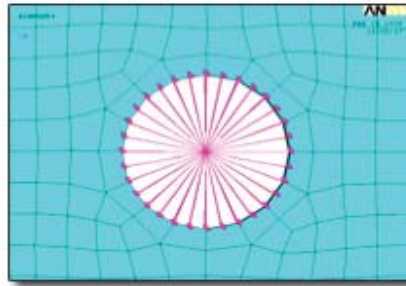


An Easy-to-Use Tool for Generating a Spoke Connection in ANSYS

The Challenge:

A common approach to applying loads to a hole surface in a finite element model is to create a “spoke” connection to a point at the center of the hole. The loading is applied to the center point and distributed to the hole surface based on the type of connection defined. There are several connection options ranging from simple spar elements to MPC based contact. Often the connection choice is based on the analysis condition (small or large deformation, rigid or flexible).



The process of creating the spoke connection can often be time consuming and the user may not be aware of which connections are valid for the analysis conditions. To address this need CAE Associates has developed an ANSYS macro that walks the user through the generation of the spoke connection. The user is prompted to provide the following information:

- Specify an existing nodal component of the hole surface or pick nodes interactively.
- Specify a mass element number or let the program define an element at the average location of the selected nodes.
- Define the connection type.
- Define a mass value (if needed) for the element attached to the center node.

All prompts specify a default value to be used if no input from the user is supplied. For the selection of the connection type the macro provides three options as described in the query menu below:

```
Type 1=rigid/small deflection. Type 2=rigid/large deflection.  
Type 3=flexible/small deflection.  
Specify connection (1, 2 or 3)  
con_type 
```

Continues >

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If the user requires more information about the type of connection that will be generated, the macro text is fully documented:

```
!  
! 1. Rigid connection, small deflection analysis:  
! The CERIG command is used to define a rigid connection using  
! constraint equations. A mass element (mass input by the user)  
! will be defined at the master node to allow moment loading for this case.  
!  
! 2. Rigid connection, large deflection analysis:  
! MPC184 elements are defined as a rigid beams with translational and rotational  
! degrees of freedom. The MPC184 rigid beams will transmit forces and moments from  
! the master node to the slave nodes. No mass element is generated at the master  
! node for this type of connection.  
!  
! 3. Flexible connection, small deflection analysis:  
! The RBE3 command is used to define a weighted connection between the master node  
! and the surrounding slave nodes. An array of the weighting factors for the slave  
! nodes must be defined prior to running the macro. If no weighting factor array is  
! defined or the specified array does not match the active slave node set, the default  
! weighting factor for each node is defined as 1.0. The user should check the ANSYS  
! output window to confirm that the correct weighting factors have been applied.
```

Over the last several years the spokes macro has been widely used at both the Hamilton Sunstrand and Pratt & Whitney divisions of United Technologies. According to one Pratt engineer, "The spokes macro saved me time and my wrist. I had to use the macro to simulate 3,000 rivets and if I did not have the spokes macro, I would still be applying elements or have carpal tunnel syndrome."

