Electrical Tutorial

Electrical Overview

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Note to Student: Online Training Workflow

Each Intergraph Smart™3D Online Training session is comprised of a series of informative video clips, a short quiz, and one PDF-based tutorial viewable on any Windows or Android-OS computer/tablet. These videos are presented through a structured, learning management system, or LMS, which logs your time and monitors all videos you have watched. In our live classroom courses, you listen to an instructor's lecture and are given the chance to practice what has been relayed using your text book and the software. The recommended student workflow for our online training course is much the same.

After logging in to the LMS, you watch a video demonstration of specific topics/techniques, complete a practice tutorial and then sit a short quiz about the session to obtain credit in the system.

Please read the following information about the Intergraph Smart™3D Online Training Series.

Videos

Videos are meant to provide visual demonstrations of specific designer tasks performable in the software. They may be viewed for note-taking purposes or followed step-by-step as you explore Smart3D. You can play/pause a video by pressing the  button or Space bar on your keyboard. Pressing the  button or R on your keyboard will rewind the video to the beginning. Videos can only be viewed using the latest Flash-compliant browsers such as Internet Explorer, Firefox, Opera, or Google Chrome.

Quizzes

A Quiz will be given at the end of each session to test what you have just learned. Once you answer the question, you will be given your score.

Tutorials

Tutorials are meant to provide information and step-by-step practice for performing specific designer tasks. Although tutorials and videos are related by subject, video and tutorial content may differ in certain areas. As a guideline, try to follow the steps noted in each tutorial while using previously viewed video content as reference to your learning experience.

If you choose to follow a video task step-by-step and the same task is listed in its tutorial, note that section as followed and proceed to the next task until you finish the tutorial.

Credit for Viewing

To obtain credit for viewing a series, watch every video session from begin to end, complete its tutorial, and answer the quiz question at the end of the video. Then close the video window using the EXIT button at the top- right-hand side. You should see a check mark appear for that session in the LMS.

SESSION 1

Electrical Overview

Objective

By the end of this session, you will be able to:

- Identify the tasks that can be performed using the Electrical task in Smart 3D.

Prerequisite Session

- Smart 3D Overview

Overview

In Smart 3D, the Electrical task is used to create a three-dimensional (3D) representation or model of various electrical design elements in your plant.

Select **Tasks > Electrical** to work in the **Electrical** task. The **Electrical** task consists of tools that allow you to create and modify electrical design elements, such as cable trays, cableways, tray parts, conduits, and cables. You will learn more about these objects including how to create and modify them in the later sessions.

Electrical Systems

Electrical systems are a way of organizing electrical objects such as cableways and conduits, within the system hierarchy of your model. You also use the electrical system to control the specifications that can be used within the system, such as conduit, cableway, and cable tray specifications.

You can create and organize electrical systems using any criteria you choose. For example, you could base an electrical system on the area where the objects are located; you could also base an electrical system on the designer who models the cableway.

You create electrical systems in the Systems and Specifications task or by right-clicking the objects on the **System** tab in Workspace Explorer. Electrical systems can later be reorganized in the system hierarchy based on your access privileges to the permission groups of the plants.

Electrical Task

The Electrical task uses point-by-point route design to insert cableway, cable tray, and conduit components into a 3-D model. After routing the cableway, cable tray, and conduit components, you can place cables to route through them. To enhance the view of the electrical parts in your model, you can apply surface style rules. See Create a Surface Style Rule in the *Common User's Guide*.

NOTE A cableway represents a path for a cable tray or bare cables. The cableway has no physical counterpart; it simply reserves space. Cable tray, on the other hand, does have a physical counterpart.

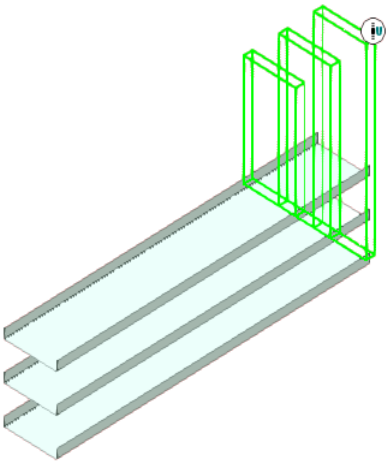
For models that include underground placement of electrical cables, the software provides a duct bank option which allows you to draw the cableway and place conduits at the same time.

