THE GROUND COUPLING COMPONENT LIBRARY (GENERAL DESCRIPTIONS)

Type501: GROUND TEMPERATURE PROFILE

This subroutine models the vertical temperature distribution of the ground given the mean ground surface temperature for the year, the amplitude of the ground surface temperature for the year, the time difference between the beginning of the calendar year and the occurrence of the minimum surface temperature, and the thermal diffusivity of the soil. These values may be found in a variety of sources including the ASHRAE Handbooks (refer to soil temperature).

Type653: SIMPLE FLOOR HEATING SYSTEM

This component models a simple radiant slab (floor heating or cooling) system that operates under the assumption that the slab can be treated as a single lump of isothermal mass and that the fluid to slab energy transfer can be modeled using a heat exchanger effectiveness approach.

Type701: BASEMENT CONDUCTION (INTERFACES WITH TYPE56)

This routine models the heat transfer from a basement (typically four walls and a floor, all made of concrete) to the soil surrounding the five surfaces of the basement. The heat transfer is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a 3-dimensional finite difference model of the soil and solves the resulting inter-dependent differential equations using a simple iterative method. The user enters the temperature of the zone air / slab interface for each of the five surfaces as well as the U value of each surface. The user is also asked to enter the soil properties, soil grid geometry, and the conditions outside of the basement (near-field). The initial soil conditions may be calculated from the Kasuda correlation [1] or read from a user-supplied data file. The surface conditions for the near-field and far-field soil may be calculated in one of three ways; 1) from the Kasuda correlation, 2) from an energy balance on the surface plane, 3) provided as an input to the model. The near-field soil temperatures are affected by the heat transfer from the basement. The far-field soil temperatures are only affected by the surface conditions (time of year) and depth. The model in return calculates the slab/ground interface temperature for each surface, which are passed back to the building model as an input.

This basement model is intended to be used in conjunction with Type56. If you wish to use this model in conjunction with a simplified building model, you should use Type702 instead.

Type702: BASEMENT CONDUCTION (INTERFACES WITH ZONE AIR TEMPERATURE)

This routine models the heat transfer from a basement (typically four walls and a floor, all made of concrete) to the soil surrounding the five surfaces of the basement. The heat transfer is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a 3-dimensional finite difference model of the soil and solves the resulting inter-dependent differential equations using a simple iterative method. The user enters the temperature of the zone air, the thermal properties of the basement wall material, the soil properties and grid geometry, and the ambient conditions in the soil outside of the basement (near-field). The initial soil conditions may be calculated from the Kasuda correlation [1] or read from a user-supplied data file. The surface conditions for the near-field and far-field soil may be calculated in one of three ways; 1) from the Kasuda correlation, 2) from an energy balance on the surface plane, 3) provided as an input to the model. The near-field soil temperatures are affected by the heat transfer from the basement. The far-field soil temperatures are only affected by the surface conditions (time of year) and depth.

This basement model is intended to be used in conjunction with simplified building models. If you wish to use this model in conjunction with Type56, you should use Type701 instead. More information on this distinction is provided in section 1 below.

Type703: SLAB ON GRADE (INTERFACES WITH TYPE56)

This routine models the energy transfer from a horizontal surface (commonly a concrete slab) to the soil beneath the surface. The energy transfer is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a 3-dimensional finite difference model of the soil and solves the resulting inter-dependent differential equations using a simple iterative method. The user enters the temperature of the zone side surface of the slab, the slab U value, the soil properties and grid geometry, and the conditions outside of the slab (near-field). The initial soil conditions may be calculated from the Kasuda correlation [1] or read from a user-supplied data file. The surface conditions for the near-field and far-field soil may be calculated in one of three ways; 1) from the Kasuda correlation, 2) from an energy balance on the surface plane,

3) provided as an input to the model. The near-field soil temperatures are affected by the heat transfer from the slab. The far-field soil temperatures are only affected by the surface conditions (time of year) and depth. The model in return calculates the slab/ground interface temperature, which is passed back to the building model as an input.

