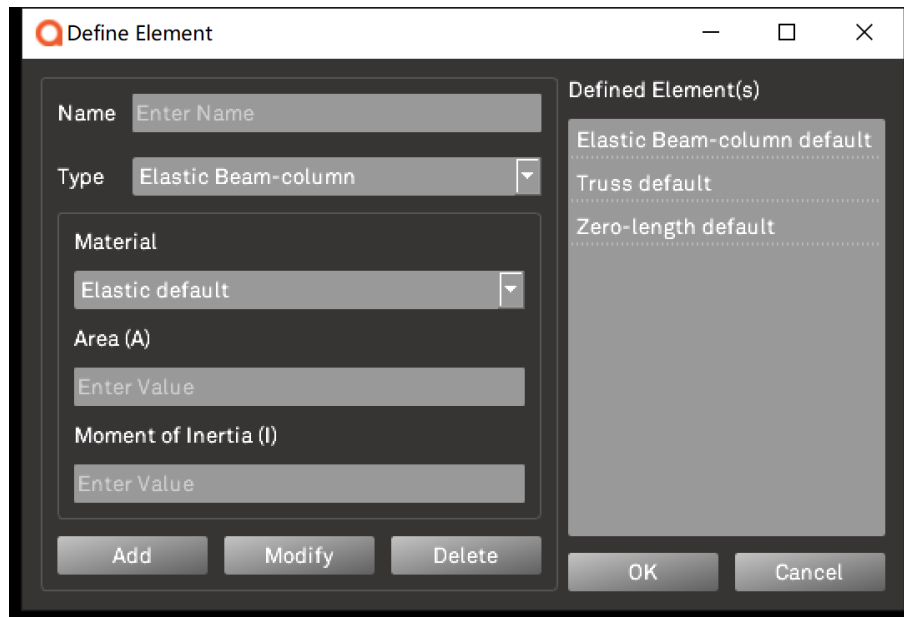


Figure 16 – Define Element window

4.2.4 Damping

By clicking “Damping” , a window as shown in Figure 17 will be opened to allow user to define Rayleigh damping.

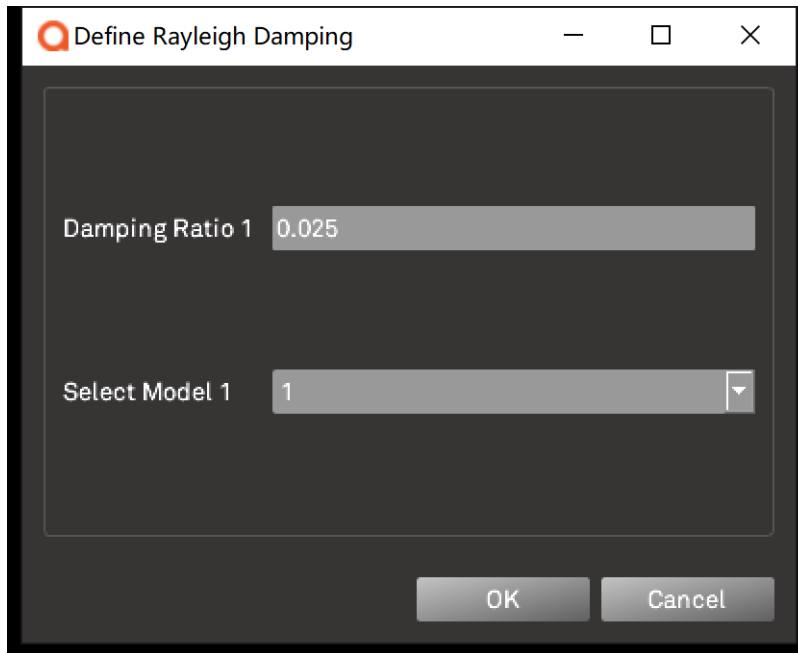


Figure 17 – Define Rayleigh Damping window

4.2.5 Ground Motion

By clicking “Ground Motion” , a window as shown in Figure 18 will be opened to allow user to define ground motion.

By clicking “Browse” , user can add ground motion file to HSS.