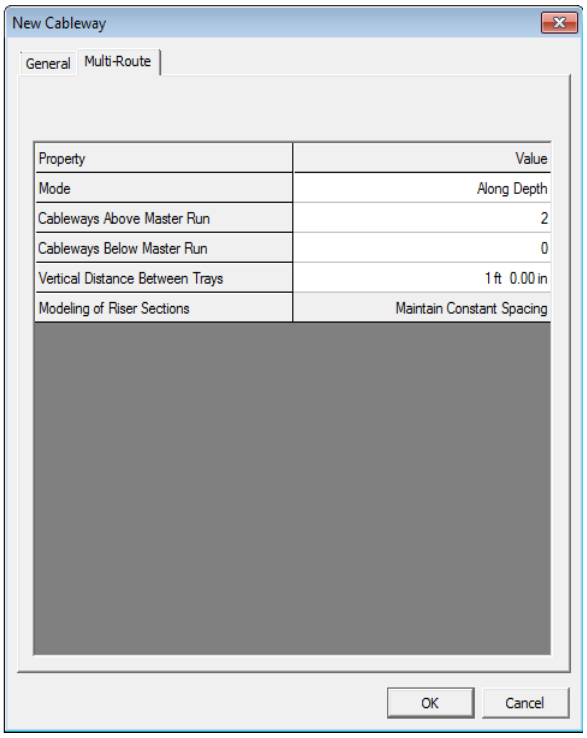
The duct bank object lets you design conduits of the same specifications or individualize each conduit run, if needed.

The Electrical task includes the following commands:

	**Select** - Resets all commands and allows you to select objects in the model.
	**Route Cableway** - Creates a new cableway, duct bank, or cable tray; extends an existing run; or routes to an end feature.
	**Route Conduit** - Creates a new conduit run or extends an existing run.
	**Insert Transition -** Adjusts the cableway to accommodate combinations of change in shape and size, manually places and modifies a transition, and indirectly changes a cross section in the cableway routing.
	**Insert Component** - Adds a component into a cableway or conduit run.
	**Auto Connect Cableways** - Automatically places the fittings needed to connect a cableway. Zero spec cableway (Cws-0) is routed between existing cableways and the new cableway is automatically placed.
	**Place Equipment -** Selects any equipment from the Catalog and places it in the model and modifies the offset of the equipment and its relationships. You can mate, connect, or align equipment, and precisely position the equipment.
	**Insert Cable** - Creates a new cable run in the model. You define the properties of the cable run by defining the relationship of the cable run to other objects in the model, such as pieces of equipment or electrical cabinets.
	**Edit Cable Path** - Routes cables through the various cableway trunks and conduits that exist in the model. You can force the cable to go through a particular cableway or force the cable to detour a particular cableway.
	**Insert Cable Marker** - Places cable markers at points along cableway or conduit features.
	**Insert Split** - Places a splice plate or other type of split in the selected cable tray.
	**Sequence Objects** - Renames objects in the selected conduit, cable tray, or WBS item such that the names are in order, based on topology.
	Set View by Cable - Assists the designer when routing cable by only showing objects of interest and hiding non-applicable objects in the model. This command is located on the **View** menu.
	View Cable Schedule - Displays a list of the retrieved cable schedule documents. This command is located on the **SmartPlant** menu.

