Flow Planner Help version 5

Table of Contents

1 Introduction

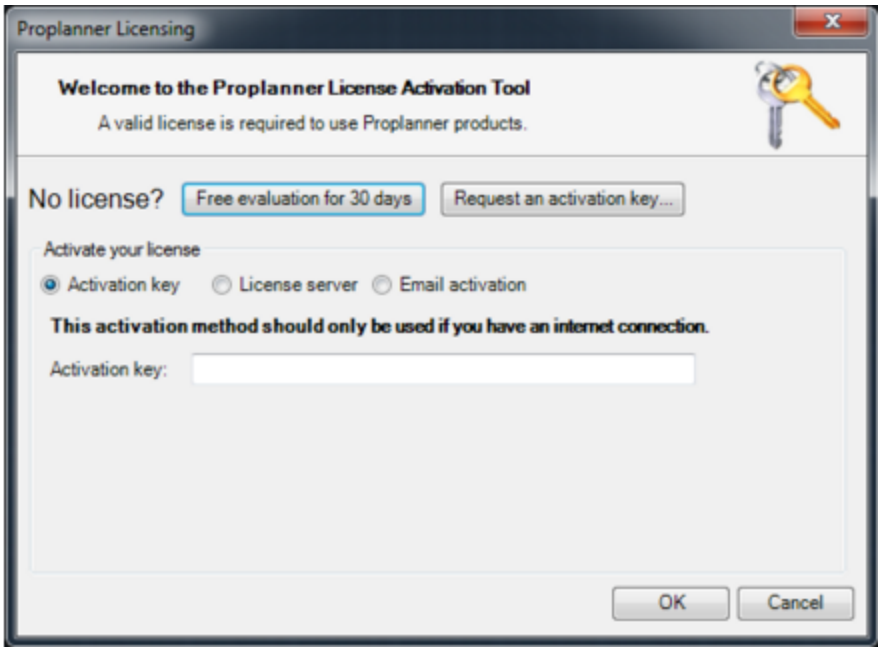
Flow Planner has two main functions: first, it diagrams material flow through your facility; second, it calculates the distance, cost, and time of this flow. This helps you identify and reduce the waste associated with materials handling.

Flow Planner is integrated within AutoCAD (Full version only, as AutoCAD LT does not include the API which is required for Flow Planner to Work) and uses specific layers in AutoCAD drawings to diagram, chart, and compute flow information. The flow data can be computed along an aisle-path route or with straight-line point-to-point routes. The material data can be compiled (aggregated) according to the trip frequency of many different entities. The Flow Planner add-on links to the license and enhances the program with Flow Planner's capabilities.

There are a number of studies and drawings used for examples discussed in this manual. These files are located in your C:\Users*insert user name*\AppData\Local\Programs\Proplanner\FlowPlanner\Help Files folder.

2 Licensing

You will see a screen similar to the one below when you open the application.



License Activation Window - Activation Key

- Free evaluation for 30 days

If you would like to try the application, select this option to begin a 30-day trial period for full-feature evaluation. This will automatically retrieve a trial license. Once this time period has expired, the software will default to the Free version which can only import 50 Routing lines, and cannot perform Tugger studies, use Processes or run Dock Solver optimizations.

- Activation Key

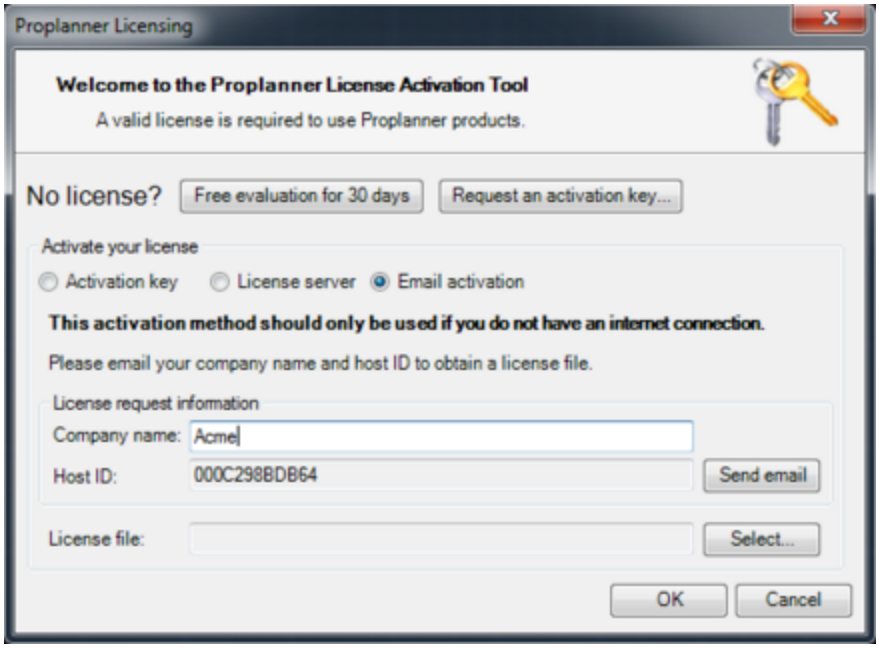
If you have purchased a stand-alone version of the application, please use the 'Request an activation key...' button to send Proplanner an email containing the necessary information. We will then return an activation key that can be copy and pasted into the Activation Key input box.

- License Server

Use this feature if you are utilizing a central licensing server. This is typically used for university lab computers and at corporations which have purchased floating/network licenses. Please contact your IT for support.

- Email Activation

If you do not have access to the internet, but you are able to send emails, please use the Email Activation button.

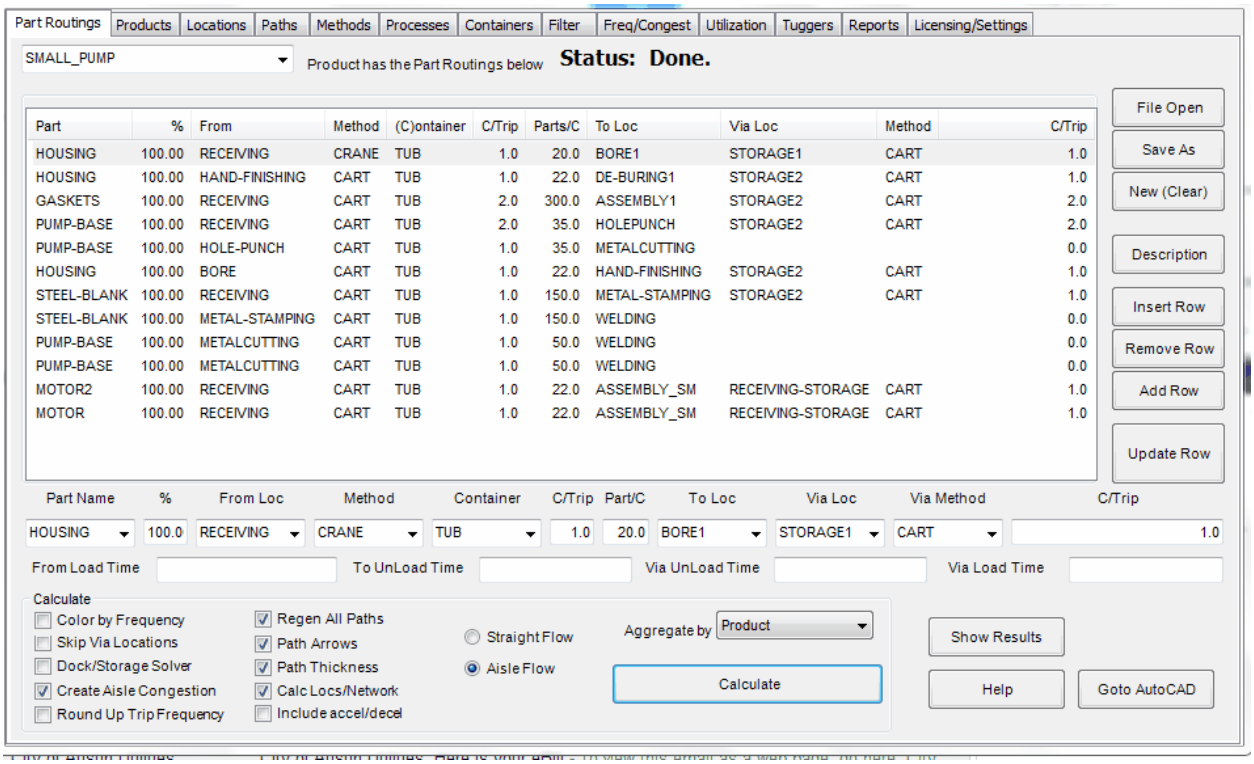


License Activation Window - Email Activation

If you have any issues or questions in regards to obtaining a license for the application, please contact licensing@proplanner.com.

3 Navigation in Flow Planner

Most of the work in Flow Planner is done in Flow Planner's main window. In this main window, there are multiple tabs that deal with specific areas of a study. The user is able to enter information directly in Flow Planner, or can import information from external files.



Part	%	From	Method	(C)ontainer	C/Trip	Parts/C	To Loc	Via Loc	Method	C/Trip
HOUSING	100.00	RECEIVING	CRANE	TUB	1.0	20.0	BORE1	STORAGE1	CART	1.0
HOUSING	100.00	HAND-FINISHING	CART	TUB	1.0	22.0	DE-BURING1	STORAGE2	CART	1.0
GASKETS	100.00	RECEIVING	CART	TUB	2.0	300.0	ASSEMBLY1	STORAGE2	CART	2.0
PUMP-BASE	100.00	RECEIVING	CART	TUB	2.0	35.0	HOLEPUNCH	STORAGE2	CART	2.0
PUMP-BASE	100.00	HOLE-PUNCH	CART	TUB	1.0	35.0	METALCUTTING			0.0
HOUSING	100.00	BORE	CART	TUB	1.0	22.0	HAND-FINISHING	STORAGE2	CART	1.0
STEEL-BLANK	100.00	RECEIVING	CART	TUB	1.0	150.0	METAL-STAMPING	STORAGE2	CART	1.0
STEEL-BLANK	100.00	METAL-STAMPING	CART	TUB	1.0	150.0	WELDING			0.0
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0
MOTOR2	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0
MOTOR	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0

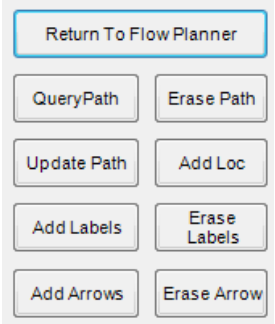
Flow Planner's Main Window

The Flow Planner window may be expanded by dragging the cursor that appears when hovering on the edges of the window.

When the "GoTo AutoCAD" command is selected from within the main window, the AutoCAD drawing will be displayed. Any AutoCAD commands can be carried out normally.

Flow Planner remains open and running; a smaller window, containing only a few editing commands, is open during this time. This smaller window is referred to as the Modeless window.

The "Return To Flow Path Calc" button allows you to return to Flow Planner's main window.



Modeless Window

4 Getting Started

To begin a study from scratch, the best approach is to first load a drawing of the factory into a Full Version of AutoCAD (not AutoCAD LT) and prepare it for analysis. Then you are ready to prepare the routing. When you have finished these tasks, you can conduct the analysis.

4.1 Preparing the Drawing

Flow Planner bases calculations on distances within your drawing. This makes it important to have a drawing that is appropriately scaled and reflects reality.

The drawing does not, however, need to be highly detailed for Flow Planner to work. In addition to reflecting the actual size and proportion of the facility, the user needs to be able to identify where the locations in the routing exist in the drawing. (For example, the drawing needs to be detailed enough that you can tell where receiving is located.)

Flow Planner Units

Flow Planner can use either Engineering (Foot-Inch) or Decimal (Metric) units. You can check and change the units in the drawing with the Units command in AutoCAD. By default, the application will assume that if your drawing is set to Engineering units that your base unit is 1 inch in size. If your drawing is set to Decimal units, then Proplanner will assume that your base drawing unit is 1 millimeter. Once Flow Planner is running, you can reset your default base units (to either Inches, Millimeters, or Meters) if these defaults are incorrect.

AutoCAD Note: If you use the AutoCAD UNITS command to change your drawing units, you will also probably need to set your drawing limits (size) by using the AutoCAD LIMITS command. You will then need to use the ZOOM ALL command to ensure you are viewing the entire work area.

Adding to the Drawing

Regardless of which units you use, remember to convert distances properly when drawing. For a Foot-Inch drawing with the default base unit size, if the distance between a table and a box is 3'6" in reality, make sure the table is 42 base units (inches) from the box in the drawing.

4.2 Preparing the Routings

The flow routing is basically a list of parts that need to move TO and FROM given locations to make a certain product. The routing can be defined within the application in the Part Routings Tab or can be created in another application (e.g. Microsoft Excel) and imported into Flow Planner.

To define the routing within Flow Planner, add and insert the appropriate lines in the Routing Tab.

If you choose to create your routing in Excel, it is very helpful to see an example first. Open the Hydra Pump.csv sample file provided (with Excel), and use it as a template to help ensure your format is correct. Remember to save the Excel file as a comma-separated value file*, so it can be used in Flow Planner.

**You can also change the delimiter type to a semicolon. To have Flow Planner read this file, change the delimiter in the Licensing/Settings Tab to a semicolon.*

For details on creating, importing, and editing routings, see the Part Routings Tab section of this manual.

4.3 Conducting the Analysis

After the drawing properly reflects the state of your facility and you have created your routing, you are ready to do an initial analysis. The analysis is started by clicking the "Calculate" button in the Part Routings Tab.

The first thing that Flow Planner will do when you select "Calculate" is make sure any Locations, Methods, and Method Types referenced within the routings exist in Flow Planner, creating them where needed. Additionally, Flow Planner will check to make sure all From Locations and To Locations referenced in the routings exist in the drawing. If any locations are missing in the drawing, you will be prompted to place them.

After this check is completed, Flow Planner calculates the time spent and distance covered in moving parts from one location to another. The program will update the list of paths (in the Paths Tab) with the computed times and distances.

The results window is prepared with a summary of distance, time, and travel information. You can see how time was utilized by viewing the graphs or charts in the Utilization Tab.

Selecting the “Save As” button will save your results to a file. The routing data, method/processes/containers data, products/parts data, and results data are all stored in separate files. These files are all simple comma-delimited text files that are easy to import into a word processor or spreadsheet (Microsoft Word, Excel, PowerPoint, etc.). Right click on the items in the list or on the chart to copy the information to other applications.

5 Reference Section

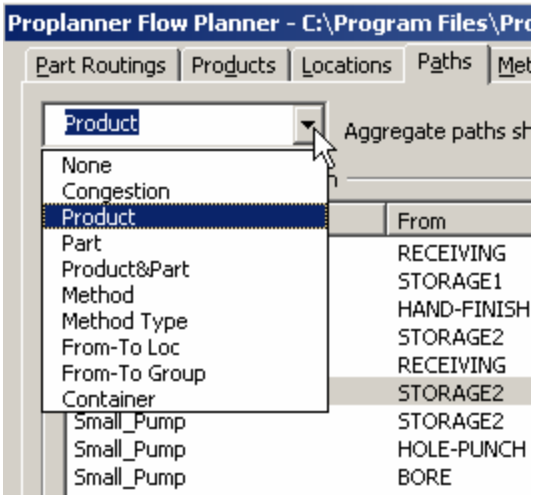
This section explains in detail the functioning of each tab control within Flow Planner.

5.1 Aggregation Methods

Flow Planner allows you to generate flow diagrams with frequency (line width) summaries using several different aggregation (grouping) methods. For each different type of aggregation, the calculations are slightly different.

Each aggregation can be generated by selecting the aggregation type from the "Aggregate by" pull-down list (just above Calculate) in the Part Routings tab and then clicking on the "Calculate" command. Once an aggregation is created, it can be viewed in the Paths Tab by selecting the appropriate aggregation name from the top-left pull-down list box. There are two exceptions. The "None" aggregation type will show all of the results in no particular order. The "Congestion" aggregation type will show a congestion diagram created during a calculation. Any aggregation can be run to create a Congestion diagram (for Aisle Flow only). Since the aisle congestion is the summary of all flows down specific aisle segments, it will be the same for any flow aggregation.

Once the paths are generated by the "Calculate" command, their frequency, distance, origin, destination, and method properties are encoded within the polylines in AutoCAD. As such, you can run Flow Planner in subsequent sessions and view, query, filter, scale and color-code these paths without needing to reload the routings file or recalculate the analysis. Please reference the Calculation Formulas section for details on how these aggregations are computed.



Aggregate Paths

None: No aggregation is used.

Congestion: Aggregates all flows between each aisle network node (the flow between every aisle path segment). Color is assigned in the Frequency/Congestion Tab. Note that a path's frequency is divided by its Material Handling Method Type Effectiveness Percentage to determine the Frequency for each particular path along that segment. For example, if a path has a frequency of 100 trips and uses a Method that references a Method Type with a 50% Effectiveness Value, then the frequency for the congestion diagram will be reported as 200 trips.

Product: Aggregates all flows between a From and To (or Via) location for all Part routings within a Product. The frequency of flow from one location to another represents all of the parts for each Product shown. Color is assigned to each unique Product in the Products/Parts Tab.

Part: Aggregates all flows between a From and To (or Via) location for all unique Part routings within all Products. The frequency of flow from one location to another represents all flow for that Part, regardless of which product it is under. Color is assigned to each unique Part by using the Part color in the Products/Parts Tab. (If the same part name is found under multiple products, the color for the last referenced part name is used.)

Product&Part: Aggregates all flows between a From and To (or Via) location for all unique Parts routings within each Product. The frequency of flow From a Location to another Location represents all of the part flows between those locations for each unique Part in each unique Product. Colors are assigned to each unique Product&Part pair by the Part color in the Products/Parts tab.

Method: Aggregates all flows between a From and To (or Via) location for all part routings that reference a unique move Method. The frequency of flow from one location to another location represents all of the part flows between those locations for each unique Method used between those locations. Colors are assigned to each unique method in the Methods Tab.

Method Type: Aggregates all flows between a From and To (or Via) location for all part routings that reference a unique move Method Type. The frequency of flow from one location to another location represents all of the part flows between those locations for each unique Method Type used between those locations. Colors are assigned to each unique method type in the Methods Tab.

From-To Loc: Aggregates all flows between a From and To (or Via) location for all part routings. The frequency of flow from one location to another location represents all of the part flows between those locations for all parts, products, methods, method types and containers. Colors are assigned to each unique From-To Location pair based upon the color assigned to the Group that is referenced by the FROM location in the Locations Tab.

From-To Group: Aggregates all flows between a From and To (or Via) location for all part routings within a product. The frequency of flow from one location to another location represents all of the part flows between those locations for each product shown. Colors are assigned to each unique From-To Group pair based upon the color assigned to the From Group in the Locations Tab.

Container: Aggregates all flows between a From and To (or Via) location for all part routings that reference each unique container. The frequency of flow from one location to another location represents all of the part flows between those locations for each container type moved between those locations. Color is assigned to each unique Container in the Containers Tab.

5.2 Calculation Formulas

Flow Planner calculates flow frequency in number of trips between any two locations on a route-by-route basis. These route frequencies are aggregated (using the user-selected aggregation method) and then used to scale the thickness of the flow lines between every pair of locations, groups, or nodes as appropriate to the aggregation method.

Flow Planner then computes the distance of each flow path and evaluates the speed of the method assigned to that path, along with that method's load and unload time and acceleration/deceleration. From these properties, Flow Planner determines the time required (as well as the travel percentage of that total trip time) and multiplies this time by the variable cost of the method to calculate at the route's travel cost.

An Aggregation, which refers to the attribute of the route (i.e. Product name, Part name, Method, Container, etc.), is used to combine trips into one line of a specific thickness and color. For example, in a Product Aggregation, the product name for the route is used for the aggregation. As such, every part in product X that travels **FROM** location A **TO** location B will be combined into one flow line between location A and B and an arrow head will be inserted at the end of that flow line near location B. Of course, there could be many parts in product X moving from A to B. (A separate flow line is created for parts moving from B to A.) Therefore, the thickness of the line between those locations will be the aggregation (or summation) of all flow trips (sometimes called Frequencies) for all parts in that product moving from location A to location B. Finally, the color of the flow diagram will correspond to the color assigned to the each product's name.

As a result of the aggregation technique, there can be several flow lines drawn on top of one another between locations A and B. Some products will have two lines drawn (one for each direction), and of course, all products with at least one part moving between those locations will have a line created in the color of that product.

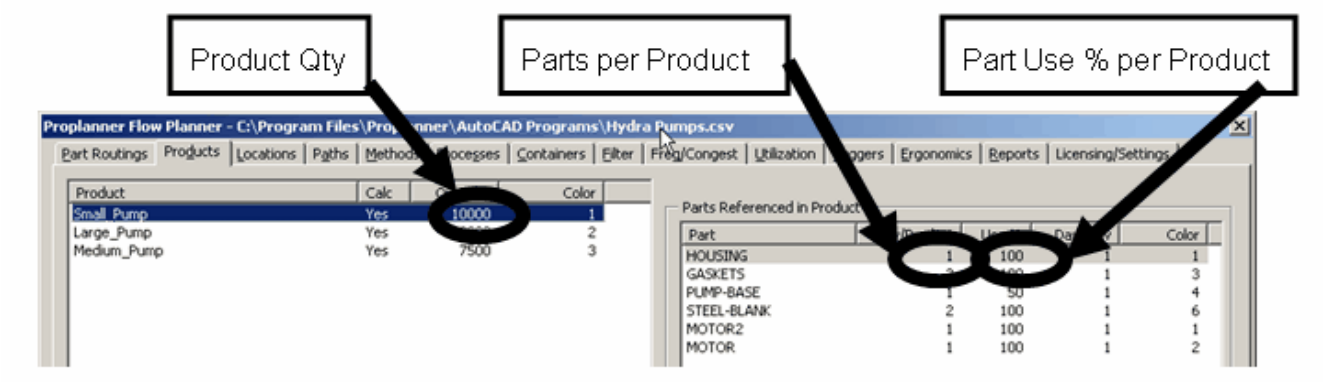
5.2.1 Route Frequency Calculation

The data used in the route frequency calculation is found in the Products Tab and the Part Routings Tab.

$$Route\ Frequency = \frac{product\ quantity \times parts\ per\ product \times part\ use\ \% \times route\ flow\ \%}{containers\ per\ trip \times parts\ per\ container}$$

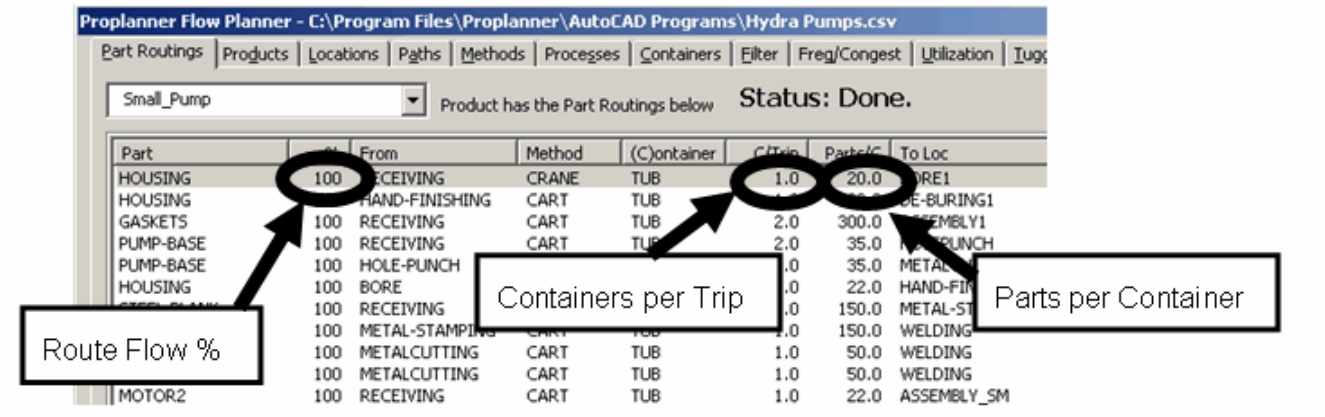
Route Frequency

Products Tab (below)



Products Tab

Part Routings Tab (below)



Part Routings Tab

5.2.2 Method Distance, Time and Cost Calculation

The data used to calculate method distances, path times, and total cost is primarily found in the Paths Tab and the Methods Tab, although preferences in the Settings tab (Walk Time, Ignore paths with zero distance) and Routings tab (Include Accel/Decel, Ignore Aisle Joins) will affect the result as well

$$Path\ Travel\ Time = \left(\frac{Path\ Dist. / Effective\ percentage}{Straight\ Speed} \right) **$$

Path Travel Time

$$Total\ Path\ Time = Path\ Travel\ Time + Unload\ Time + Load\ Time$$

Total Path Time

$$Quantity\ of\ Method\ Type = Round\ Up\left(\frac{Total\ Method\ Type\ Minutes}{Maximum\ Minutes\ available\ per\ time\ period}\right)$$

Quantity of Method Type

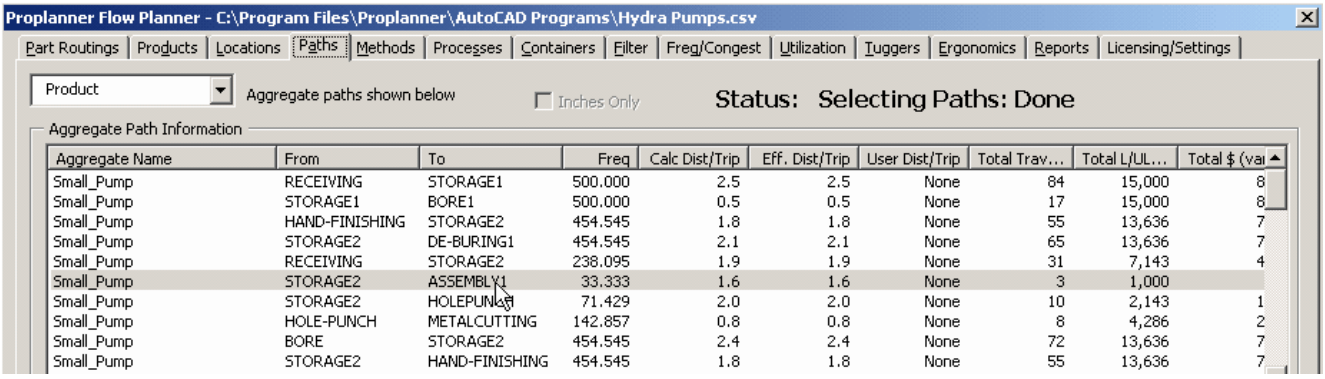
$$Total\ Method\ Type\ Cost = \left(Fixed\ Cost\ per\ Method\ Type \times Quantity\ of\ Method\ Type\right) + \left(\left(\sum_{path=1}^{n} Time\ for\ path\right) \times Variable\ Cost\ per\ hour\right)$$

Total Method Type Cost

***This Path Travel Time formula is the simplified version with no acceleration or deceleration through passthru points with the STOP property, or aisle intersections with angles less than the amount specified for the Method Type used. If the "Include Accel/Decel" checkbox is selected on the routings tab, then travel times on aisle paths with Passthru-STOP and tight turn intersections will increase.*

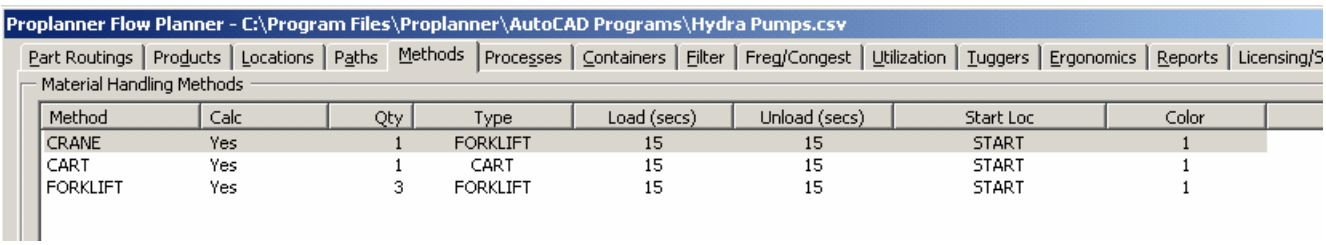
Also, if Aisle Paths are used to compute distance (versus straight flow lines), then the aisle join lines (for locations not placed directly on the aisle) will be included in the distance value. Users can choose to ignore the distance of aisle join lines, because they often do not represent actual travel of the fork truck, but instead walking by the operator. In that situation, a Walk Speed should be specified to increase the time for the Load and Unload activity that is specified directly to the path route, or to the Method used by that route. If the specified Load/Unload time already includes a time for the operator to walk along the join line, then specifying a value of Zero for the walk speed, along with checking the option to ignore aisle join lines, will result in those join lines having no impact on distance or time for that route (they will effectively be ignored).

Paths Tab (below)



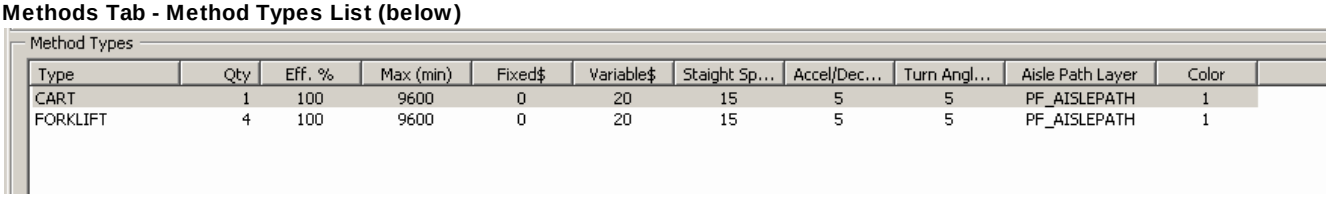
Paths Tab

Methods Tab – Methods List (below)



Methods Tab - Methods List

Methods Tab - Method Types List (below)

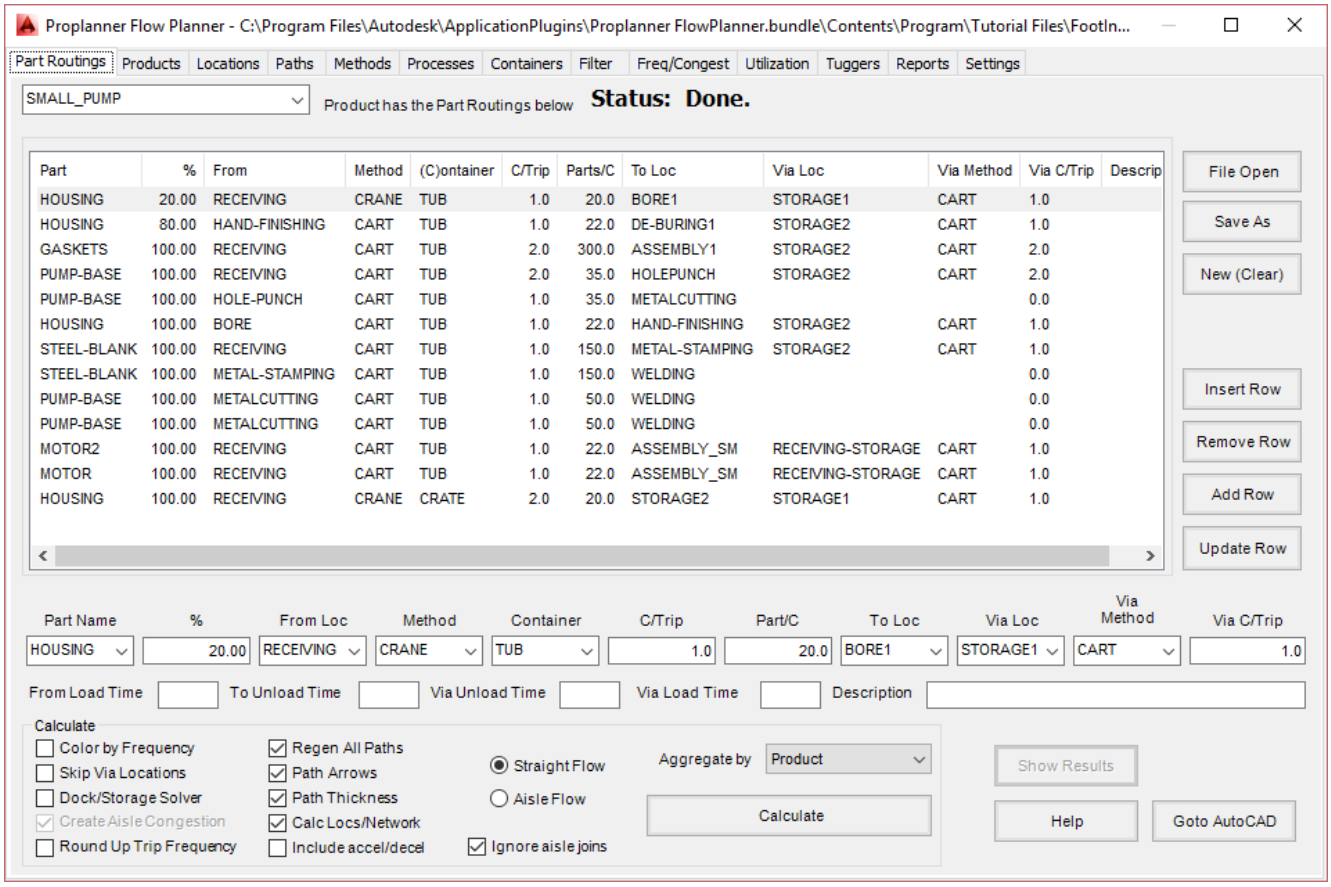


Method Types

Type	Qty	Eff. %	Max (min)	Fixed$	Variable$	Staight Sp...	Accel/Dec...	Turn Angl...	Aisle Path Layer	Color
CART	1	100	9600	0	20	15	5	5	PF_AISLEPATH	1
FORKLIFT	4	100	9600	0	20	15	5	5	PF_AISLEPATH	1

Methods Tab - Method Types List

5.3 Part Routings Tab



Part	%	From	Method	(C)ontainer	C/Trip	Parts/C	To Loc	Via Loc	Via Method	Via C/Trip	Descrip
HOUSING	20.00	RECEIVING	CRANE	TUB	1.0	20.0	BORE1	STORAGE1	CART	1.0	
HOUSING	80.00	HAND-FINISHING	CART	TUB	1.0	22.0	DE-BURING1	STORAGE2	CART	1.0	
GASKETS	100.00	RECEIVING	CART	TUB	2.0	300.0	ASSEMBLY1	STORAGE2	CART	2.0	
PUMP-BASE	100.00	RECEIVING	CART	TUB	2.0	35.0	HOLEPUNCH	STORAGE2	CART	2.0	
PUMP-BASE	100.00	HOLE-PUNCH	CART	TUB	1.0	35.0	METALCUTTING			0.0	
HOUSING	100.00	BORE	CART	TUB	1.0	22.0	HAND-FINISHING	STORAGE2	CART	1.0	
STEEL-BLANK	100.00	RECEIVING	CART	TUB	1.0	150.0	METAL-STAMPING	STORAGE2	CART	1.0	
STEEL-BLANK	100.00	METAL-STAMPING	CART	TUB	1.0	150.0	WELDING			0.0	
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0	
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0	
MOTOR2	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0	
MOTOR	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0	
HOUSING	100.00	RECEIVING	CRANE	CRATE	2.0	20.0	STORAGE2	STORAGE1	CART	1.0	

Part Routings Tab

First, we will look at the format of the part routing list so you see what makes up each routing. Then, the various controls will be discussed. Finally, we will look at the results.

The Part Routings Tab is in the main window of the Flow Planner interface. In this tab, you can Import, Save, and calculate your studies, as well as enter and edit part routings.

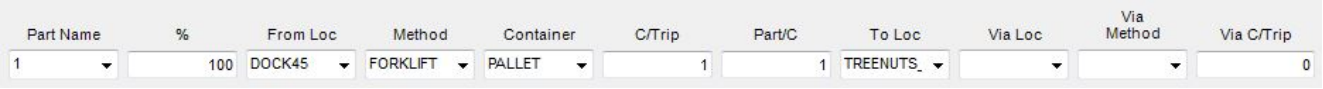
Flow routings are organized by Product names. These do not need to be actual products, but could instead be main flow path groupings. In each Product (flow grouping), you could have many parts (sub flow groupings) with multiple from-to and via location routings.

Product names are entered, or selected, in the top left combo box (showing RTE in the image above). Once a name is entered or selected, the associated Part routings for that Product

selection will be shown in the main routings list view (in the part routings area). Routings may be added, removed, or updated with the editing controls located in the middle of the right panel.

5.3.1 Route Format

The part routing list contains some of the most vital information for Flow Planner's analyses: information about how parts are moving around the facility. Below, each of the columns in the part routing list is described.



List Columns

Part Name: The name of the part, or sub-flow group, moving along the given route. In a tugger study route where multiple parts may be loaded or unloaded on this route line, then only the first part number will be listed. The entire list of part numbers will be shown in the description field.

%: Percentage of total part flow for the given part in the given product taking the given route. This flow is always absolute to the Product Quantity unique to every routing line. As such, the software is not computing a percent of flow from the inbound flow which might have also had a percent less than 100.

From Loc: The origin of the part for the flow path analysis (the FROM location).

Method: The transport device (fork truck, AGV, hand cart, etc.) used to move the material from the FROM location to either the TO location or the VIA location (if a via location is specified).

Container: Name of the container (pallet, tub, barrel, etc.) used for holding the parts. The container may also have specific information regarding the loading/unloading of the device (see the Container Tab). If the container name is preceded by an asterisk "*", then the software will assume that this container is empty. Empty containers are referenced when computing processing time with templates (CF/CE) and ergonomic fatigue.

C/Trip: The quantity of containers that will typically fit in one trip for the method.

Part/C: Quantity of Parts that will fit in the normally-loaded container. This value is typically a positive integer, except when performing tugger studies where the value is -1 or -2 depending on if that trip is loading or unloading the container on to the cart respectively. In this situation, the software will only calculate the Load or Unload process time, but not both. If the user chooses to ignore aisle join lines and chooses to include a walk speed, then the operator walk time on the join line to the To location will also be included in that process time.

To Loc: The destination of the part for the flow path analysis (the TO location).

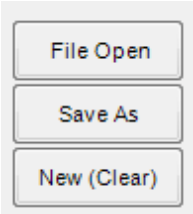
Via Loc: An (optional) intermediate travel location as the part moves between the FROM and TO locations. This may be an intermediate storage point or a pass through point, for example. Via location fields may not be used on tugger route lines.

Via Method: This second Method column specifies the transport device used to move the material from the VIA location, if one is specified, to the TO location.

Via C/Trip: This second container/trip column specifies the quantity of containers that will typically fit in one trip for the via method.

5.3.2 Main Controls

The main controls in the Part Routings Tab allow you to open an external routing file, save the current routing information, or clear the routing information.

