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Creating a Radiative Heat Source

Use *Radiative Heating* to define selected elements as diffusely radiating heat sources, and to calculate their direct view factors to other elements. You can define heat source elements as radiating either solar or infrared spectrum energy. Reflection and absorption of the incident radiative energy throughout the enclosure is automatically computed. Ray-tracing is used for specular or transmissive surfaces. Heat flux view factors from the source elements to the illuminated elements are calculated. You can control the accuracy of the shadowing calculations by selecting an Error Criterion value.

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Specifying the Heat Source

Select the geometry group or elements which comprise the radiating surface. For Solar spectrum heat sources, only surface elements with solar absorptivity values between 0 and 1 are acceptable; see *Creating a Radiation Request* for a complete description of the element types.

Characterize the radiating surface by specifying an emitted flux or a total power per element. You can define the radiative heat source to be time varying: pick *Create Table...* to define the time dependence. If the largest time value in the table is smaller than the End Time of the analysis, the resulting element heat loads are treated as periodic, with a period equal to the largest defined time value.

The *Collimated* option specifies that the radiative source emits colllimated (parallel) rays. The total energy emitted is not affected by the specified direction of the rays in relation to the emitting surface. However, if the direction is specified at an oblique angle to the surface, the energy will be more concentrated (narrower beam) than it would be if the specified direction is perpendicular to the same surface (broader beam). Use standard vector definition techniques to define the direction of the rays. The *Information* icon **[i]** prints the current vector definition to the List region.

Illuminated Elements

The *Illuminated Elements* selection defines the elements for which direct heat flux view factors to the source elements are to be calculated. Note that radiative heat loads due to reflection will be calculated for all elements in the enclosure.

Shadowing Checks

Shadowing checks should normally be performed for all *Radiative Heat Source* requests. These checks may only be safely deactivated in situations where you are certain that all illuminated elements have an unobstructed view of all source elements. Elements are subdivided according to the specified parameter; a higher subdivision parameter will yield more accurate heat flux view factors at the cost of additional computation time.

The *Error Criterion* value is the difference that is allowed between the view factor sum of each element and one. Individual elements are subdivided until TMG estimates that they will meet this level of accuracy. TMG uses the subdivided elements to compute the shadowed radiative view factors. You can also set a constant subdivision parameter to use for all elements with the *Fixed Subdivision* option.

Setting up a Radiative Heating Model

To simulate radiative heating, you must:

1. Create a complete model of the enclosure containing the radiating elements

   - Make sure you know which are the front and reverse sides for all elements in the enclosure (see *Front and Reverse Element Sides*). If some elements face the wrong way, reverse their connectivity with the TMG menu pick *Radiation / Elem. Reverse Conn.* (Control+M shows the menu).

2. Define appropriate properties for all elements in the enclosure

   - Use material type *Thermal/Fluid* - *Thermal Solid*

   - For a solar type Radiative Heating entity, define solar absorptivity for all illuminated elements and emissivity for all elements in the enclosure (if you want to model diffuse radiation).

   - You can exclude elements from the radiative heating process by using *Element Radiation Switches* and selecting *Ignore Elements for all Solar/Orbital/ Radiative Heating* or *Ignore Elements for all View Factor Calculations* . Alternatively, for a solar type Radiative Heating entity, you can leave solar absorptivity undefined (Null).

3. Create *Radiation Requests* to compute a complete set of black body view factors for the enclosure. This step is necessary to model diffusely reflected solar radiation.

Locate the icon.

5. Create the desired *Radiative Heating* requests to compute direct heat flux view factors for the selected elements, and to define the radiative source characteristics.

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Elements for Radiative Heating

The following element types are supported as Source Elements or Illuminated Elements.

Front of:

- 2-D thin shell elements
- Beam elements with cross section defined
- Lumped mass elements
- Free faces of 3-D solid elements
- Axisymmetric shell elements
- Free edges of axisymmetric solid elements

Reverse of:

- 2-D thin shell elements
- Axisymmetric shell elements

Notes on Radiative Heating

- Black body view factors are used by TMG to determine the distribution of reflected radiative flux. Be sure that they are complete and accurate; i.e. the view factor sums for all elements should be close to 1. (see *Creating a Radiation Request* and *Include*

Shadowing Checks)

- The automatic treatment of specular surfaces does not account for the specular reflection of diffusely-reflected flux. You can model this effect by activating ray-tracing for the calculation of the black body view factors under *Radiation Request*. (see the article *Ray-Tracing*).

- Note that the sequence of the Radiative Heating requests can be important. If a computed heat flux view factor is recalculated by a subsequent request, the original value is overwritten. You can use this feature to improve the heat flux view factor accuracy for selected elements. Be sure to use the same source elements to define subsequent Radiative Heating requests for this purpose; otherwise fluxes will be added rather than overwritten. To determine the sequence of Radiative Heating requests in an existing model, use the TMG Model Manager. The default sequence in the listing is the determining sequence.