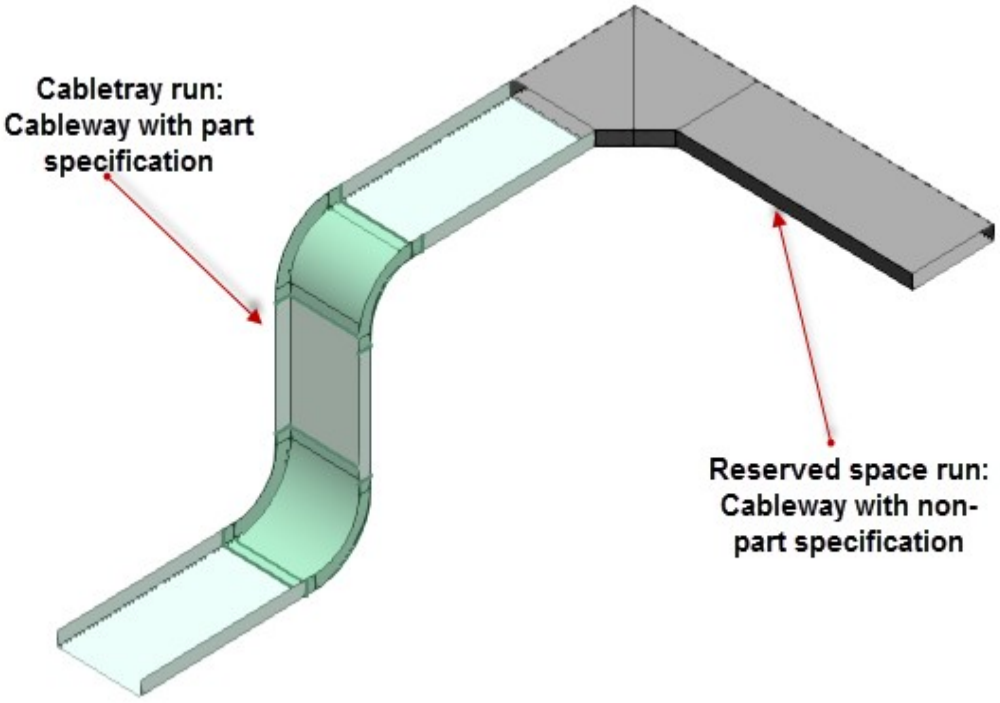
- **Create and route cableways:** You can create a new cableway, extend the existing cableways, and route a cableway to or from nozzles and features. You can perform this task by using **Route Cableway** on the vertical toolbar.
- The **Multi-Route** tab is used to specify the parameters that multiple cableways need to routed. Smart 3D supports the routing of multiple cableways, cable tray runs, or multi trays. You can route them in one of two modes: vertical (stacked) or horizontal (side-by-side). To route multi trays, you use **Route Cableway** on the vertical toolbar and set the required options on the **Multi-Route** tab of the **New Cableway Properties** dialog box. You simply enter the number of runs above and/or below the master run along with the number of cableways to the left or right of the master run. All the parallel cableways in a vertical arrangement or in a horizontal arrangement have identical properties to those specified in the **New Cableway** dialog box.





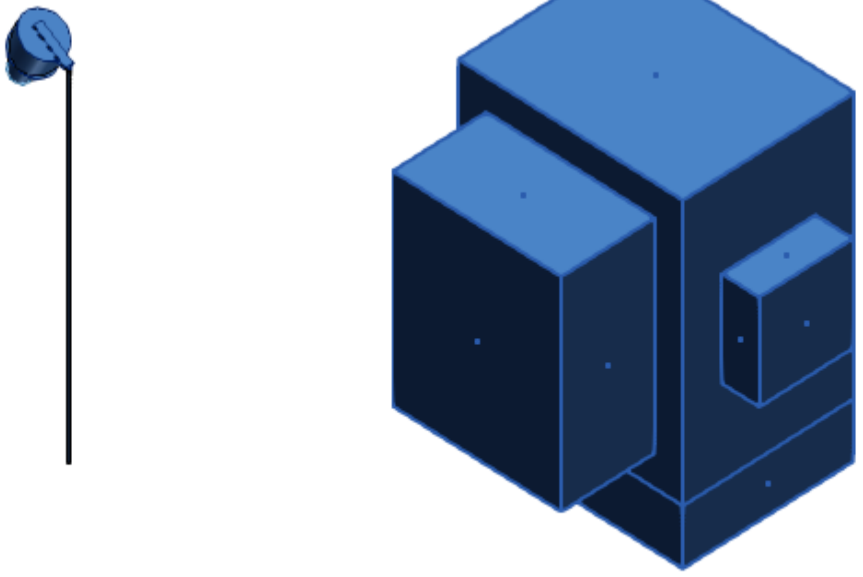
- Two Types of Cableway:
  - Specification Cableway (Cable Tray)
  - Non-Part Specification Cableway

Cableways are reserved space for the cable trays by routing a cross section using a non part specification. Smart 3D places cable trays from a part specification at the time of routing cableways. Trays are specified by their width and depth and are placed along the cableway. Part type is dependent upon the cableway feature, size and specification.



