THE GREEN BUILDING COMPONENT LIBRARY (GENERAL DESCRIPTIONS)

Type 56 Window Library

Historically, five generic windows have been included with the multizone building model (Type56) in the TRNSYS package. Users can create new windows for use with Type 56 by running a freely downloadable software product called "Window," written by Lawrence Berkeley National Labs. The Green Building Library includes an expanded library of windows that were created using version 5.2 of the LBNL Window software package. The windows come from four sources; ASHRAE Standard 90.1.99 Table A17, ASHRAE Standard 90.1-99 code minimum windows for various wall coverages and for a particular climate zone (defined in terms of heating and cooling degree days). A window that matches the window defined in ASHRAE Standard 140 and in the BESTEST Standard, and a set of windows that are used in the Building America program. In all, over 100 new windows are available for use with Type56.

Type 551: PHOTOVOLTAIC ARRAY SHADING

It is known that even partial shading of photovoltaics (PV) can have a dramatic effect upon array performance. However, the relationship between the shaded area of a photovoltaic array and the drop in electrical performance due to that shaded area is not only highly non-linear but depends upon the placement of the array with regards to surrounding objects and upon the array's inter and intra modular electrical connections. In order to accurately perform a shading analysis of a photovoltaic array, information about the specific order in which modules are connected in series in parallel, as well as some method for determining time dependent shadow patterns on the array are needed. Only in very rare circumstances would a user have access to such information. As an alternative, component Type551 has been developed as a simplified method for bracketing the effect of shading. Users are asked to select between two general array configurations: generally horizontal rows or generally vertical rows. The first configuration would be appropriate for a series of ballasted roof pan photovoltaics on a flat or sloped roof. The second would be appropriate in a high rise building in which PV is used as a window shading device.

The Type assumes that the array is divided into a user specified number of equal length rows and that all rows in the array are identically sloped. Based on configuration parameters and current input values, the component outputs two different estimates of radiation incident on the array rows. In the more conservative of the two estimates, a row that is partially shaded from beam radiation is assumed to "see" only diffuse radiation. In the less conservative estimate, the fraction of the array exposed to beam radiation is computed and the entire array is assumed to be exposed evenly to that reduced amount.

Type 560: FIN-TUBE PV/T SOLAR COLLECTOR

This component models an un-glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to a fluid stream passing through tubes bonded to an absorber plate located beneath the PV cells. The waste heat rejected to the fluid stream cools the PV cells allowing higher power conversion efficiencies and can be used to provide a source of heat for various low-grade temperature applications such as space and water heating.

This model relies on linear factors relating the efficiency of the PV cells to the cell temperature and to incident solar radiation. The cells are assumed to be operating at their maximum power point condition.

The thermal model of this collector relies on algorithms presented in Chapter 6 of "Solar Engineering of Thermal Processes" by J.A. Duffie and W.A. Beckman.

Type 562: SIMPLE GLAZED OR UNGLAZED PHOTOVOLTAIC PANEL

Type562 models either a glazed or unglazed photovoltaic array, basing its performance calculation on a user provided overall array efficiency. Efficiency may be constant, variable, provided as a function of cell temperature and incident radiation in an external file or provided for reference conditions along with coefficients that describe the effect of cell temperature and incident radiation changes. This model is appropriate for PV arrays that are connected to a load through a maximum power point tracking device since the efficiency of the Type562 PV is not dependent upon load voltage.

Type 563: UNGLAZED FIN-TUBE PV/T SOLAR COLLECTOR

This component is intended to model an un-glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to a fluid stream passing through tubes bonded to an absorber plate located

beneath the PV cells. This model relies on linear factors relating the efficiency of the PV cells to the cell temperature and to the incident solar radiation. The cells are assumed to be operating at their maximum power point condition.

The thermal model of this collector relies on algorithms presented in Chapter 6 of "Solar Engineering of Thermal Processes" by J.A. Duffie and W.A. Beckman.

This version of the PV/T collector may be connected to the multi-zone building model in TRNSYS so that the impact of the collector on the building heating and cooling loads can be evaluated.

Type 566: BUILDING-INTEGRATED PHOTOVOLTAIC SYSTEM (INTERFACES WITH ZONE AIR TEMPERATURE)

This component is intended to model a glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to an air stream passing beneath the absorbing PV surface. This model is intended to operate with simple building models that can provide the temperature of the zone air on the back-side of the collector and possibly provide an estimate of the radiant temperature for back-side radiation calculations (the room air temperature may be used as a suitable estimate of the radiant temperature if surface temperatures are not available).

The model allows for the user to choose between two methods of handling the off-normal solar radiation effects. The model also allows the user three options on specifying how the cell temperature and the incident solar radiation affect the PV efficiency. The cells are assumed to be operating at their maximum power point condition, implying that the voltage and current are not calculated by the model.

The thermal model of this collector relies on algorithms supplied in "Solar Engineering of Thermal Processes" by J.A. Duffie and W.A. Beckman.