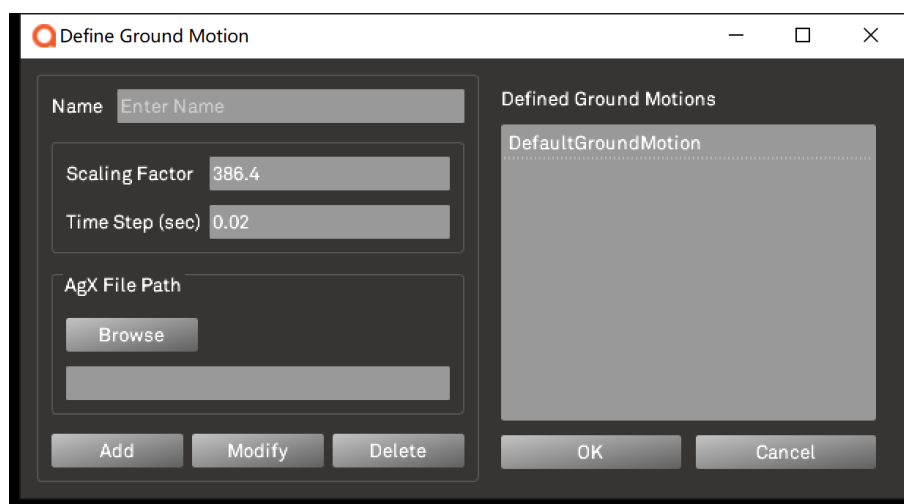


Figure 18 – Define Ground Motion window

4.2.6 Analysis Option

By clicking “Analysis Option” , a window as shown in Figure 19 will be opened to allow user to define analysis option. HSS has six analysis algorithm types: Displacement Dynamic, Displacement Static (Limited), Force Dynamic, Force Static (Limited), Switch Dynamic and Switch Static (Limited). HSS also has three error types: Norm Displacement, Unbalance Force and Energy.

Figure 19 – Define Analysis Option window

4.2.7 Experiment Site

HSS can performs hybrid testing via communicating with Advanced Low-level Controller (ALC).

By clicking “Experiment Site” , a window as shown in Figure 20 will be opened to allow user to define experiment site. The window provides Experiment Site information to define for ALC.

By clicking “Browse” , user can add ALC database path and name to HSS.

“Ref Signal Name” ,will be replaced by ALC sending reference signal.

“Disp Feedback 1” , ALC will monitor this signal as condition of sending feedback signal to HSS. Feedback 1 signal will be sent from ALC as first feedback signal.

“Force Feedback 2” , this signal will be sent from ALC as second feedback signal.

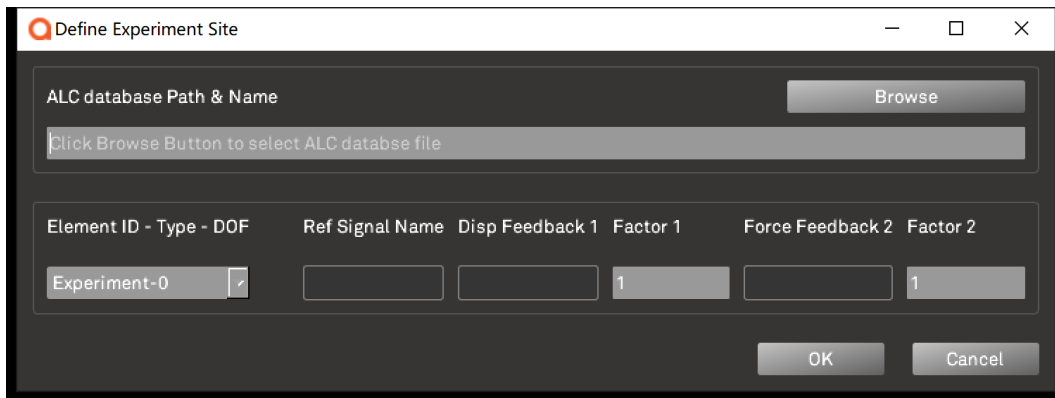


Figure 20 – Define Experiment Site window

4.3 Assign Menu

This section describes the details of the function under “Assign” as shown in Figure 21.