This slab model is intended to be used in conjunction with Type56. If you wish to use this slab model in conjunction with a simplified building model, you should use Type704 instead.

Type704: SLAB ON GRADE (INTERFACES WITH ZONE AIR TEMPERATURE)

This routine models the heat transfer from a horizontal surface (slab) to the soil beneath the surface. The heat transfer is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a 3-dimensional finite difference model of the soil and solves the resulting inter-dependent differential equations using a simple iterative method. The user enters the temperature of the zone air above the slab, the thermal properties of the slab, the soil properties and grid geometry, and the ambient conditions outside of the slab (near field). The initial soil conditions may be calculated from the Kasuda correlation [1] or read from a user-supplied data file. The surface conditions for the near-field and far-field soil may be calculated in one of three ways; 1) from the Kasuda correlation, 2) from an energy balance on the surface plane, 3) provided as an input to the model. The near-field soil temperatures are affected by the heat transfer from the slab. The far-field soil temperatures are only affected by the surface conditions (time of year) and depth.

This radiant slab model is intended to be used with simple building models that calculate the zone air temperature and not with detailed building models that are capable of calculating inner surface temperatures based on provided outer surface temperatures (such as the standard TRNSYS Type 56 model). If you wish to use this radiant slab model in conjunction with Type56, please refer to the companion model, Type703.

Type705: RADIANT SLAB WITH EMBEDDED PIPES (INTERFACES WITH TYPE56)

This component is intended to model a radiant floor-heating slab, embedded in soil, and containing a number of fluid filled pipes. The heat transfer within the slab and surrounding soil is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a three-dimensional finite difference method, solving the resulting inter-dependent differential equations using an iterative approach. The user may define any number of pipes within the slab and surrounding soil through a separate data file containing information about the path that the pipes follow through the slab/soil for each pipe. The slab is assumed to be embedded in the soil and the user may define bottom and/or perimeter insulation that extends below the slab if desired. Default numbers of maximum slab nodes, maximum pipe nodes and maximum number of pipes are set, but may be increased by modification of the Fortran code.

This version of the radiant slab model is designed to be used in conjunction with the Type56 building model. If you wish to use the same model in conjunction with a different building model (one that computes a zone air temperature but does not calculate interior surface temperatures), you should use Type706 instead.

Type706: RADIANT SLAB WITH EMBEDDED PIPES (INTERFACES WITH ZONE AIR TEMPERATURE)

This component is intended to model a radiant floor-heating slab, embedded in soil, and containing a number of fluid filled pipes. The heat transfer within the slab and surrounding soil is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a three-dimensional finite difference method, solving the resulting inter-dependent differential equations using an iterative approach. The user may define any number of pipes within the slab and surrounding soil through a separate data file containing information about the path that the pipes follow through the slab/soil for each pipe. The slab is assumed to be embedded in the soil and the user may define bottom and/or perimeter insulation that extends below the slab if desired. The slab may also be exposed to incident radiation whether from interior lights or from the sun. Default numbers of maximum slab nodes, maximum pipe nodes and maximum number of pipes are set, but may be increased by modification of the Fortran code.

If you wish to use this radiant slab model in conjunction with Type56, you should use Type705 instead. This version (Type706) is designed to be used with building models that do not contain the notion of a boundary wall and compute interior surface temperatures.

Type707: BURIED VERTICALLY CYLINDRICAL STORAGE TANK WRAPPER

This component can be used in conjunction with most thermal storage tank models to calculate the energy exchange through the bottom, top, and sides of a vertically cylindrical tank that is entirely buried beneath the ground surface. As inputs, the model takes the U values of the tank top, bottom, and each thermal node section as well as the temperature of each tank node.

The user is also asked to define a 3 dimensional radial soil node structure. In return, Type707 computes the temperature of each tank node / soil node boundary, passing those temperatures back to the tank model for its own loss calculations.