- **Create and route conduit runs:** You can create a new conduit run and a branch from a conduit run, extend an existing conduit run, and route a conduit run to or from nozzles and features. You can perform this task by using **Route Conduit** on the vertical toolbar.
- **Insert electrical transitions:** You can create cableway transitions by using **Insert Transition**. The inserted transition feature modifies the cross-section of a cableway which allows you to change a cableway path to all possible combinations.
- **Insert electrical components in cableway and conduit systems:** You can insert electrical components to create more sophisticated cableway/conduit layouts that divide, branch, and route the cables between equipments. While adding electrical components, Smart 3D might add necessary mating parts. The **Insert Component** command adds inline components, reducing components, and other components to a cableway/conduit run.
- **Place vertical drop-outs between crossing cableways:** You can model vertical drop-outs with a non-part specification cableway between crossing cableway systems. You can perform this task by using **Auto Connect** on the vertical toolbar.
- **Place electrical equipment:** You can select electrical equipment from the Smart 3D catalog and position them in the 3D model. These equipment are referred to as *catalog equipment*. You can perform this task by using **Place Equipment** on the vertical toolbar. Electrical equipment can also be modeled directly in the model. In this case a user has to select a type definition from the catalog to determine the property set. These equipment are referred to as *designed equipment*. Both may be composed of equipment components, ports, and

geometric shapes. You need to switch to the **Equipment and Furnishings** task to model designed equipment.

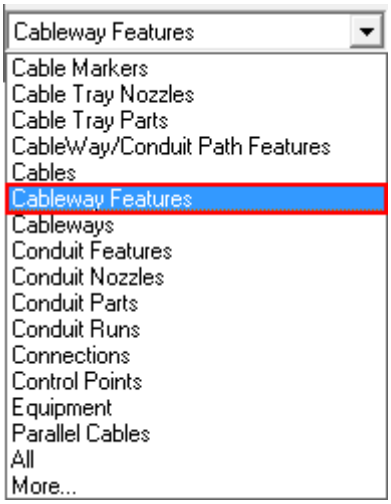


Catalog Equipment:
Stanchion Mounting Light

Designed Equipment:
Medium Voltage Transformer

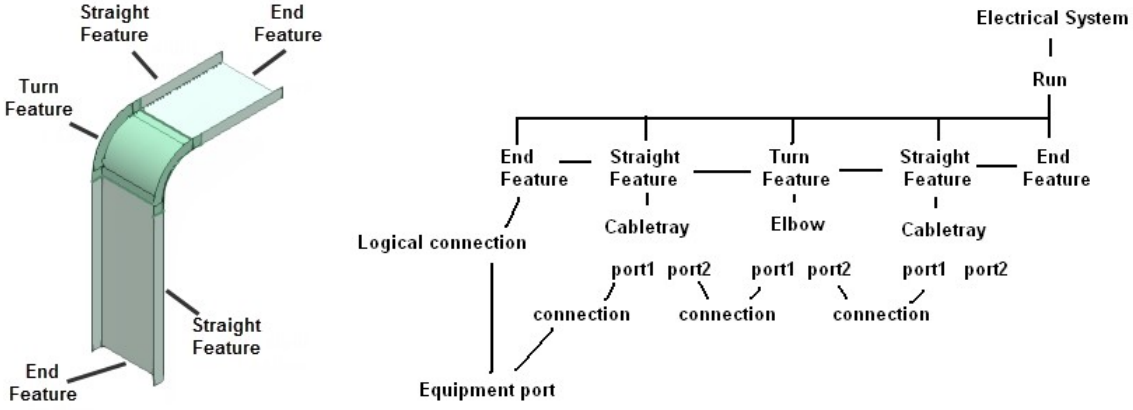
- **Add cable objects:** You can create cables and then route those cables through existing conduit and cableway systems. You create cables manually by using **Insert Cable** command or you can create the cables by retrieving cable data from SmartPlant Electrical (SPEL) using the integrated environment. SPEL is a schematic design application that stores cable schedules. A cable schedule is a list of cables with connectivity information, such as cables connecting two types of equipment like a junction box and an electric motor and the type of cable used to make this connection.
- **Edit cable path:** You can activate auto-routing option, which routes the cable in the shortest path between the starting point and ending point on the cableway. Or, you can manually route the cable. Cables cannot be routed if the "Originating & Terminating Device" does not exist in the model. You can perform this task by using **Edit Cable Path** on the vertical toolbar.
- **Insert cable marker:** You can place cable markers at points along cable tray or conduit features. After being placed, the cable markers can be used to describe a cable path on a cable-routing report. You can perform this task by using **Insert Cable Marker**.
- **Insert splits:** You can divide up a section of tray into the appropriate lengths based upon the catalog data or at whatever location you deem appropriate. If the catalog data is set up to generate them, the **Insert Split** command will model gaps between connecting trays.