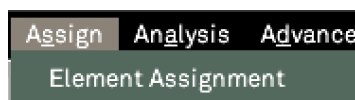


Figure 21 – Drop-down menu of Assign

By clicking “Element Assignment” , a window as shown in Figure 22 will be opened to allow user to assign element type to element.

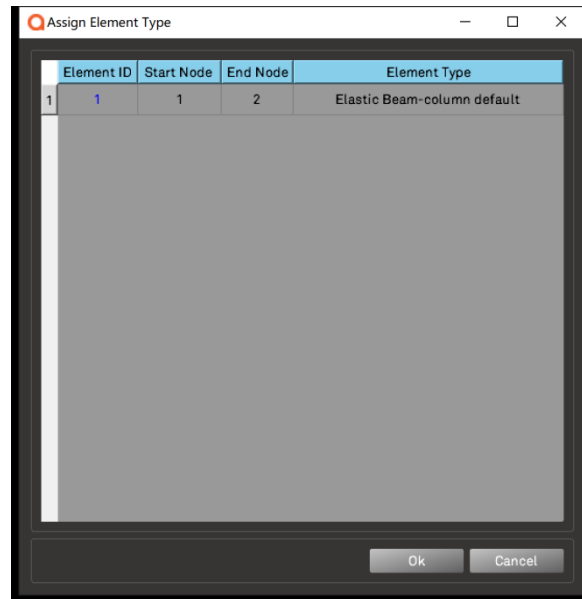


Figure 22 – Assign Element Type window

4.4 Analysis Menu

This section describes the details of the function under “Analysis” as shown in Figure 23.



Figure 23 – Drop-down menu of Analysis

By clicking “Model Analysis” , user can get the structural periods and modes of model, as shown in Figure 24.

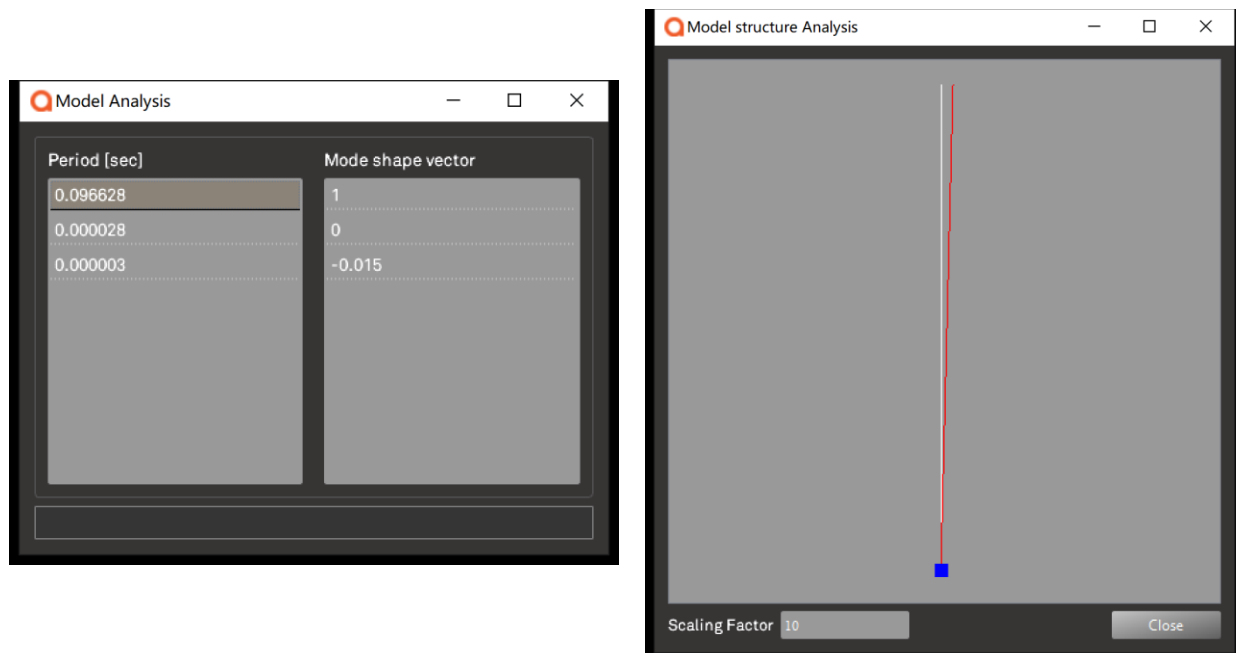


Figure 24 – Model Analysis window

4.5 Advance Menu

This section describes the details of the function under “Advance” as shown in Figure 25.