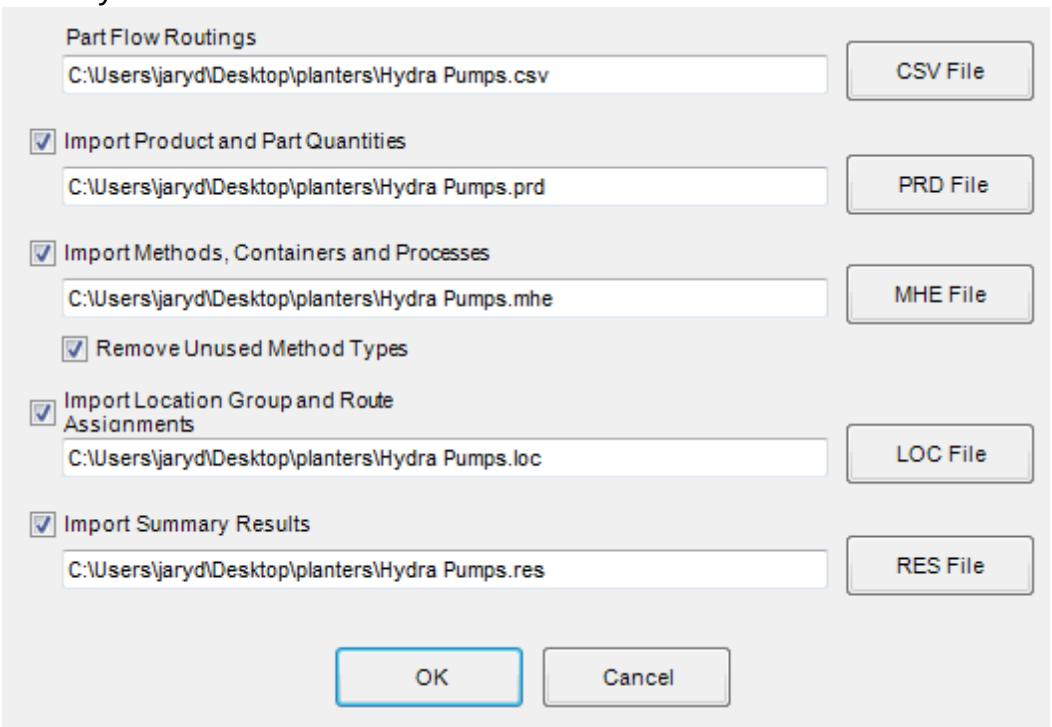


Main Controls

File Open: The File Open command allows you to select external files created for the part routing(s). Additionally, you can import information from files for Product and Part Quantities; Methods, Containers and Processes; and Location Group and Route assignments.

It is not necessary to have the additional files created immediately. When you open a routing file, Flow Planner reads any information about the products, parts, methods, containers, processes, location groups, and routes. This creates temporary files. You can then save this information and create the files so they are available to open in the future.

You also have the option to remove unused method types. Unused method types occur if the routing changes or if a file has a method type no longer used. It is generally a good idea to check the "Remove Unused Methods" box to reduce extraneous information and simplify interpretation for yourself.



File Open

The routing file can be defined within the application in the Part Routings Tab, or it can be created in another application (e.g. Microsoft Excel) and imported into Flow Planner.

To define the routing within Flow Planner, add and insert the appropriate lines in the Routing Tab by typing data into the appropriate input fields and using the Add function.

If you choose to create your routing in Excel, it is very helpful to see an example first. Open the Hydra Pump.csv sample file with Excel and use it as a template to help ensure your format is correct. Remember you will need to save the Excel file as a comma-separated file, so it can be used in Flow Planner.

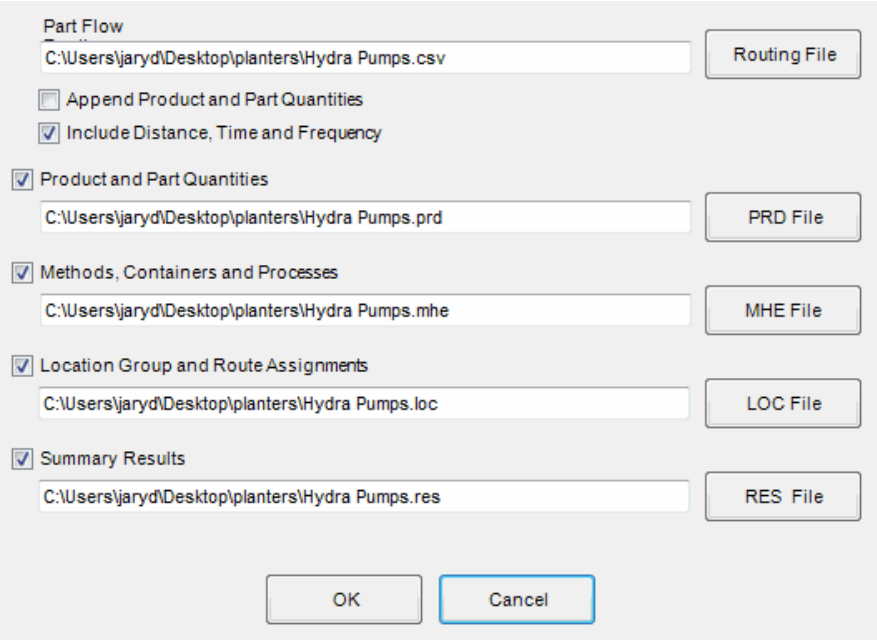
Notes: When loading existing data files, Flow Planner first loads the part flow routings file and creates all referenced parts, locations, methods and containers. After that, Flow Planner loads the corresponding products, methods and locations files and updates any user-specified quantity, color and option information. In this way, any locations, methods, parts or containers that did not exist in previous sessions will automatically be added. Any locations, parts or methods that no longer exist in the routing will not be loaded and will not appear in the editor.

Save As: Allows you to save the routings shown in the editor to a file.

You also have the option of saving the following information to files: Products and Part Quantities; Methods, Containers and Processes; Location Group and Route Assignments; and Summary Results from the last calculation. To save these other files, check the box next to the file type.

There are two other check boxes in the Save Files window:

- **Append Product and Part Quantities:** Though product and part names and quantities were originally stored only in the PRD file, they can now be attached to the CSV Routing File. This means that you can now edit both route and part information in the same file.
- **Include distance, time, and frequency:** Includes output frequencies, distances, and times to the Routing File. This means the Routing input file can be analyzed route-by-route.

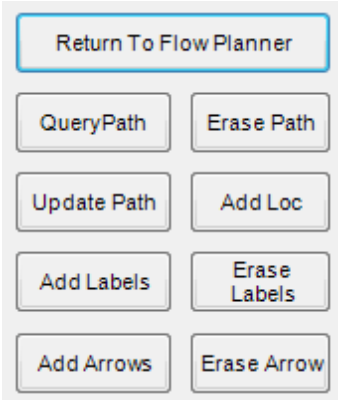


Routings: Save As

New (Clear): Clears the current routings list so that new routings may be entered.

GoTo AutoCAD: Hides Flow Planner's main window and displays the smaller Modeless window, which contains some editing commands. Use this when you need to work in AutoCAD and then return to Flow Planner without having to reload your information.

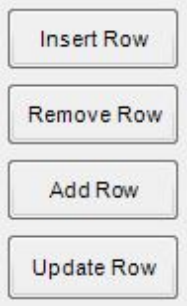
The controls included within the Modeless window (shown below) are discussed in their respective sections (Locations, Paths, etc.).



Modeless Window

5.3.3 Editor Controls

The editor controls in the Part Routings Tab allow you to modify routing information without leaving Flow Planner.



Editor Controls

Insert Row: Inserts a row (above the row selected in the list) with the information in the input boxes.

Remove Row: Removes the selected row.

Add Row: Adds a row at the end of the routing file with the information in the input boxes.

Update Row: Updates the selected row in the routing list with the information in the input boxes.

5.3.4 Calculate

The Calculate section of the Part Routings Tab is where you specify the details of and execute the analysis. The most important pieces of the Calculate section are the "Aggregate by" selection and Straight Flow or Aisle Flow radio buttons. Additionally, several options can be enabled by checking boxes. Finally, the Calculate button will execute the analysis.

Calculate Section

Aggregate by: There are several different ways the calculations can be performed. The flow could be calculated according to the Product, Part, Method, etc. For a more comprehensive explanation, see the Aggregation Methods section. NOTE: If you are performing a calculation on a tugger study, you **MUST SELECT THE AGGREGATE type PRODUCT** since tugger products are actually contiguous flow routes performed by a Method at a specific time. Selecting a different aggregate type than Product for a tugger study will generate erroneous results.

Straight or Aisle Flow: The Straight Flow and Aisle Flow radio buttons determine the method used for the generation of missing paths.

Straight Flow paths are typically the best for viewing where flows originate from and travel to, as they go straight from the origin to the destination regardless of obstacles.

Aisle Path flows, however, are best for evaluating actual travel distances, travel paths, and aisle congestion, since they consider routes from the origin to the destination using user defined aisles in the drawing.

If Flow Planner is unable to find any aisle path between a FROM and TO or VIA location, it will default to using the Straight Flow method for that specific path. If you notice straight flow lines in an Aisle Flow study, check the path network and make sure intersecting aisle path lines exist from the origin to the destination. If you have chosen to use directional aisle lines, please also verify these lines are drawn in appropriate directions and do not unduly prevent traffic.

Each aggregation (e.g. Product, Part, Method, Container, etc.) is stored in its own set of layers, but Flow Planner has one set of layers for each flow type. This means your drawing will only contain one type at a time, so you need to choose whether it will show Aisle Flow or Straight Flow. If you wish to save both types of flow routes for each aggregation, you should create one layout drawing for Aisle Flow diagrams and another for Straight Flow diagrams.

Prior to performing an Aisle Flow study you will need to create an Aisle Path network (in the Path Tab with the Add/Edit Aisle button), and you will then want to select the Join Locs to Aisle button in the Paths Tab to join your location points to the path network.

If you want to create a congestion diagram, you will need to select Aisle Flow. It is highly recommended that "Regen all Paths" is also selected when creating congestion diagrams to ensure that all flow paths are included in the analysis. Furthermore, settings in the Products Tab and Methods Tab allow you to perform congestion analyses for specific products or method types. Set the "Calculate" option to Yes for the desired products or method types, and the rest to No.

Calculate: The calculate button calculates the distance, time, and cost and generates and updates the flow paths. The calculation is aggregated according to the selected item in the “Aggregate-by” drop-down list. Please reference the Calculation Formulas section for a better understanding of the calculation algorithms.

The Calculate function first looks in the drawing to see whether all of the referenced locations exist. If some locations in the routing do not appear in the drawing, then Flow Planner will prompt the user to add each missing location to the drawing. At the command line of AutoCAD, you will see a prompt for adding each missing location.

Each aggregation (e.g. Product, Part, Method, Container, etc.) is stored on its own unique set of layers in AutoCAD. As such, one drawing file could contain the flow diagrams for all aggregations. Once the calculate command finishes, the selected aggregation will be shown. To look at other aggregated flow diagrams, go to the Paths Tab and select the appropriate aggregations from the top left combo box.

If the congestion diagram is selected during an Aisle Flow aggregation, then it will be shown at the end of the calculation. A congestion diagram created in this way can only be seen by selecting the Congestion aggregation in the Paths Tab.

Show Results: This will display the calculated results window for the last calculation performed. If no results have been calculated in your current session, this button will be grayed out.

Color by Frequency: By default, Flow Planner will color code the flow lines according to the aggregate color specified in the appropriate tab (i.e. Products and Parts, Methods, Containers, or Groups). Optionally, you may color code the flows according to their trip frequency. Trip frequency colors and intensities are specified in the “Freq/Congest” tab.

Skip Via Locations: The routing file requires a minimum of a FROM and a TO location for each route. However, in many factory logistics situations, there is a storage area between the dock where the material is received and the line or workstation the material is delivered to. For these routings from the dock to the line via a storage location, you will want to enter the storage location name in the “VIA” field of the part’s routing. Selecting the Skip-Via option will allow the Flow Planner calculation to generate flow directly from the FROM location and to the TO location to quickly assist you in evaluating the travel issues caused by off-line storage locations.

Dock/Storage Solver: The Dock/Storage Solver tool evaluates how to minimize a part's travel distance between receiving and the part's destination on the line. This is accomplished with the help of a user-provided list of dock and storage options, and the tool helps find the best option.

To use this feature, you must first create the location groups PP_DOCK and/or PP_STORE and then assign desired alternate dock and/or storage locations to those groups.

When the Dock/Storage Solver runs, Flow Planner will look for parts that specify locations named either "PP_DOCK" or "PP_STORE". It will then replace these location names with a specific Dock location name or a specific Storage location name from a previously created list of locations that belong to the PP_DOCK or PP_STORE location groups respectively.

Please note that you will need to save this modified routing under a new name if you want to preserve your original version where PP_DOCK and PP_STORE are defined.

The replacement Dock or Storage location is determined by an algorithm which seeks the shortest travel distances (either Straight or Aisle-based, depending on your selection prior to calculation) between each location in the location list for that group. Once a location is found, the routing is modified by replacing the PP_DOCK or PP_STORE with the specific location name.

To illustrate how the Dock/Storage Solver works, assume that Part X needs to be delivered to Workstation A. It can be received at either dock D1 or dock D2 and could be stored at any of three different storage areas, S1, S2 or S3. Flow Planner can determine which dock and storage area will represent the shortest overall distance to Workstation A.

To accomplish this, you need to create the location groups "PP_DOCK" and "PP_STORE" and then assign the individual locations to those groups. Docks D1 and D2 are assigned to the PP_DOCK group and S1, S2 and S3 are assigned to the PP_STORE group.

Next, you would create a routing where Part X travels from location PP_DOCK to Workstation A via location PP_STORE. When the routing is ready, select Dock/Storage Solver and click "Calculate". Suppose that after the calculation, Flow Planner replaces PP_DOCK with D2 and PP_STORE with S1. This means that Part X travels the shortest distance if it arrives at D2 and is stored in S1.

Create Aisle Congestion: Congestion diagrams can only be created when an Aisle Flow diagram is being generated. Because the aisle congestion is the summary of all flows down specific aisle segments, it will be the same for any aggregation. Thus, there is only one aisle congestion diagram and this option should only be selected for one aggregation to save on processing time. Note that it is highly recommended to use the “Regen all Paths” option when creating congestion diagrams to ensure that all flow paths are included within the analysis.

As of version 4.0 and later, Congestion diagrams are only generated along aisles, and therefore never include Aisle Join lines.

As of version 5.0 and later, Congestion diagrams are generated as the aggregate of all aisle path layers as specified by the Method Types referenced within your last calculation. To ensure that shared aisles specified in the aisle paths on multiple layers (mapped to Method Types) are

properly aggregated, it is necessary to for those aisle layers to be EXACTLY overlapping, although they do not need to have the same endpoints, or aisle intersection points. The Congestion algorithm will properly aggregate all possible aisle intersections for all aisle paths specified on all referenced aisle layers.

To perform congestion analyses for specific products or method types, select them in either the Products or Methods Tab and set the Calculate option to Yes while turning the undesired products or methods to No.

Round Up Frequency: When this item is NOT selected (default), the program computes the trip frequency using the formula specified in the Calculation Formulas section of this document. This formula will most often generate a fractional frequency number (i.e. 1.5 trips instead of 2 trips). The fractional frequency represents the fact that over the course of the time period (as specified in the Products Tab and associated to the production quantity of those products during that time) there would be 1.5 trips to satisfy the delivery demand. So over the course of 2 time periods (i.e. shifts, days, weeks, months, years, etc) there would be 3 trips required to satisfy the demand.

In some cases, where all of the demand must be satisfied during the stated time period, it would be acceptable to round up those frequencies to their next whole number. In those cases, you will want to select this option ON.

Regen All Paths: Selecting this option means that Flow Planner will regenerate all paths, even if they already exist. When this option is unchecked, only the missing flow lines will be drawn during the calculation. ***NOTE: The ability to UNCHECK this option was disabled in version 5.4.0.0. This feature will return in a future release***.

This selective path generation capability is useful if you have generated many manually routed paths and do not wish these to be deleted upon your next calculation. In addition, large studies will benefit from the performance advantages of re-generating only missing flow paths instead of all existing flow paths.

For example, consider a situation in which 'Regen All Paths' is OFF. The prior flow analysis was done using the Straight Flow method, and your current analysis is to use the Aisle-Path method. In this case, only the new flow lines will be generated along the aisles. To delete all of the previously existing straight flow lines and generate all new aisle flow lines, you will want to have the 'Regen All Paths' option ON before selecting the Calc button.

Path Arrows: Selecting this option tells Flow Planner to generate arrows at the end of all flow lines.

If arrows are not generated at the time of the calculation, then they can always be added later via the Arrows button in the Paths Tab.

Path Thickness: Selecting this option has Flow Planner scale the thickness of the displayed route based on the frequency the route is traveled. If you are performing an analysis on a large number of calculations, leaving this option off (unchecked) will save time during calculations.

Calc Locs/Network: This feature is responsible for two different tasks:

First, it finds the current location of all work center points and records their coordinates. Any time you have moved work centers around in your layout, you will want to use this feature.

The second task applies to Aisle Flow studies only. In Aisle Flow studies, it will read the aisle paths in the drawing and then determine how parts should move along those paths.

Include Accel/Decel: Checking this option on will apply an Acceleration and Deceleration time to **each segment** of a flow path. As such, selecting this option will not affect travel distances, but will increase the Time and Cost for trips. Aisle Path studies will be especially affected if travel paths have many turns, because acceleration/deceleration time will be applied to each turn based on the user inputs for the given method type. Additionally, if you have added Passthru points on aisle paths and you have specified the STOP property on those passthrough points (i.e. typically done at intersections) then additional accel/decel times will be added to your travel time. Any stop placed at an intersection will only result in the accel/decel being applied once (i.e. a stop point on an intersection where you take a turn will not result in two stop times being applied).

Ignore Aisle Joins: Selecting this option means your distances and times will be calculated between two Locations along only the aisle lines WITHOUT including the distance of the Aisle Join line from the Location to the Aisle. In addition, if you enter a walkspeed value on the Settings tab (other than the default of zero), the program will add a walktime value to the Load and Unload time for the path.

This walk time is computed by the following formula 2*(1/Walkspeed)*JoinDistance. We multiply the Join Distance by two to account for walking to the location point and then back to the aisle. Keep in mind, this walktime is ADDED to any Load/Unload times you specify elsewhere. This walktime value is then multiplied by each container being delivered to that location by your Routing row. In tugger studies, it is often common for multiple containers to be delivered to a location on a trip. In this situation, Flow Planner assumes that each container has a walktime required to move it to the location from the aisle. For example, assume you were using a BT process of 10 seconds per stop and 5 seconds per container, and you chose to ignore aisle joins while specifying a walk speed of 5ft/sec. If you were delivering 3 containers to a location with a 7ft join line, then Flow Planner would compute a stop time of 10sec+5sec*3cont+((7ft*2trips)/7ft/sec)*3cont = 31seconds for this stop.

You can specify that the material handling operator can carry multiple containers at one time by setting the Full Stack Quantity value for that container to a value greater than one (in the Containers tab).

When you Save your Routing CSV file after an aisle-based calculation, Flow Planner creates additional columns of data which include calculated results for each routing line. In column AD of your spreadsheet there will be a column labelled "Process/Walk/Dist" which shows the Load/Unload time, the Walk time on the aisle join line and the distance of the aisle join line (base units such as inches or millimeters). Remember that this distance needs to be multiplied by 2 and factored by the unit of walk speed (i.e. Feet or Meters) and then factored by the number of walks required on that join line for your particular routing line. If you include flows on aisle joins (i.e. do not ignore join lines), or if you use straight flow lines, then no values will be shown in this column.

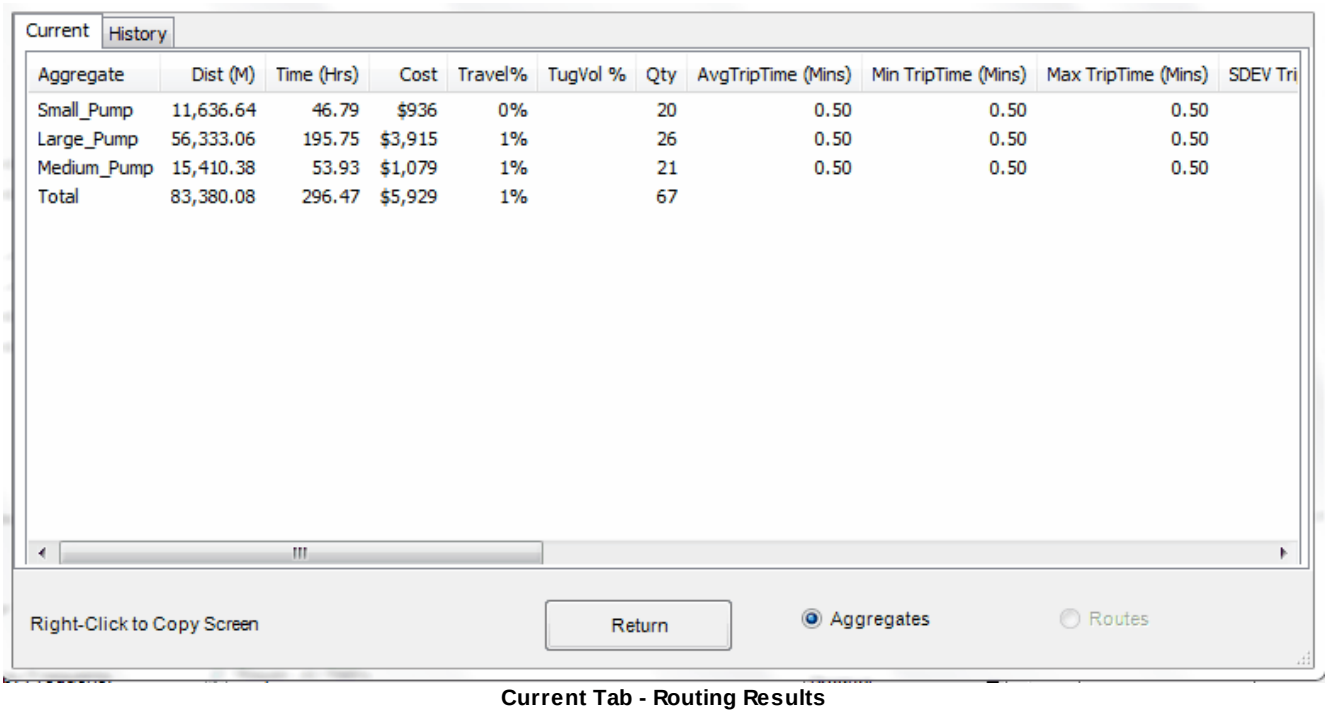
If the parts per container field of the routing line is positive, then the distances for both the Load join line and Unload join line will be used. If that field is -1 or -2 then only the join line distance to the To location will be used. Tugger studies always use a parts per container value of -1 or -2 depending on if the route is loading containers onto the cart or unloading them from the cart. In both of those situations, only the join line for the To location (where the activity is occurring) is used.

5.3.5 Results

The Results window will pop up after you perform your calculation. If you are performing a Tugger study, please refer to the next section. There are some differences in the way results in the Current tab are interpreted for tuggers. See tugger results details in the next section.

Please note that all results are calculated per the time period set in the Products tab, with the assumption that the part routing requirements will persist over multiple time periods. Thus, the results calculated are time period averages. For example, the time period is set to Day, there is a demand of 100 for a Product A, that product requires Part G in a quantity of 1, and the distance the part will travel is X. Part G is carried in containers with capacity of 200. The daily distance calculated for the part is X/2, because while only 100 of Part G are required each day, they are delivered in quantities of 200, so a container carrying Part G will be delivered every other day, making the daily average 1/2 the total distance for 1 trip.

For result statistics about each Routing line (row), you can save your Routing after performing a calculation and then load the CSV file into a spreadsheet. You will see additional columns at the end of this CSV file which include the Time, Cost, Distance, Frequency and Volume values computed by Flow Planner. When Flow Planner reads this CSV file in the future, those columns are ignored.



Current Tab - Routing Results

Current tab

Aggregate: The name of each entity for which flow was calculated. Based on the "Aggregate by" selection.

Dist (M *or* Ft): The total sum of the distance in Feet or Meters.

Time (Hrs): The total sum of the time in Hours.

Cost: The total sum of the cost by aggregate and by total. Note that only variable costs are shown with each aggregate and then these are totaled and added to the total fixed cost in the Cost total. The only exception to this is when the aggregate “Method Type” is selected. With this aggregate, the fixed costs are included for each method type in the individual aggregate summaries.

Travel%: The travel percentage is the percentage of time that is travel time versus the total time which would also include Load and Unload times associated with each trip. This statistic is provided to aid in prioritizing your effort in reducing waste associated with traveling versus loading/unloading.

TugVol %: Used for Tugger Analysis to represent the percentage of a full tugger train required on this route.

Qty: The quantity represents the number of point-to-point paths taken into account by the study. If one Part Routing defines a From and To location, the quantity counted for that routing is 1. If one Part Routing defines a From, To, and Via location, the quantity counted for that routing is 2.

Trip Time: The trip time is the time spent going out and back – it is the time it takes to make an entire trip. A trip includes both Travel Time and Handling Time.

Avg Trip Time (mins): The average time a trip takes, in minutes.

Min Trip Time (mins): The shortest (minimum) trip time, in minutes.

Max Trip Time (mins): The longest (maximum) trip time, in minutes.

SDEV Trip Time (mins): The standard deviation of all trip times, in minutes.

Travel Time: The portion of a trip spent driving.

Avg Travel Time (mins): The average time spent traveling, in minutes.

Min Travel Time (mins): The shortest (minimum) time spent traveling, in minutes.

Max Travel Time (mins): The longest (maximum) time spent traveling, in minutes.

SDEV Travel Time (mins): The standard deviation of all travel time, in minutes.

Handle Time: The portion of a trip spent processing the load (loading/unloading).

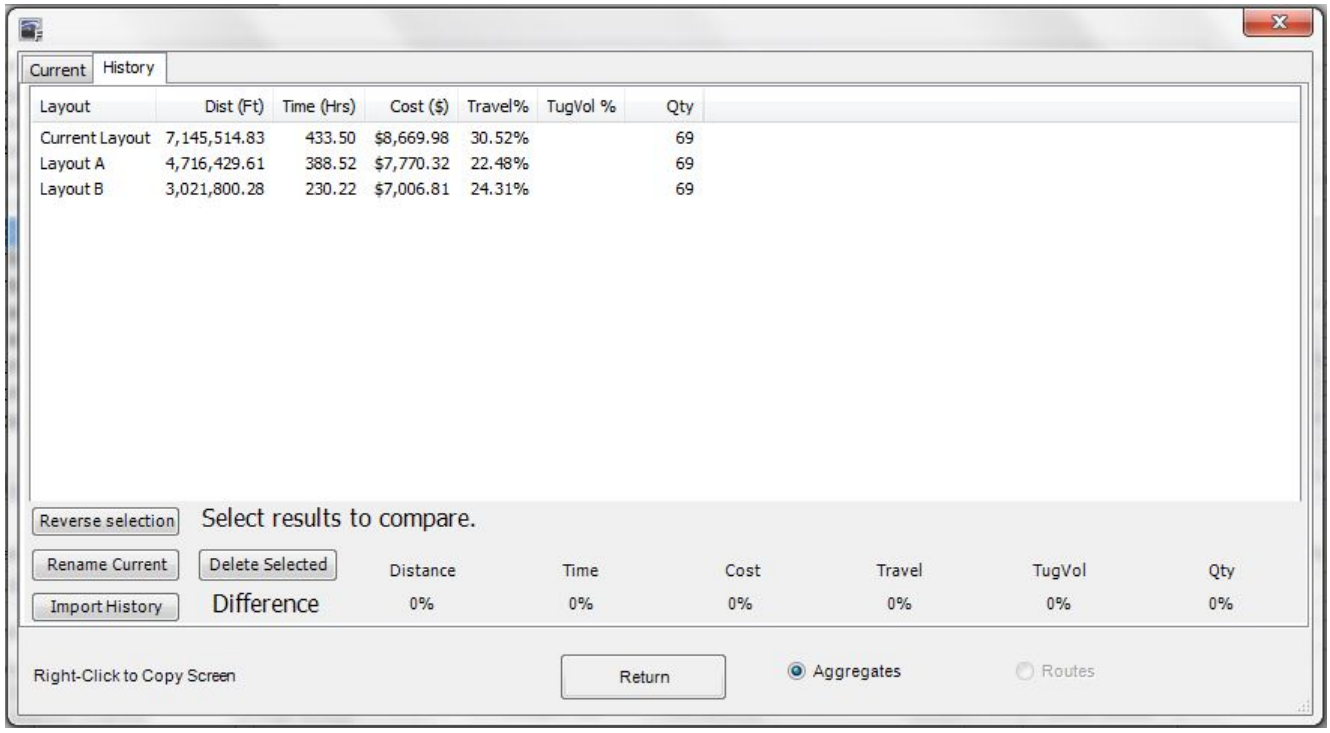
Avg Handle Time (mins): The average time spent handling the load, in minutes.

Min Handle Time (mins): The shortest (minimum) time spent handling the load, in minutes.

Max Handle Time (mins): The longest (maximum) time spent handling the load, in minutes.

SDEV Handle Time (mins): The standard deviation of time spent handling the load, in minutes.

Container Qty: The MAXIMUM number of containers which would be placed on the tugger cart (tugger study) for the duration of the route. This calculation is performed by looking at the entire route of container pickups and dropoffs and then determining the maximum number of containers loaded on the carts any an point in time of that route.



History Tab - Routing Results

History tab

Layout: The name of the layout for which results are displayed. The most recent calculation will always be saved as "Current Layout."

*The last 6 columns in the table represent the same data as their corresponding columns in the Current tab.

Reverse Selection: This reverses the selection of the rows when calculating the results in the Difference section. Typically, you would want your initial layout to be selected first to see the effect the new layout has on the calculations.

Rename Current: This allows you to rename the current layout so its results are saved. This must be done before running the flow calculation on a new layout, as the new layout's results will show up in the "Current Layout" line.

Delete Selected: Select a row and click this button to remove the layout's results from the list.

Import History: Flow Planner calculation results are saved in .res files. The open study's .res file results will be shown by default in this tab, but if you want to compare previously saved

results, you can click this button and browse to the particular .res file with which you wish to compare results.

Difference: If two rows are selected, the difference between the two layouts will be calculated and shown as a percent for distance, time, cost, travel, tugger volume, and quantity.

5.3.6 Results for Tugger Study

For a Tugger study, the results look slightly different. This is because tuggers work on a route, and trips are therefore different. Trips are defined as the time between different stops on the route, as opposed to a regular study where the trips are the time between leaving and returning.

For tugger studies, you can look at the results by aggregate or by route by selecting the appropriate radio button in the lower right hand corner of the Results window.

Aggregate: The name of each entity for which flow was calculated. Based on the "Aggregate by" selection.

Dist: The total sum of the distance in Feet or Meters.

Time (Hrs): The total sum of the time in Hours.

Cost: The total sum of the cost by aggregate and by total. Note that only variable costs are shown with each aggregate and then these are totaled and added to the total fixed cost in the Cost total. The only exception to this is when the aggregate “Method Type” is selected. With this aggregate, the fixed costs are included for each method type in the individual aggregate summaries.

Travel%: The travel percentage is the percentage of time that is travel time versus the total time which would also include Load and Unload times associated with each trip. This statistic is provided to aid in prioritizing your effort in reducing waste associated with traveling versus loading/unloading.

TugVol%: Used for Tugger Analysis to represent the percentage of a full tugger train required on this route. This is equal to the number of containers of each container size multiplied by their respective volumes, divided by the tugger volume capacity.

Qty: For the aggregated view in the tugger study, the Quantity represents the number of times the driver made stops on one route. In the route view, the quantity is the number of times the driver traveled the entire route.

Trip Time: The trip time for tuggers is slightly different than a regular study. The term 'trip' refers to a period between two stops on a route.

Avg Trip Time (mins): The average time a trip takes, in minutes.

Min Trip Time (mins): The shortest (minimum) trip time, in minutes.

Max Trip Time (mins): The longest (maximum) trip time, in minutes.

SDEV Trip Time (mins): The standard deviation of all trip times, in minutes.

Travel Time: The portion of a trip spent driving.

Avg Travel Time (mins): The average time spent traveling, in minutes.

Min Travel Time (mins): The shortest (minimum) time spent traveling, in minutes.

Max Travel Time (mins): The longest (maximum) time spent traveling, in minutes.

SDEV Travel Time (mins): The standard deviation of all travel time, in minutes.

Handle Time: The portion of a trip spent processing the load (loading/unloading).

Avg Handle Time (mins): The average time spent handling the load, in minutes.

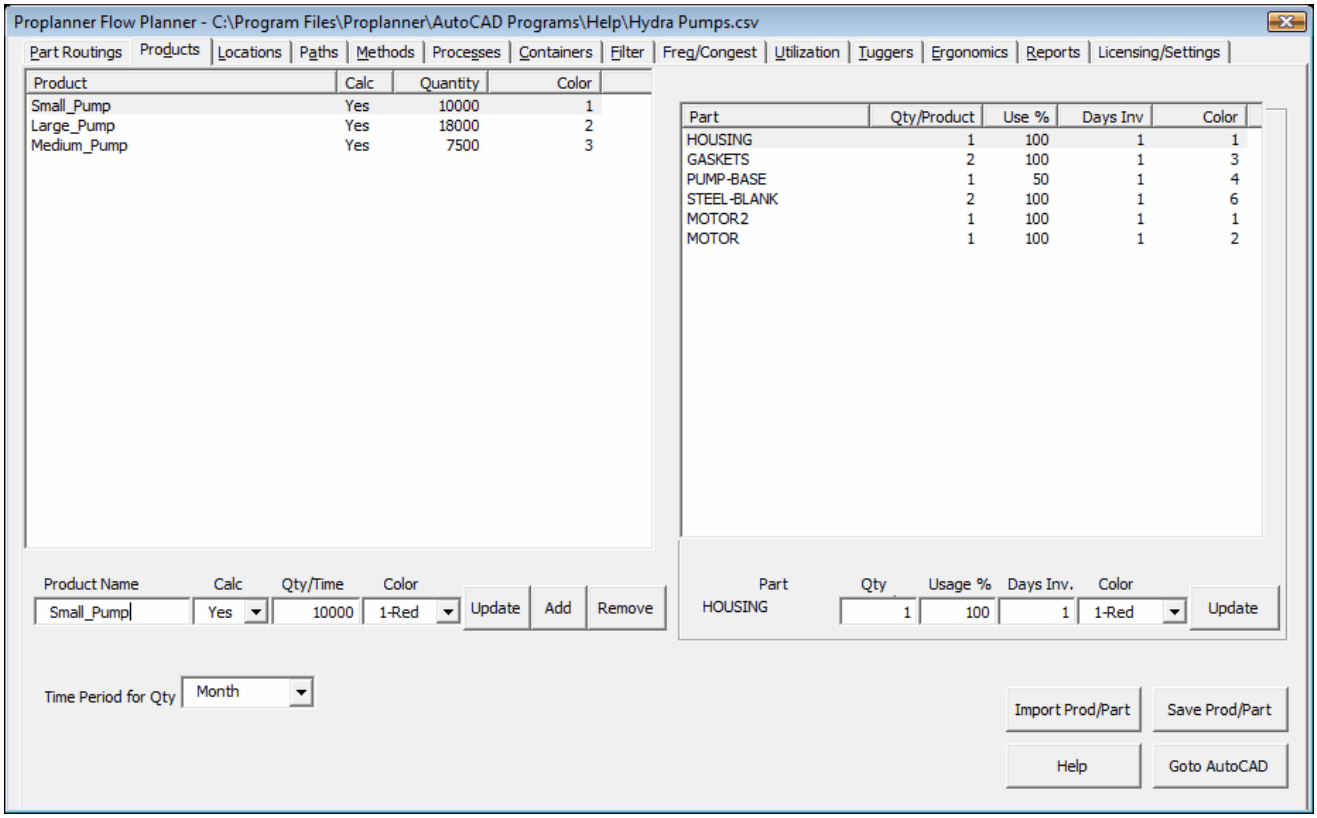
Min Handle Time (mins): The shortest (minimum) time spent handling the load, in minutes.

Max Handle Time (mins): The longest (maximum) time spent handling the load, in minutes.

SDEV Handle Time (mins): The standard deviation of time spent handling the load, in minutes.

Containers: The number of containers used to complete the trips for the given route.

5.4 Products Tab



Products Tab

The Products Tab contains details about the Products in the routing and the Parts that make up each Product. Information about quantity, color, and calculation attributes are stored in tables

and are created from reading the routing file. Information can also be added or edited in the Products Tab.

The Parts displayed on the right are the parts used in the Product selected on the left. Selecting a different Product from the list will pull up the Parts list for that Product.

Users can multi-select rows in this editor and change a field value with one entry which will affect all rows for either products or parts.

Products

Information about the products, or main flow groups, is shown on the left side of the screen.

New products can be added to this list. These will then appear in the pull-down list of products in the Part Routing Tab. You can also create a new product in the Part Routings Tab by typing the name into the pull-down list; the product will automatically appear in the Products Tab in the Product list box.

The columns deal with the following information:

Product Name: Name of the Product. Changes to the name of the product in this field will subsequently update the name of the product in the routings file.

Calc: This setting tells Flow Planner whether calculations should be performed for the product (flow diagrams, distances and costs). This feature is typically only used for studies with thousands of flow routes and the size is large enough that it may be desirable to speed up the calculation by only calculating products of immediate interest.

To filter the flow diagram by product, use the features in the Filter Tab.

Quantity: The quantity of the Product that will be examined in the study. This number will be multiplied by the Parts per Product quantity to calculate the total number of parts that are moving.

Color: The color used for product layers created by the Product Aggregation.

Parts

Details of the parts making up the product are displayed in columns on the right-hand side of the screen. These columns include:

Part Name: Name of the Part. Part names cannot be changed in this editor.

Qty/Product: The Quantity of Parts per referenced Product.

Use %: The portion of the referenced Product's quantity that uses the Part at the Quantity/Product rate.

Days Inventory: This column is for a feature that is not yet implemented.

Color: The color for the Part and Product&Part layers created by the Part and Product&Part aggregations.

Commands in the Products Tab

Time Period for Qty: This indicates how long it takes to use the specified quantity of the product. Note: The time period is constant for all products and also applies to the Available

Minutes for each material handling device (seen in the Method Type Available Minutes field in the Methods Tab).

The Time Period For Quantity field is used for reporting and for dialog box display purposes.

Import Prod/Part: Reads a new product/part file (of the extension .PRD), which will update the properties (color, quantity, percent, etc) of all Products and Parts found in the current routing.

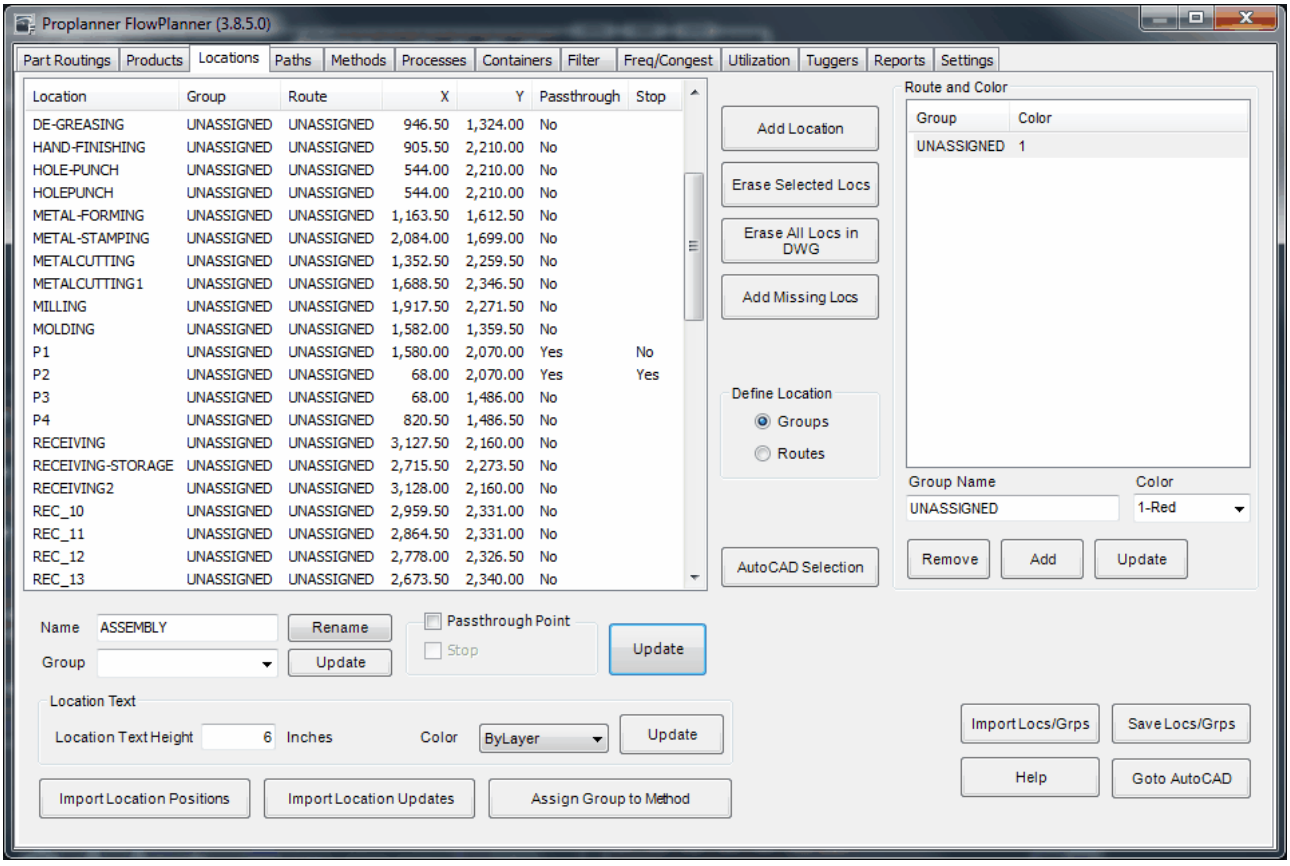
Save Prod/Part: Saves the Product and Part properties to a product/part file (of the extension .PRD) for future use.