The objects with which you work in the Electrical environment can be located in a model by using the Locate Filter drop-down list in this environment.



Electrical systems are a way of organizing electrical objects, such as cableways and conduits, within the System hierarchy of your model and controlling the specifications that can be used within that system, such as conduit, cableway, and cable tray specs. You can create electrical systems in the **Systems and Specifications** task or by right-clicking the objects on the **System** tab in the **Workspace Explorer**. Electrical systems can later be reorganized in the System hierarchy based on your access privileges to the permission groups of the plants. If an electrical system exists in your model, you can route cableways and cable trays and arrange them as children in the System hierarchy.

Before you start modeling, you need to become familiar with the cableway feature model and all the objects that play a role in routing a cableway system. The figure below shows a cableway feature model and the relationships between features, which represent a portion of a cableway system.



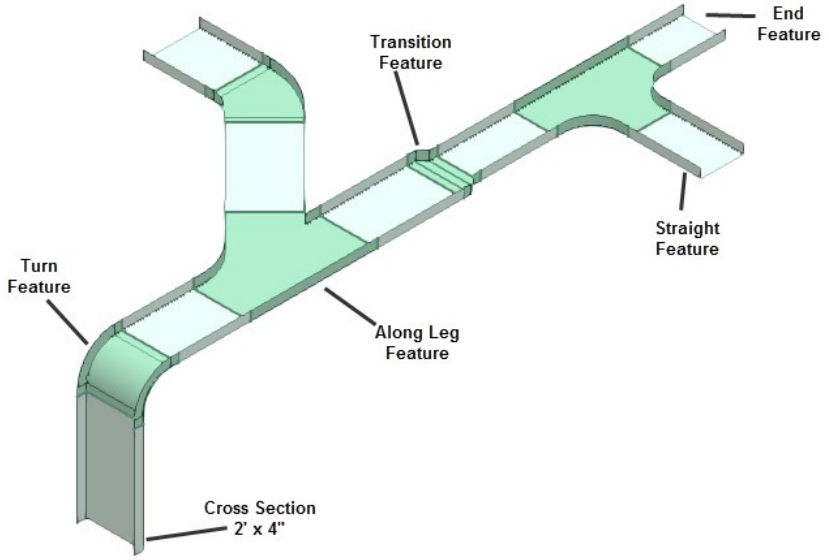
A cableway feature model would generally consist of the following components:

- **Electrical System:** An electrical system is a way of organizing cableways within the system hierarchy and controlling the specifications that can be used within that system. If an