Figure 25 – Drop-down menu of Advance

By clicking “Define Material Type” , a window as shown in Figure 26 will be opened to allow user to add other material types to HSS. But the material file must be in *.dll format.

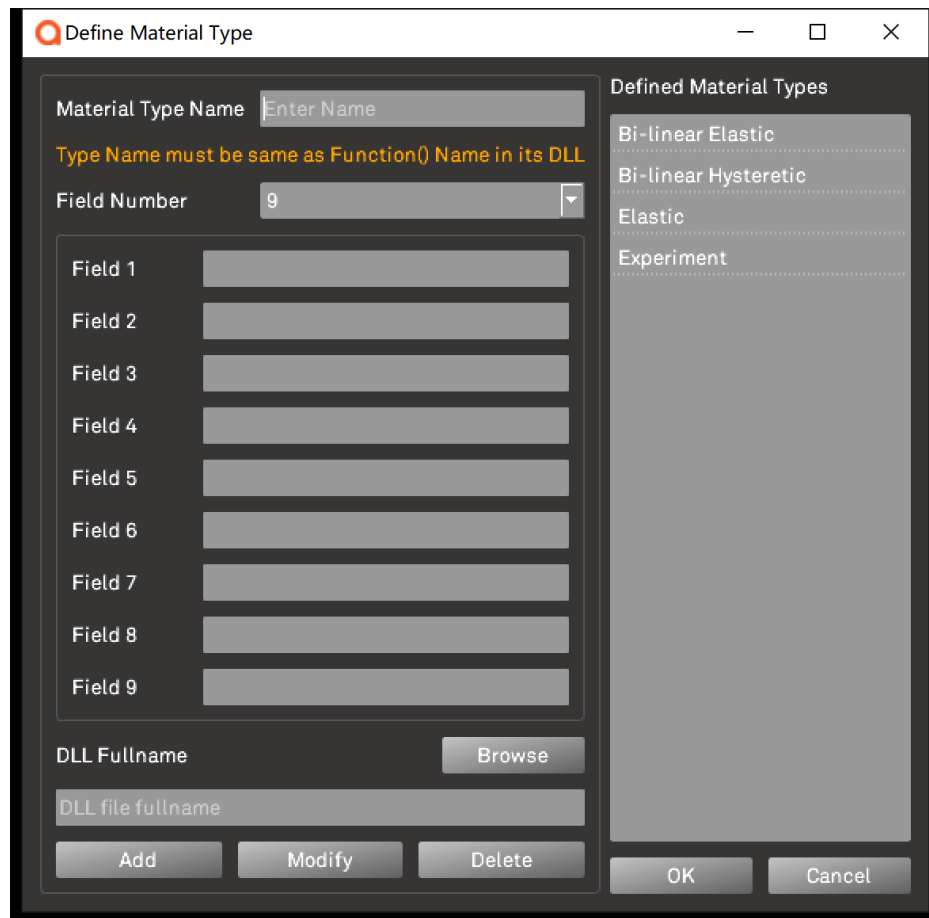


Figure 26 – Define Material Type window

4.6 Help Menu

This section describes the details of the function under “Help” as shown in Figure 27.

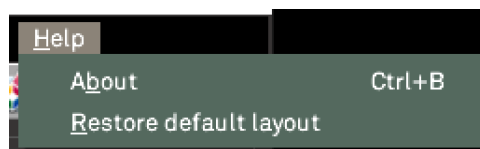


Figure 27 – Drop-down menu of Help

4.6.1 About

By clicking “About” , a window as show in Figure 28 will be opened.



Figure 28 – About window

4.6.2 Restore default layout

By clicking “Restore default layout” , layout will be restored to default.