Non-Traditional Studies

Note that studies do not necessarily have to stick to the traditional Product-Part setup. If you wish to do something different, just consider the term "Product" to mean "Main Flow Group" and "Part" to mean "Sub-Flow Group". In this way, you can set up different sorts of studies.

The Relationship Planning Tutorial gives an example of a non-traditional study. The relationship types (A_RELS, E_RELS, etc.) are set up as products, even though they are a quantitative, intangible entity.

5.5 Locations Tab



Locations Tab

The Locations Tab contains details about all locations available for use in the routing. Locations can be added to the list, updated, assigned to a location group, and added to the drawing in this tab.

5.5.1 Location Table

The location table is a list of all locations referenced by the routing file. The table displays the location group to which the location belongs. For studies involving the tugger add-on, the route is also recorded. Finally, the X-Y coordinates of the location in the drawing is listed.

Each location exists in the drawing as a text item on a specific layer of the drawing. The default layer is PP_LOCATIONS, but the layer can be changed in the Settings Tab.

When you select the "Calculate" command in the Part Routings Tab, Flow Planner automatically reads the drawing to make sure all referenced locations exist in the drawing. The position is updated if necessary. When there are missing locations, you will be prompted to place them on the drawing.

5.5.2 Group Table

A Location Group is a set of locations with something in common. For example, all locations on an assembly line may be placed in the same Location Group. The members of the group are often geographically contiguous. Other examples include dock banks, storage areas, work centers, and departments.

Assigning locations to Location Groups means specific colors can be assigned to the locations, flow diagrams can be filtered according to groups, and the From-To Group flow aggregation is enabled. If a location is not assigned to a group, it will belong to the UNASSIGNED group by default.

Groups can have the same name as an existing location (although this is not recommended). In this situation, the location's position in the drawing will determine the location for the group when a From-To Group aggregation flow diagram is generated.

Changing the name of a group and then selecting the Update button will do a search and replace in the location list and update the referenced groups in that list with the group's new name.

5.5.3 Locations Tab Commands

Add Location: Prompts you to enter a location name and click on a position in AutoCAD. When this is completed, the location is added to the display list.

Erase Selected Location: Erases the selected location from the drawing if the location is not referenced in the routing. If the routing references the location, the location will be retained in the list, but the position will be reset to (0,0).

Another way to erase locations from the drawing is to select Goto AutoCAD in the Part Routings Tab, and then use the AutoCAD Erase command.

Erase All Locs in DWG: Erases all locations not referenced in the routing from the drawing. The locations referenced in the drawing are retained in the list, but their positions are reset to (0,0).

Another way to erase locations from the drawing is to select Goto AutoCAD in the Part Routings Tab, and then use the AutoCAD Erase command.

Add Missing Locs: Compares the list of locations to the locations that exist in the drawing, then takes the user to AutoCAD and gives prompts to enter any missing locations on the drawing.

The same process occurs whenn a calculation is performed and any locations are missing from the drawing. This command will also refresh the Locations list with the current X,Y position of location text objects in the drawing. This is especially helpful if the drawing was loaded after Flow Planner was started.

AutoCAD Selection: Takes the user to AutoCAD to select locations from the drawing.

Rename Location: Renames all location references in both the Routings tab and also the Text label in the drawing.

Location Groups and Routes: Locations have both Group and Route properties. Location Groups are referenced when assigning color to text labels in the drawing, or when performing GROUP Aggregation calculations, or when using the PROCESS macros for calculating material handling Load and Unload times. Routes can also be used to assign color to text labels, but are primarily intended to assign a location to be served by a specific (tugger) Route driver when performing tugger calculation studies. Routes and Groups can be assigned to locations by selecting one or more locations from the interface; then selecting the group; and finally selecting the UPDATE button. Of course, Locations can be alternatively selected using the AUTOCAD SELECTION button.

Passthru Point: Allows the user to identify a location as a passthru point. Passthru points are used by the Tugger module to force tugger drivers to move through a specific location even though no material needs to be picked up or dropped off at that location. Fork truck routings can also reference passthru points, causing the Load/Unload time to not be added to the stop. In addition, passthru points can have a STOP attribute assigned to them, which forces the Automatic Aisle Path Routing algorithm (version 4.0 and later) to come to a complete stop and start up again at that position along the path. For this feature to work, the passthru point must be placed directly on an aisle path line and referenced by all paths that flow through that point (just as if it was an aisle intersection). For this Stop and Start to affect the time of a path travel, the user must have the Accel/Decel checkbox checked (on the Routing Tab) prior to performing a calculation.

Import Locs/Grps: Importing a Locations/Group file will update the current Flow Planner information to that of the file. Any group names referenced in the file will automatically generate and get assigned the specified color. For any location existing in both the Location Tab list and in the group file, the group name will be updated.

Save Locs/Grps: Saves the locations list, group assignments and X,Y drawing positions to a comma-delimited CSV file in the same format as shown in the display. It is used for exportation of locations to other applications, and for saving the group assignment and group color information. Flow Planner only uses the group and color information when it reads this file. It will not create locations which are not referenced in the current routing, nor will it modify the position of any locations in the location list.

Import Location Positions: Normally, when Flow Planner reads the Locations file, it imports only the Group and Route assignments for those locations which it finds in the current AutoCAD drawing and/or Routing file. As such, Flow Planner is using the X,Y coordinates of the locations as currently read from the AutoCAD drawing instead of the X,Y coordinates in the Location File.

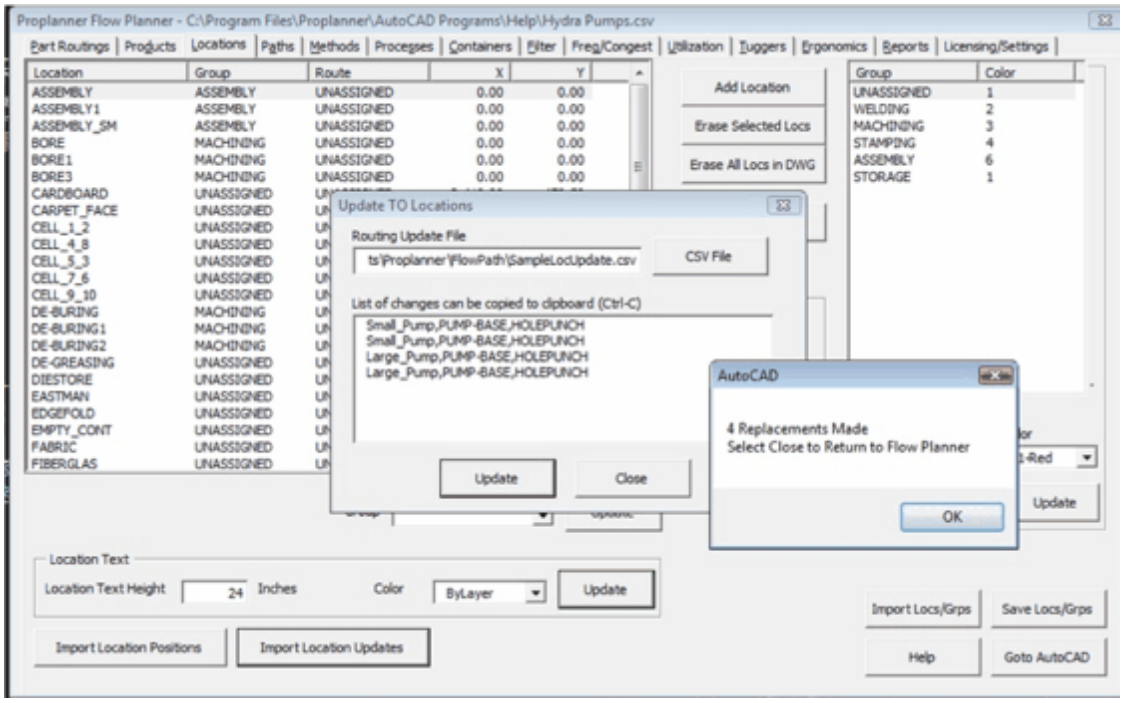
Selecting "Import Location Positions" will actually read the X,Y coordinates from the file. This allows you to use the location file to re-locate existing locations and also to create new locations. The Locations list in Flow Planner will be updated to match the Location file.

Import Location Updates: This feature allows the user to specify a file of mass updates (sample shown below) to the TO locations for flow routings (i.e. the CSV routing file). Flow Planner will automatically update the currently loaded routing. This feature is primarily used when a line balancing study has relocated the consumption (i.e. usage) location for parts along an assembly line. Proplanner's ProBalance and Assembly Planner applications can automatically create the appropriate update file.

This mass update file is a comma delimited text file that contains four fields: Product, Part, PrevTo, and NewTo. The first three fields can contain an asterisk wildcard, indicating that all routes with a corresponding Product, Part or PrevTo value is to be assigned to the NewTo location. This feature will start processing records starting on the second line of the file, therefore the first line can be used for headers or comments.

Product	Part	PrevTo	NewTo
*	Housing	*	Welding
Small_Pump	Gaskets	*	Assembly6
*	Pump-Base	Welding	HolePunch

The following screenshot shows the result of an updated list for routing TO locations.



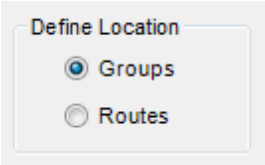
Routing TO List

Assign Group to _Method: Will automatically assign a material handling METHOD to all routings with a TO location that has a group name which begins with an underscore. For example, to graphically select a set of workcenter points and have their material handling method automatically assigned for all routings that deliver parts to those TO locations, you would create a method name as a group with an underscore "_" as the first character. Then you would graphically select a set of workcenter points (using the "AutoCAD Selection" button) and you would assign that method name group to those TO locations.

In the previous screen you can see that a group called "_FORK7" was assigned to a set of De-Buring stations. On the screen below, you can see that FORK7 has not been assigned as the Method used to deliver all materials TO the Deburing locations. Now selecting the "Assign Group to _Method" button will replace all Method names in the routing lines that reference those TO locations, with the method name specified as the Group for those locations (without the underscore of course).

Goto AutoCAD: Hides Flow Planner's main window and displays the Modeless window, which contains some editing commands.

Define Location: Use these radio buttons to select which set of groups is shown in the groups list view. You may choose either Location Groups or Tugger Routes.

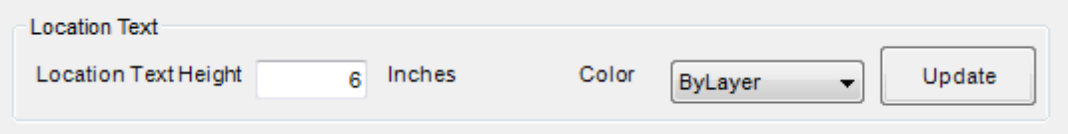


Define Location Option

Groups are used to aggregate flow diagrams. They are also used to provide flow data between groups of locations. For example, you may use groups to see flow between different assembly lines instead of flow between different locations on those lines.

Routes are used by the Tugger module to assign locations to route drivers.

Location Text



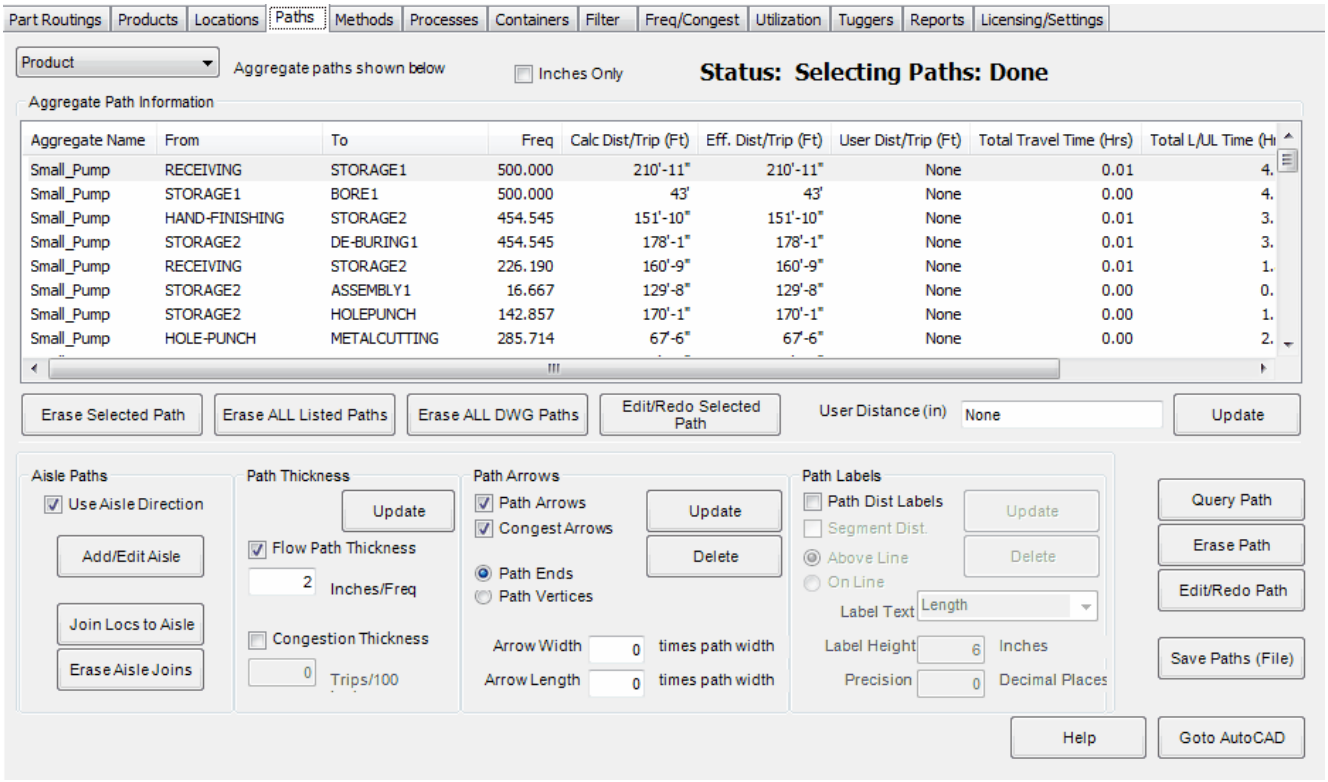
Location Text

Location Text Height: Specifies the height of text of a location label in the drawing.

Color: Specify how color is used for location label text. Choices are “ByLayer”, “Group,” or “Route”.

Update: Use this to update the drawing with any changes made to Location Text Height or Color.

5.6 Paths Tab



Paths Tab

When Flow Planner does a calculation on a drawing for a specific aggregation type, information about each path is filled in the Paths Tab. This information includes, among other things, the total distance traveled and the cost of the trip. The Paths Tab allows you to see the calculations for each path, as well as allows editing and annotating paths.

Note: If there are no paths in AutoCAD for the selected aggregation, no paths will be shown in the list view.

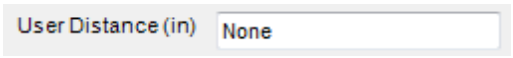
Since the information in the Paths window is pre-generated, it is not necessary to load the routing file and perform a calculation in order to view, query, filter, color code (via the Freq/Congest tab), delete, or alter the thickness of the flow lines for all previously generated aggregations.

5.6.1 Aggregated Paths List Group

When you select an aggregation type from the pull-down list at the top left of the Paths Tab, all flow lines except the selected aggregation are turned off. Then the list view is populated with the information calculated and stored within the flow polylines for the selected aggregation.

Aggregation Method: Selecting an aggregation method from the pull-down menu turns off all flow paths except the selected aggregation method. This means that if the "Product" aggregate is selected, all of the path information displayed relates to paths for each individual product.

User Specified Distance Update: For all selected paths, you can specify a path distance, it will override the distance Flow Planner computed from the drawing. This feature is useful for paths that may extend to other buildings or other locations not included in the current drawing.



Specified Distance Field

Erase Selected Paths: Will erase the selected flow path in the current drawing and the list view.

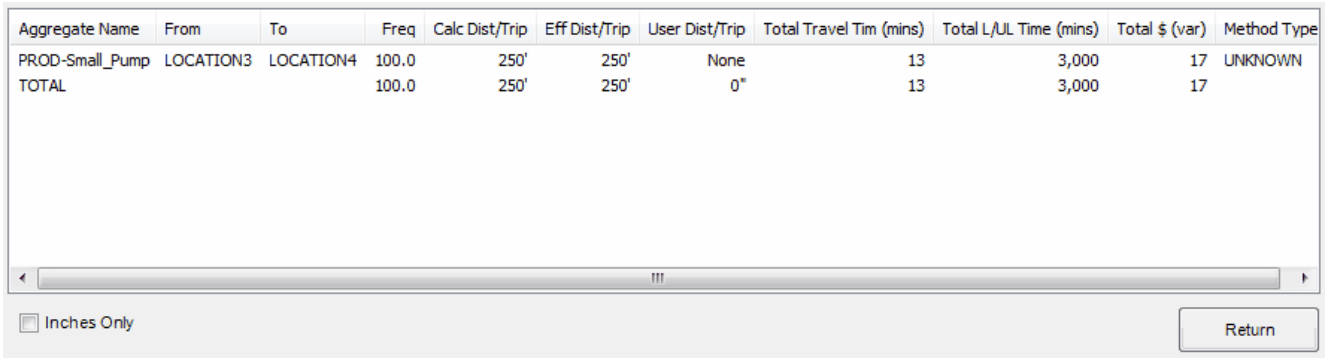
Erase All Listed Paths: Will erase all of the listed flow paths in the current drawing for the selected aggregation.

Erase All DWG Paths: Will erase all of the flow paths in the current drawing for the selected aggregation.

Edit/Redo Selected Path: Will allow you to specify a manually generated flow path line for the selected path.

5.6.2 Editing Commands in Paths Tab

Query Path: This button hides Flow Planner's main window and allows you to click on and select flow paths to query. You may select one line or more lines; when you are done selecting lines, hit enter on the keyboard to display the path information. The information will be displayed as shown in the screenshot below.



Query Path Information

Erase Path: Will allow you to select a flow path in the drawing to erase.

Edit/Redo Path: Will allow you to select a flow path in the drawing to edit and specify a manual route.

Goto AutoCAD: Hides the Flow Planner main window and displays the Modeless window, which contains some editing commands. You can also execute any AutoCAD command on the menus or command line.

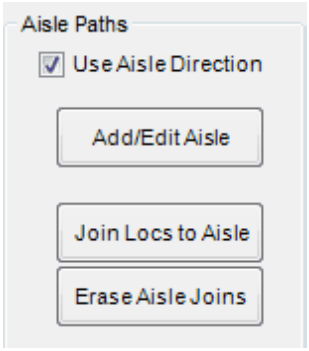
Save Paths (File): Saves the displayed information to a comma-delimited CSV file in the same format as shown in the display. This can be used to export flow path distances to other applications. Flow Planner does not read this file.

5.6.3 Aisle Paths

Flow Planner can look at the aisles drawn in your factory layout and use a shortest-path algorithm to find the best route from one point to another. To do this, Flow Planner references a layer in the AutoCAD drawing that contains lines (not polylines) that show which aisles exist. If these lines intersect, Flow Planner assumes the aisles intersect.

Additionally, you can specify more than one layer for the aisle lines. If you have more than one aisle layer, you could assign specific layers to specific Methods. This means, for example, that you are able to specify a set of aisles for Fork Trucks that is different than the set of aisles that people would use. *Note: If you are planning to specify more than one layer, you must add the newlayer before adding aisle paths to that layer.*

- Aisles can be added or edited in the AutoCAD drawing with the Add/Edit Aisle button in the Paths Tab. Select the layer on which the aisle paths will reside by using the Aisle layer drop-down menu. There are three different types of aisles that can be drawn (see Aisle Types below); the different aisle types are differentiated behind-the-scenes by line type, and in the drawing by color (as shown in the table below).



Aisle Paths

Width	Color
16'	Red
14'	Yellow
10'	Green
8'	Blue

Aisle Types

Aisles can be bidirectional, meaning that travel in any direction is allowed. The bidirectional paths have the "BYLAYER" line type.

The second aisle type is the Right and Up aisle, which means that flow can only move up and/or right as you look at your drawing. These are labeled with "UR" as their line type, and flow is restricted to directions between 0 and 179 degrees.

Finally, there is the Down and Left aisle, where flow only moves down and/or left as you look at your drawing. These have "DL" as their line type and flow is restricted to directions between 180 and 359 degrees.

Obviously, it is important to use some bidirectional or at least ensure that the layout of Up and Right and Down and Left aisles allows access to the entire facility.

You may only add aisles to layers on the pull-down list in the Add/Edit Aisle window. The pull-down list is populated from the layers for method types. To add a layer to draw aisle lines on, add that layer to one of the method types in the Methods Tab.

Other Aisle Path Commands

Join Locs to Aisle: Lines must be connected from each Location text insertion point to an aisle path line in order for Flow Planner to know how to get to and from that location. You can manually draw the line from the insertion point (make sure to use your object snap modes) to another aisle path line, or you can select this button and have those lines drawn for you.

When Flow Planner automatically creates "Join Lines" from each Location text to the aisle network it does so by selecting the closest aisle path line perpendicular, or end-point connection. Join lines are placed on a layer of the same name as the user-specified aisle path layer plus the following extension "-JOIN". In this way, Flow Planner can easily remove these lines and recreate them as the Location points are moved around in the drawing by the user.

While you can use this "-JOIN" layer to manually draw connecting lines from the Location text to the aisle network, the program will remove these lines whenever the Erase Aisle Joins button is selected. As such, it is recommended that all manually joined Locations are created on the same layer in which the aisle path lines are drawn. UNLESS you wish to ignore aisle join distances. In that situation, you will need to join your Locations to the aisles by using the Aisle Join layer, and therefore, you will not want to Erase Aisle Joins automatically.

The "Join Locs" function will first check to see if the Location text is already joined to the aisle network, and will not add an automatic Join line if an existing line is found drawn to that insertion point.

The "Join Locs" command **will only join Location text to an aisle path line on a particular layer if that location is referenced in a routing** that uses a method that references a method type mapped to that layer. For tugger studies, it is recommended that you first generate your routes using a straight flow analysis and then once your routings have been created, you can select the Join Locs command to join those selected workcenter points to the aisle network. Keep in mind that if you generate new tugger routing students in the future, that some new locations may now show up in the routing and you may need to join locations to connect them after that routing is created.

As such, the Join Locs command requires that a routing file (or tugger delivery file) is loaded into the application.

Erase Aisle Joins: Will remove all lines found on the Aisle Path Join Layer (the name of the aisle path layer with a "-JOIN" suffix). Note: If you manually edit the aisle joins, this command will remove them.

Incorrect Aisle Drawings

If the aisle paths are drawn incorrectly, the calculation will produce straight-line flows. Examples of the most common errors in drawing aisles are shown below.

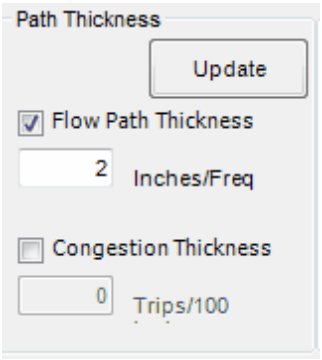
Incorrect Aisle Drawing Examples

Other common problems involve having the aisle lines drawn in 3D space (whereby the Z-coordinate of the line endpoints is not zero), or having lines drawn on a different layer than what is mapped to the Method Type which you desire to use those aisles. These errors are hard to spot unless you zoom in to the drawing quite a bit, or if you know where you overlapped. If you see an aisle line that has no flow lines using it, then you should view the properties of that aisle line and pay specific attention that it is an AutoCAD LINE (not POLYLINE), both endpoints have Z-coordinates equal to zero, and it is actually drawn on the layer you think that it should be. If all else fails, it may be quickest to delete the trouble aisle lines and recreate them using the Add-Aisle command.

If you have a pre-made drawing that has these issues, consult the troubleshooting section of the Flow Planner help manual.

5.6.4 Path Parameters

Path Thickness



Path Thickness

Flow Path Thickness: Allows you to specify a scale factor for the flow line path thickness. Clicking "Update" will apply this scale factor to the flow path lines for the selected aggregation.

Congestion Thickness: Allows you to specify a scale factor for the congestion flow lines. Selecting "Update" will apply this scale factor to the congestion lines.

Path Arrows

Path Arrows

Delete: Deletes all arrows in the selected aggregation.

Update: Updates any changes to the arrow size or placement. This update can also occur on the next calculation.

Path Arrows checkbox: If this box is checked, the paths will appear with arrows.

Path Ends/Path Vertices: If the Path Ends box is checked, arrows will be placed only at path ends. If the Path Vertices box is checked, arrows will also be placed at each path vertex.

Arrow Width/Arrow Length: Specifies the size of the arrow for a zero width path. As the path is scaled larger by the Path Thickness value and the Path Frequency, the arrows for those specific paths will be factored accordingly.

Path Labels

Path Labels

Delete: Deletes all labels.

Update: Any change to the label size or placement option will only occur on the next calc or when this Update button is selected.

Path Labels checkbox: Determines if paths should have labels.

Segment Dist.: Includes the distance of the individual segment with the path label.

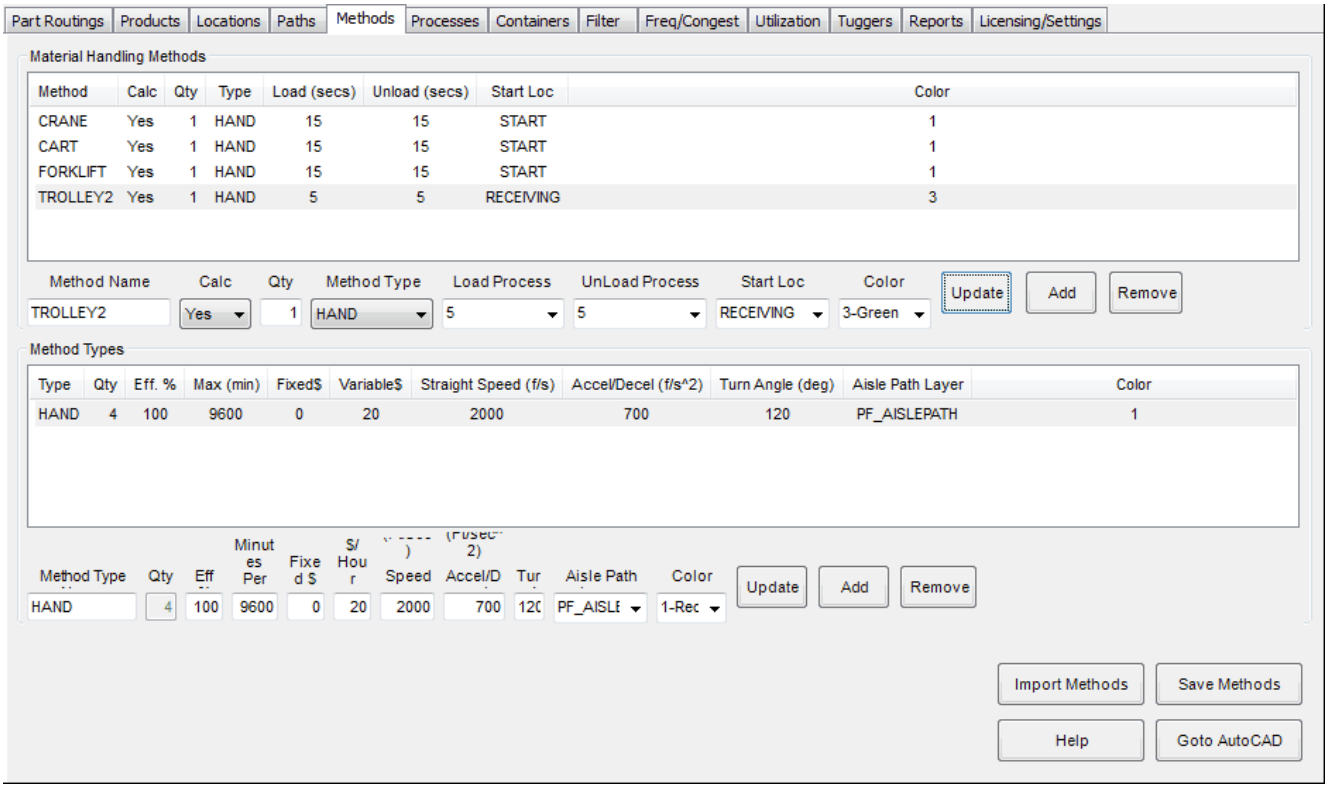
Above Line/On Line: Determines if labels are centered on the line or positioned slightly above the line (i.e. text insertion point Center or Bottom-Center) to the center of the line segment.

Label Text: Determines if the path label will be Length, Aggregate, From/To, Frequency, and Method Type.

Label Height: Specifies the height of the label.

Precision: Determines how many decimal places to show in the path distance labels.

5.7 Methods Tab



Methods Tab

Methods are used to determine the time and cost of a flow routing. The Methods Tab contains a list of Methods and a list of Method Types. A Method must fit into and reference a more general category, which is a Method Type.

Methods are device instances (specific devices) or device usage types (specific load and unload combinations), while Method Types are classes of devices with performance and cost information. In the example shown above, the CART is a method with a 15 second load and unload time that uses the performance and cost properties of the method type HAND. A flow routing would reference the method CART which would have the performance of the Method Type HAND.

The user can set the quantity of vehicles/entities that exist for a certain Method. However, Method Type quantities are automatically calculated by summing up all referenced method quantities. Note: The Method Type quantity may not be correctly updated until a calculation is done in the Part Routings Tab.

Quantities for Methods or Method Types can be fractional or whole. This allows the user to get more exact numbers for output and later round them to whole numbers representing whole carts or forklifts, as desired.

5.7.1 Methods

Material Handling Methods

Method	Calc	Qty	Type	Load (secs)	Unload (secs)	Start Loc	Color
CRANE	Yes	1	HAND	15	15	START	1
CART	Yes	1	HAND	15	15	START	1
FORKLIFT	Yes	1	HAND	15	15	START	1
TROLLEY2	Yes	1	HAND	5	5	RECEIVING	3

Method Editor

Users can multi-select rows in this editor and change a field value with one entry that will affect all rows.

Method Name: The name of the method, as referenced in the routing file. Changing this name in the Methods Tab and clicking Update will update the method anywhere it is found in the routing file.

Calc: For large studies, you may wish to turn off the calculation of certain method types when they are not the focus of a particular study.

The congestion diagram is generated for all Products and Methods that have their Calc option selected to YES. As a result, if you wish to generate a congestion analysis for a subset of Products and/or material handling methods, then you need only de-select (by setting the calc option to NO) the Products and/or methods you do not wish included in your congestion analysis.

Qty: Quantity of the Method. For example, if the facility has three forklifts available to move material, the quantity should be set to three.

Method Type: Name of the method type that this method fits in. The performance data and aisle network information from the method will be applied to this method type.

Load & Unload: Determines the time (in seconds) for the Load or Unload activity. Times can be specified directly by typing a time or indirectly by naming a process that was created in the Process Tab.

Note: Any load/unload times specified in the Part Routings Tab for a specific route will always override this value.

Start Loc: Sets the default starting location for material handling device objects in the flow animation (coming with a future release).

Color: Color for the paths drawn for the method.

5.7.2 Method Types

Method Types

Type	Qty	Eff. %	Max (min)	Fixed$	Variable$	Straight Speed (f/s)	Accel/Decel (f/s^2)	Turn Angle (deg)	Aisle Path Layer	Color
HAND	4	100	9600	0	20	2000	700	120	PF_AISLEPATH	1

Method Types

Method Type Name: The name of the method type. The method type is essentially a group containing methods. The Method Type is referenced by methods in the Method list. Changing this name in the Methods Tab and clicking Update will updated the method type anywhere it is found in the method list file.

Quantity: The total number of individual entities of this Method Type (the sum of quantities of methods with this type). Used to determine the total fixed costs for the Method Type.

Effective %: The portion of the moves by this method type that are productive. This can have a value anywhere from 1 to 100.

Typically, the routings file contains only productive moves of material. However, method types will need to deadhead (move empty to another pickup location) a certain percentage of the time.

The effective percentage is the time that the device typically travels loaded (accounted for in the routings) divided by the total travel time (including both loaded and empty deadheading).

If every move made by this Method Type is accounted for in the routing, set this value to 100. If only productive moves are accounted for in the routing but the device will return empty to reload, this value should be 50.

Maximum Minutes: The maximum number of minutes per time period that the device is available. 115200 minutes per year is the default, which is equivalent to 1 shift, full-time operation.

The time period is the same time period for which the Product Quantity is specified.

Fixed Cost $: The fixed cost per time period. Fixed costs are allocated across flow paths based on the percentage of total time of the method type attributed to each respective flow path. For example, if a Method Type is used on only two flow paths, and one flow path uses the device for a total of 200 minutes and the other path uses the device for 100 minutes, then the first path will get 2/3 of the fixed costs allocated to it, and the other path will get the remaining 1/3 of the fixed costs.

The time period is the same time period for which the Product Quantity and Maximum Minutes are specified.

Variable Cost $: The variable cost per hour for use of the method type. This value is multiplied by the time of usage for the method type.

Straight Speed: Straight moving speed for the Method Type.

Acceleration/Deceleration: Rate of acceleration and deceleration for the method type. This is used to slow down and speed up the device around corners. As a result, a 100' straight move will take less time (and thus be cheaper), than a 100' move that turns several times. Note: You must select the checkbox "Include Accel/Decel" located on the main Routings Tab for the accel/decel times to be added to the travel time.

Turn Angle: The integer value (in degrees) of an angle that constitutes a turn for this method type. This is used to determine if an internal angle between two path segment lines constitutes a turn for which the device would need to accelerate or decelerate. The default value is 100 degrees; this means that any angle less than or equal to 100 degrees would be considered a turn and the device would slow down and stop at the intersection and then accelerate on the next path.

Aisle Path Layer: Identifies the AutoCAD layer in which the Aisle Path lines used by the method type are located.

Each method type may use a different layer. In this way, different aisle networks can be specified. This is useful if Fork Truck, Tugger Trucks, AVGs, and people use different aisle networks.

Color: Color for the Method Type when 'Aggregate by Method Type' is selected.

5.7.3 Editing

Update: This button updates the data, making any changes you have specified in the text boxes. Changes to the Method will automatically be made anywhere in the Routing that Method is referenced. Changes to the Method Type will automatically be made anywhere in the Method list that the Method Type is referenced.

Remove: Methods cannot be removed if they are currently being referenced in the routing, and Method Types cannot be removed if they are currently being referenced by a Method.

Add: Creates a new Method or Method Type.

A new Method will be displayed in Method and Via Method pull-down lists on the Part Routings Tab.

A new Method Type will be displayed in the Load and Unload pull-down lists on the Methods Tab.

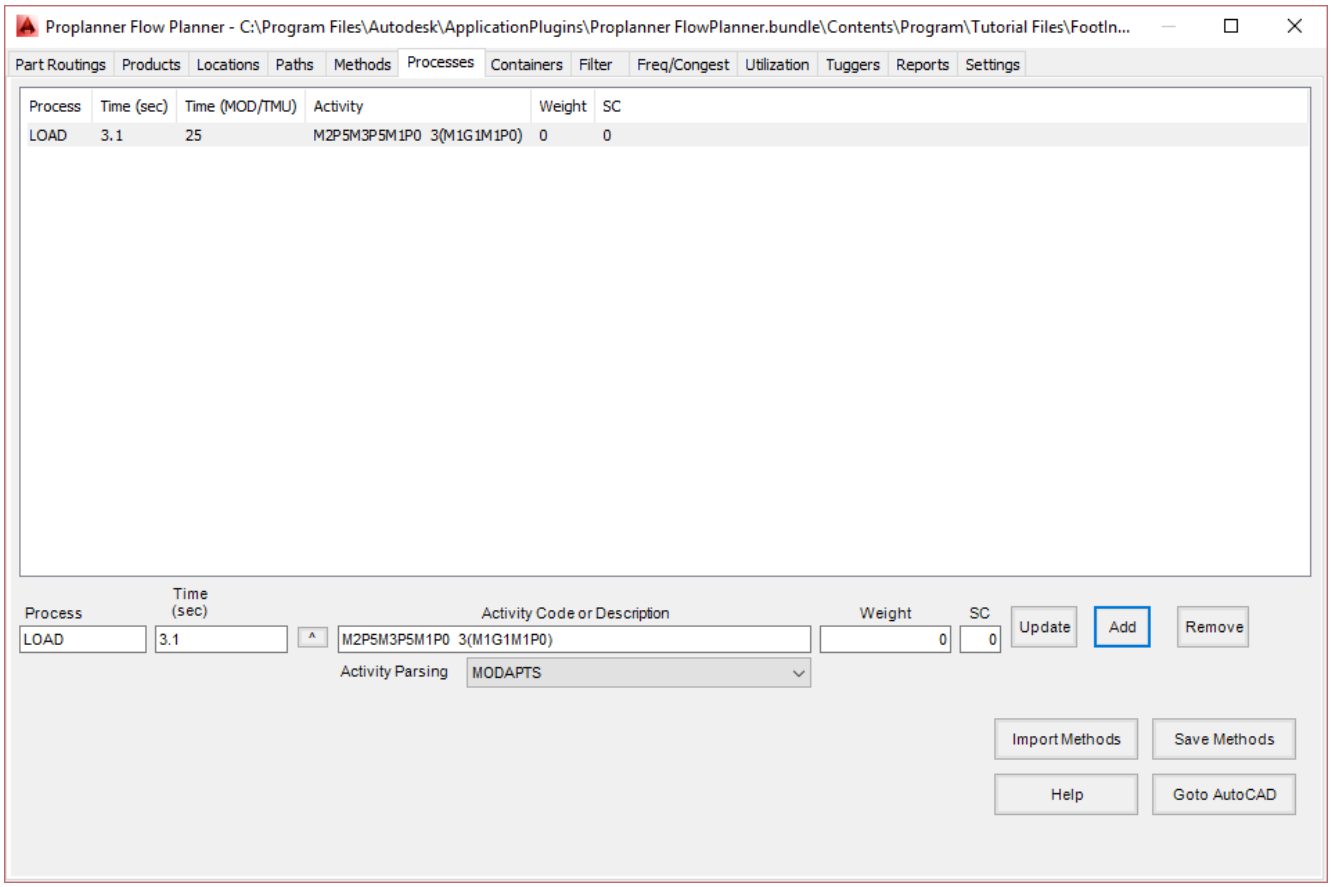
Import Methods: The methods file contains information about Containers, Methods, Method Types and Processes. Selecting the Import option will reload all three lists in their appropriate tabs.

Save Methods: The methods file contains information about Containers, Methods, Method Types and Processes. Selecting the Save option will save all three lists from their appropriate tabs

5.8 Processes Tab

To move parts around with any of the methods, the Load and Unload process is an important part of calculating the time (and thus cost) of the method. The Load/Unload time could be directly defined in the Methods Tab, but the Process Tab allows you to define a specific process that determines the time. These processes can then be called by name in the Methods Tab for use by any of the methods.