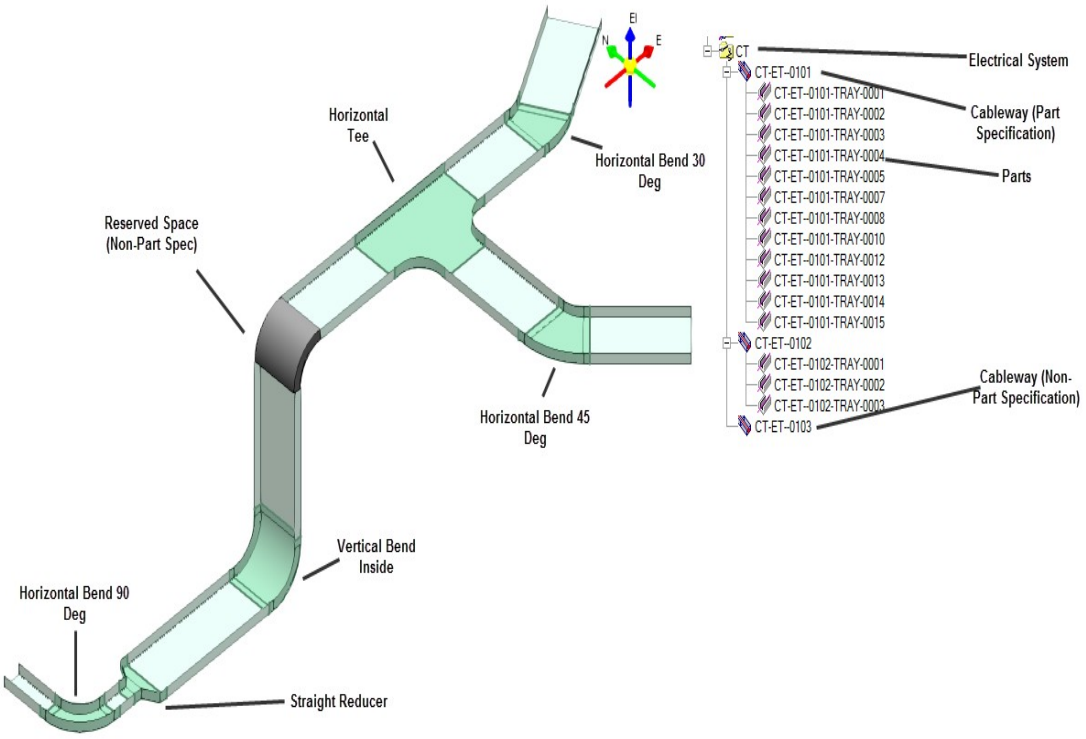
electrical system exists in your model, you can route cableways and arrange them as children in the system hierarchy.

- **Run:** is a collector for features and parts and is typically a child to another system in the Workspace Explorer. The run typically specifies the default size and design constraints for features that exist as children to the run and the catalog specification from which the parts are chosen.
- **Feature:** Feature is a child to a run and a parent to a part. It is not displayed in the Workspace Explorer because of the ability for a feature to own several parts and one part can be owned by multiple features. When a designer is routing in the Smart 3D routing environments, they are defining a series of features based on the feature types listed below. It is via a combination of the run data and the feature data that the software selects the purchasable part to be placed in the model. A feature is defined by the data points provided by the designer, and the data points are provided to describe the overall path of the routing. It is via these data points that the feature is further categorized:
  - **Straight Feature** – It is a feature whose path describes a straight line. This feature is defined by two linear data points from a user. Basic geometric principles dictate that two points define a line, thus the result is a straight feature.
  - **Turn Feature** – It is a feature that represents a deviation in a path resulting in a turn. An example would be three data points provided by a user. The first two data points would generate a straight feature. The third data point, if not 'in-line' with the first set, would constitute a deviation in path from the existing straight projection. The result would be a turn feature.
  - **End Feature** – It is a feature that acts as a place holder for future connections to the run. It is located at the end of a run, where a port exists on a part that is managed by the run. So, it is termed an end feature. When an end feature is connected to a run, it is removed and replaced with another feature based on the nature of the addition to the run. However, at conclusion of the routing, a new end feature will exist should the last part have a second port that is still unallocated. Unlike a tee or a cross, an end feature does not exist by default on a third or fourth port.
  - **Transition Feature** – It is a feature whose path is defined by a transition between cross sections or sizes or other defining constraints that result in the first port of the part being fundamentally different from the second port. The result is a feature that must close the gap between these parts.

- **Branch Feature** – It is a feature whose path is defined by branching, such as a tee or a cross connection. The 3rd and 4th ports of a branch feature will always (by rule) constitute a new run, independent of the header connections.