4.7 Time History Analysis

As shown in Figure 29, user can do time history analysis with following steps:

Step 1: Choose “Ground Motion”

Step 2: Choose “Analysis Option”

Step 3: Define “Max iteration” and “Numerical Tolerance”

Step 4: Click “Apply” button

Step 5: Click “Start” button and HSS will start the numerical analysis

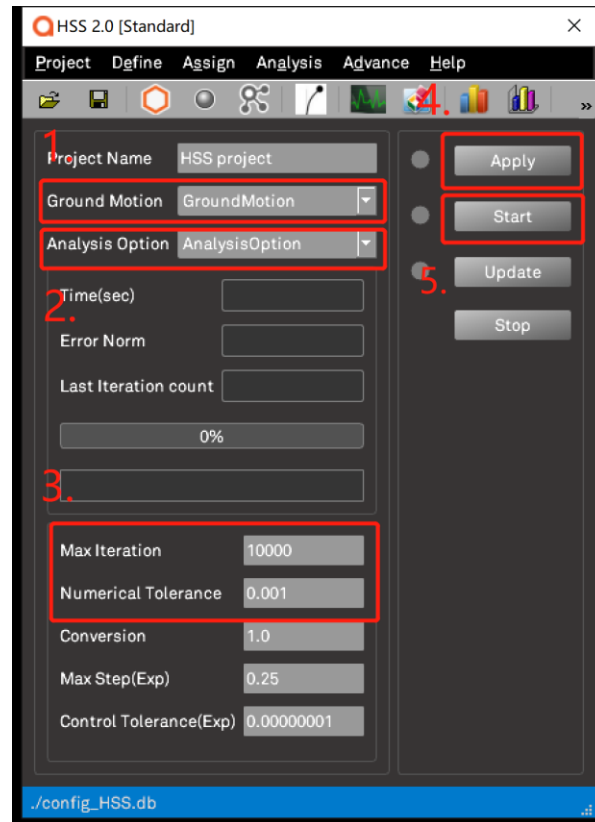


Figure 29 – Time History Analysis window

Click “Stop” button, and the analysis will be stopped.

4.8 Show Analytical Curve

Figure 30 shows the “Show Analytical Curve” icon. By clicking the icon, a window as shown in Figure 31 will be opened to allow user to get the results of time history analysis.



Figure 30 – Show Analytical Curve icon

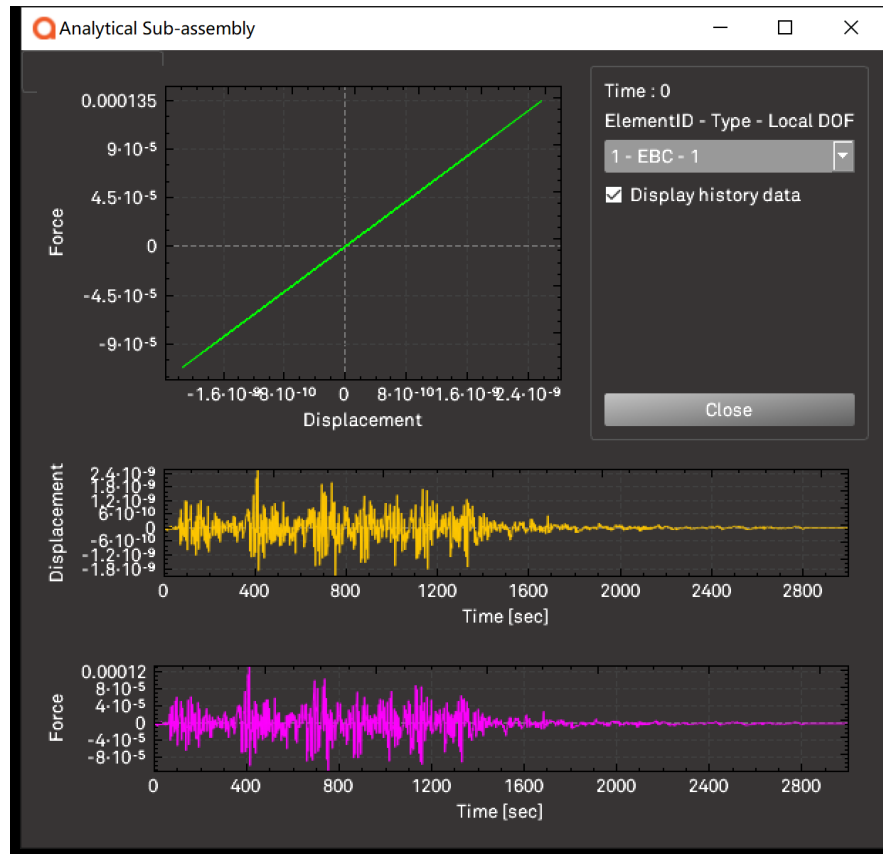


Figure 31 – Analytical Sub-assembly window

If user click it during time history analysis, the window provides real-time plotting.