Times for Processes may be defined by using predetermined time systems (MODAPTS, MTM-B, MTM-UAS or BasicMOST) or by building a "Template."



Processes Tab

Predetermined Time Systems

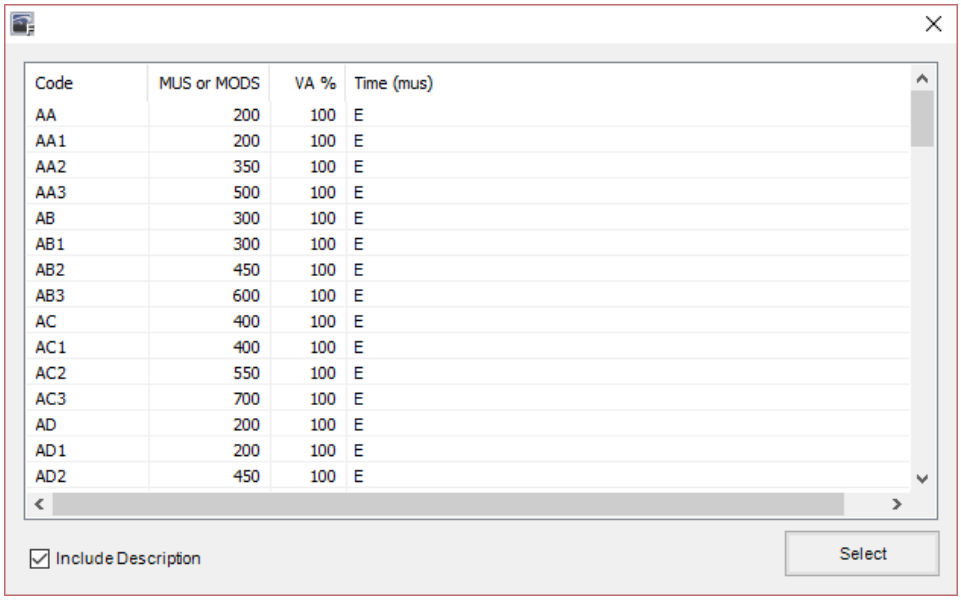
To calculate the process time with a predetermined time system, type the codes in the Activity Code field or the SC (special codes) field. Then select the appropriate predetermined system from the Activity Parsing drop down menu. When you select either the Add or Update buttons, the time codes will be parsed and the calculated time will be displayed in the Time field (next to the Process name field).

Modapts and BasicMost are parameter-based parsed. This means that each number referenced in the code is added and then the total is multiplied by a constant time value called a MOD (Modapts) or a TMU (BasicMOST). A MOD is 0.129 seconds and a TMU is 0.036 seconds.

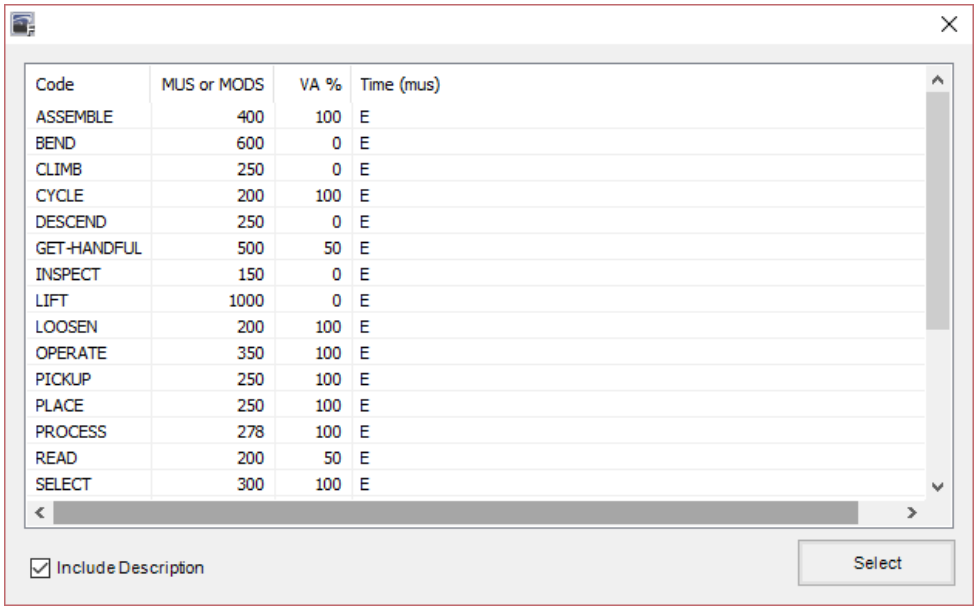
The following Modapts example includes 16 Mods to the left of the space and 3*3=9 Mods to the right of the space. You can see that Flow Planner does allow for implicit multiplication when parameter-based codes are included in Parens.

M2P5M3P5M1P0 3(M1G1M1P0)

MTM-UAS (below) MTM-B (below)



MTM-UAS Time Standard



MTM-B Time Standard

MTM-UAS and MTM-B are keyword parsed. There is a CSV formatted table in the Flow Planner program directory for each of these standards. These tables are used by Flow Planner as a Lookup table for the TMU value associated with each code. These lookup tables can be viewed

by selecting the carat button (Shift-6 up arrow) to the left of the Activity Code text box. These files use MUs (divide by 10 to get TMU) for time.

You can specify a multiplier on a code by following that code with an integer number.

For example in MTM-B, the following ASSEMBLE code is 40 TMU's but when followed by the number 3 will parse to 120 TMU's

ASSEMBLE 3

Building a Template

The Activity Parsing "Template" allows users to set process times specific to container groups and TO/FROM location groups. These times may vary from route to route, so in building the template, you build the basic structure of the calculation, and then Flow Planner evaluates it for each route.

Note: The Time field should have a value of -1; this indicates to Flow Planner that the time needs to be recalculated for each individual route.

The template is built by using three different types of codes; base time, container condition, and location of container. Each type of code has slightly different parameters that allow you to specify conditional times. Any one of the codes can be used to define a process time, but you may also use multiple codes for an additive effect.

Base Time Code:

BT(base time/variable time)

The base time code has two parameters: the base time and a variable time that applies to each container. Specifying a variable time means that the process time increases if more containers are present. Below are some examples of how the BT code would be used:

BT(6/9) – Base time of 6 seconds plus a time of 9 seconds per container.

If six containers are present, total time is 60 seconds.

If two containers are present, total time is 24 seconds.

BT(6/0) – Base time of 6 seconds with no additional time per container.

If six containers are present, total time is 6 seconds.

If two containers are present, total time is 6 seconds.

BT(0/5) – Base time of 0 seconds plus a time of 5 seconds per container.

If six containers are present, total time is 30 seconds.

If two containers are present, total time is 10 seconds.

Container Condition Codes:

CF(base time/variable time/include or exclude/container name)

CE(base time/variable time/include or exclude/container name)

CX(base time/variable time/include or exclude/container name)

The container condition codes allow you to build conditional times based on whether or not the container is full. CF applies to containers that are full, CE applies to containers that are empty, and CX applies to both containers that are full or containers that are empty.

The base time and variable time specifications work in the same way as they do with the Base Time code.

The include or exclude parameter is applied as followed: "I" means inclusive for the container (or container group) and "E" means exclusive of the container (or group). For the container TUB, the I would indicate the parameter applies to any TUB container. The E would mean the parameter applies to all containers (or container groups) *except* the TUB.

Following are examples of how the Container Condition Codes would be used:

CF(6/9/I/TUB) – Base time of 6 seconds plus a time of 9 seconds per container, inclusive of TUBS.

If six full TUB containers are present, total time is 60 seconds.

If two full TUB containers are present, total time is 24 seconds.

If six empty TUB containers are present, this time does not apply. (If you want to include empty containers, use CE or CX.)

If six empty or full CRATE containers are present, this time does not apply. (If the "I" was an "E" instead, this time would apply to the CRATE containers; it would apply to all containers *except* TUB.)

Container Location Codes:

LF(base time/variable time/include or exclude/location name)

LE(base time/variable time/include or exclude/location name)

LX(base time/variable time/include or exclude/location name)

The Container Location Codes allow you to build conditional times based on which location the full or empty container is located. The base time and variable time are the same as in the other two types of codes. The main difference between Container Condition Codes and Container Location Codes is that a location name is specified in the Container Location Codes instead of a container name. The Include/Exclude refers to the location as well; if the code is inclusive (I), it applies only if the route is at the location. If the code is exclusive (E), it applies to all routes that do not involve that location.

Even the container condition is a parameter in the Container Location Codes; LF is a location for a full container, LE is a location for an empty container, and LX is a location for either full or empty containers.

Here are some examples of how a Container Location Code would be used:

LF(6/9/I/ASSEMBLY) – Base time of 6 seconds plus a time of 9 seconds per container, which applies only if the location ASSEMBLY is on the route.

If six full containers are present at ASSEMBLY, total time is 60 seconds.

If two full containers are present at ASSEMBLY, total time is 24 seconds.

If six empty containers are present at ASSEMBLY, this time does not apply. (If you want to include empty containers, use LE or LX.)

If six full containers are present at WELDING, this time does not apply. (If the "I" was an "E" instead, this time would apply to the full containers at WELDING; it would apply to all full containers at locations *other than* ASSEMBLY).

Additive Combinations:

The different types of codes can be combined to create a more complex process time calculation. All of the code types are optional; you don't need to use BT if you do not want to.

An additive= example:

BT(4/0) CF(3/0/I/TUB) CE(1/1/I/TUB) LE(-2/0/E/DOCK)

This means that there is

a base time of 4 seconds per stop

plus

a time of 3 seconds *if* the container is a full TUB

OR

a time of 1 second plus 1 second per each container *if* the container is an empty TUB

minus (because the time is -2)

a time of 2 seconds for all locations *except* the DOCK *if* the container is empty.

In other words, if I am moving 3 full TUB containers from the DOCK, the time is 4+3=7 seconds.

If I am moving 3 empty TUB containers from the DOCK, the time is 4+(1+(1*3))=8 seconds.

If I am moving 3 empty TUB containers from ASSEMBLY, the time is 4+(1+(1*3))-2=6 seconds

Process Tab Buttons

Update: Changes to the process name will automatically be made in the routings that reference the process.

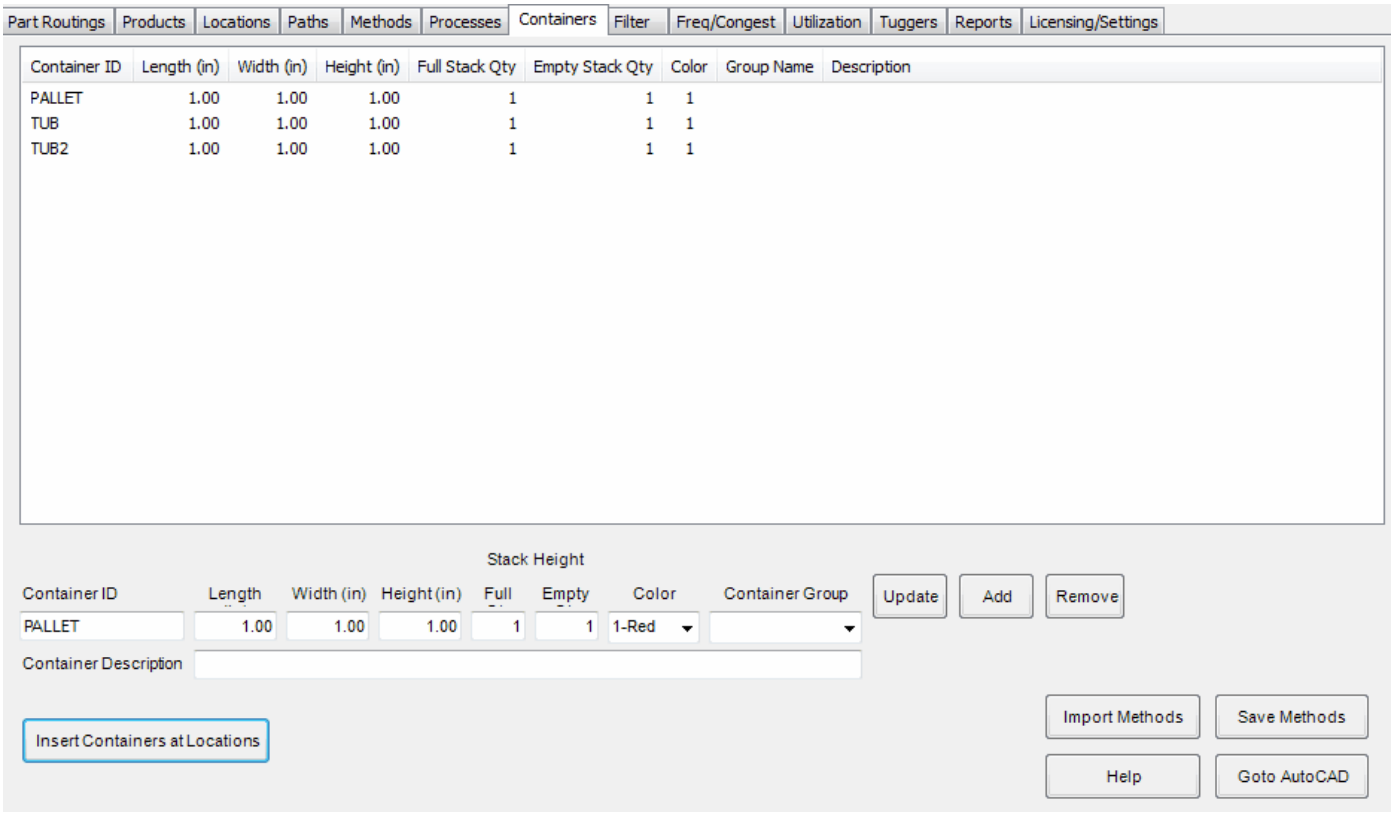
Remove: Removes the process. Processes cannot be removed if they are currently being referenced in the routing.

Add: Adding a process will create it, and it will be displayed in the Load and Unload pull-down lists in the Methods Tab.

Import Methods: The methods file contains information about Containers, Methods, Method Types, and Processes. Selecting "Import" will reload all three lists in their appropriate tabs.

Save Methods: Selecting "Save" will save Container, Method, Method Type and Process information to the methods file.

5.9 Containers Tab



Containers Tab

The Containers Tab has information about the containers (pallets, crates, tubs, etc.) used to hold parts as the parts are moved throughout the facility. Any containers specified in the routing will be displayed in the list in the Container Tab. In this tab, information about the container's physical properties (length, width, height) can be added or edited.

The physical properties of the container are used in normal studies to factor congestion frequency where the container width is greater than or equal to some specified percentage of the aisle width. Furthermore, in Tugger studies, the container's length, width, and height are used to estimate the number of containers per trip for mixed pallet routes.

The Full Stack Quantity field specifies how many containers that a person can carry at one time when walking along the Aisle Join Line. This value is only referenced if the user is performing an Aisle-Path calculation, and they have chosen to Ignore Aisle Joins on the Routings tab, and they have selected a Walk Speed greater than zero on the Settings tab.

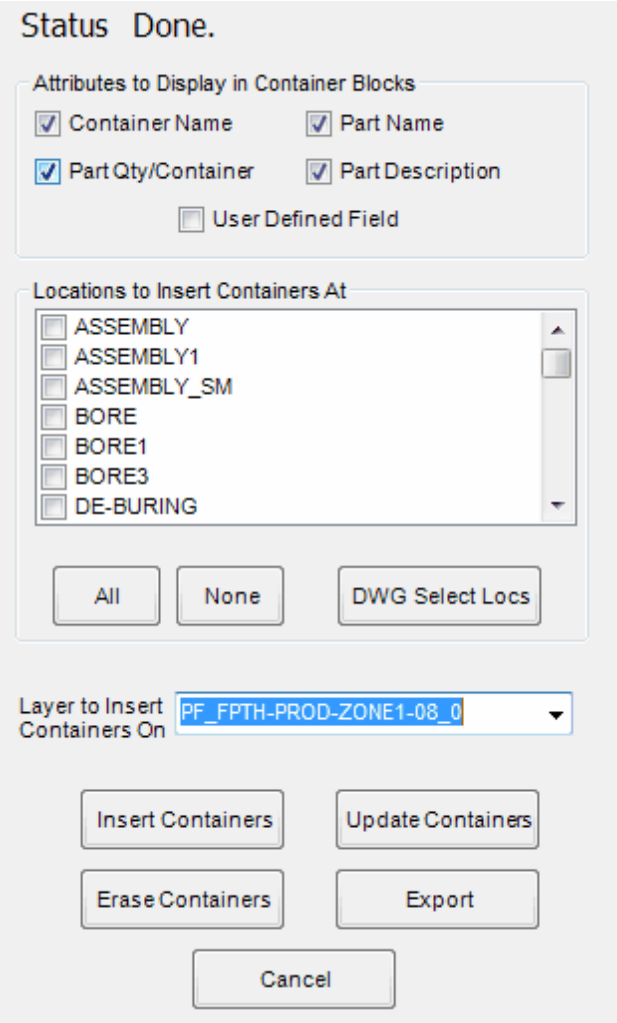
Container Tab Commands

Update: Any changes made to the selected container will be applied when you click "Update". The changes will be applied anywhere the selected container is referenced in the routing.

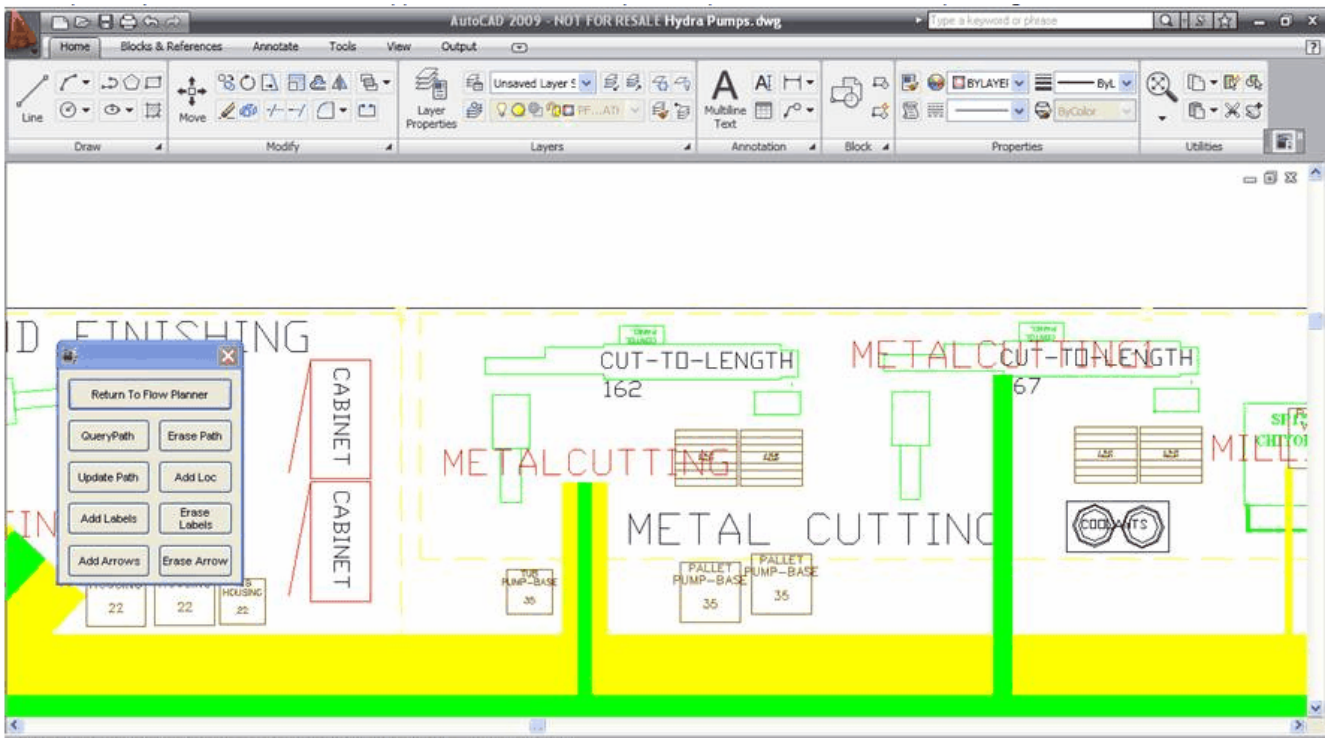
Remove: Deletes the selected container if it is unused in the routing. Containers cannot be removed if they are currently being referenced in the routing.

Add: Adds a new container. The new container will be displayed in the Part Routings Tab pull-down list, and can then be used in the routing.

Insert Containers at Locations: This allows you to add container blocks in the drawing that show where the parts are delivered. The following dialog will appear:



Container Location Dialog



Delivered Parts Drawing

Container Insertion Window Commands

Insert Containers: The automatic container insertion feature will automatically create and insert container blocks at Activity locations. The current routing file will be read and all of the containers delivered at a TO location matching the locations in the dialog box will be found. The number of containers delivered at a matching TO location each trip is counted, and the appropriate number of container blocks are inserted. The blocks are inserted at the point the activity location text label is inserted.

If a container block is defined (by the name of the container) in the drawing, the block will be inserted. If the block is not defined, the container block will be created using the sizes specified for the container (in the Container Tab).

Attributes to Display in Container Blocks: Choose data to be displayed.

Layer to Insert Containers On: In the dialogue box above, you can see that there is a drop-down menu that allows you to select which layer the containers are inserted on. It is recommended that the containers are inserted on a unique layer, so that they are easy to identify and/or remove if necessary.

Locations to Insert Containers At: Select the locations where container blocks should be displayed.

Clear Selections: Clear the selected locations in the list box.

DWG Select Locs: Select the locations in the drawing by specifying an area instead of a location name.

Update Containers: The update containers option is used to make changes to a set of activity locations that already have containers inserted. Flow Planner will insert containers at any of these locations missing containers.

Containers may be missing from a location because they were moved from their insertion point; each container block has an attribute that states which activity location it is assigned to.

Note: The Update command will not redefine a container block if you change the size later. If you need to change the size of a container and want to use the same name, you must delete all insertions. You can then re-insert the newly defined containers.

Erase Containers: Erases the container blocks for the selected locations.

Insert Containers: Inserts container blocks for the selected locations.

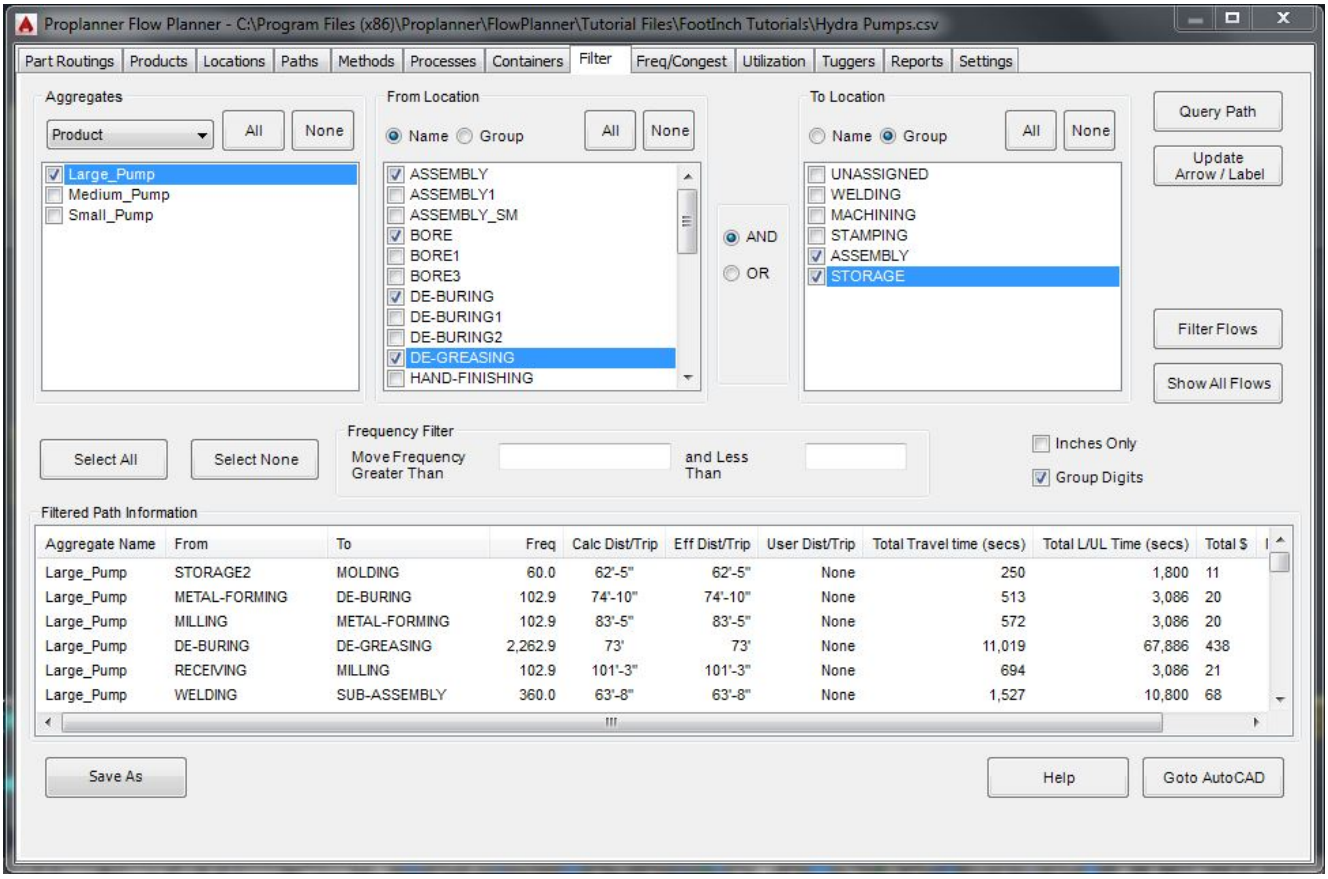
Cancel: Exit and return to the main Flow Planner window.

Import Methods: The methods file contains information about Containers, Methods, Method Types and Processes. Selecting the Import option will reload all three lists in their appropriate tabs.

Save Methods: The methods file contains information about Containers, Methods, Method Types and Processes. Selecting the Save option will save all three lists from their appropriate tabs.

Container Group: Container groups are sets of containers that have something in common. Using container groups allows you to set container-specific load/unload times for them in the Process Tab.

5.10 Filter Tab



Filter Tab

The Filter Tab lets you select to show or hide different portions of a given aggregation. You can filter specific flow lines by any of the aggregate types, from and/or to locations, and flow frequencies.

Aggregates

The Aggregates section of the Filter Tab features a pull-down that allows you to select which aggregate method you would like to filter. The check box list lets you select specific items to view from that aggregate type. In the example above, you can see Product is the aggregate type, and that only the Large Pump product flows are selected.

The names included in the list are generated from the flow lines in the drawing. This means if new flow routes or different aggregates have been added since your last calculation, you will not see them in the Filter Tab. If you want to see new routes, go to the Part Routings Tab and recalculate.

Locations

In addition to filtering by aggregate type, Flow Planner is able to show or hide specific locations. The Locations area in the Filter Tab has a section dealing with the 'From Loc' and another dealing with the 'To Loc'.

From Loc: Only flows originating from the selected locations will be shown. You may select either locations or location groups. Choose the 'Name' radio button to select locations and the 'Group' radio button to select location groups.

To Loc: Only flows going to the selected locations will be shown. You may select either locations or location groups. Choose the 'Name' radio button to select locations and the 'Group' radio button to select location groups.

And/Or: This allows you to specify the required relationship between the From and To Locs. If the AND option is selected, then only the flows that are going from selected locations to selected locations will be shown. If the OR option is selected, then flows from the selected locations (even if they are not going to the selected locations) or to the selected locations (even if they are not coming from the selected locations) will be shown. OR will show more flow lines; AND is the more restrictive option.

In the example above, only flows going from the 4 selected FROM locations AND going to locations in the selected TO Group will be shown for the Large Pump.

Frequency Filter

The Frequency Filter allows you to further filter the view based on the frequency of flows. In the example shown above, only the flows with trip frequencies greater than 250 will be shown.

Filtered Path Information (Results)

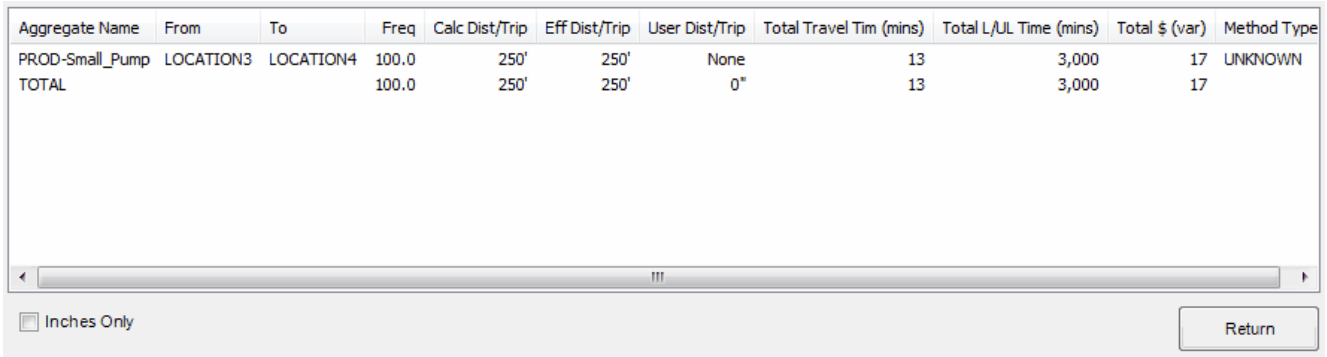
The Filtered Path Information displays the path information for the filtered results. This can be copied and pasted into an external application, like Microsoft Excel.

Filter Tab Commands (Buttons)

Filter Flows: Executes the filter function, displaying only the selected flows.

Show All Flows: Shows all flows for the selected aggregation, ignoring the filter selection.

Query Path: Hides Flow Planner's main window and allows you to select one or more flow paths to query.



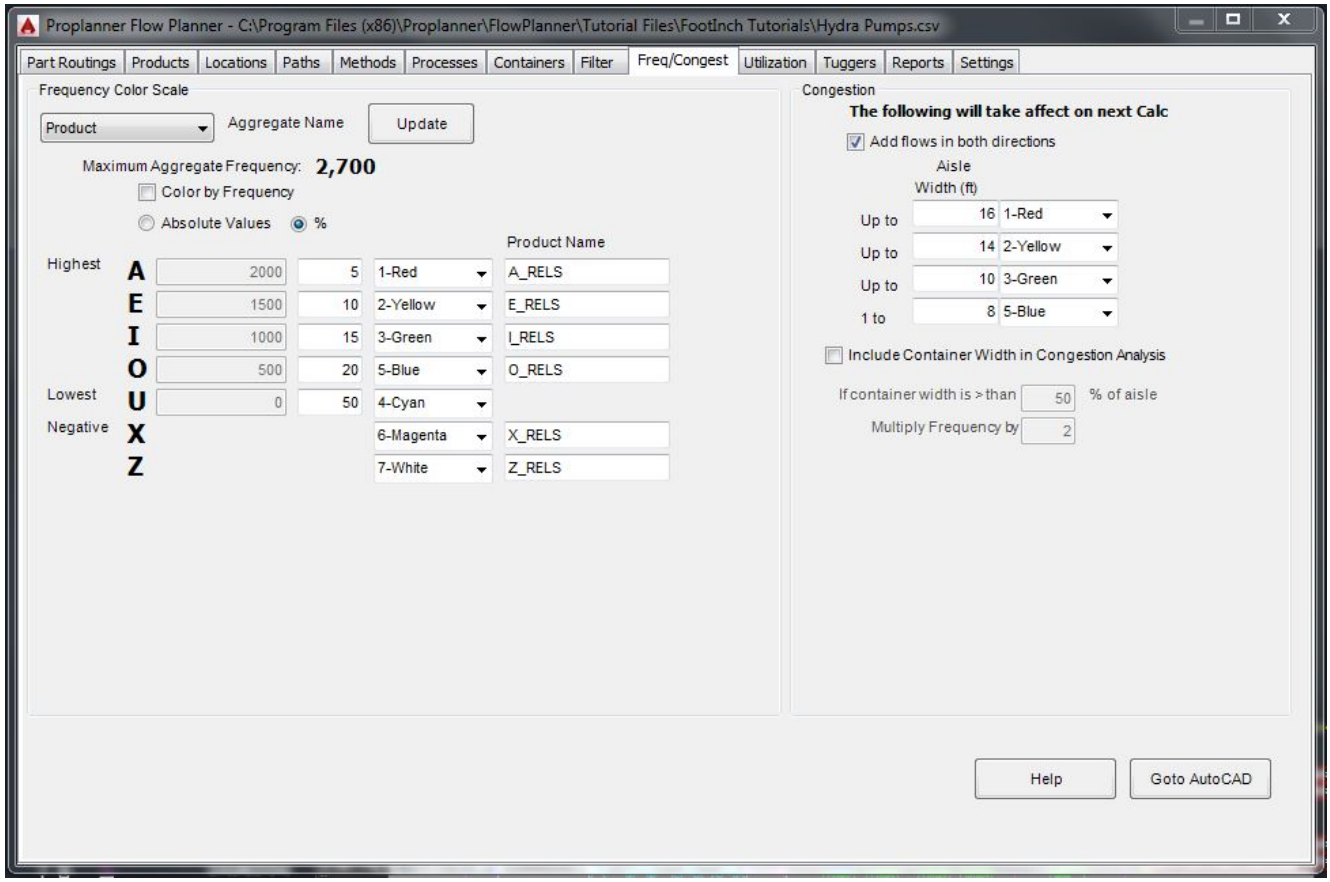
Query Flow Path

Update Arrows/Labels: Regenerates the Arrows and Labels such that only the filtered paths displayed will have arrows.

Inches Only: Converts measurements from feet and inches (e.g. 5'6") to inches (e.g. 66") to avoid possible conversion problems. This makes it easier to paste the distance into a spreadsheet and then perform additional calculations.

Goto AutoCAD: Hides Flow Planner's main window and displays the Modeless window, which contains some editing commands. You can also execute any AutoCAD command in the menus or command line.

5.11 Frequency/Congestion Tab



Frequency/Congestion Tab

The Frequency/Congestion Tab has three main purposes: to provide the ability to color-code flow lines by frequency, to allow parameters for congestion analyses to be set or changed, and to provide the ability to set up relationship planning studies.

The Frequency portion of the tab is used to set values and colors for color coding the aggregate flow paths or congestion paths by frequency. The default setting color codes flow paths by their aggregate name, according to settings in the Product/Part, Container, Method and Locations/Groups Tabs, but those defaults are overridden by settings in the Frequency/Congestion Tab.

The Congestion portion of the tab is used to set the aisle width parameters for the congestion analysis. Additionally, it contains the setting that determines whether or not the container width is considered in the congestion analysis.

Frequency Color Scale

Aggregate Name: Select the aggregate flow paths for which to change the color coding.

Maximum Aggregate Frequency: Shows the highest-frequency path found in the selected aggregation.

Color by Frequency: If selected, the flow lines for the selected aggregation will be color coded by the following frequency parameters when 'Update' is pressed.

If not selected, the flow lines will return to their aggregation name colors when 'Update' is pressed.

% (Values): This allows you to color code based on a percentage of the total congestion frequency.

In the example above, the percent value is 5, and the color is red. This means that the highest 5% of flows will be colored red. Flow Planner looks at each segment of the congestion flow; the segment with the highest flow is set to 100%.

Absolute Values: Instead of using a percentage, the frequency values can be specified in absolute terms. To do this, enter a value. Any segment with flow greater than or equal to that number will be assigned the corresponding color.

In the example above, you can see that there are absolute values in the grayed out boxes. If the Absolute Value radio button were selected, these boxes would be activated. Anything with 2000 trips or more would be colored red. Anything with 1500 trips up to 1999 trips would be yellow.

Product Names: The product names column is provided specifically for creating relationship charts and doing relationship studies. In the product names column, you can associate the Product names you will include in the routing file to relationship values.

A, E, I, O and U are the positive relationships, with A being the most positive and U being the lowest positive relationship. The X and Z relationships are negative relationships; they will be assigned negative distance values.

All product names assigned to relationships will be scanned for location routings when a relationship chart is generated. Please reference the Relationship Tutorial for more information.

Congestion

The Congestion controls allow the user to set parameters for the congestion analysis regarding the aisle width and the container width.

Note: Any changes made here do not take effect until the next Calculate is performed.

Add Flows in Both Directions: If selected, there will only be one line between each pair of aisle nodes in the drawing. The thickness of the line will represent the total flow frequency along that segment in both directions.

If not selected, there will be two lines created between any two aisle nodes (one on top of the other). The width of each line will represent the flow frequency in one direction.

Aisle Width: Allows you to specify which colors represent the specified aisle widths. This is used to color the aisle lines when they are created in the drawing.

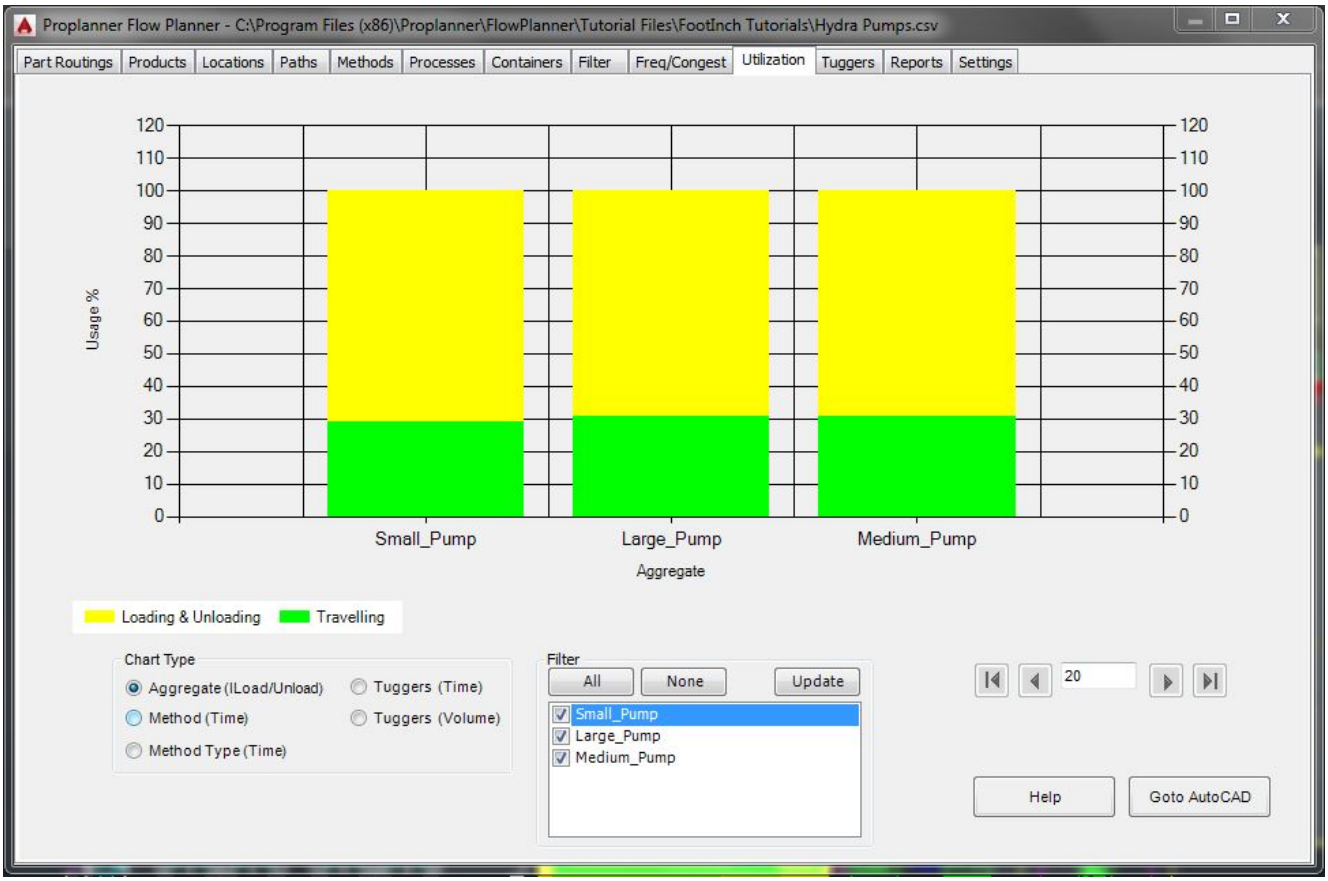
As mentioned in the Path Tab section, the color of the aisle lines determines their thickness.