Type 567: BUILDING-INTEGRATED PHOTOVOLTAIC SYSTEM (INTERFACES WITH TYPE56)

This component is intended to model a glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to an air stream passing beneath the absorbing PV surface. This model is intended to operate with detailed building models that can provide the temperature of the back surface of the collector (zone air/collector back interface) given the mean surface temperature of the lower flow channel. The Type 56 multi-zone building model in TRNSYS in one of these detailed zone models. Instructions for connecting this model to a Type 56 building can be found in this model's technical documentation.

The model allows for the user to choose between two methods of handling the off-normal solar radiation effects. The model also allows the user three options on specifying how the cell temperature and the incident solar radiation affect the PV efficiency. The cells are assumed to be operating at their maximum power point condition, implying that the voltage and current are not calculated by the model.

The thermal model of this collector relies on algorithms supplied in "Solar Engineering of Thermal Processes" by J.A. Duffie and W.A. Beckman.

Type 568: UN-GLAZED BUILDING-INTEGRATED PHOTOVOLTAIC SYSTEM (INTERFACES WITH TYPE56)

This component is intended to model an un-glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to an air stream passing beneath the absorbing PV surface. The waste heat rejected to the air stream is useful for two reasons; 1) it cools the PV cells allowing higher power conversion efficiencies and 2) it provides a source of heat for many possible low-grade temperature applications including heating of room air. This model is intended to operate with detailed building models that can provide the temperature of the back surface of the collector (zone air/collector back interface) given the mean surface temperature of the lower flow channel. The Type 56 multi-zone building model in TRNSYS in one of these detailed zone models. Instructions for connecting this model to a Type 56 building can be found later in this document.

The model allows the user three options on specifying how the cell temperature, and the incident solar radiation affect the PV efficiency. The cells are assumed to be operating at their maximum power point condition; implying that the voltage and current are not calculated by the model.

The thermal model of this collector relies on algorithms supplied in “Solar Engineering of Thermal Processes” by J.A. Duffie and W.A. Beckman.

Type 569: UN-GLAZED BUILDING-INTEGRATED PHOTOVOLTAIC SYSTEM (INTERFACES WITH ZONE AIR TEMPERATURE)

This component is intended to model an un-glazed solar collector that has the dual purpose of creating power from embedded photovoltaic (PV) cells and providing heat to an air stream passing beneath the absorbing PV surface. This model is intended to operate with simple building models that can provide the temperature of the zone air on the back-side of the collector and possibly provide an estimate of the radiant temperature for back-side radiation calculations (the room air temperature may be used as a suitable estimate of the radiant temperature if surface temperatures are not available).

The model allows the user three options on specifying how the cell temperature, and the incident solar radiation affect the PV efficiency. The cells are assumed to be operating at their maximum power point condition, which implies that the voltage and current are not calculated by the model.

The thermal model of this collector relies on algorithms supplied in “Solar Engineering of Thermal Processes” by J.A. Duffie and W.A. Beckman.

Type 687: NATIONAL FENESTRATION RATING COUNCIL (NFRC) WINDOW

The Type687 model calculates the amount of solar energy and illumination transmitted through a window given only the basic information available on the National Fenestration Rating Council label of any window commercially available in the United States. It takes, as input data the window’s solar heat gain coefficient, overall u value and visible light transmittance.

Type 726: PROPORTIONAL LIGHTING CONTROLLER

This component returns a control signal between a user defined minimum value and 1 that is related to the value of an input signal at the current time step and compared to user defined minimum and maximum values. The component can be used to simulate an ON/OFF controller by setting the minimum and maximum set point values equal to one another. The controller differs from other proportional controllers in that it generates its maximum signal at the lower set point and its minimum signal at its upper set point. In this regard, the output is inverted from that of a typical controller.

Type 727: CONTINUALLY STEPPED LIGHT FIXTURES

This component is intended to model one of many control strategies for reduced energy usage lighting. It takes two control signals and is only ON if both control signals are ON. One of the two control signals is digital, the other an analog value between 0 and 1. The light supplied by the fixture (and its corresponding heat gain) are stepped linearly with the value of the analog control signal. In a typical application, the digital control signals might be connected to the occupancy of the a room, while the analog signal is connected to a daylight level sensor. The model also features an automatic delayed shut off as would be appropriate to model lighting connected to a motion sensor. When the digital control signal drops to zero, the lights stay on (and continue to draw power and create a heat gain in the space) for a user settable amount of time.

Type 728: MULTIPLE POWER LEVEL LIGHTS

This component is intended to model one of many control strategies for reduced energy usage lighting. It takes two control signals and is only ON if both control signals are ON. In a typical application, one of the control signals might be connected to the occupancy of the a room, while the other is connected to a daylight level sensor. The model also features an automatic delayed shut off as would be appropriate to model lighting connected to a motion sensor. When one of the two control signals drops to zero, the lights stay on (and continue to draw power and create a heat gain in the space) for a user settable amount of time. Finally, users may specify the number of power levels at which the lighting may be operated. Both power draw and heat gain are correspondingly stepped back.