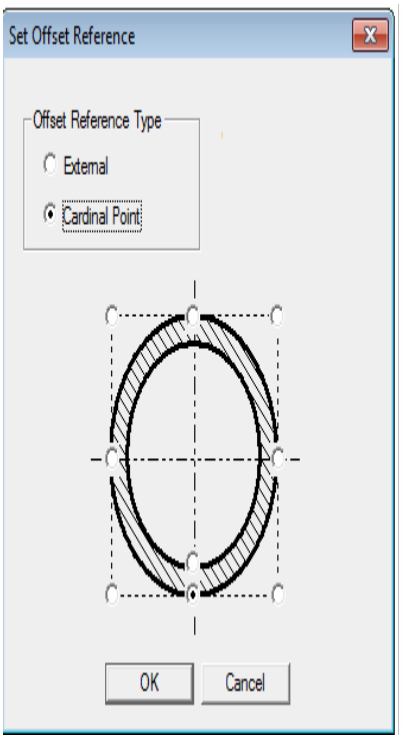


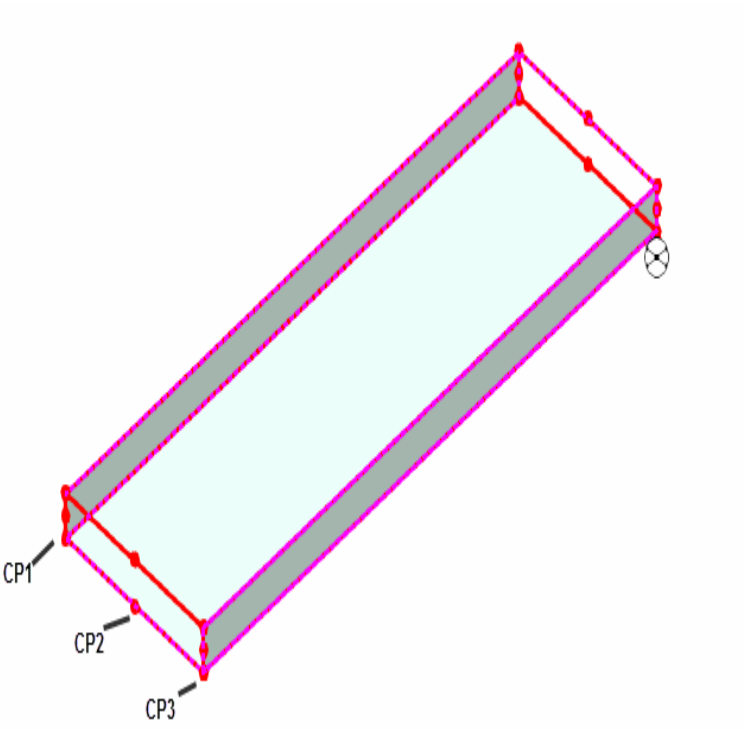
- **Part:** It is a term used to describe a catalog item that has true graphics, as opposed to a feature and a run that are simply managers of the part and skin over the graphics. The part brings with it a catalog basis making it a material item that can be ordered or purchased in most cases and represents a source of information for material take-off reports and the like. However, the selection of the part is primarily an indirect thing, with the designer governing the feature and the run and the part ultimately being selected by the details derived from the feature and the run. The figure below shows some examples of tray parts that represent a portion of a cableway system. The highlighted portion in the figure shows a section of the Workspace Explorer containing the hierarchy of tray parts.


Horizontal Tee
Horizontal Bend 30 Deg
Reserved Space (Non-Part Spec)
Horizontal Bend 45 Deg
Vertical Bend Inside
Horizontal Bend 90 Deg
Straight Reducer
CT
CT-ET-0101
CT-ET-0101-TRAY-0001
CT-ET-0101-TRAY-0002
CT-ET-0101-TRAY-0003
CT-ET-0101-TRAY-0004
CT-ET-0101-TRAY-0005
CT-ET-0101-TRAY-0007
CT-ET-0101-TRAY-0008
CT-ET-0101-TRAY-0010
CT-ET-0101-TRAY-0012
CT-ET-0101-TRAY-0013
CT-ET-0101-TRAY-0014
CT-ET-0101-TRAY-0015
CT-ET-0102
CT-ET-0102-TRAY-0001
CT-ET-0102-TRAY-0002
CT-ET-0102-TRAY-0003
CT-ET-0103
Electrical System
Cableway (Part Specification)
Parts
Cableway (Non-Part Specification)

Cardinal Point

When the designer defines a data point for routing, this data point lies on the centerline of the cableway profile that is being routed by default. Smart 3D provides the functionality to route a cableway by the top, sides, or bottom of the cableway instead of the cableway centerline. The figure below shows the bottom cardinal points with the actual graphical view of the cableway. The same configuration applies to the top and side.





For more information, refer to the Electrical User's Guide.

Quiz

1. What are the main differences between runs, features, parts, and systems?
2. Which feature type is described by two linear data points?
3. What is a cableway with non-part specification?
4. What is a catalog equipment and designed equipment?