If the color of an aisle path line is "BYLAYER" then it is given the "Undefined" Aisle thickness. It will be ignored for container-width congestion analysis.

Include Container Width in Congestion Analysis:

If selected, Flow Planner will evaluate the container width for each route. If the container width is greater than or equal to the user-specified Container-to-Aisle width percentage, the flow frequency of the route is multiplied by the user-provided factor.

5.12 Utilization Tab



Utilization Tab

The Utilization Tab contains charts that visually depict usage of the material handling equipment. The basic information included is how much time is spent traveling compared to Loading and Unloading; there are a variety of ways to break this information down. There are additional utilization charts specifically for the Tugger module; the Tugger charts show how often the equipment is busy, idle, or over-utilized.

These charts or their values can be copied and pasted into an external application, like Microsoft Excel.

Chart Type Options

Aggregate (Load/Unload): (Shown above) Shows percentage of time spent Traveling versus Loading/Unloading for the most recent aggregate type. You can see that the aggregate used was Product, since information is broken down by pump type.

Method (Time): Shows percentage of time spent Traveling, Loading/Unloading, Idle, and Over Utilized broken down by each Method.

Method Type (Time): Shows percentage of time spent Traveling, Loading/Unloading, Idle, and Over Utilized for each Method Type.

If in your current editing session, you had generated routes from the tugger module, the application will allow you to view the Tugger Time and Tugger Utilization charts.

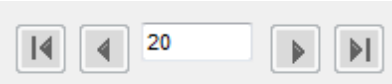
Tuggers (Time): Shows percentage of time the tugger is Full, Empty, and Over Utilized.

Tuggers (Volume): Shows percentage of available tugger volume that is Full, Empty, and Over Utilized. Available volume for each delivery route is specified on the Tuggers Tab. Volume is shown as the Largest volume demand on the tugger for that route. For example, if you picked up 2 parts, then dropped off one part and picked up 2 more parts and then dropped off 1 part at one location and 2 parts at another location, the Volume for that route would be recorded as 3, which is the maximum number of part containers sitting on the tugger during its route.

Filter

This section displays all of the bars available to display in the chart and allows you to filter what is shown in the chart. The filter is populated based on which Chart Type is selected.

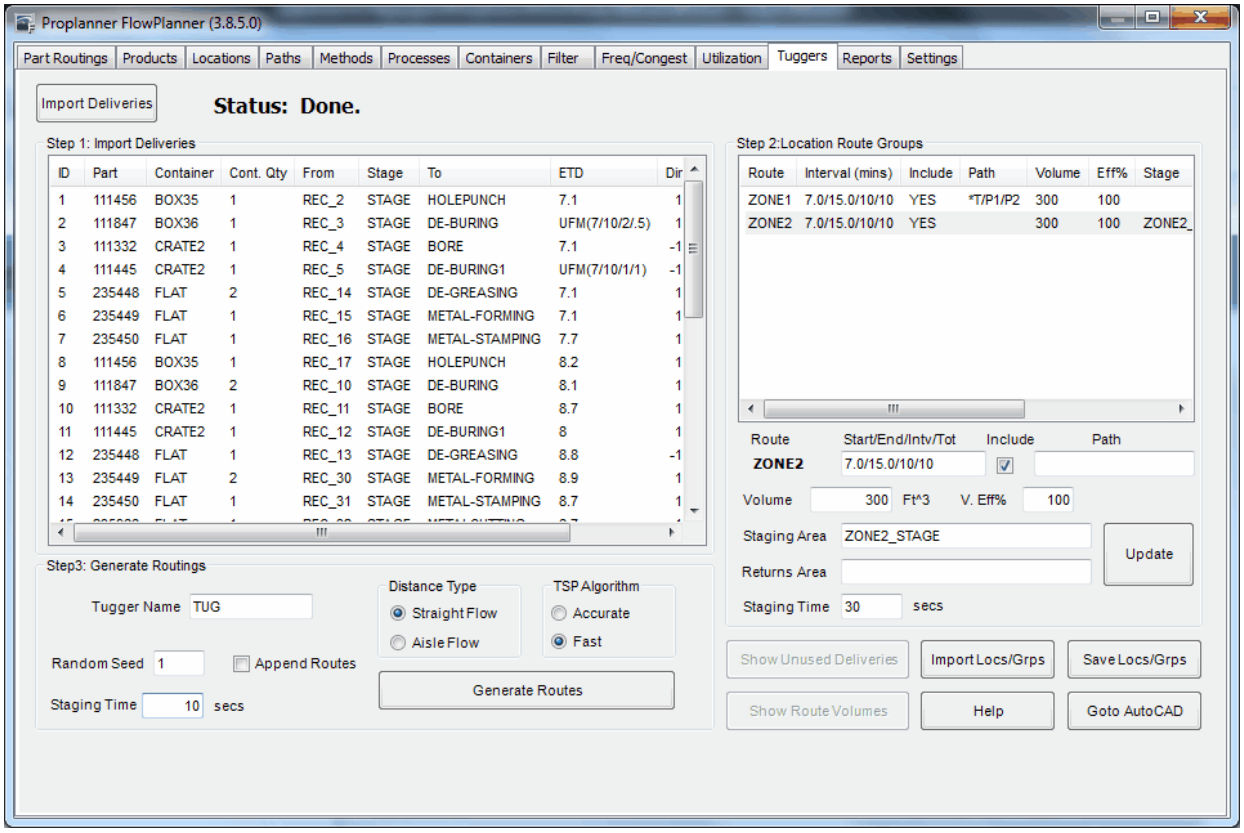
Number of Columns Displayed Per Page



Number of Columns

In some cases, there may be more information to report than there is room on the screen. You can adjust the total number of columns displayed by changing the number in the text box. Scroll from page to page with the arrows.

5.13 Tuggers Tab



Tuggers Tab

Note: This tab is functional only with purchase of the Tugger Add-on.

The Tuggers Tab creates tugger routings. It generates the path for a tugger, which is a material handling device used to pick up and deliver multiple parts from and to multiple locations. Unlike a "fork truck study", in which the user defines the part routings, Flow Planner calculates a shortest-path routing for a "tuggers study" based on the necessary deliveries specified, the estimated times of delivery, and the aisles in the layout (if aisle-flow selected).

Generating the routings requires three steps: import deliveries, verify location route groups, and generate the routings. These three steps are covered in depth in the next three subsections. Once the Routings have been generated by the Tugger module, you can continue with a Calculation of those Routings as you would in a traditional unit-flow based study **WITH ONE EXCEPTION**. Calculations of Tugger routings **MUST ALWAYS BE CALCULATED BY PRODUCT**. You cannot calculate a Routing generated by the Tugger module by Part, Method, Container or any of the other aggregate types since the Products in a tugger study are actually contiguous Routes of Methods. Selecting a different aggregate type than that of Product will generate erroneous results.

There is often considerable confusion regarding the Tugger tab "Aisle Flow" radio button versus Calculation "Aisle Flow" radio button.

Good Practice

Keep in mind that finding the best routes will be an iterative process. The recommended approach requires several passes:

- For each area of the plant that you wish to have a common driver, generate routes using one route driver that visits all locations (one driver per area). When these routes are generated, Flow Planner will display a minimum trip frequency for the drivers you specified. This is the minimum number of trips required to satisfy the container volume requirements of that route.
- Set the route frequency about 20% higher than the given trip frequency. The extra 20% is used as an initial buffer to handle variances in delivery volume requirements and stacking efficiencies.
- If the time needed to complete a route is *less* than the time between route trips, use the driver to serve multiple routes. You can do this as long as the sum of the routes is slightly less than the minimum time between route trips.

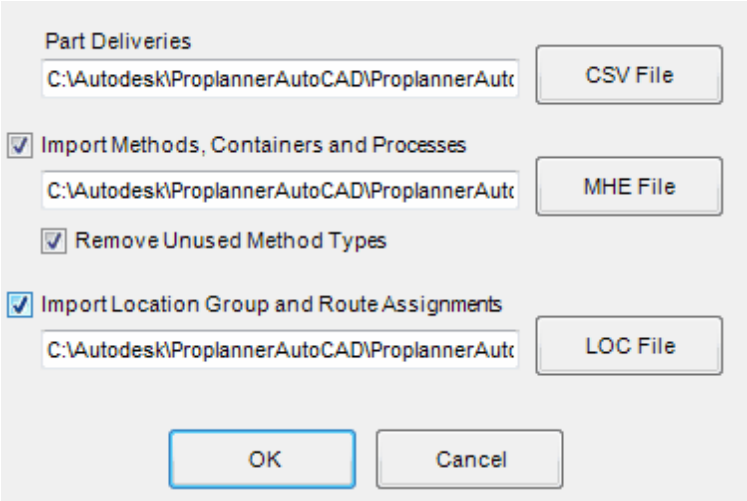
  If the time needed to complete a route is *more* than the given trip frequency, and it takes more time to complete the route than there is between route trips, add multiple drivers to that route. They should be added in parallel, staggered by dispatch time.
- Generate your initial tugger routes using the Straight Flow option. Once you have verified that the routes look correct, you can go back later and generate the tugger routes using the aisle flow approach. Remember that you cannot use the Join Locations to Aisles command unless there is first a routing that references those locations. Generating a straight flow tugger study will enable you to create that initial routing.
- While you can directly specify a tugger route driver to a delivery, the power of Flow Planner's tugger module is that the route driver for a part delivery can instead be derived from the location you are delivering to. This approach greatly simplifies the task of mapping parts to route drivers, and it also makes the process of reassigning parts to different route drivers as simple as selecting a set of location points in AutoCAD and mapping them to a new tugger route driver.
- Using the ability to color code location text labels based on the Route driver that uses them (Locations Tab) is a great way to quickly see which locations are currently mapped to what route drivers. As such, all route drivers should be assigned to a unique color which is used for both the location text labels and flow lines.

For more details, reference the Systematic Design of Tugger Delivery Routes by Dave Sly. It is posted on the Proplanner website.

5.13.1 Step 1: Import Deliveries

The delivery file contains information about the parts that need to be delivered and the locations to which they must be delivered.

When you click the Import Deliveries button, the window below will pop up. This is where you specify the delivery file name, as well as the file names for the methods and locations.



Import Deliveries Pop Up

Information in the Delivery File

The fields that should be included in the delivery file are described below. This is information that needs to be provided so Flow Planner can complete the study. Each row in the delivery file represents one delivery.

There is a sample delivery file in the Help folder for this software.

ID: The ID is a unique identifier for the delivery of this part to these locations. It is important that the values in this field are not duplicated anywhere else in the file.

Part: The name of the part being moved in this delivery. This will populate the Products Tab automatically.

Container: The name of the container being used to transport this part. The name here will be matched with the size information outlined in the Containers Tab, which means container sizes can be used to determine loaded container volume on the tugger's carts.

Container Qty: The number of containers to be delivered between these locations for *each delivery event.* That is, the container quantity specified applies only to the row in the delivery file in which it is entered.

There is a special condition if you are using a Uniform or Triangular distribution method. Please refer to the information about the ETD field for more information.

From: The location from which the part is picked up to be taken to the staging area. This may be a dedicated pickup location; it may also serve as a drop-off location.

The 'FROM' location is typically specified for pickups; however, containers could also be dropped off at these locations (i.e. drop off an empty container and pick up a full one).

Use the Direction field to specify if a container is being picked up (dir = 1), or dropped off (dir = -1) at this 'FROM' location.

Stage: The location from which the carts (trailers) are staged to be delivered to the final destination.

Note: Load and unload time is added (combined) at the staging area via the staging time input box at the bottom of this window.

To: The final destination of the parts. It may be a dedicated delivery location or an in-plant drop-off location.

The 'TO' location is typically specified for deliveries; however, containers could also be picked up at these locations (i.e. drop off a full container and pick up an empty one).

Use the Direction field in this file to specify if a container is being picked up (dir = -1), or dropped off (dir = 1) at this 'TO' location.

ETD (Estimated Time of Delivery): This sets the time parameters for when the deliveries need to be made. The ETD establishes boundaries for the earliest and latest the delivery can be made, and may have some information about a delivery distribution.

Time is entered as either a fixed decimal time, a fixed-interval decimal time, or a randomly determined decimal time from a Uniform or Triangular Distribution.

Decimal Time

Using decimal hours specifies an exact time at which the delivery should be made. Decimal time is entered as a number between zero and twenty-three. It represents the hour plus a decimal portion of that hour.

A value of **7.5** represents a delivery made at 7:30AM. A value of **20** represents a delivery made at 8:00PM.

Sequenced or Fixed Interval

Using a sequenced or fixed interval allows more flexibility than the regular decimal time. The user can set an upper and lower bound for when the delivery should be made and specify the interval between deliveries.

The first delivery will be made at a randomly determined time from the start time to a time computed as the start time plus the interval time. Deliveries will continue up to and including the end time, provided the end time fits with the fixed interval.

SEQ(7/15/0.5/1): SEQ represents a sequenced set of fixed-interval deliveries. This distribution will generate a delivery on a fixed time interval between 7:00AM and 3:00PM.

SEQ(**7/15**/0.5/1): 7/15 means the deliveries will be made between 7:00PM and 3:00PM. 3:00PM is 15 on a 0 to 23 hour scale.

SEQ(7/15/**0.5**/1): 0.5 represents the time interval between deliveries in decimal hours. Since each delivery carries the Container Qty, this number indicates that a delivery is made every 30 minutes (i.e. 0.5 hours) between 7:00AM and 3:00PM, inclusive. By default, the program will assume that the first sequenced delivery COULD start at the beginning time (i.e. 7am for this example), however the program randomizes this start time such that a delivery will occur anytime from the Beginning time to a time of Beginning+Interval (i.e. 7am plus 30 minutes). You can suppress this randomized start time by making your interval time negative (i.e. -0.5) in this case. Doing so will ENSURE that the delivery will occur at the beginning time.

SEQ(7/15/0.5/**1**): 1 means there is a 100% probability of being delivered with each delivery interval between 7:00AM and 3:00PM.

Uniform Distribution

Using a uniform distribution allows the user to set an upper and lower bound for when the delivery should be made. The actual delivery times will fall somewhere between the bounds in a bell-curve shaped uniform distribution. Most deliveries will take place around the median time.

UFM(7/15/3/0.5): UFM represents a uniform distribution of deliveries. This distribution will randomly generate a delivery time (between 7:00AM and 3:00PM, as we see next).

UFM(**7/15**/3/0.5): 7/15 means the deliveries will be made between 7:00AM and 3:00PM. 3:00 pm is 15 on a 0 to 23 hour scale.

UFM(7/15/**3**/0.5): 3 means three deliveries will be made. Each delivery carries the Container Qty; this number acts as a multiplier for the number of containers being delivered.

UFM(7/15/3/**0.5**): 0.5 means there is a 50% probability of being delivered between 7:00AM and 3:00PM. Otherwise, this delivery will not result in a container delivery being scheduled in the routings file.

Another example: If you have a container with a daily requirements of 2.3, then you could use UFM(7/15/2.3/1). This means that 2 containers will be delivered 100% of the time, and the remaining 0.3 containers will also be delivered 100% of the time. What this looks like is 2 containers are delivered every trip, and a third container is delivered every three trips (about 30% of the time).

Triangular Distribution

Using a triangular distribution is similar to using a uniform distribution; however, the triangular distribution has one more parameter. The third time parameter allows you to specify the mean (average) time at which most of the deliveries occur.

TRG(7/15/10/2/0.33):TRG represents a triangular distribution of deliveries. As we will see, this distribution will randomly generate a delivery time between 7:00AM and 3:00PM with a statistical preference for times around 10:00AM.

TRG(**7/15**/10/2/0.33): 7/15 means that the deliveries will be made between 7:00AM and 3:00PM. 3:00PM is 15 on a 0 to 23 hour scale.

TRG(7/15/**10**/2/0.33): 10 is the mean time at which the deliveries occur. The distribution has a statistical preference for deliveries that occur at 10:00AM.

TRG(7/15/10/**2**/0.33): 2 means that two deliveries are made. Each delivery carries the Container Qty; this number acts as a multiplier for the number of containers being delivered.

TRG(7/15/10/2/**0.33**) The containers have a 33% probability of being delivered between 7:00AM and 3:00PM. The other 67% of the time, this delivery will not result in a container delivery being generated in the routings file.

Another example: If you have a container with a daily requirements of 2.3, then you could use TRG(7/15/10/2.3/1). This means that 2 containers will be delivered 100% of the time, and the remaining 0.3 containers will also be delivered 100% of the time. Most of these deliveries happen around 10:00 am. What this looks like is 2 containers are delivered every trip, and a third container is delivered every three trips (about 30% of the time).

Dir (Direction): The value here tells Flow Planner in which direction the delivery is going. The container may be loaded at the 'FROM' location and unloaded at the 'TO' (Dir = 1) location, or it may be unloaded at the 'FROM' location and loaded at the 'TO' (Dir = -1) location. This allows the user to account for returning empty containers.

The example below shows how the activities at differ at the same locations when the direction value is different.

1: STAGE → FROM (load) → STAGE → TO (unload) → STAGE

-1: STAGE → FROM (unload) → STAGE → TO (load) → STAGE

Load (*optional*): This tells Flow Planner how long it takes to load the container for this part. It may be an actual time or a code whereby time can be calculated. Typically the Load time is determined from the value assigned to the Method (Tugger Route Named Method) in the Methods tab. Any value specified in the Delivery file will override the time specified for the Method.

For carts or containers temporarily stored in the staging area, you should leave the load and unload times blank. The codes for processes are specified in the Process Tab.

Unload (*optional*): This tells Flow planner how long it takes to unload the container for this part. It may be an actual time or a code whereby time can be calculated. Typically the Load time is determined from the value assigned to the Method (Tugger Route Named Method) in the Methods tab. Any value specified in the Delivery file will override the time specified for the Method.

For carts or containers temporarily stored in the staging area, you should leave the load and unload times blank. The codes for processes are specified in the Process Tab.

Route (*optional*): This assigns a specific Tugger Route to that delivery. Typically a Tugger Route is assigned to the Location being visited, but specifying a Tugger Route name in this field will override the assignment of the tugger driver based upon the location visited.

Strategies for Creating the Deliveries File

There are four different data formats that can be used to define deliveries in the Tugger Deliveries File. The delivery file can contain any combination of these formats. For each item you specify, there could be a delivery scheduled for each delivery time interval on every route.

1) Define FROM, STAGE, and TO locations. The Tugger module infers the time required for the tugger to return from the route delivery (the RETURN time interval). It is assumed that the RETURN time is the sum of the time required to go from STAGING to all of the FROM locations, back to STAGING, to all of the TO locations, and back to STAGING.

   For this type of data, the Tugger Route Generator basically assumes the material handler who loads the carts is the same person who makes all deliveries in the factory. As such, the same Tugger Route is used for both the FROM and TO locations. If those locations are assigned to different Tugger Routes, then the Route assigned to the TO location will be selected (unless of course that Delivery Record (row) has a ROUTE assigned to it which will overrride the Tugger Route mapped to the FROM and TO locations).

2) Define FROM and STAGE locations, but leave the TO field blank.

For this type of data, the Tugger Route Generator assumes the material handler is taking carts to all of the FROM locations, loading the cart, and returning it to the STAGE location. The implication is that another material handler is working in parallel to unload the containers at the TO locations.

3) Define STAGE and TO locations, but leave the FROM field blank.

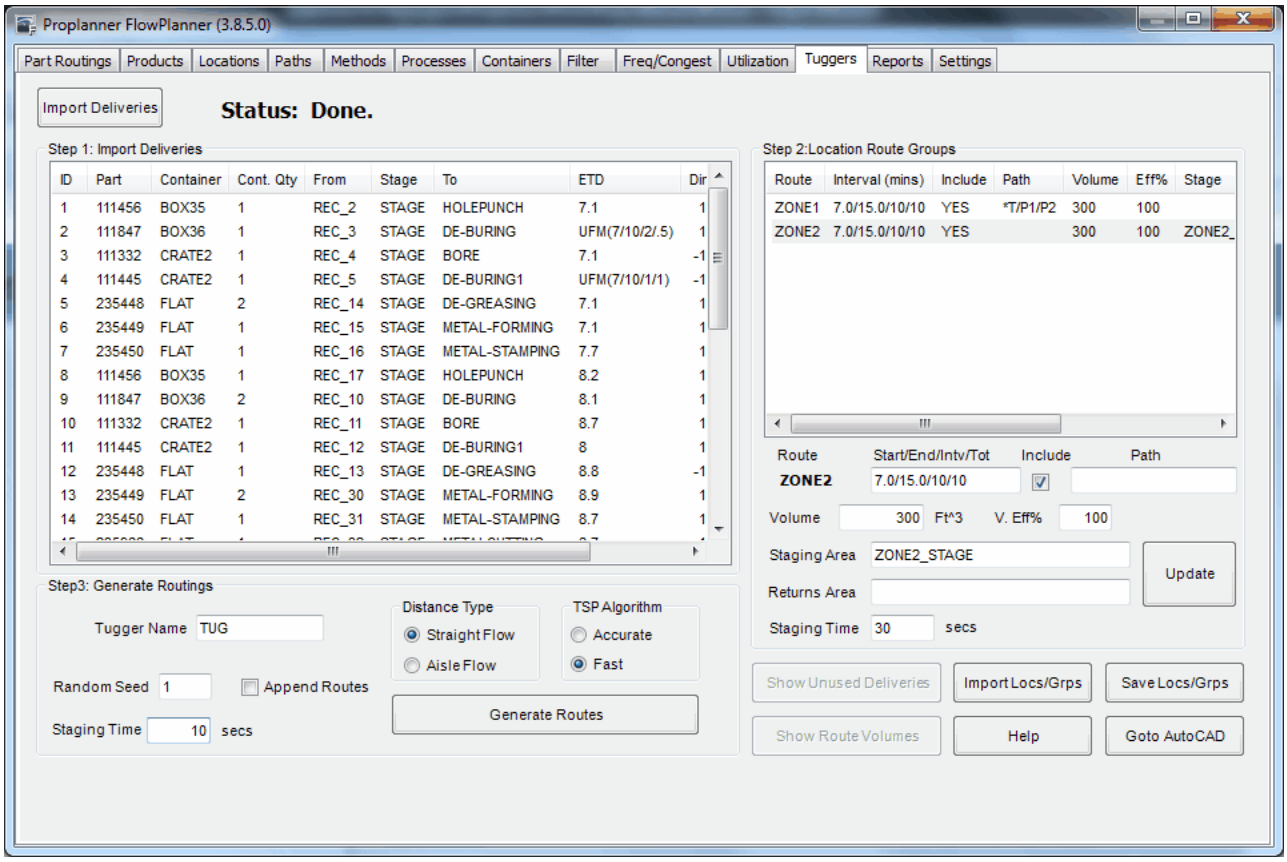
   For this type of data, the Tugger Route Generator assumes the material handler is picking up a (loaded) cart from STAGE and delivering at the TO locations. The implication is that another material handler is working in parallel to load the containers at the FROM locations.

4) Define FROM and TO locations, but leave the STAGE field blank.

   For this type of data, the Tugger Route Generator will assume there is no staging area. The containers are picked up at the FROM locations and delivered directly to the TO locations. The routes will be generated in a sequence that minimizes the total distance for all pickups and deliveries.

5.13.2 Step 2: Create Location Route Groups

The location route groups provide information about how tuggers will travel. It includes times the routes are operative, volume available in the tugger cart, and other information about the locations the cart is required to visit.



Location Route Groups

Import Locs/Grps: Imports a location file with includes route information needed for a tugger study.

Save Locs/Grps: Saves the location file with any route information that has been added.

Route: Name of the route. In the screenshot above, it is ZONE2. In other cases, it may be something like Tugger1, Route3, etc.

Interval field (Start/End/Intv/To): The interval field defines daily start and end times in decimal hours. It also defines the time interval a driver can be out making deliveries in decimal minutes. This is the time allowed between the times the driver leaves and returns to the staging area.

Important note: The interval is in hours for start times and end times, but it is in minutes for departure and return intervals.

For example:

7/15/30/60:7/15 means that the deliveries will be made between 7:00AM and 3:00PM. 3:00 pm is 15 on a 0 to 23 hour scale.

7/15/**30/60**: 30 means that the deliveries are made in thirty minute intervals. The 60 means that the route driver has sixty minutes to complete deliveries and return to staging.

The fact that a driver is dispatched every 30 minutes and has 60 minutes to complete their work implies that there are two people delivering on this route, working in parallel.

The return time must always be greater than or equal to the interval time. The departure time interval should be a multiple of the return time interval.

Include: This tells Flow Planner whether or not to include the route in the study. Turning off routes is one way to speed calculations if reports and diagrams for a subset of the route drivers are desired.

Path (Tugger Path): You can force a driver to take a specific route by defining either a set of passthru points or a specific method name. If no specific route is required, leave this field blank and Flow Planner will determine the best route.

Reminder: Flow Planner uses the aisle network layer assigned to the method called TUG. Aisles not on this layer will not be used to create routes.

Using a Specific Method Name

Two cases make it desirable to use a specific method name. First, if the drawing is large and has many aisles, using a specific method name is helpful. Second, if there is a very specific set of aisles the route driver can take, using a specific method name is helpful.

To do this, you should define a specific METHOD for that route driver (in the Tugger Path Field). Then assign a specific aisle layer to that METHOD (in the Methods Tab); your aisle layer should include only those aisles allowed for the specific route driver.

This technique will greatly speed your aisle calculations for both route generation and flow path creation, since the algorithm will have a smaller set of aisles to evaluate.

Using Passthru Points

Passthru points are effective for creating specific routes on studies with smaller aisle networks. If the driver is able to take any aisle in the path network, but you want to force the driver through a specific aisle intersection, passthru points apply. You can force the driver thorough a specific intersection or set of intersections, even though the shortest path would not require traveling through that intersection.

To specify passthru points, enter the appropriate names in the "Path" cell in the Tugger Tab. Multiple passthru points are separated by forward slashes. They must be listed in the same sequence that you wish the route driver to visit those locations.

Take special care to ensure that pass-thru points are located directly on an aisle path or are "Snapped" to an aisle path intersection.

A Passthru point sequence of P1/P2/P3 specifies that this route's deliveries have to pass through points P1, P2 and P3, in that order. If the points do not exist in the drawing, you will be prompted to place them when you try to generate routes.

The passthru locations must be uniquely named; they must be different than FROM, TO or STAGE locations. It is recommended that these names be very short. A Passthru point can appear multiple times in the path field (i.e. P1/P2/P3/P1/P4).

Passthru points apply to routes in both directions; they apply when traveling the FROM to STAGE route and when traveling the STAGE to TO route.

Most studies involve a round-trip circuit that follows a path like this: STAGE → FROM → STAGE → TO → STAGE. If you want the Passthru point to only apply to the FROM → STAGE portion or to the TO → STAGE portion, you must prefix the Passthru point sequence with *F or *T to restrict it to the FROM portion or TO portion, respectively. For example, *T/P1/P2/P3 would apply only from STAGE to TO portion of the delivery.

Volume: This represents the volume capacity of the tugger carts (trailers) for the route. It is specified in cubic meters or cubic feet.

Based on other information that has been provided, Flow Planner will compute the quantity of containers required for storage on the carts for deliveries on each route. The quantity of containers required will then be multiplied by the volume of each of the containers being delivered, and then the total requested delivery volume will be computed. The actual available volume is compared to the requested container volume; you can see this comparison in either the Utilization Tab or the Reports Tab.

If you set tugger cart capacity by the *quantity* of containers as opposed to *volume* of containers, specify the size of each container as 12x12x12 inches (or 1000x1000x1000 millimeters, depending on your base drawing units), so that each container is exactly one cubic foot (or meter).

Eff% (Efficiency Percentage): This represents the packing efficiency of the tugger carts (trailers) that operate along a given route. For example, a tugger with a total volume capacity of 10 cubic meters and a packing efficiency of 80% would have an actual volume capacity of 8 cubic meters. The packing efficiency for each tugger cart should be specified with consideration of the general size and shape of the containers that will be put on the cart.

Staging Area: Entries in this field allows you to override the staging area specified in the delivery file. This may occur when the staging area should be mapped to the zone driver and not the delivered part.

Please note: You should still specify a staging location in the delivery file, even though you intend to override it with a zone driver staging area. It could be a default name (i.e. stage) that does not represent a real location. If you do not specify a staging location in the delivery file, Flow Planner will assume the part goes directly from the FROM location to the TO location without a staging area in between.

Returns Area: Making an entry in this field will cause the tugger to drop off empty containers at an additional location before returning to staging. (Normally, the tugger returns to the staging area after making deliveries at the TO locations.)

If you specify the location in the Returns Area field, Flow Planner will insert the Returns Area as the location visited immediately before returning to the staging area.

Staging Time: You can specify a unique time to stage for this Route driver (regardless of staging area). This value (if it exists) overrides the global staging time value specified in the lower left of the tugger screen. If this value is blank (i.e. no text characters) then the global value will be used.

Update: Clicking 'Update' will apply any changes to the properties of the route.

5.13.3 Step 3: Generate Routings

When the delivery information and route information is entered, it is time to generate the routings. There are a few more specifications that must be made before hitting the "Generate Routes" button.

Tugger Name: Name of the Method Type that will represent the tugger routes. The name of the Route will be represented in the Method name. Each tugger Route will have its own unique method.

Distance Type

> **Straight Flow:** This creates routings where the shortest path between locations is determined based on Euclidean (straight point-to-point) flows.
>
> **Aisle Flow:** This creates routings where the shortest path between locations is determined considering the available aisles. NOTE: For a new study, you will first need to generate Routes using Straight Flows. This is required because the "Join Paths" command will require a routing file for the creation of appropriate aisle connections. Once the Routes are created, simply run "Join Paths" to complete the aisle network and you can then go back and regenerate the routing file using the Aisle-Flow method.

TSP Algorithm (Traveling Salesperson Algorithm)

> **Accurate:** The 'accurate' traveling salesman algorithm uses an exhaustive branch-and-bound technique that delivers the shortest overall route, visiting every delivery location only once. The exhaustive algorithm requires time, so selecting this type will cause a longer calculation time.
>
> **Fast:** The 'fast' traveling salesman algorithm uses a shortcut technique that delivers a very short (but not always the shortest) overall route, visiting every delivery location only once. The calculation time with this type is much shorter.

Random Seed: The random seed is a value that is the starting point from which random samples are created. These random samples are used to create the Uniform or Triangular distributions, as well as the randomized start times for Sequenced deliveries. Changing this seed and then regenerating results will allow you to see a range of different statistically possible delivery scenarios for each day. This will be helpful for the user to understand just how much variability is likely in the overall delivery times and volumes for routes.

Append Routes: If Append Routes is selected, any existing flow path routings will not be overwritten. Tugger routings will be added after the existing routings in the Part Routings Tab instead of overwriting them.

Generate Routes: This creates the tugger routes in the Part Routings Tab. A routing is created for each tugger route for each departure time in which there are containers to deliver. Note that each delivery route time slot is created as a new product whereby the delivery time is shown in Hours and Minutes. If a delivery time period is not created, it means no products were desired to be delivered at that time interval.

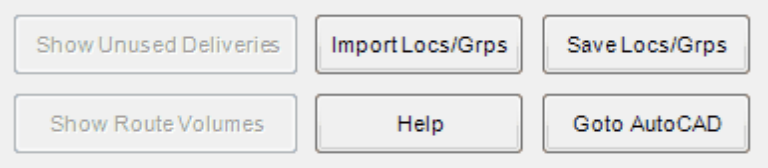
Staging Time: The staging time defines the delay time (in seconds) for any tugger at the staging location. Note: This time is added once per cycle (trip out and back) and not for both the trip out and the trip back. You can also assign a staging time to a particular route driver. If a route driver has a staging time, that time will override this global staging Time value (they are not added).

Unused Deliveries: The unused deliveries will be displayed when you select the "Show Unused Deliveries" button in the Tugger Tab (see example below).

If one or more delivery lines (from the deliveries file) does not generate at least one corresponding routing line, the original delivery lines will be shown in the unused deliveries list. The delivery lines may not generate routing lines if:

1) The delivery's ETD is not within the corresponding route driver service interval (it falls outside of the start and end time).
2) The FROM and/or TO location (if specified) is not assigned to a route.
3) If the delivery time was specified with a random probability of occurrence and it did not get selected by the random number generator.

As with all list boxes in Flow Planner, you may copy and paste this list into MS Excel.



Unused Deliveries Box

Volume Requirements

When the tugger routes are generated, you can review the volume requirements list by clicking the "Show Route Volumes" button in the Tuggers Tab.

Flow Planner will display a list of each tugger route, along with the total volume of all containers that need to be delivered for that day and the volume of containers that can be delivered per trip. It will then compute the minimum number of trips per hour required to satisfy those volume requirements. The minimum trips per hour is determined from the number of hours available for the route driver (end time minus start time).

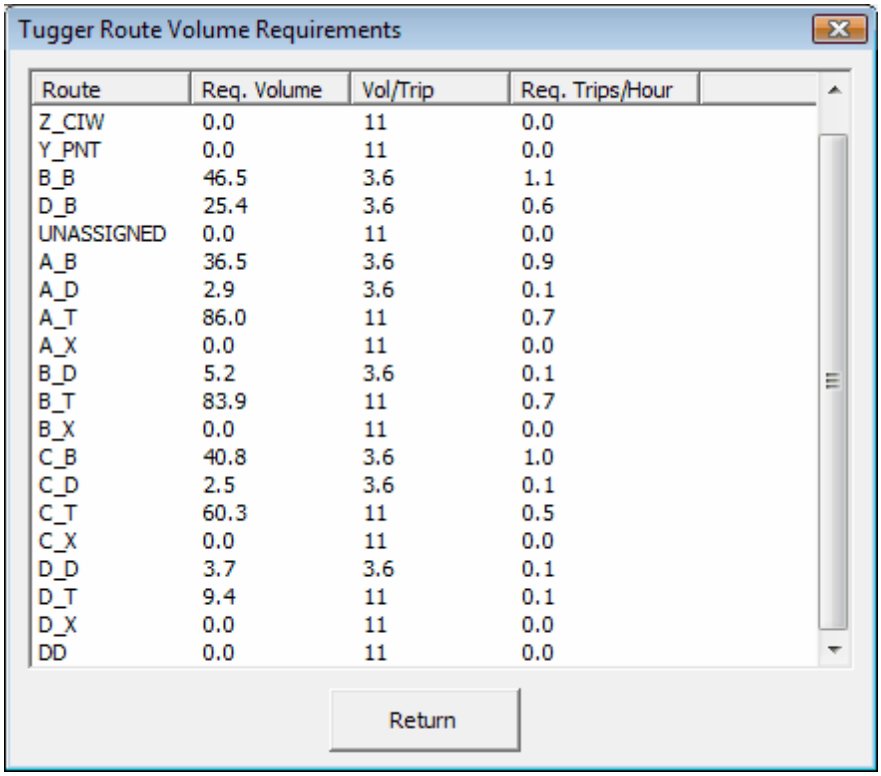
For example:

1. The route driver operates from 7:00AM to 11:00AM.
2. The driver must deliver 100 cubic meters of part containers.

3. The tugger volume is 7.5 cubic meters and the volume efficiency is 67%.

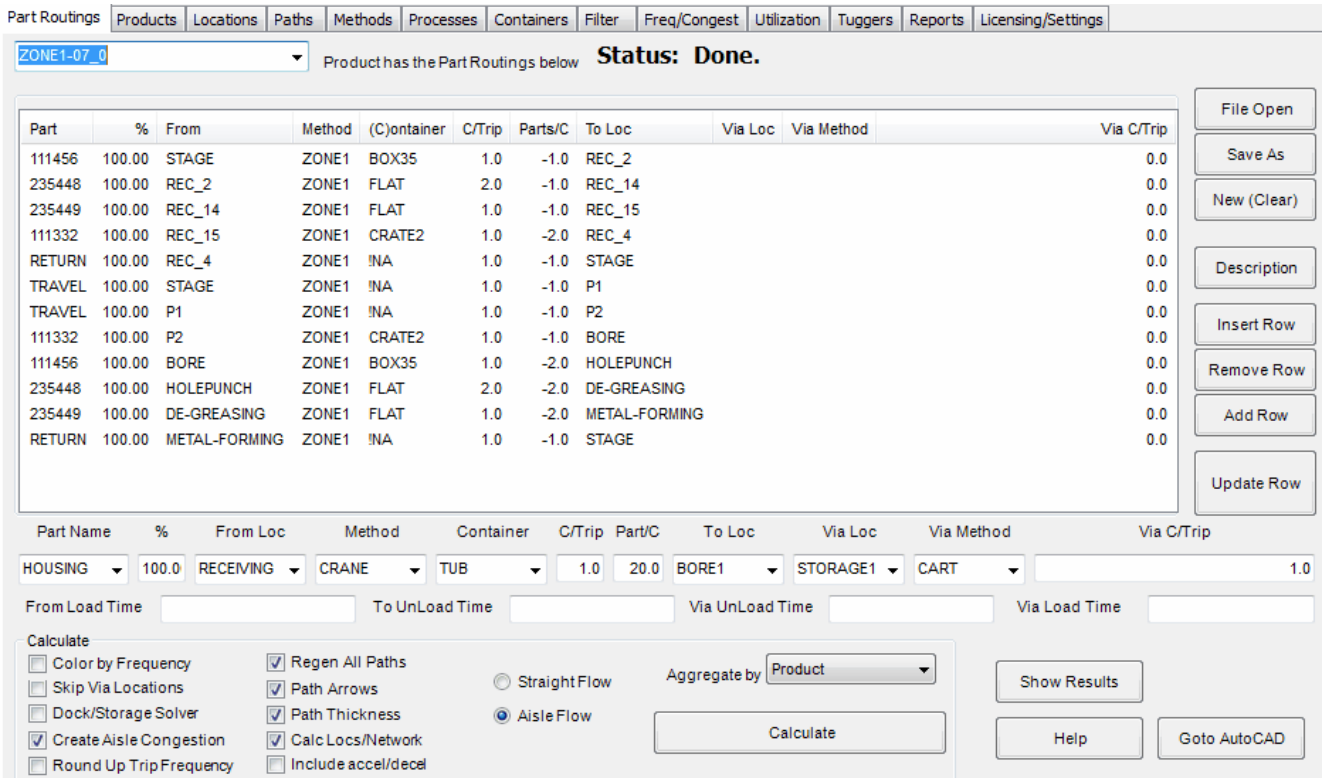
This means that the tugger can move 5 cubic meters of containers per trip (7.5 cubic meters times 67%). Therefore, 20 trips are needed to deliver all of the containers (100 cubic meters divided by 5 cubic meters per trip).

The route driver operates for 4 hours (11 minus 7), so there need to be 5 trips per hour (20 trips divided by 4 hours). This means that a route driver needs to leave every 12 minutes at the most; leaving every 10 minutes would handle minor fluctuations in desired delivery capacity.



Volume Requirements

Tugger Created Routing Notes



Generated Routings In Tuggers Tab

The routings generated by the Tuggers tab for the Part Routings Tab look very different than the standard setup for Flow Planner. We will use the simple example above to discuss the differences.

