Global Local Modeling: Tools and Techniques
Global Local Modeling

Overview

Global –Local Modeling is a general topic where results from a global/system or coarse model are applied as boundary conditions to a more refined model of a component or subsection of the global model.

Femap has implemented a tool under the *Model/Load/From Freebody* Menu to help make this process easier for the user.

The new tool allows the user to select source nodes in a global model freebody and target nodes in the local refined model. The tool then creates RBE3 connections in the local model to apply the freebody loads and automatically creates local model load cases from the selected global cases.
Global Local Modeling Model

Wing Global Model

Global Rib Model

Freebody

Load from Freebody Tool

Local Rib Model
Global Local Modeling

The Process:

Open Global Model
• Global “Vehicle or System Level” model. This will be the “Source Model”.
• Create freebody of the component or area of interest.

Open Local Model
• Local or “Target” Model.
• The tool will create RBE3 connections in this model to apply the loads from the source model.
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The Process:
With both models open, and Target Model Active; 
*Model/Load/From Freebody*

- Select “Multi-Model”
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The Process:
Select Source Model from dropdown
Select Freebody
Select desired Output Sets
Select Moments if desired
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The Process:
Select Method (Two Options)

• **Match ID (1 to 1):**
  • use when source nodes already exist in target model (previously connected)
  • or check “create new” to add the source nodes to target model.
  • RBE3 connections are **not** created.
  • Target model load cases are created.

• **Rigid Element (1 to many) (default)**
  • Source nodes are added to target model
  • RBE3 connection created for each source node
  • Automatic; closest target nodes limited by Max number and Max Distance
  • User Defined; user selects subset of target model nodes, still limited by Max Number and Distance
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The Process:
Select Rigid Element Options

- **Dependent DOF (Source)**
  - RBE3 Reference/master source node
  - Choose force and moment components to be included

- **Independent DOF (Target)**
  - Choose force and moment components to be included

- Choose limits for number of nodes and search distance

- **General Options**
  - Choose Source Node ID offset to prevent ID conflicts
  - If conflict is found, then user has option to renumber on the fly or cancel operations
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The Process:

RBE3 Connections have now been Generated in the target model

- User has the option edit the connections by selecting “yes”

- Toggle Rigid Element Nodes dialogue
  - Graphically turn on/off nodes for RBE3
  - First Select the RBE3 element of interest
  - Select a connected node, it is toggled off (not connected)
  - Select an unconnected node; it is toggled on (connected)
  - RBE3 is automatically updated as selections are made
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The Results:

- Source Nodes Copied to Detail Model
- RBE3 Connections Connect Global Nodes to Local Model
- Local Model Load Cases are created
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Boundary Conditions:
• Local/Target Model Boundary Conditions
  • Load case is a balanced set which should sum to zero.
  • User must supply constraints to stop rigid body motion without corrupting the load paths in the local model.
  • In some cases constraining a single node in all 6 DOF’s is appropriate.
  • Inertia Relief solution can be used to allow static solution.
  • Engineering Assumptions should also be considered
    • For Example: Buckling Solution Considerations
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Boundary Conditions:

- Local/Target Model Boundary Conditions
- Static determinate:
  - Minimum Constraint to stop rigid body motion
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Boundary Conditions:

- Local/Target Model Boundary Conditions
- Wing Skin Boundary:
  - Constrain Rib out of Plane Motion: Z
  - Constrain Rigid body Motions: X, Y
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Compare 3 Choices of Boundary condition

- Inertia Relief
- Wing Skin BC
- Static Determinate
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Buckling Solution with Wing Skin Constraint, Combined Torsion Wing Bending
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Advanced Uses for Tool:

• Attach External Superelement
  • Set up external superelement creation run in the global model using the Freebody node set.
  • Freebody nodes from the global model will be the external superelement boundary nodes.
  • Use Model/Load/From Freebody to connect boundary nodes to local model
  • Once the RBE3 connections have been generated, attach boundary stiffness using external superelement using *External Superelement Reference* in *Analysis Set Manager*

• Merge Target/Detailed Model into Global Model
  • Create RBE3 connections in target model
  • Remove component or detail model region in Global Model
  • Use *File/Merge* to insert detail component into global model
Global Local Modeling Model

Wing Global Model

Global Rib Model

Freebody Tool

Load from Freebody Tool

File/Merge Tool

Local Rib Model
Global Local Modeling

Summary:

• New Tool in Femap *Model/Load/FromFreebody*
  • *Multimodel* Option Created to Assist the User in Global/Local Modeling Task
  • Uses the Freebody Display
  • Copies Freebody Loads from Global to Local Model and Automatically Creates RBE3 Connections Between Global Model Nodes and Local Model
  • Options to Control Selection of Target Nodes
  • Interactive RBE3 Editing of Created Connections
  • Allows Selection of Multiple Result Cases
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