5 Hybrid Testing

HSS can performs hybrid testing via communicating with Advanced Low-level Controller (ALC). After creating the model, user can do the testing with following steps:

Step 1: Click "Define" - Click "Material" - Define material type to Experiment (as shown in Figure 32) – Click "Add"

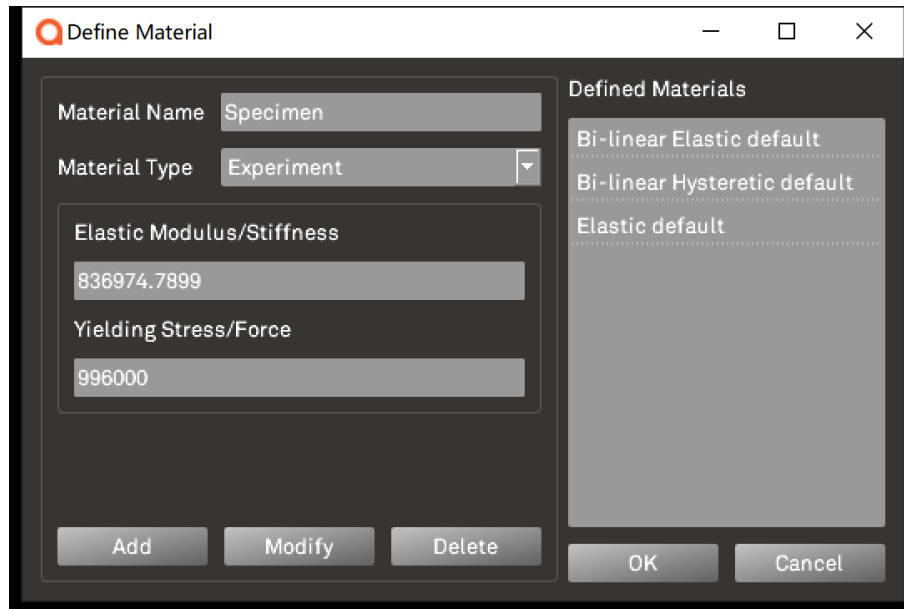


Figure 32 – Define Experiment Material window

Step 2: Click “Define” - Click “Element” - Define element type with Experiment material (as shown in Figure 33) – Click “Add”