- The Product name is the Route name followed by the Time (in hours and minutes), which are separated by a pipe symbol "|". Note: You specify time in the tugger module with Decimal Hours, but the delivery window times in the Routings tab are Hours and Minutes. For example, if for the Route ZONE1 you specified a SEQ delivery every 0.5 hours with a start time of 7am, then the Routing window would show Products named ZONE1|07.00 and ZONE1|07.30.
- This route makes eight deliveries of one part to eight different locations (A-H). The part name Return represents a return trip to the staging area where no load or unload time is calculated; this explains the “!NA” container name. The "!NA" container name tells the program to calculate the distance and walk time and ignore the load/unload time.
- The Tugger Module creates products that represent the tugger route name and start time (Route1-7 means these are the routings for Route 1 at 7:00 AM).
- The routings themselves are broken down into their individual segments. They show every load or unload at each location for the appropriate number of containers.
- Because the material handling device starts at STAGING and goes to the FROM location first, the volume is calculated for the first routing from staging to receiving because it is loading eight containers at receiving.
- The value of parts per container is set to -1 if a load is performed at the TO location. It is set to -2 when an unload is performed at the TO location. This is only a signal for the program, not a value actually used for calculation.

- Sometimes multiple different parts are picked up at or delivered to the same location. If their containers are different, then two routing lines To and From the same location will be shown (since they could have different Load or Unload times as defined by a Process which references the container type). If those parts have the same container, then only one of the part names will be shown for the Routing Line. You can look at the Description field to see the list of all parts delivered on that Routing line.

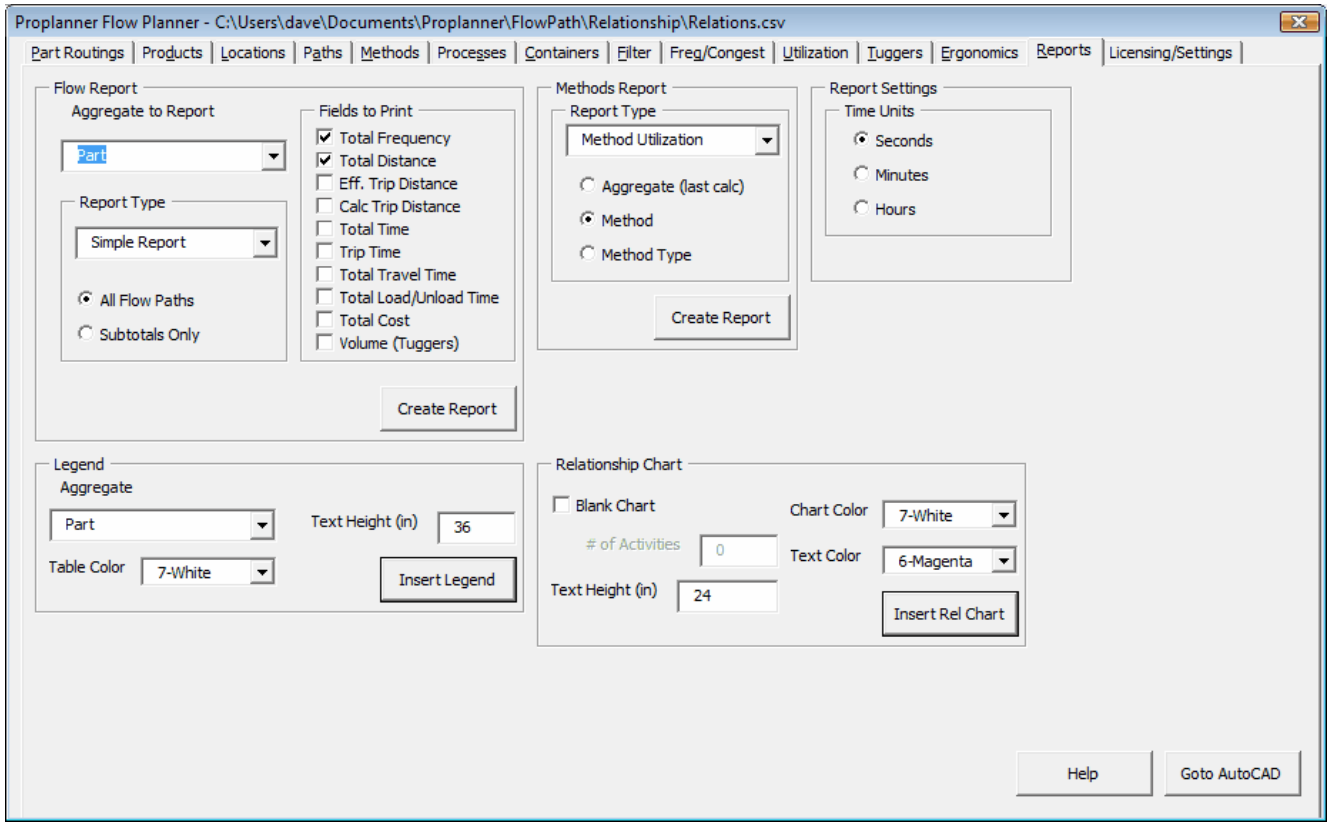
Given this information, the example above shows the empty material handling device starting at STAGING. It then goes to RECEIVING, where it loads eight containers, and then returns to STAGING.

The next step takes the tugger to the delivery locations, visiting A through H in the shortest path sequence. This ensures that deliveries are made at the times designated in the Tuggers Tab.

Finally, the material handling device returns to STAGING. There is no load/unload time included because the device is assumed to be empty at this time.

The deliveries in this example were made in this order due to having sequential ETDs on the Tuggers tab. Had these been set up using Uniform or Triangular Distributions with a random seed, there is no guarantee the routes would have been scheduled at this time of day or in this order.

5.14 Reports Tab

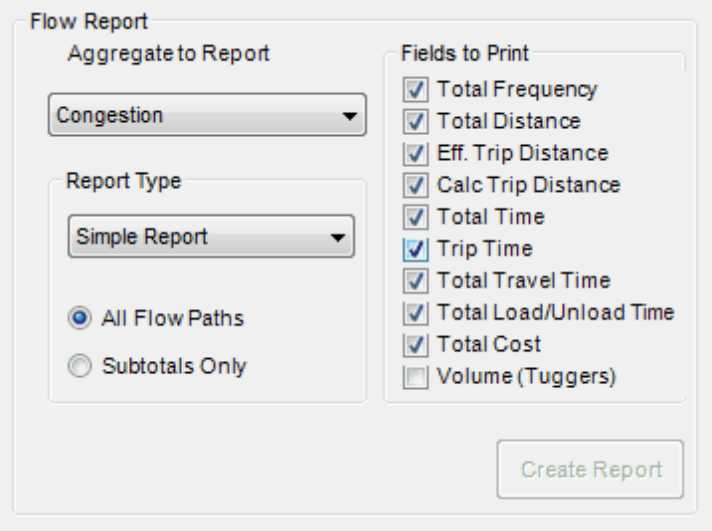


Reports Tab

The Reports Tab is an interface for creating an XML-based spreadsheet output preformatted with the Path output information desired by the user. This setup allows for easy printing, viewing, and sending to other programs such as Excel for further evaluation.

Once the report is generated, you can hit Ctrl+A to select all. Then copy and paste the information into Excel for a preformatted, editable Excel file. Right clicking on the data will give the option to export to Excel as a non-formatted but editable Excel table.

5.14.1 Flow Report



Flow Report

Aggregate to Report: Selects the aggregate type from a pull-down list. Path information will be displayed for the selected aggregate type.

Report Type: Choose the report type from a pull-down list. Here you can also designate whether All Flow Paths or only their Subtotals are displayed.

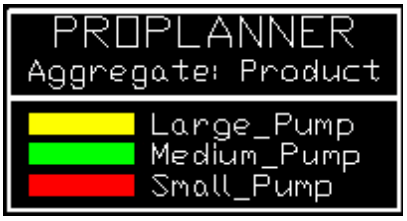
Fields to Print: This column selects which datasets to display in the final reports. The reports will automatically be resized and formatted to allow for any combination of this information desired.

Create Report: Generates the XML report in a browser window. You may have to tell Windows to allow the active content if using Windows XP service pack 2 or higher.

5.14.2 Legend

Legend

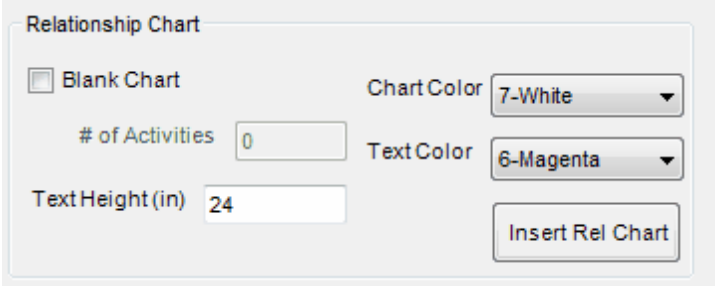
Creates a legend that identifies flow paths by aggregate color shown below. The user designates the default size and selects the insertion point within the drawing. This legend can be resized by selecting its height from the reports tab or using the scale command within AutoCAD.



Legend - Paths By Aggregate Color

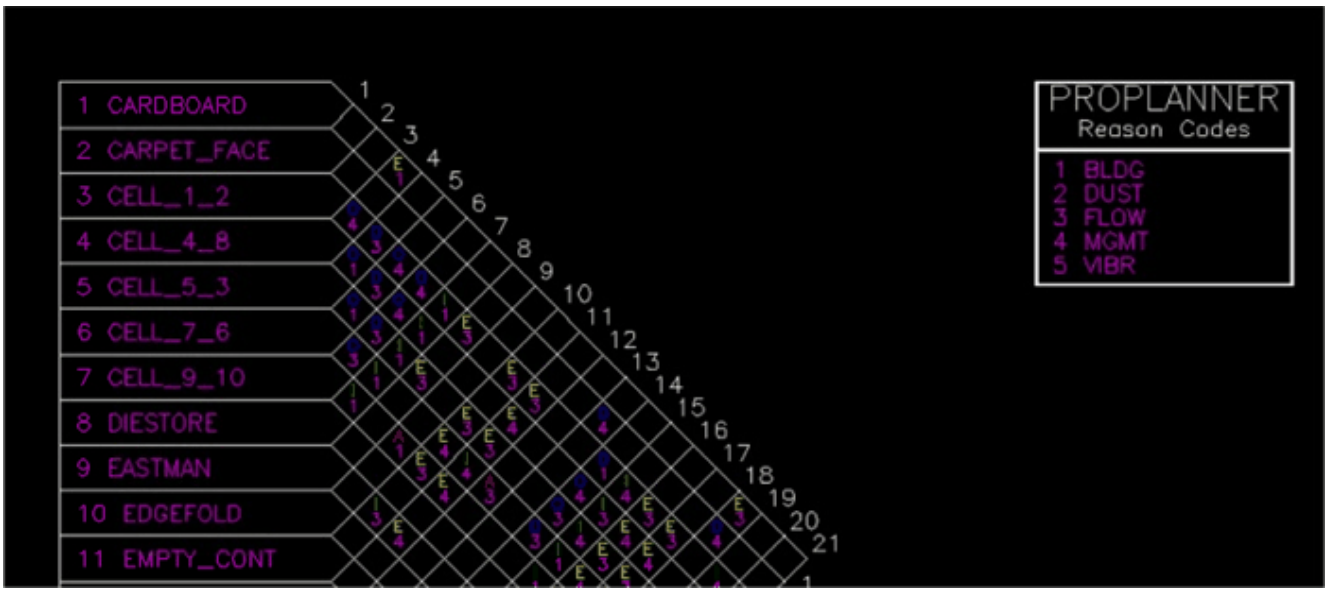
Once the legend has been placed for an aggregation method, it will automatically update if any changes are made in subsequent calculations or in line color settings. The legend must be placed once for each aggregation type, but will remain for future viewing. The legend will not automatically appear for all aggregate methods, only for those in which it has been placed.

5.14.3 Relationship Chart



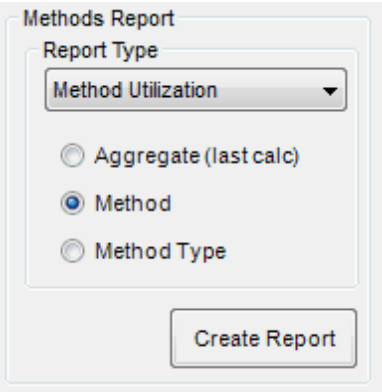
Relationship Chart Editor

Creates a relationship chart that shows the A, E, I, O, X, and Z relationships between locations, and a corresponding table of reason codes. Relationship charts are created when using Flow Planner to diagram and evaluate non-flow relationship-based layout issues. Product names are mapped to A, E, I, O, X and Z relationships via fields in the Freq/Congest tab. For more information on relationship charts, please consult the Relationship Tutorial.



Relationship Chart

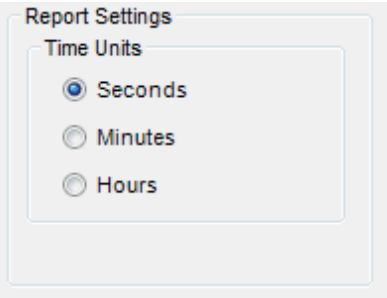
5.14.4 Methods Report



Methods Report Editor

Creates a report that will display quantity, travel time, load/unload time, total time, available time/quantity, and the utilization percentage. This can be set to be displayed for the most recent aggregation method or by Method or Method Type.

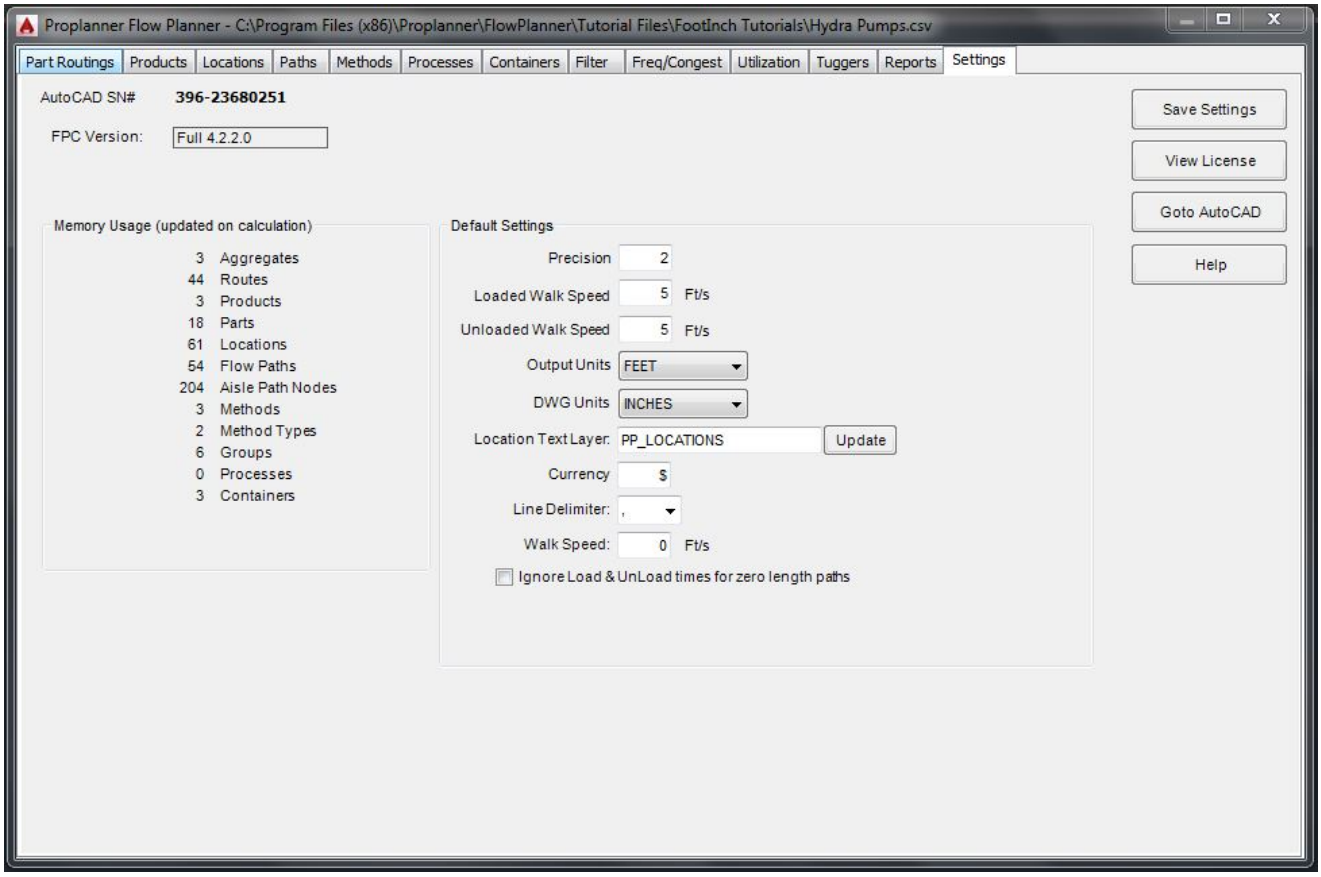
5.14.5 Report Settings



Report Settings Editor

You may select which time unit is used to display reported information. Conversions will automatically be made if the reporting unit is different than the input unit for the routings.

5.15 Settings Tab



Settings Tab

The Settings Tab allows you to view your license information and change the default settings for some of Flow Planner's parameters.

Licensing

If you have a valid license file, you can view the license details (including expiration date) by clicking View License.

To obtain a temporary or permanent license, see the installation instructions in www.proplanner.com/support.

Default Settings

Precision: Sets the number of decimal places displayed in the results.

Loaded and Unloaded Walk Speed: These variables are no longer used, and will be removed in a future version.

Output Units *(Feet/Meters)*: Sets the output units for results and for the Paths Tab. This unit is also the basis for calculating the speed of a Method Type.

DWG Units *(Inches/Meters/Millimeters)*: Specifies the value of one unit of distance in the drawing. This is used for determining travel distances between locations and the lengths of paths extracted from the drawing.

Location Text Layer: Designates the layer on which the location information is stored. This may be changed, and you could have multiple layers with different label configurations. You are allowed to save different location settings on the same drawing.

Currency: The monetary units used in Flow Planner for calculating costs.

Line Delimiter: This setting allows the user to select either the comma or semi-colon for the delimiter used to separate information in the input files. The default comma-separated files may not be useful for numeric notations which use commas instead of periods. The Flow Planner Metric tutorial files use the semi-colon line delimiter setting.

Walk Speed: The speed used in Flow Planner for computing the walk speed along Aisle Join lines. It is only referenced if the "Ignore Aisle Join Lines" checkbox is selected on the Routings tab. Also note that Join Lines are only valid for Aisle-based calculations, so this will not have any effect in a Straight-Flow study. Once you are done editing these options, click Save Settings.

Ignore Load/Unload times for zero length paths: If a path is routed FROM and TO the same location, the travel distance and time will be zero, but it will still have a Load and Unload time, and perhaps even a Join Line Walk time. If this option is checked on, then Flow Planner will not report any distance, time or cost (basically it will ignore) those zero length flows.

The settings are saved to the license, so if you use temporary licenses, you will need to update your settings each time you receive a new license. Save Settings is unavailable for the 30-day trial.

6 Tutorials

The following three tutorials are provided to help you get familiar with the various ways of using Proplanner's Flow Planner application.

The Hydra Pumps example shows how to evaluate unit load material flows which involve moving a load of material between specific locations in a plant. In this tutorial, you will learn how to generate flow diagrams and reports, as well as evaluate changes to the layout.

Hydra Pumps Tutorial

The Tugger tutorial shows you how to evaluate route-based flows that involve driving a tugger on a fixed route through the facility and dropping off or picking up material at different locations along the way. Since this tutorial builds on concepts learned during the Hydra Pumps Tutorial, it is recommended that you start with that tutorial first.

Tugger add-on Tutorial

The Relationship Planning tutorial shows you how to create relationship-based layouts. The method used to set up the relationship study requires thinking about Flow Planner slightly differently than in the Hydra Pumps Tutorial or the Tugger Tutorial. After working through this tutorial, you will have a better idea of ways that you can set up non-traditional studies.

Relationship Planning Tutorial

6.1 Hydra Pumps Tutorial

This tutorial gives examples of unit load moves of material (i.e. fork truck moves) between different locations in the layout, such as docks, storage areas, and workstations.

In this tutorial, you will learn how to define material flow routes within either MS Excel or the routing editor, and then automatically generate straight and aisle-based flow diagrams, as well as distance/cost reports from those routings within an AutoCAD layout drawing. The tutorial moves through all of the tabs in Flow Planner.

STEP 1: Getting Started

To get started, run AutoCAD and open the Hydra Pumps.dwg file, which is provided in the Tutorial Files folder where the Flow Planner application was installed. (Typically, it will be in "C:\Program Files\Proplanner\FlowPlanner"). You can also open the file from the Tutorials Files button in the Proplanner ribbon.

STEP 2: Opening Flow Planner

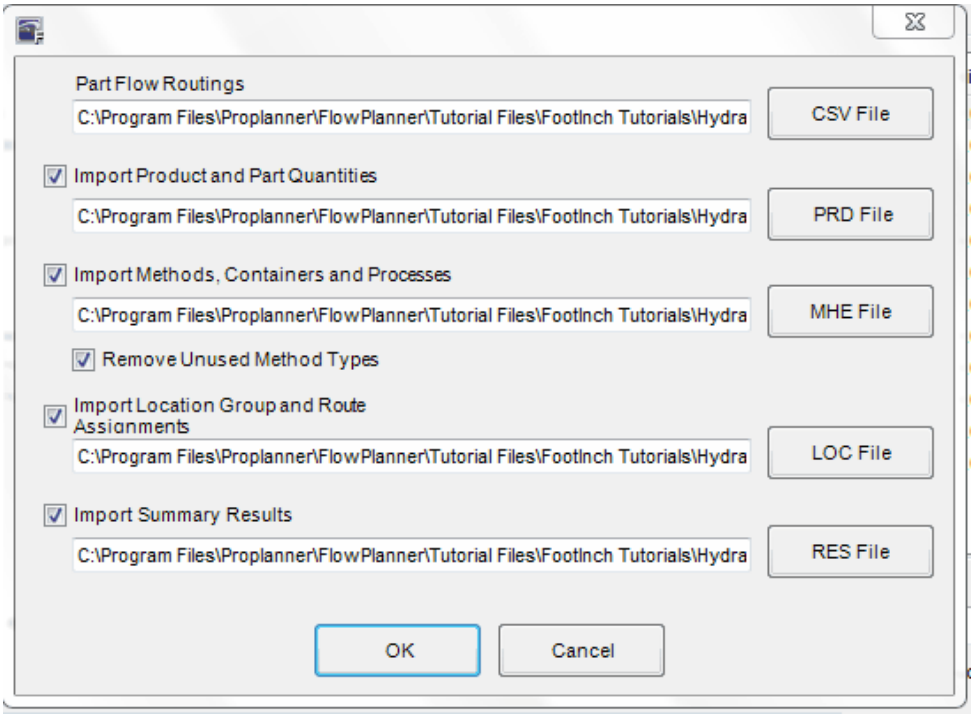
Select the Flow Planner icon button from the Proplanner ribbon to open the main Flow Planner application window.

STEP 3: Opening the Routing File

When Flow Planner first starts, you will automatically be taken to the Part Routings tab of the application. To import an existing flow routing file, select the "File Open" button at the top right corner of the Part Routings tab. This will open a window that allows you to browse to the file; click on the "CSV File" button.

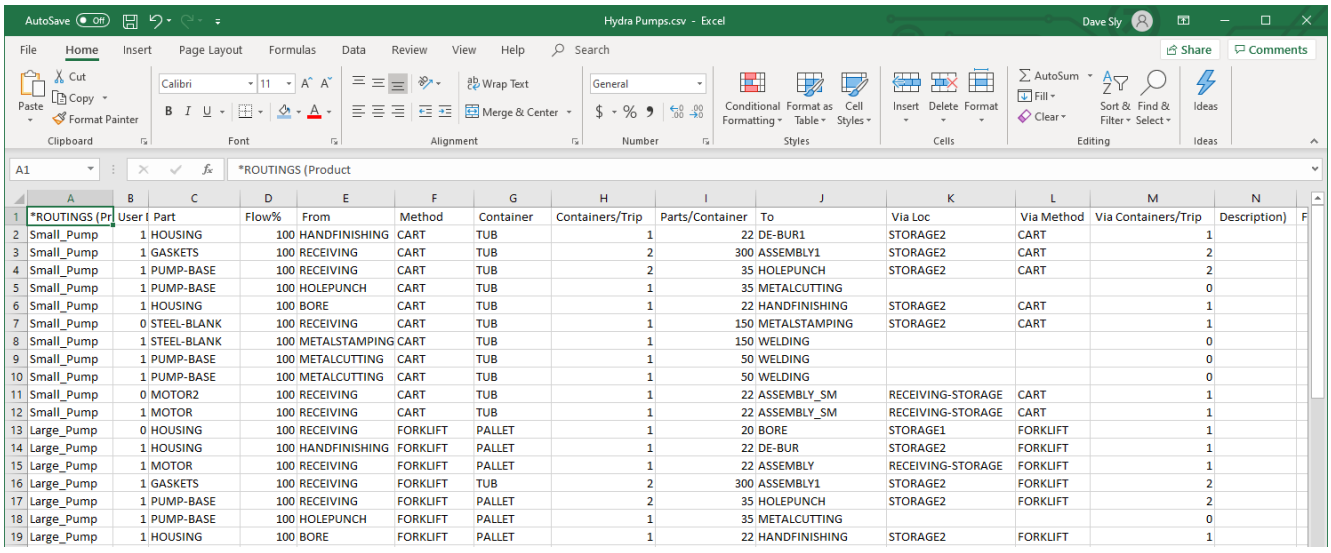
For this tutorial, browse to the directory where Flow Planner was installed (this will be the same directory where the .dwg file was saved). In that directory, open the Tutorial Files > FootInch Tutorials folders and select the Hydra Pumps.CSV file.

Once the file is selected, click OK to load it. The application will now fill in the other file paths with default names for the files; these are based on the CSV file that was opened.



Import File Window

You may have noticed the HydraPumps file has the extension of CSV. This extension indicates the file is a comma-separated ASCII file that can be easily created or edited with MS Excel or any text editor. If you would like to see the contents of the file, you may wish to open this file in MS Excel and look at the fields and formatting.



*ROUTINGS (Pr	User I	Part	Flow%	From	Method	Container	Containers/Trip	Parts/Container	To	Via Loc	Via Method	Via Containers/Trip	Description)
Small_Pump	1	HOUSING	100	HANDFINISHING	CART	TUB	1	22	DE-BUR1	STORAGE2	CART	1	
Small_Pump	1	GASKETS	100	RECEIVING	CART	TUB	2	300	ASSEMBLY1	STORAGE2	CART	2	
Small_Pump	1	PUMP-BASE	100	RECEIVING	CART	TUB	2	35	HOLEPUNCH	STORAGE2	CART	2	
Small_Pump	1	PUMP-BASE	100	HOLEPUNCH	CART	TUB	1	35	METALCUTTING			0	
Small_Pump	1	HOUSING	100	BORE	CART	TUB	1	22	HANDFINISHING	STORAGE2	CART	1	
Small_Pump	0	STEEL-BLANK	100	RECEIVING	CART	TUB	1	150	METALSTAMPING	STORAGE2	CART	1	
Small_Pump	1	STEEL-BLANK	100	METALSTAMPING	CART	TUB	1	150	WELDING			0	
Small_Pump	1	PUMP-BASE	100	METALCUTTING	CART	TUB	1	50	WELDING			0	
Small_Pump	1	PUMP-BASE	100	METALCUTTING	CART	TUB	1	50	WELDING			0	
Small_Pump	0	MOTOR2	100	RECEIVING	CART	TUB	1	22	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1	
Small_Pump	1	MOTOR	100	RECEIVING	CART	TUB	1	22	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1	
Large_Pump	0	HOUSING	100	RECEIVING	FORKLIFT	PALLET	1	20	BORE	STORAGE1	FORKLIFT	1	
Large_Pump	1	HOUSING	100	HANDFINISHING	FORKLIFT	PALLET	1	22	DE-BUR	STORAGE2	FORKLIFT	1	
Large_Pump	1	MOTOR	100	RECEIVING	FORKLIFT	PALLET	1	22	ASSEMBLY	RECEIVING-STORAGE	FORKLIFT	1	
Large_Pump	1	GASKETS	100	RECEIVING	FORKLIFT	TUB	2	300	ASSEMBLY1	STORAGE2	FORKLIFT	2	
Large_Pump	1	PUMP-BASE	100	RECEIVING	FORKLIFT	PALLET	2	35	HOLEPUNCH	STORAGE2	FORKLIFT	2	
Large_Pump	1	PUMP-BASE	100	HOLEPUNCH	FORKLIFT	PALLET	1	35	METALCUTTING			0	
Large_Pump	1	HOUSING	100	BORE	FORKLIFT	PALLET	1	22	HANDFINISHING	STORAGE2	FORKLIFT	1	

CSV File - Excel

While all of the data fields in this file can be created or modified within the Flow Planner Editor, you will find that Excel is a quicker environment for the creation and mass editing of large data sets.

Note: All data files used by Flow Planner (such as files ending in MHE, LOC, and PRD) are CSV formatted files and thus can be easily modified with Excel, Notepad, or any text editor.

STEP 4: Learning the Part Routings Tab

The pull-down menu at the top left of the Flow Planner window (as indicated by the arrow in the image below) contains the different products available in the routing file. The “SMALL_PUMP” will already be selected from the list of products available.

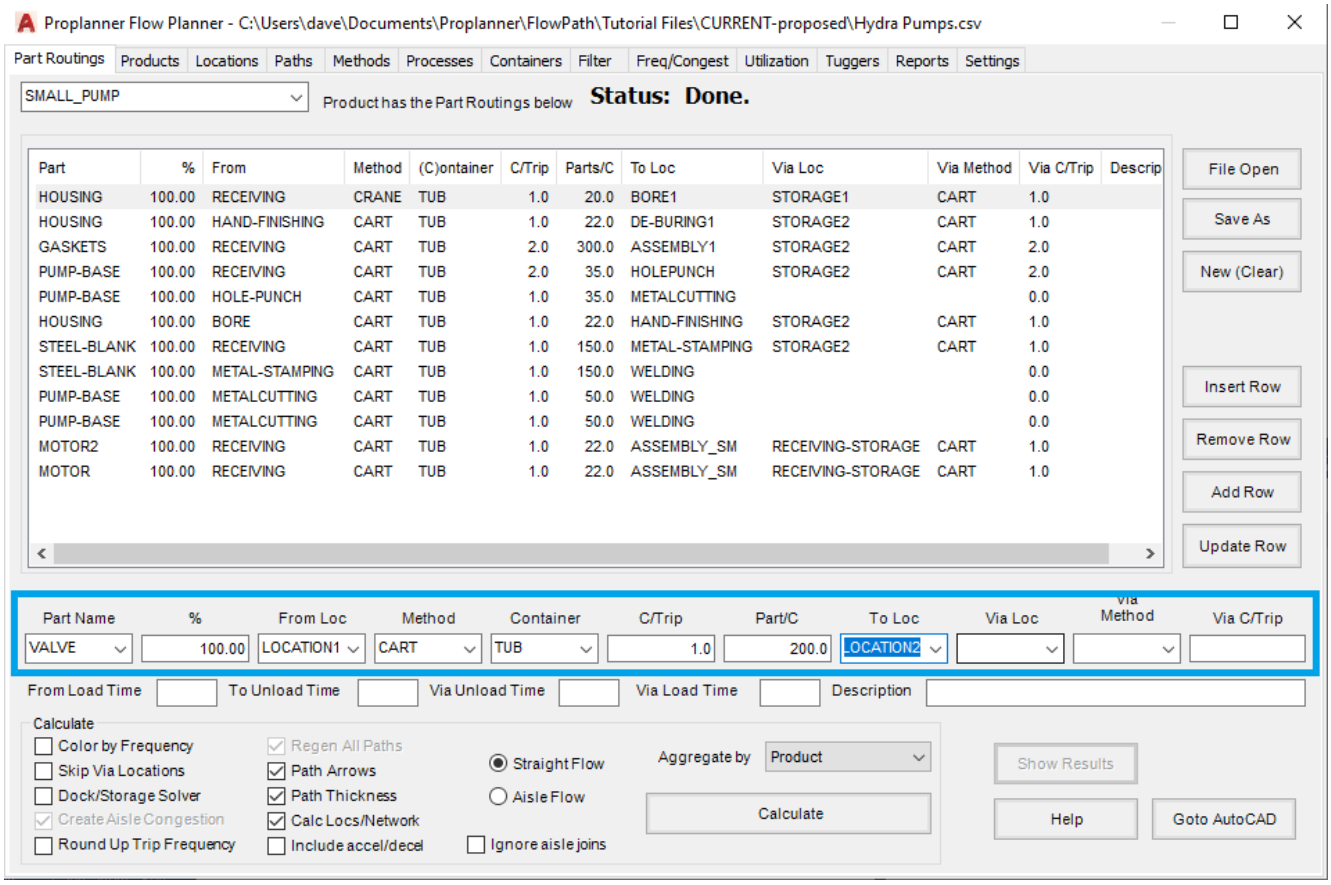
Add, Update, and Remove Rows

We are first going to learn to add and modify data one row at a time within the Flow Planner Editor. Enter routing information into the input boxes highlighted in the screenshot below.

For this example, give the following details for the part routing (type these values in the boxes if they are not available in the drop-down list):

Part name	= “VALVE”
%	= “100”
From Loc	= “LOCATION1”
Method	= “CART”
Container	= “TUB”
C/Trip	= “1.0”
Part/C	= “200”
To Loc	= “LOCATION2”

Leave the last three fields (Via Loc, Method, C/Trip) blank.



Part Routing Editor

Click on the “Add Row” button after entering these values. "Add Row" is near the bottom of the column of buttons on the right side of the screen. The newest row will be highlighted.

Now click on “Insert Row”. The route information for VALVE is added again, but is inserted above the previously highlighted row. We will change this information and use the update function.

Next, go back to the input boxes. Change the following details and click "Update Row" at the bottom of the button column.

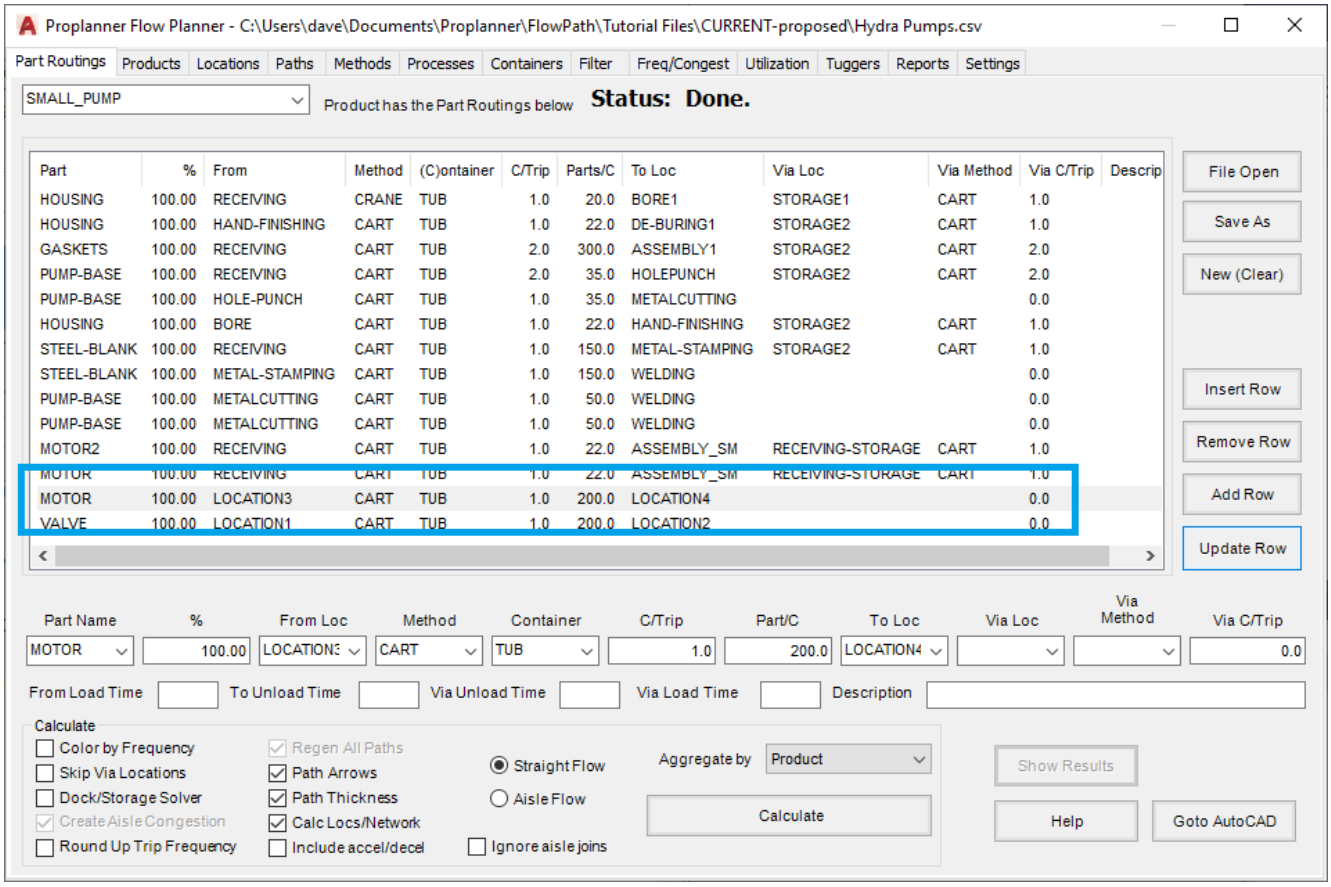
Part Name = “MOTOR”

From Loc = “LOCATION3”

Part/C = “100”

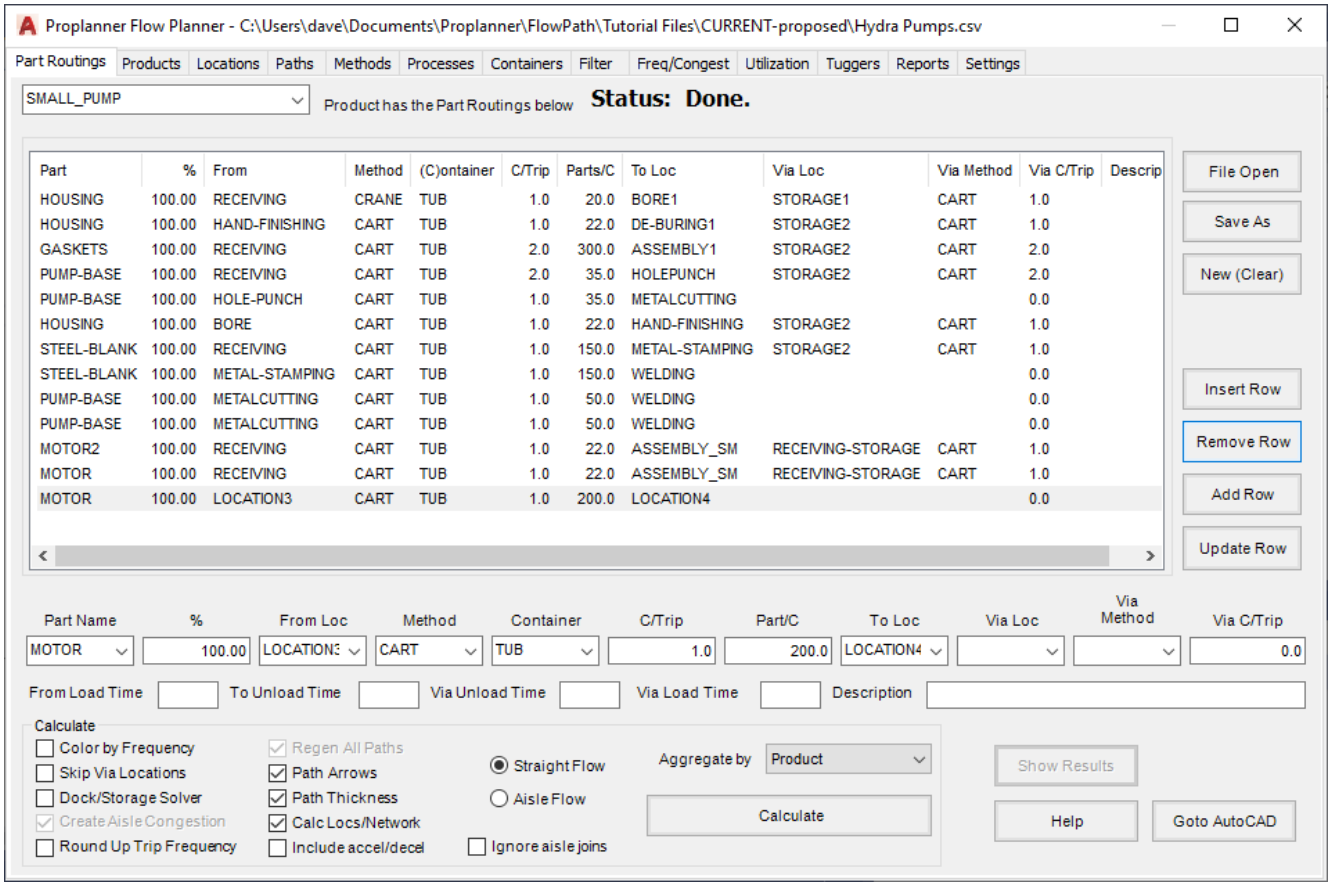
To Loc = “LOCATION4”

The screenshot below shows that the information has been updated.