Type711: BURIED PIPE WRAPPER

This component can be used in conjunction with most pipe models to calculate the energy exchange through the sides of a horizontally oriented pipe that is entirely buried beneath the ground surface. As inputs, the model takes the U values of the pipe as well as the temperature of each axial pipe node. The user is also asked to define a 3 dimensional radial soil node structure. In return, Type701 computes the temperature of each pipe node / soil node boundary, passing those temperatures back to the pipe model for it's own loss calculations.

Type712: RADIANT SLAB WITH EMBEDDED PIPES AND NO GROUND STORAGE EFFECTS (INTERFACES WITH TYPE 56)

This component is intended to model a radiant floor-heating slab, embedded in soil, and containing a number of fluid filled pipes. The heat transfer within the slab is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a three-dimensional finite difference method, solving the resulting inter-dependent differential equations using an iterative approach. The user may define any number of pipes within the slab through An external data file containing information about the path that the pipes follow through the slab for each pipe. The slab is assumed to be embedded in the soil and the user may define bottom and/or perimeter insulation that extends below the slab if desired. Default numbers of maximum slab nodes, maximum pipe nodes and maximum number of pipes are set, but may be increased by modification of the Fortran code. This model differs from Type705 in that it does not extend the 3D grid into the soil that surrounds the slab. Instead, the zone temperature communicates (through the slab) with a ground surface temperature generated by the Kasuda [1] correlation.

This version of the radiant slab model is designed to be used in conjunction with the Type56 building model. If you wish to use the same model in conjunction with a different building model (one that computes a zone air temperature but does not calculate interior surface temperatures), you should use Type713 instead.

Type 713: RADIANT SLAB WITH EMBEDDED PIPES AND NO GROUND STORAGE EFFECTS (INTERFACES WITH ZONE AIR TEMPERATURE)

This component is intended to model a radiant floor-heating slab, embedded in soil, and containing a number of fluid filled pipes. The heat transfer within the slab is assumed to be conductive only and moisture effects are not accounted for in the model. The model relies on a three-dimensional finite difference method, solving the resulting inter-dependent differential equations using an iterative approach. The user may define any number of pipes within the slab through An external data file containing information about the path that the pipes follow through the slab for each pipe. The slab is assumed to be embedded in soil and the user may define bottom and/or perimeter insulation that extends below the slab if desired. The slab may also be exposed to incident radiation whether from interior lights or from the sun. Default numbers of maximum slab nodes, maximum pipe nodes and maximum number of pipes are set, but may be increased by modification of the Fortran code. This model differs from Type706 in that it does not extend the 3D finite element grid into the soil that surrounds the slab. Instead, the zone temperature communicates (through the slab) with a ground surface temperature generated by the Kasuda [1] correlation.

If you wish to use this radiant slab model in conjunction with Type56, you should use Type712 instead. This version (Type713) is designed to be used with building models that do not contain the notion of a boundary wall and compute interior surface temperatures.

Type714: ASHRAE METHOD FOR CALCULATING SLAB HEAT TRANSFER

In 2001 ASHRAE Fundamentals Chapter 31, the American Society of Heating and Refrigeration Engineers proposes a simplified method for calculating the energy transfer through a rectangular slab on grade with various insulation schemes (back insulation, side insulation, no insulation, etc.). The same chapter extends the simplified method to calculating energy transfer through basements. This Type should be used for slabs while Type715 is available for calculating energy transfer through basements.

Type715: ASHRAE METHOD FOR CALCULATING BASEMENT HEAT TRANSFER

In 2001 ASHRAE Fundamentals Chapter 31, the American Society of Heating and Refrigeration Engineers proposes a simplified method for calculating the energy transfer through a rectangular aspect ratio basement with various insulation schemes (back insulation, side insulation, no insulation, etc.). The same chapter also presents the simplified method as it applies to calculating energy transfer through slabs. This Type should be used for basements while Type714 is available for calculating energy transfer through slabs. Because of the methodology used, this model is not appropriate for use with Type56 but can be used with simplified building models such as standard TRNSYS Type12, or 88, or the TESS simplified multizone building model (Type660).