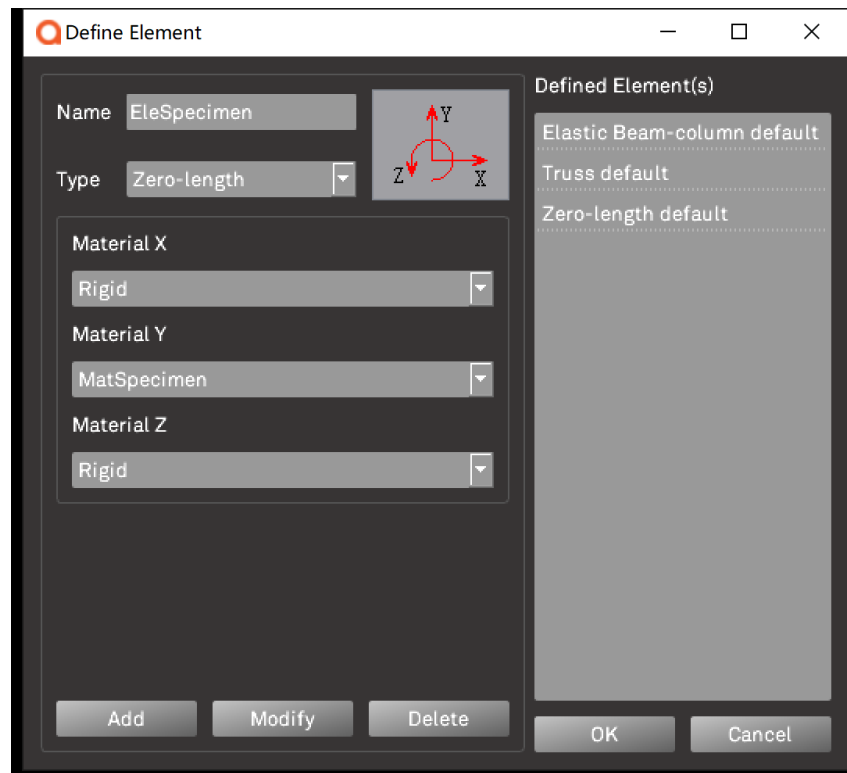


Figure 33 – Define Experiment Element window

Step 3: Click "Assign" - Click "Element Assignment" - Assign Experiment type to element (as shown in Figure 34) – Click "OK"

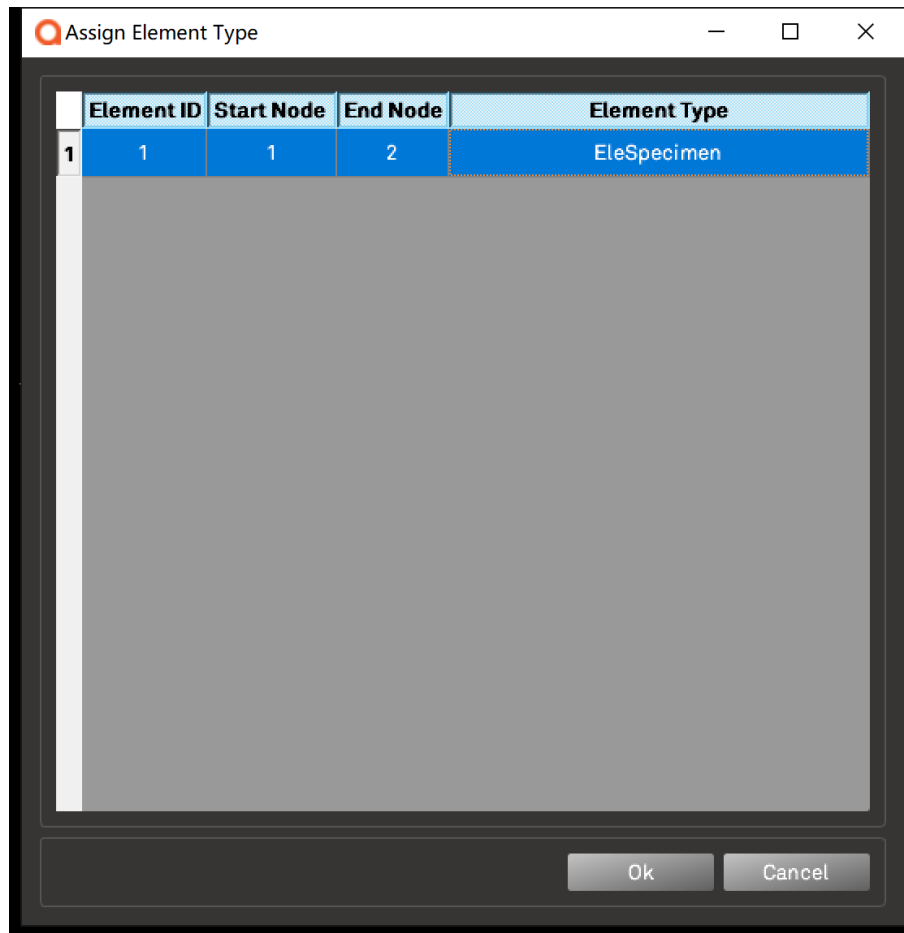


Figure 34 – Assign Experiment Element window

Step 4: Click "Define" - Click "Experiment Site" - Click "Browse" to select ALC database file (as shown in Figure 35) – Click "OK"



Figure 35 – Define Experiment Site window

Step 5: Open ALC software, finish ALC settings and start the hybrid testing.

If you have any questions regarding this manual, please contact ACTS.