Updated Part Information

Finally, select the last row (VALVE) and click the "Remove Row" button, leaving us with the following:



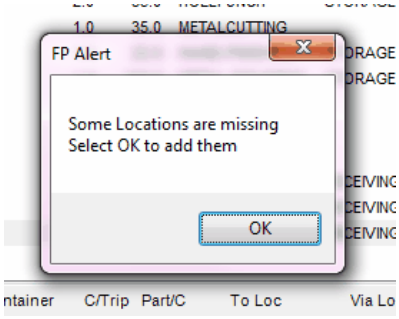
Removed Row

Generate a Flow Study

Now we will generate our first flow study. Initially, you should generate your flow studies using straight flow diagrams. Straight flow diagrams draw the route arrows in a birds-eye fashion and do not follow defined aisles; this makes it easy to verify that your flow lines are going To and From the proper locations. For this first study, you will want to ensure the "Straight Flow" radio button (in the bottom center of the Part Routings Tab) is selected.

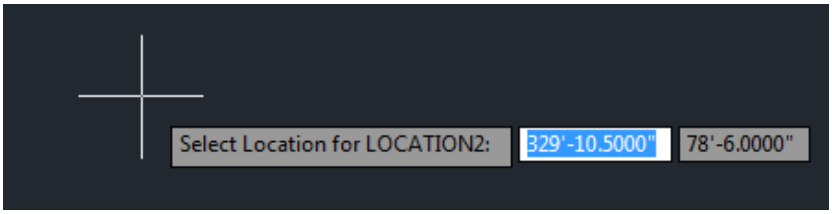
Part Routings Tab - Straight Flow

To generate your flow study, click on the “Calculate” button. Since we added new parts with new locations, a Flow Path Alert message shows up. This indicates one or more of the location names referenced in your routings list are missing on the location layer of your drawing. (Note: The application looks for AutoCAD text objects on the layer specified in the "Settings" tab)



Flow Path Alert Message

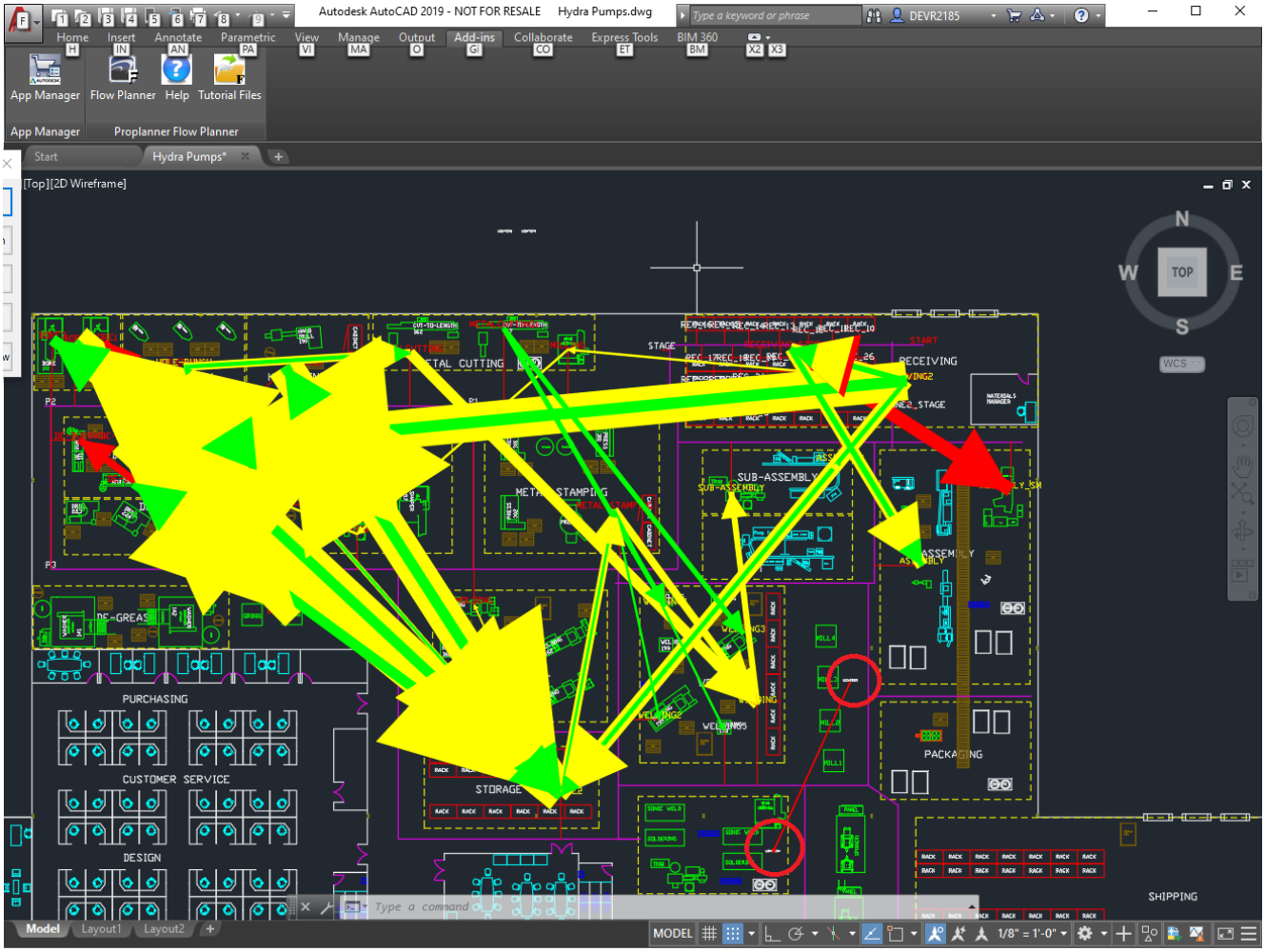
Click OK. AutoCAD then prompts you to select the location name in a small moving window next to the cursor.



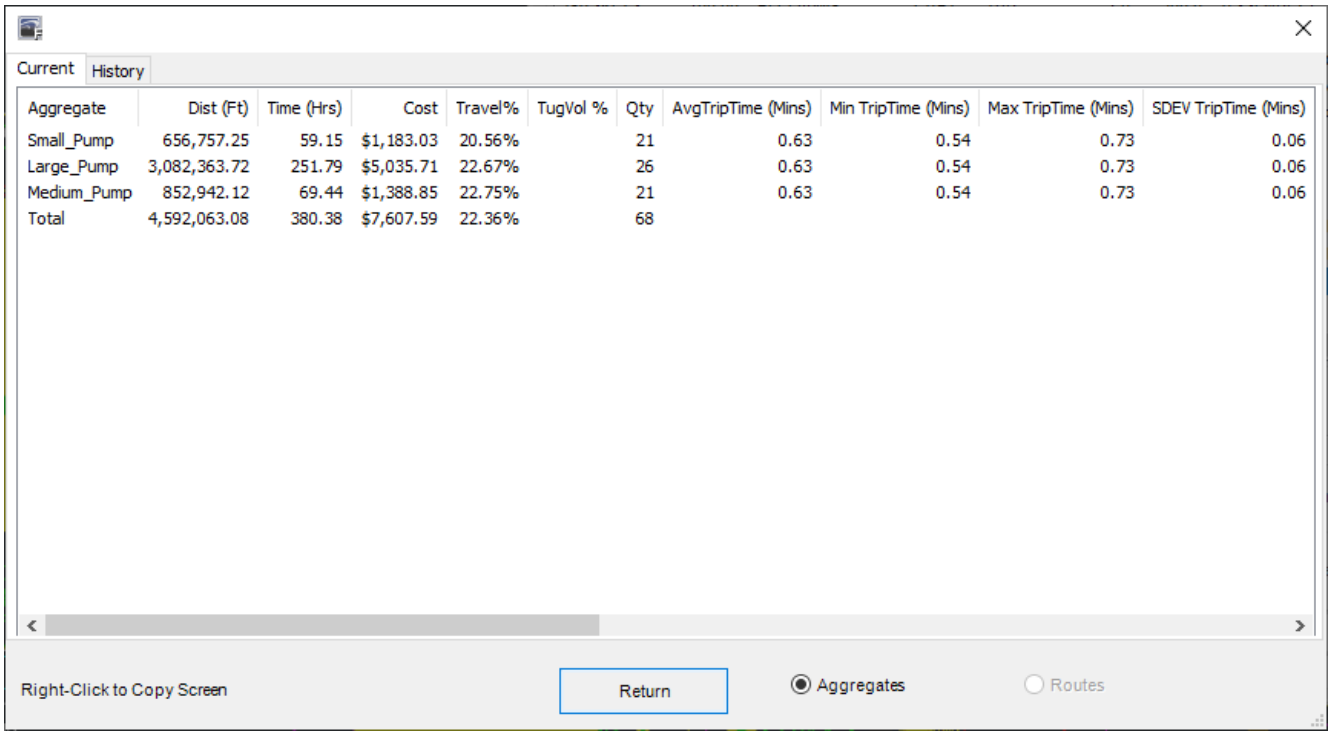
Location Name

Add Location1 and Location 2 by clicking anywhere on the drawing. For Location3 and Location4, refer to the image below and click to add them as shown. [NOTE: Red circles will not appear in the drawing.] You can remove Location 1 and Location 2 in the Locations tab later, since they are no longer needed.

After entering Location4, the flow study can be calculated. Paths are drawn on the AutoCAD drawing. After looking at the paths and results, click "Flow Planner" to get back to Flow Planner's main window. Clicking on "Show Results" will return the bottom window.

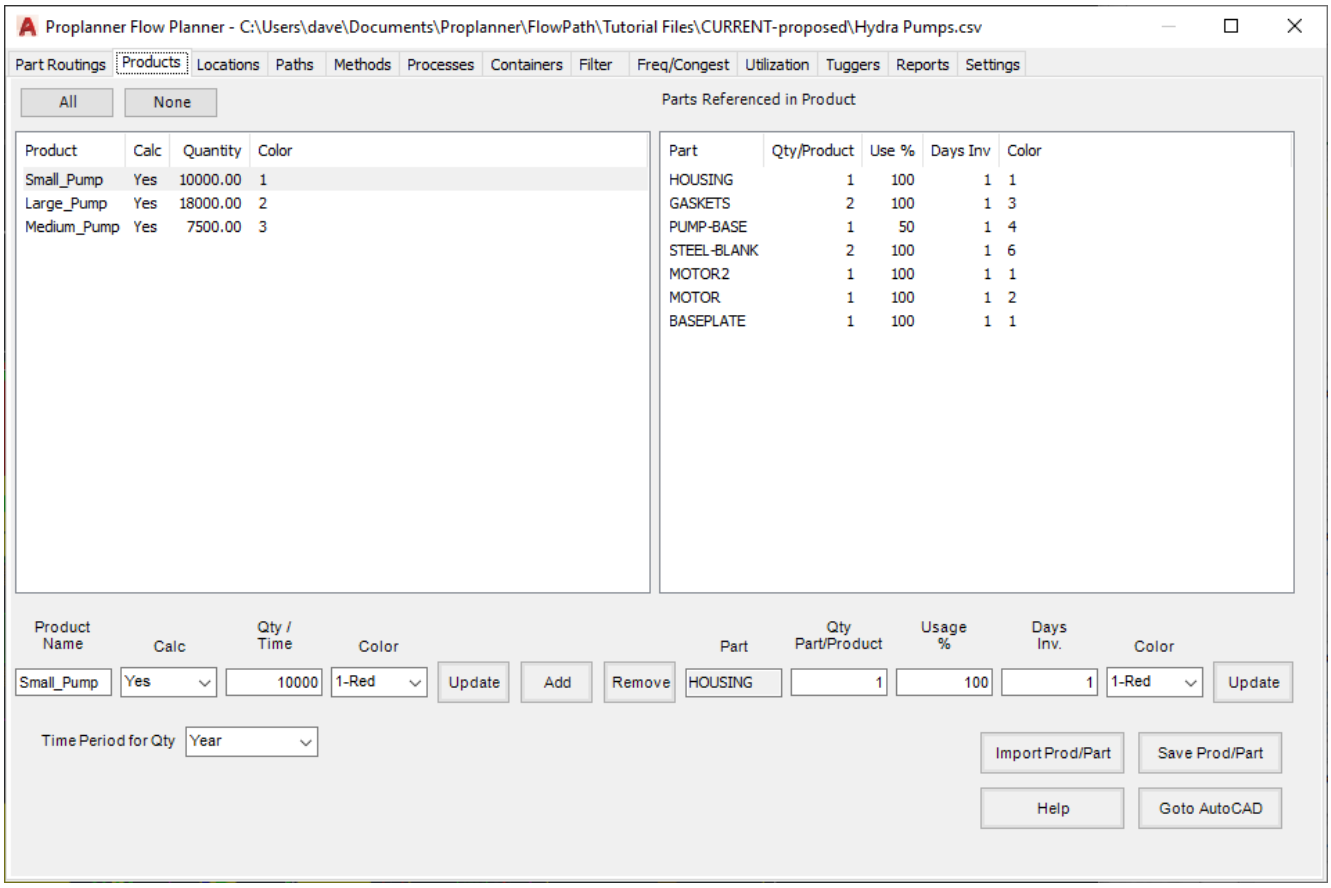


Paths



Flow Planner Main Window

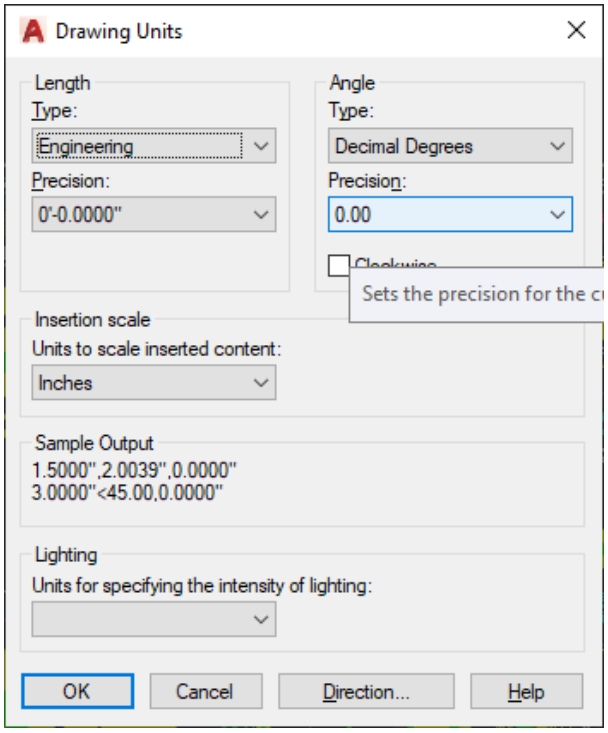
Note: Your calculations may vary slightly based on the exact placement of your locations, but should be similar to the results shown above. If they vary significantly, check the Products tab and ensure the quantities for your Products match what is shown below.



Product Quantity Match Checking

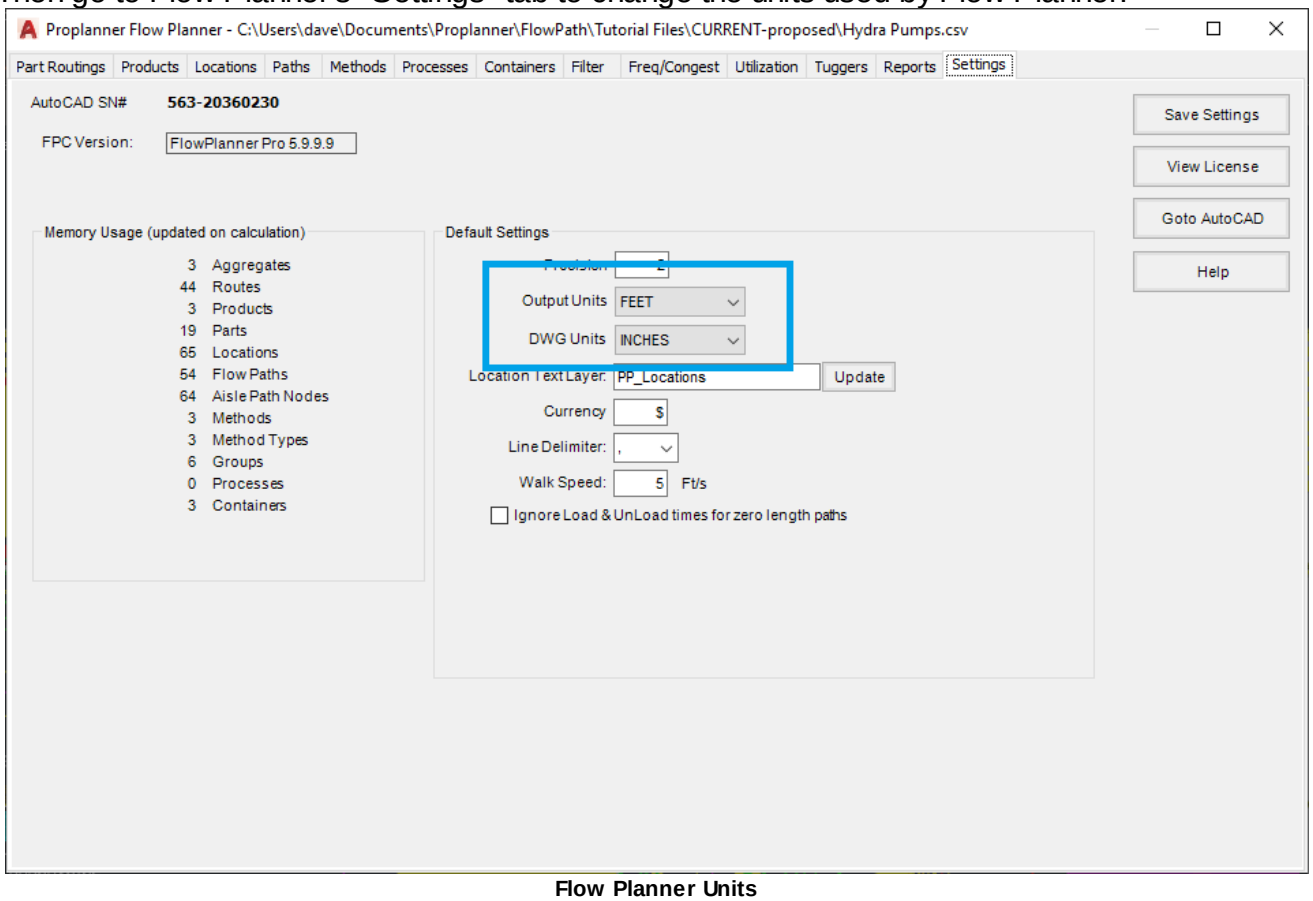
Special Note

If the drawing displays very large, overlapping arrows, overlapping each other after you click the “Calculate” button, it is likely that the drawing and Flow Planner are using different units. You can type in "units" in the AutoCAD command line and see which units are used in the drawing.



Units Window

Then go to Flow Planner's "Settings" tab to change the units used by Flow Planner.

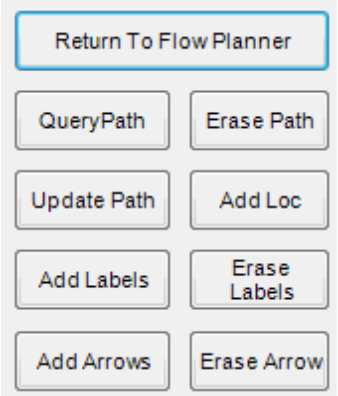


Flow Planner Units

Query Paths

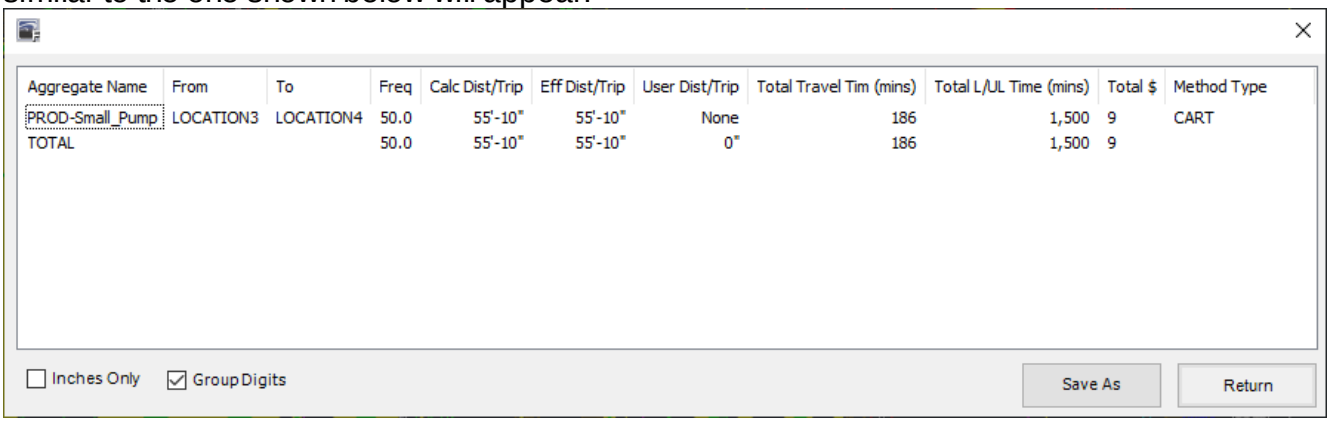
Next, we will learn how to find information about individual paths. Click on the "Go to AutoCAD" button.

Click on “QueryPath” in the Flow Planner window that comes up.



Goto AutoCAD Window Pop Up

Click on the edge of the path connecting Location3 and Location4. Hit Enter and a window similar to the one shown below will appear:



Aggragate Name Window

STEP 5: Using the Products Tab

The Part Routings tab showed us information about the parts and the trips that needed to be made. Next, we are going to learn about the Products tab, which organizes information based on the different products available.

"Aggregate by" Parts

In the next flow study, we are going to look at how parts (specifically, the baseplate we added) move for a specific product. To do this, we will change the color of line used for our particular part.

Click on “Flow Planner".

To change the color of the flow lines for MOTOR, go to the “Products” tab.

Select “Small_Pump” from the product window on the left. This will update the part names listed on the right to reflect the parts in Small Pump.

Select MOTOR from the parts window on the right. Change the color to “2-Yellow”; this is a selection made from the pull-down menu located left of the "Update" button (lower left portion of the screen). Click "Update" to apply the color.

Go back to the Part Routings Tab and change the “Aggregate by” control (located at the bottom right part of the screen, near the "Calculate" button) to “Part” and click "Calculate".

You will now see that the line going from Location 3 to Location 4 changed from red to yellow. The calculations and lines are now drawn by part movements, not summarily for the product movements.

Return to Flow Planner by clicking on “Return”.

"Aggregate by" Methods

In the next flow study, we are going to look at how parts move with a specific method. To do this, we will change the color used for our particular method. To change the color of the method CART, go to "Methods" tab.

Select "CART" from the material handling methods window on the top.

Change the color to "5-Blue"; this is a selection made from the pull-down menu located left of the "Update" button. Click "Update" to apply the color.

Go back to the Part Routings Tab and change the "Aggregate by" control (located at the bottom right part of the screen, near the "Calculate" button) to "Method" and click "Calculate".

You will now see that the line going from Location 3 to Location 4 that was red is now blue.The calculations and lines are now drawn by methods, not summarily drawn by part movements.

Return to Flow Planner by clicking on "Return".

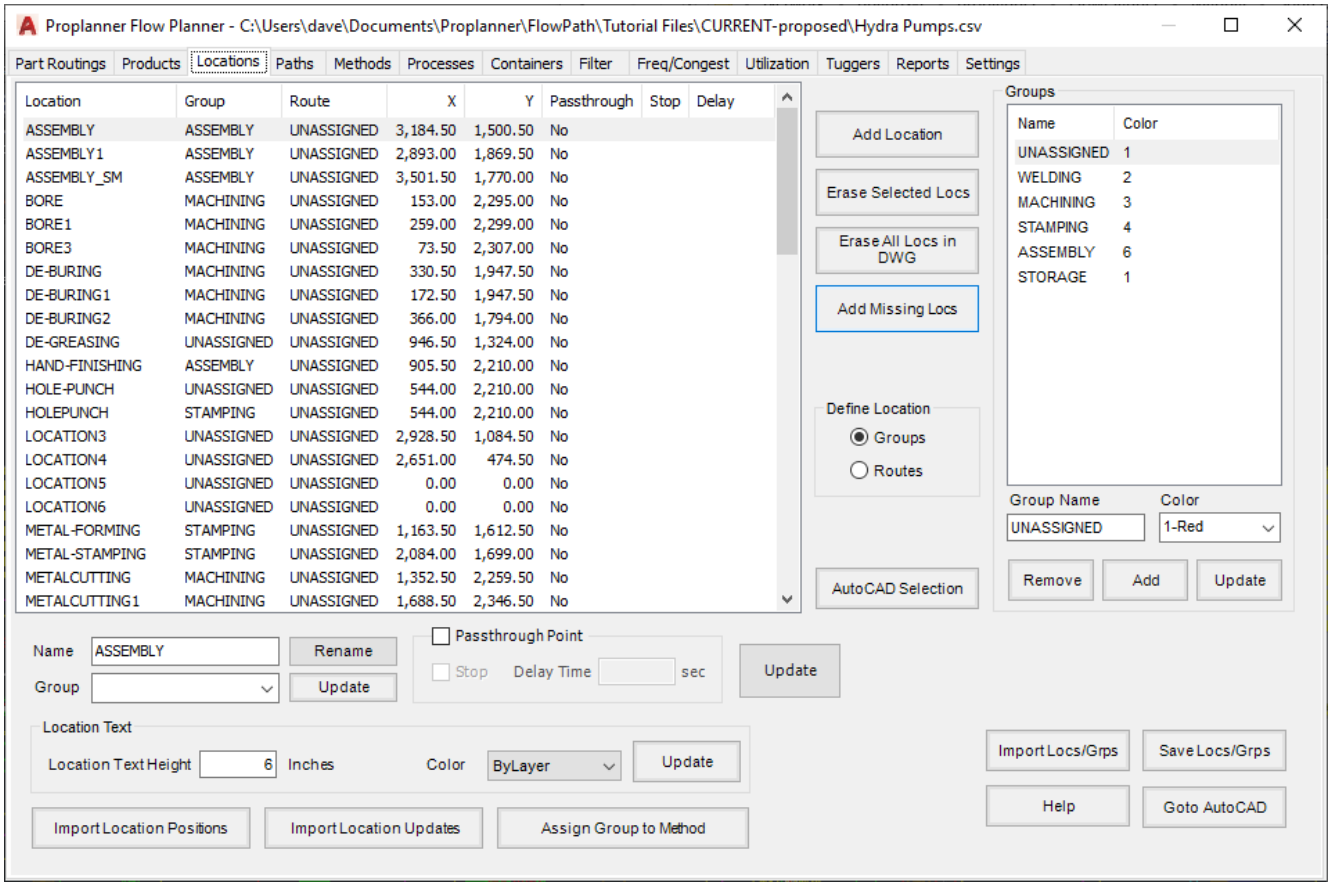
Note: To prepare for the next steps, re-run the calculation by “Product” instead of "Method".

Next, in the Part Routings tab, change the 'From' and 'To' locations for the MOTOR trip. Click on MOTOR to select the row, and you will be able to change the locations. Instead of Location 3, change 'From' to Location 5. Instead of Location 4, use Location 6 as the 'To' location.

Click "Update Row" to update the information in the list. Wait to do another calculation, because you are going to learn a new way to add locations to the drawing in the next step.

STEP 6: Using the Locations Tab

Early on, we saw that flow studies cannot be completed if some of the specified locations do not exist in the drawing. Clicking "Calculate" will prompt you to define any missing locations. You can also add them in the Location tab, as described below.



Locations Tab

To prepare for this step, you changed the trip to travel from LOCATION5 to LOCATION6 instead of traveling from LOCATION3 to LOCATION4 as it was in the previous step. These new locations (5 and 6) need to be added to the drawing. This can be done by selecting “Add Missing Locs”.

The program will return you to AutoCAD, where you can specify where LOCATION5 is. For this example, click somewhere near where LOCATION3 was. With LOCATION6, click where LOCATION4 was.

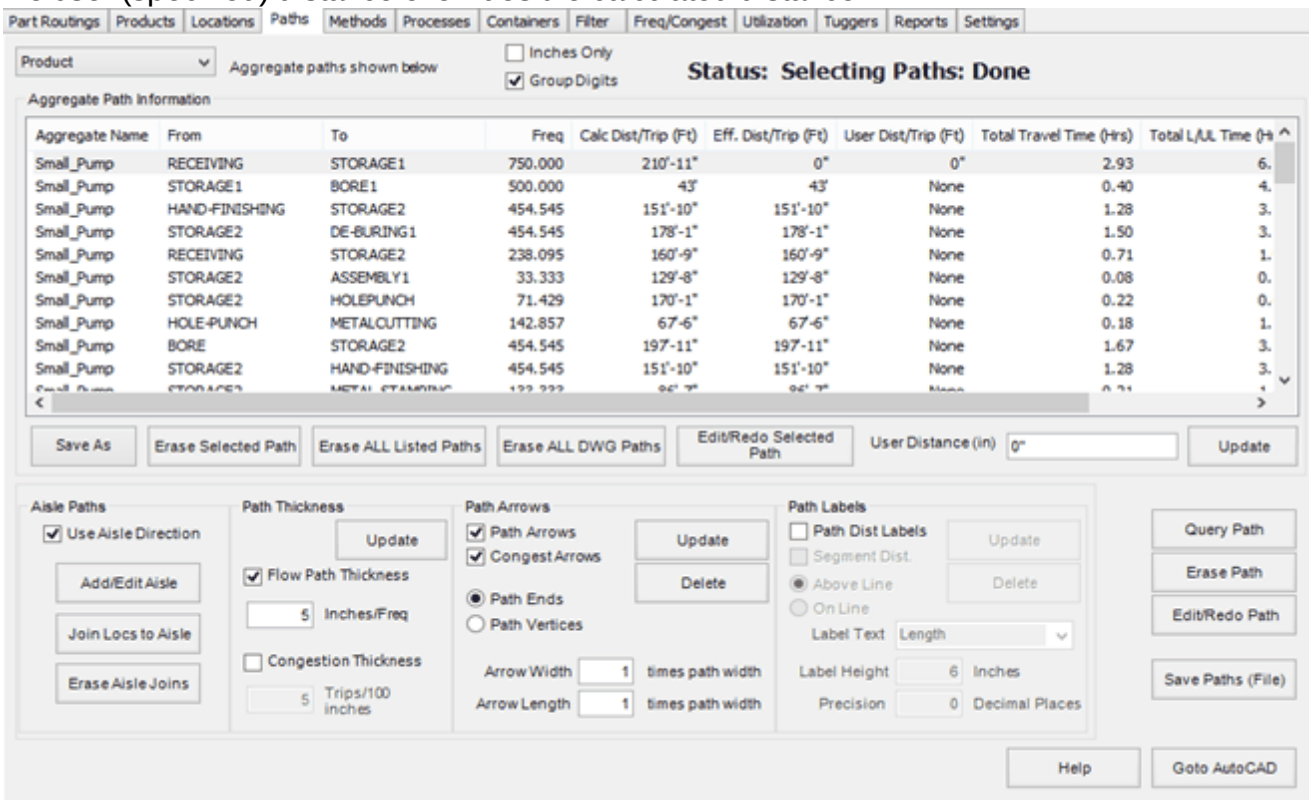
The new locations will show up in the Locations display list. The “Group” of the location will be assigned to "UNASSIGNED” by default. This part of the exercise was to demonstrate that locations can be added in this tab one-at-a-time as an alternative to entering several of them during a calculation.

STEP 7: Using the Paths Tab

In the Paths tab, you can override Flow Planner's calculated distance for any trip. The Paths tab is also where aisles are defined for the drawing.

The effects of User-Specified Distance

Click on the first routing listed on the Paths tab. It should be for the product Small Pump going from HANDFINISHING to STORAGE2. Enter “0” in the “User Distance” box and select update. The user (specified) distance overrides the calculated distance.



Paths Tab

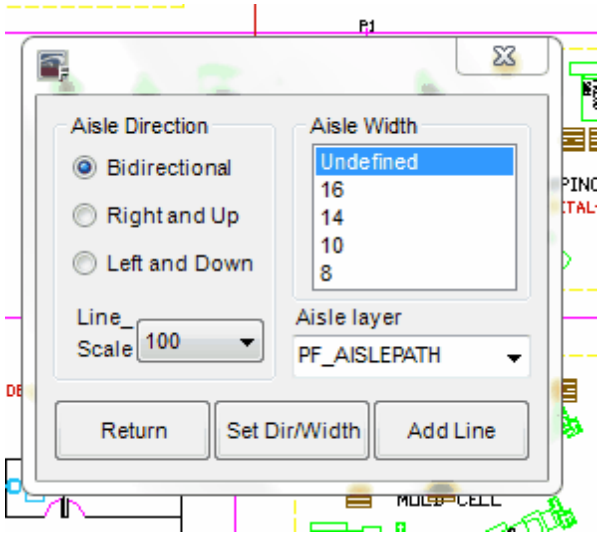
The column “User Dist/Trip” for the selected path changes to zero after updating. On the Part Routings tab, uncheck “Regen All Paths” and then click "Calculate".

The total distance for Small_Pump is reduced from the previous calculations, since there is no distance between Receiving and Storage1.

Now that we've seen this, re-check “Regen All Paths” and leave it selected for the rest of this tutorial. User defined distances will not be utilized further.

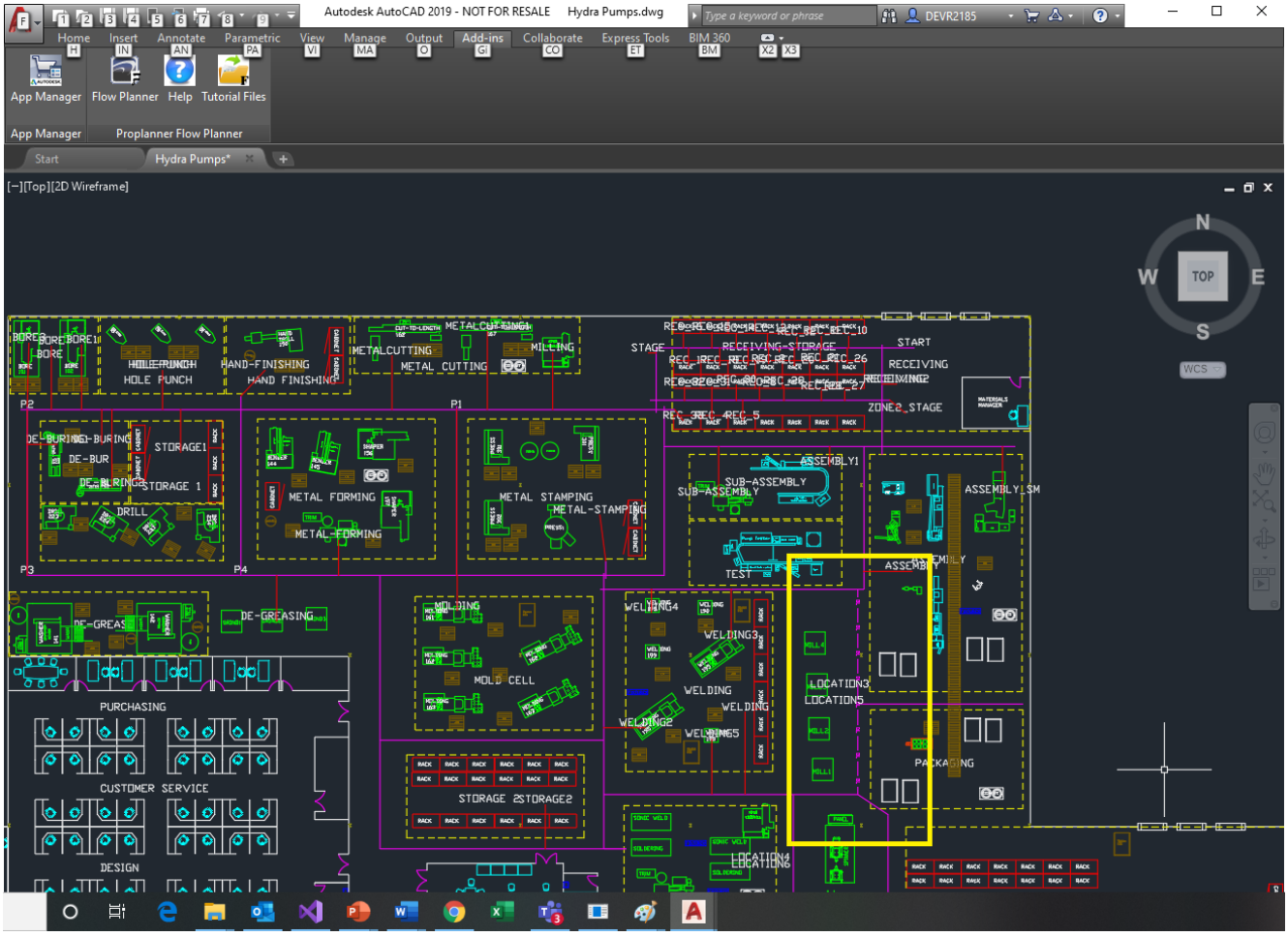
Adding and Editing Aisles

Click on “Add/Edit Aisle”, located in the lower-left corner of the Paths tab. You will be taken to the AutoCAD drawing with the Aisle Add/Edit window.



Add/Edit Aisle Window

Set the aisle direction to "Right and Up" and press "Set Dir/Width". The Aisle Add/Edit window will remain open as you find the aisle to use. Click on the aisle (the purple line) to the right of "LOCATION5". The solid line changes to a dashed-line to show it represents a “Right and Up” directional aisle (shown in Yellow Box).

