# TYPE 693: LOAD IMPOSED ON AN AIR STREAM

## General Description

Often in simulating an HVAC system, the heating and cooling loads on the building have already been determined, either by measurement or through the use of another simulation program. This component allows for there to be an interaction between such precalculated loads and the HVAC system by imposing them upon air flowing through a duct.

## Nomenclature

| | | |
|---|---|---|
| $h_{out}$ | [kJ/kg] | the enthalpy of air leaving the interaction point. |
| $h_m$ | [kJ/kg] | the enthalpy of air entering the interaction point. |
| $\dot{Q}$ | [kJ/h] | the rate at which energy is added to or removed from the air stream. |
| $\dot{m}$ | [kg/h] | the rate at which air flows past the load. |
| $p_{out}$ | [atm] | the air pressure leaving the interaction point. |
| $p_{in}$ | [atm] | the air pressure entering the interaction point. |
| $\Delta p$ | [atm] | the air pressure drop across the interaction point. |
| $Q_{met}$ | [kJ/h] | the load met by the air stream |

## Detailed Description

Type 693 can be thought of as an interaction point between a building load and the air stream in an HVAC system. If the interaction point is between the building and a liquid stream, Type682 may be used instead.

Mathematically, the model is very simple, the user provides the flow rate, relative humidity or humidity ratio, pressure and temperature of air at a point in the system loop. The pressure drop across the interaction point must also be provided. The specified building load is added to, or subtracted from the air stream, resulting in new air conditions just past the interaction point.

The outlet enthalpy of the air is calculated according to equation 693.1

$$h_{out} = h_{in} + \frac{\dot{Q}}{\dot{m}} \qquad \text{(Eq. 693.1)}$$

It is assumed that the absolute humidity ratio of air entering and leaving the interaction point is the same. However, the humidity ratio may have been reset to the saturation humidity ratio if the conditions of the inlet air were above saturation.

The remaining outlet conditions of the air are then calculated through a call to the TRNSYS psychrometrics utility subroutine with the pressure modified according to equation 693.2.

$$p_{out} = p_{in} - \Delta p \qquad \text{(Eq. 693.2)}$$

The load met is calculated according to equation 693.3

$$Q_{met} = \dot{m}\left(h_{out} - h_{in}\right) \qquad \text{(Eq. 693.3)}$$

According to the sign convention, a positive load will result in an air outlet temperature higher than the inlet temperature and vice versa; a negative load results in an outlet temperature lower than the inlet temperature.

**Example**

Type693 is used in an example that can be found in:
“ ..\trnsys16\TESS Models\Studio Projects\Loads and Structures Library\Synthetic Building.tpf”