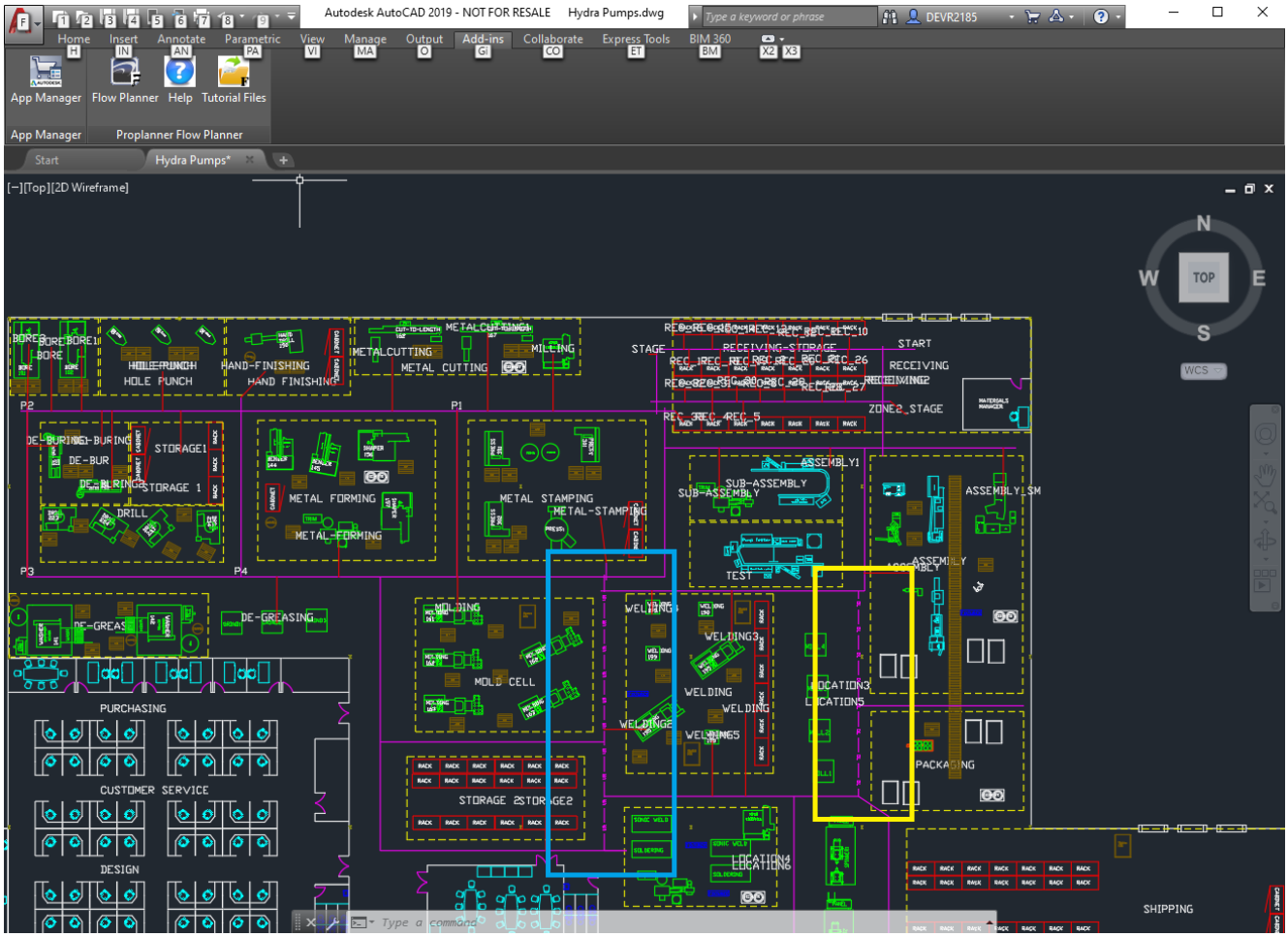


Left and Down Directional Aisle

Next Set “Left and Down” direction to the Immediate Left aisle path (Blue Box) in the drawing.

Click the “Return” button. You will be taken back to the Paths tab.

In the Paths tab, click on “Join Locs to Aisle”.

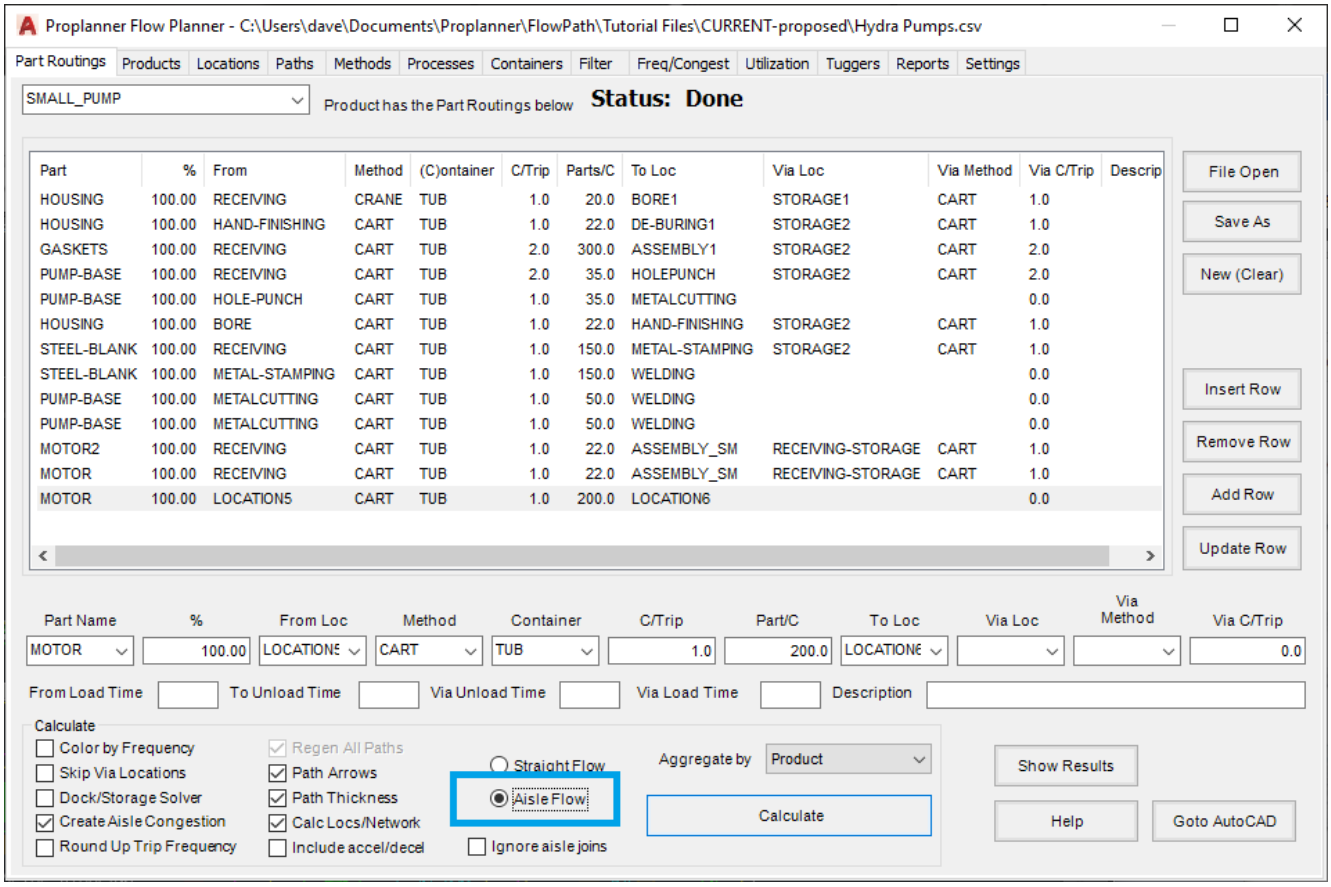


Join Locs to Aisle Button

When complete, a pop-up will tell you that “All Locations Now Joined To Paths”.

Flow Studies with Directional Aisles

Go back to the Part Routings tab. Check the “Aisle Flow” option (as shown below) and click "Calculate".



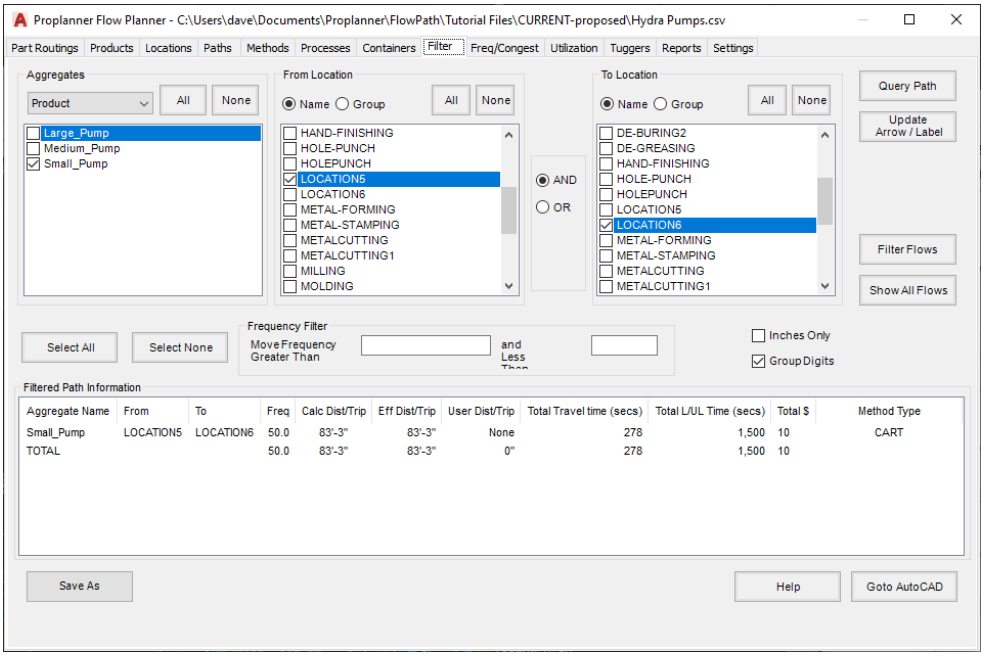
Aisle Flow Option - Calculate

This will calculate distances based on the aisles drawn (whereas Straight Flow ignored aisles). The Aisle Flow will calculate the shortest possible aisle path between two points, considering constraints like one-way aisles, if they exist. The results will be displayed. Clicking on "Return" will close the results and show you the aisle flow lines.

Step 8: Using the Filter Tab

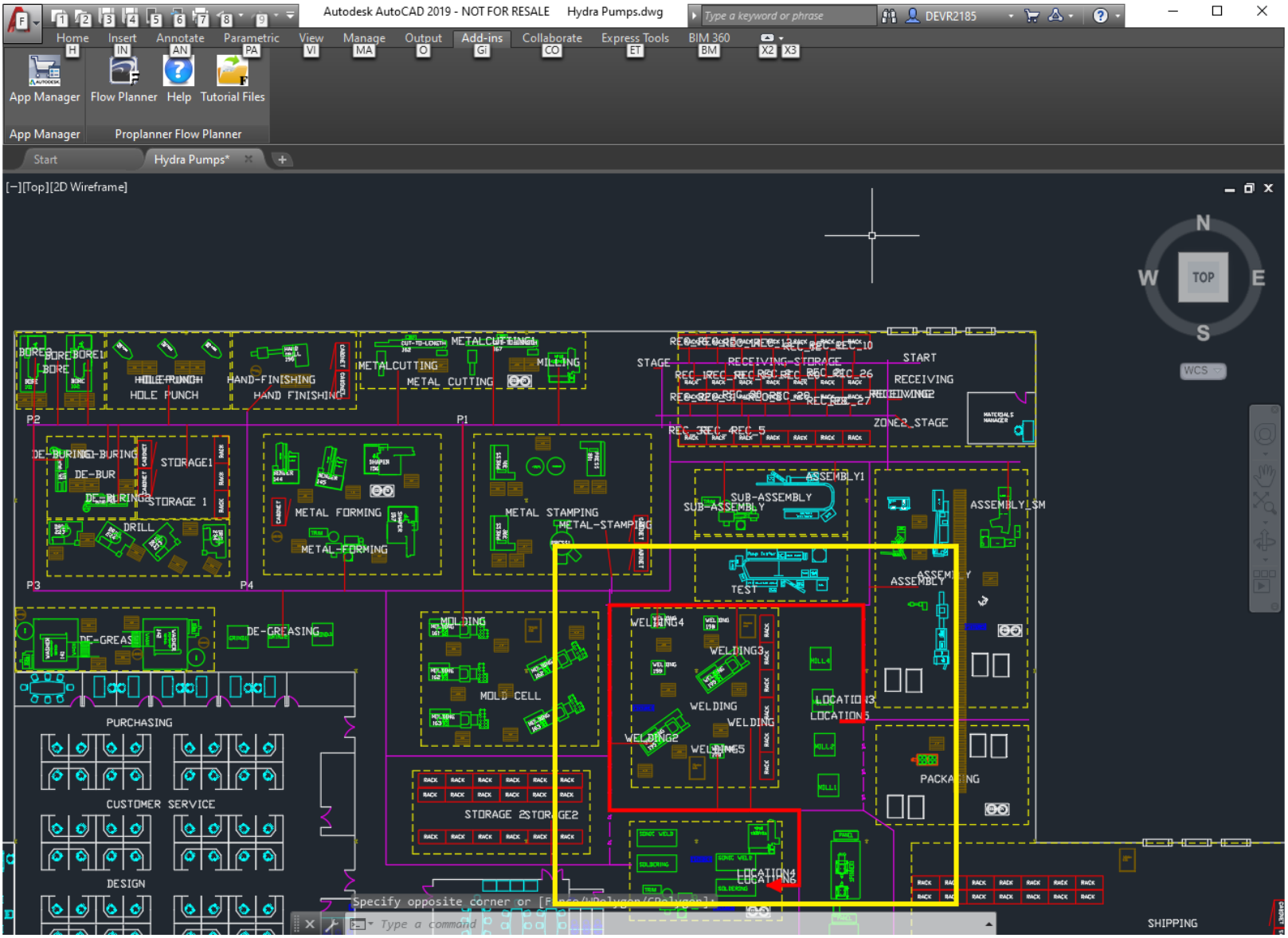
Go to the Filter Tab.

Select the Small_Pump Product. Then select LOCATION5 and LOCATION6 as the From and To locations, respectively.



Filter Tab

Click “Filter Flows”. The AutoCAD drawing shows the path taken from LOCATION5 to LOCATION6 as shown in the image. Though it appears there is a shorter path, the shorter path has been assigned a "Right and Up" direction, which conflicts with the flow in this case.

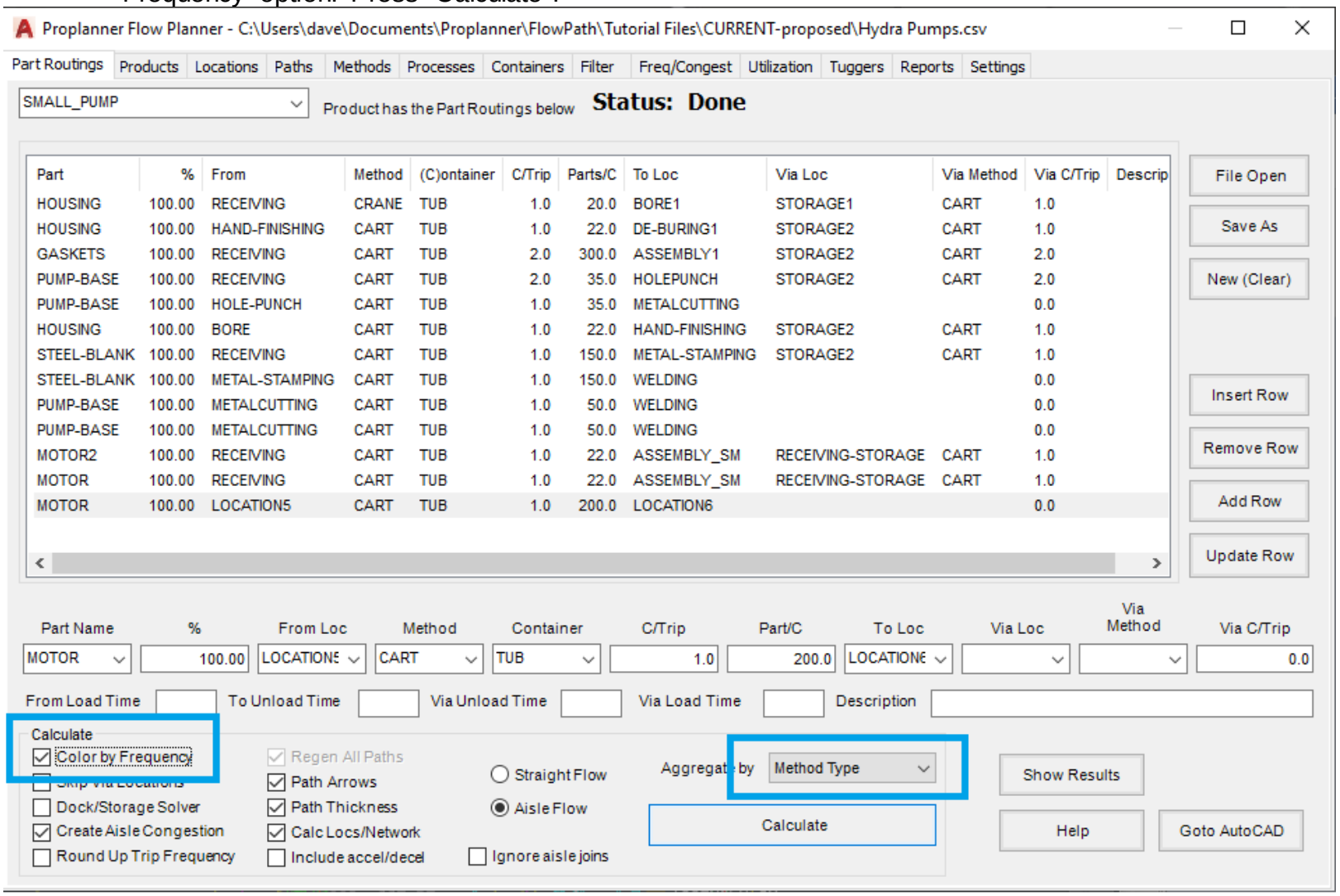


Filter Flows Path

Step 9: Congestion

Visual Congestion in the Part Routings Tab

Go to the "Part Routings" tab. Change 'Aggregate by' to "Method Type" and check the "Color by Frequency" option. Press "Calculate".



Part	%	From	Method	(C)ontainer	C/Trip	Parts/C	To Loc	Via Loc	Via Method	Via C/Trip	Descrip
HOUSING	100.00	RECEIVING	CRANE	TUB	1.0	20.0	BORE1	STORAGE1	CART	1.0	
HOUSING	100.00	HAND-FINISHING	CART	TUB	1.0	22.0	DE-BURING1	STORAGE2	CART	1.0	
GASKETS	100.00	RECEIVING	CART	TUB	2.0	300.0	ASSEMBLY1	STORAGE2	CART	2.0	
PUMP-BASE	100.00	RECEIVING	CART	TUB	2.0	35.0	HOLEPUNCH	STORAGE2	CART	2.0	
PUMP-BASE	100.00	HOLE-PUNCH	CART	TUB	1.0	35.0	METALCUTTING			0.0	
HOUSING	100.00	BORE	CART	TUB	1.0	22.0	HAND-FINISHING	STORAGE2	CART	1.0	
STEEL-BLANK	100.00	RECEIVING	CART	TUB	1.0	150.0	METAL-STAMPING	STORAGE2	CART	1.0	
STEEL-BLANK	100.00	METAL-STAMPING	CART	TUB	1.0	150.0	WELDING			0.0	
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0	
PUMP-BASE	100.00	METALCUTTING	CART	TUB	1.0	50.0	WELDING			0.0	
MOTOR2	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0	
MOTOR	100.00	RECEIVING	CART	TUB	1.0	22.0	ASSEMBLY_SM	RECEIVING-STORAGE	CART	1.0	
MOTOR	100.00	LOCATION5	CART	TUB	1.0	200.0	LOCATION6			0.0	

Color By Frequency

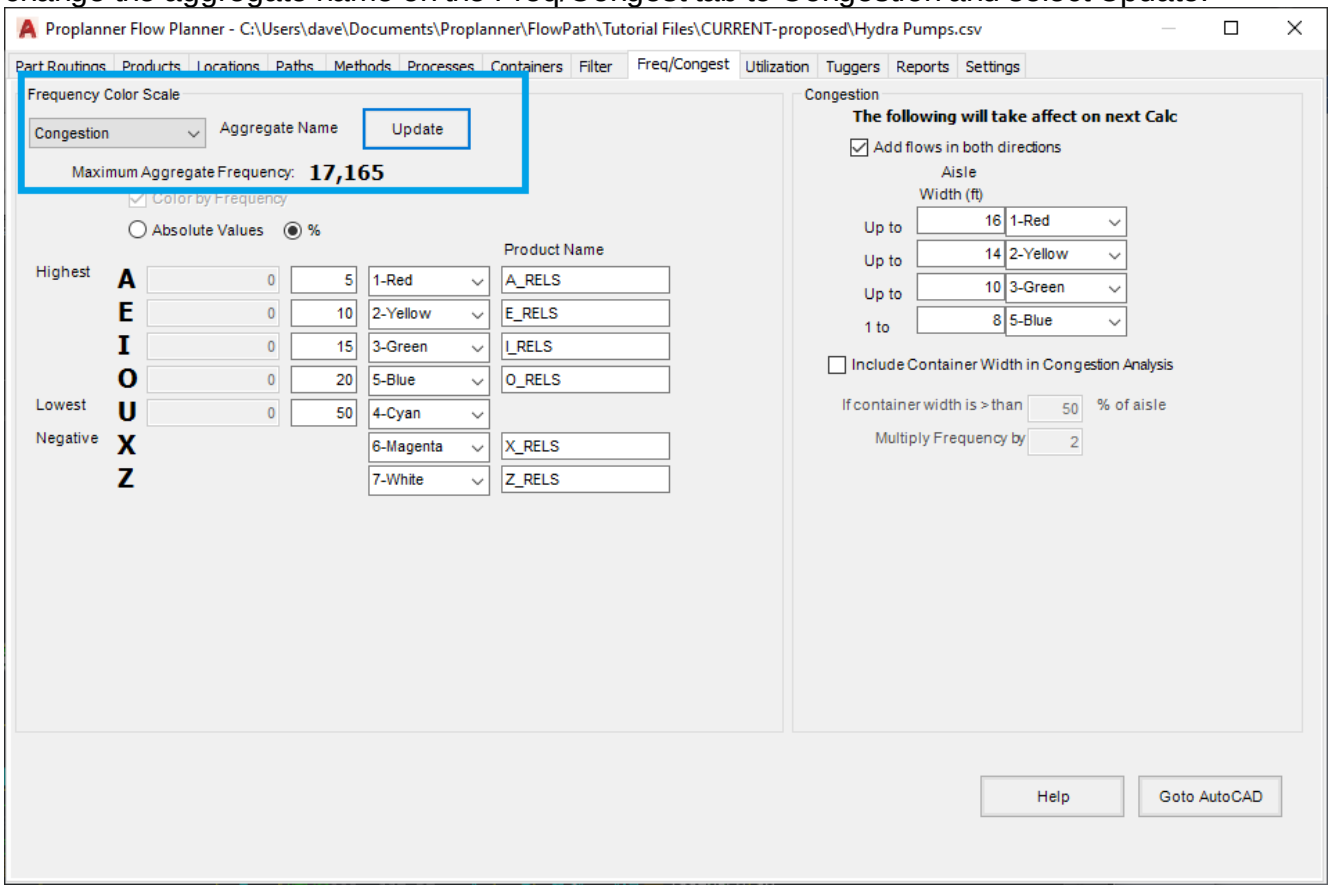
The drawing shows the colors according to settings on the "Freq/Congestion" tab. The "Frequency Color Scale" shows that the path colors are.

0 - 50%	- Cyan
51 - 70%	- Blue
71 - 85%	- Green
85 - 95%	- Yellow
96 - 100%	- Red

The percentages are based upon the highest frequency of flow. Therefore, the red lines will be those with flow frequencies between 95% and 100% of the highest frequency flow in the study.

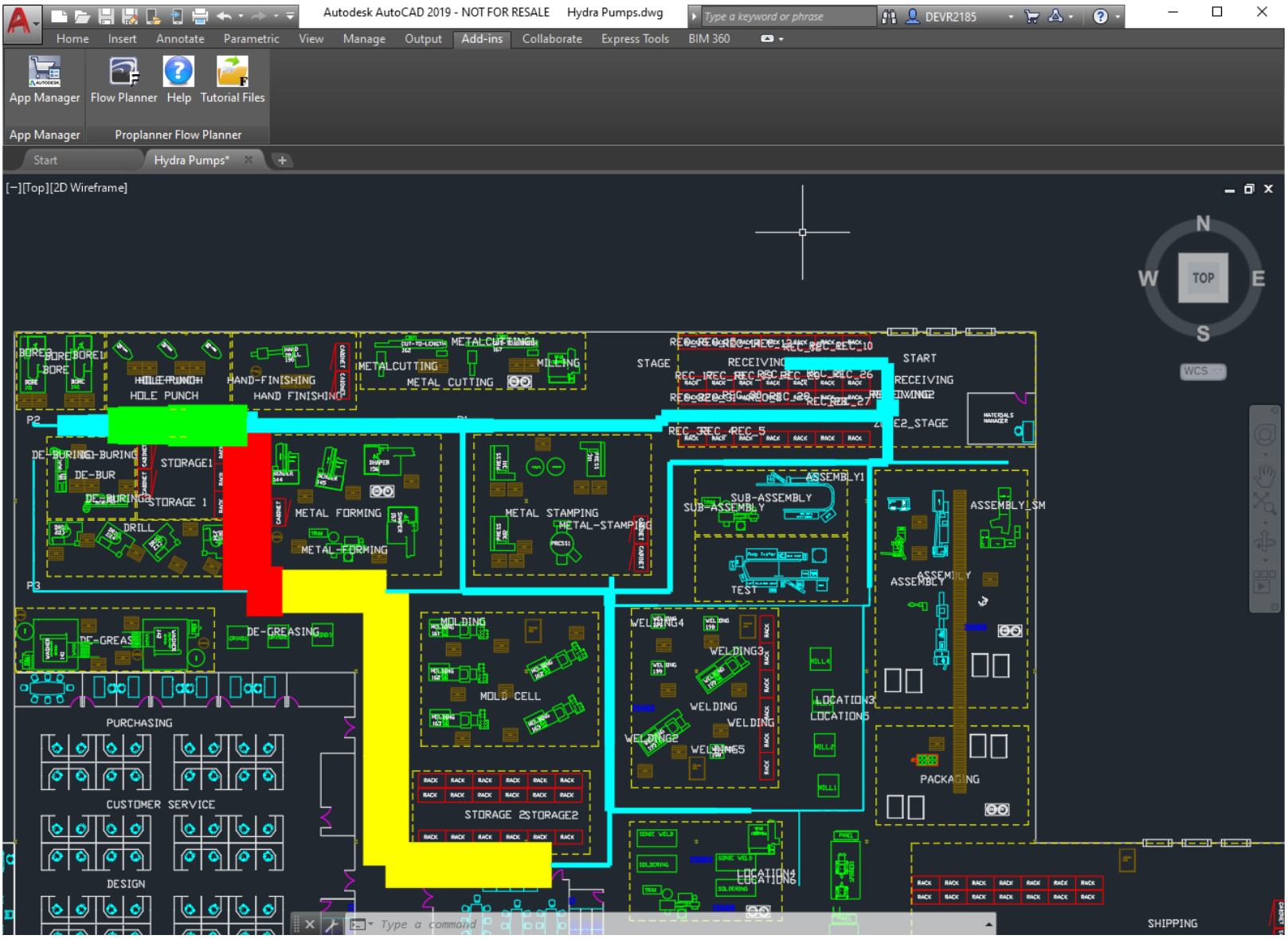
Congestion Diagrams from the Congestion Tab

To see a Congestion diagram that demonstrates where the largest amount of plant-wide flow is, change the aggregate name on the Freq/Congest tab to Congestion and select Update.



Updating To Congestion In Freq/Congest Tab

This will show information based on the calculation you have already done and sum travel over each segment of the aisle path network. When finished, a diagram showing where transportation bottlenecks may occur is provided.



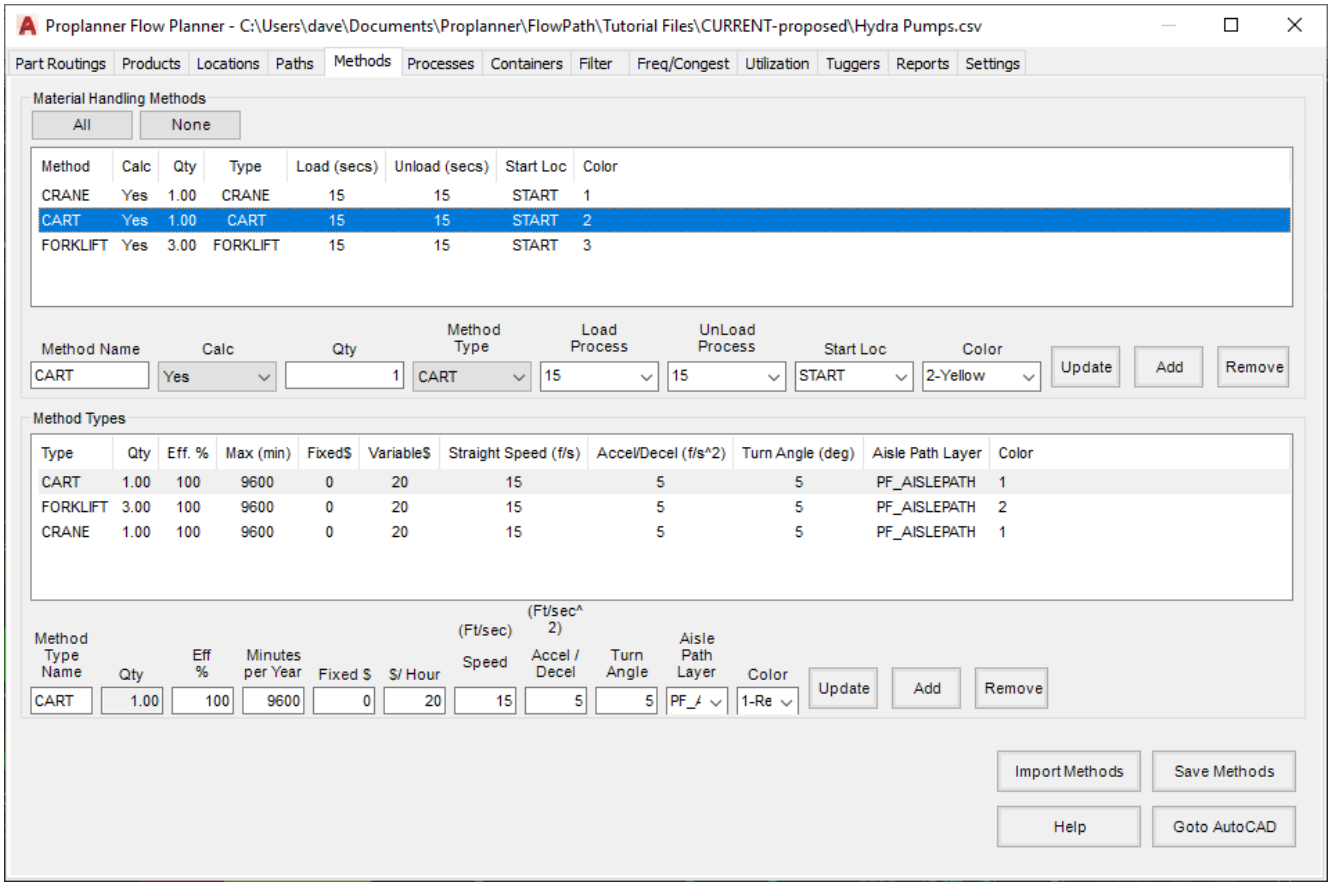
Congestion Drawing

STEP 10: Using the Methods Tab

Go to the Methods tab.

Methods and Method types are added automatically from the routing information or can be added manually. Method types are often specific instances of equipment, such as a specific fork truck or a specific group of fork truck drivers. By identifying the specific person, device or group of material handling devices on this tab and thus referencing these Method Types in your Routing, you can generate aggregated Flow Diagrams and Reports specifically for those people or equipment sets when you Calculate-by-Method on the Routings tab.

You can add a new “Method Type” by adding new values in the “Method Types” control in the lower half of the window, as shown in the following:

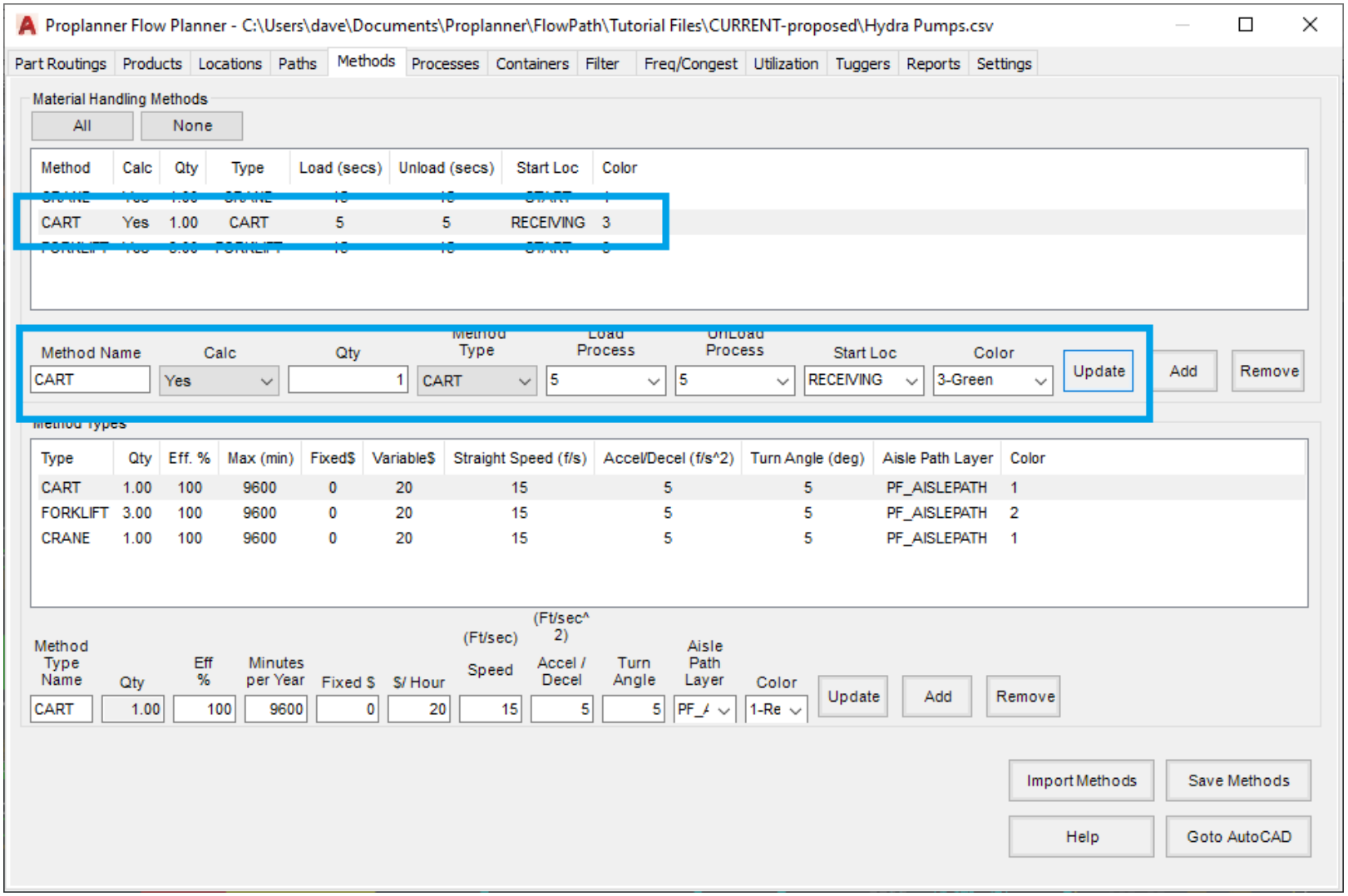


Add A New Method In Methods Tab

The user can add or edit a method type or use an existing one for this tutorial.

Next, we can add or edit a “Material Handling Method”. In the upper half of the window, select the CART method. Update the following values in the “Methods” parameters.

Method Name	= “CART”
Calc	= “Yes” (drop-down selection)
Qty	= “1”
Method Type	= "CART" (drop-down selection)
Load Process	= “5” (drop-down selection)
UnLoad Process	= “5” (drop-down selection)
Start Loc	= “RECEIVING” (drop-down selection)
Color	= “3-Green” (drop-down selection)



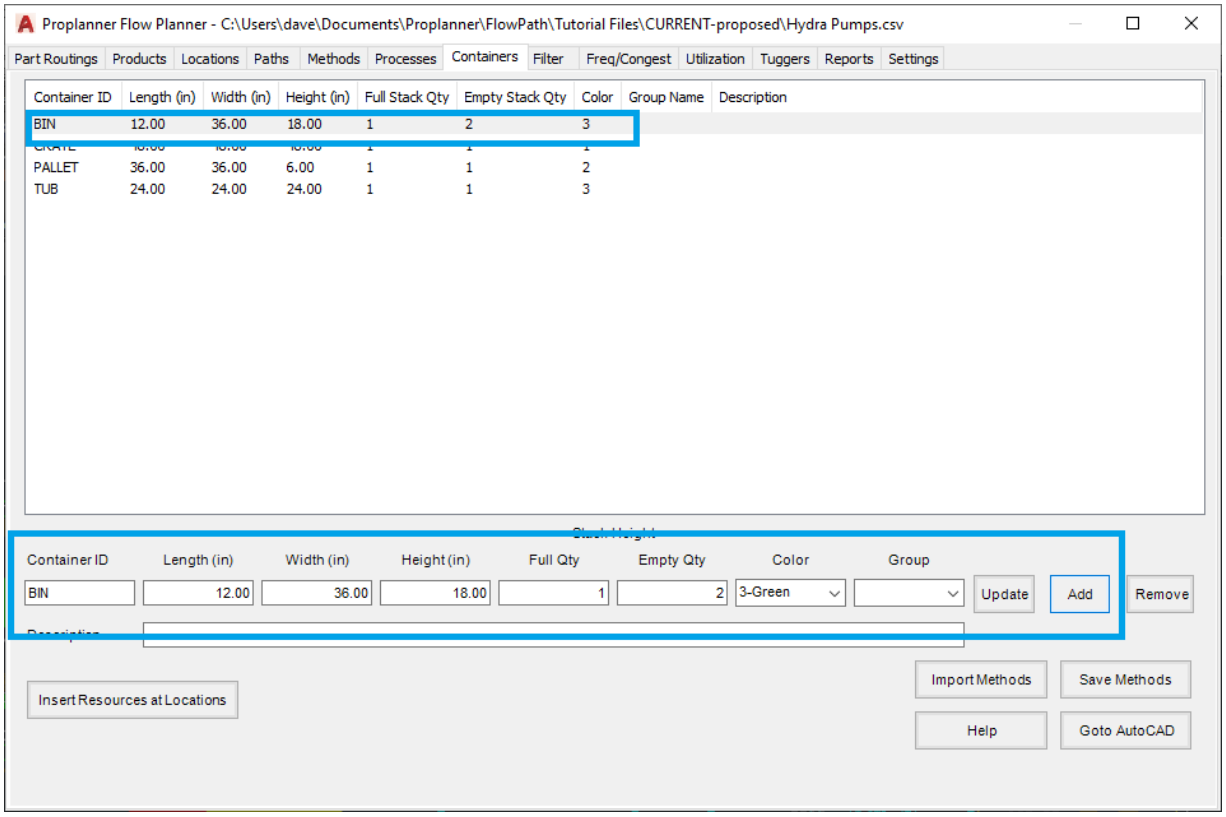
Methods Tab - Updating

Click on the "Update" button after entering the values.

STEP 11: Learning the Containers Tab

Go to the Containers Tab. (Also added automatically from the routing information or manually in this tab.) Give the following values to the “Containers” parameters.

Container ID = “BIN”
Length = “12”
Width = “26”
Height = “18”
Full Qty = “1”
EmptyQty = “2”
Color = “3-Green” (drop-down selection)



Containers Parameters - Add

Click on the “Add” button to add this new Container.

STEP 12: Reports

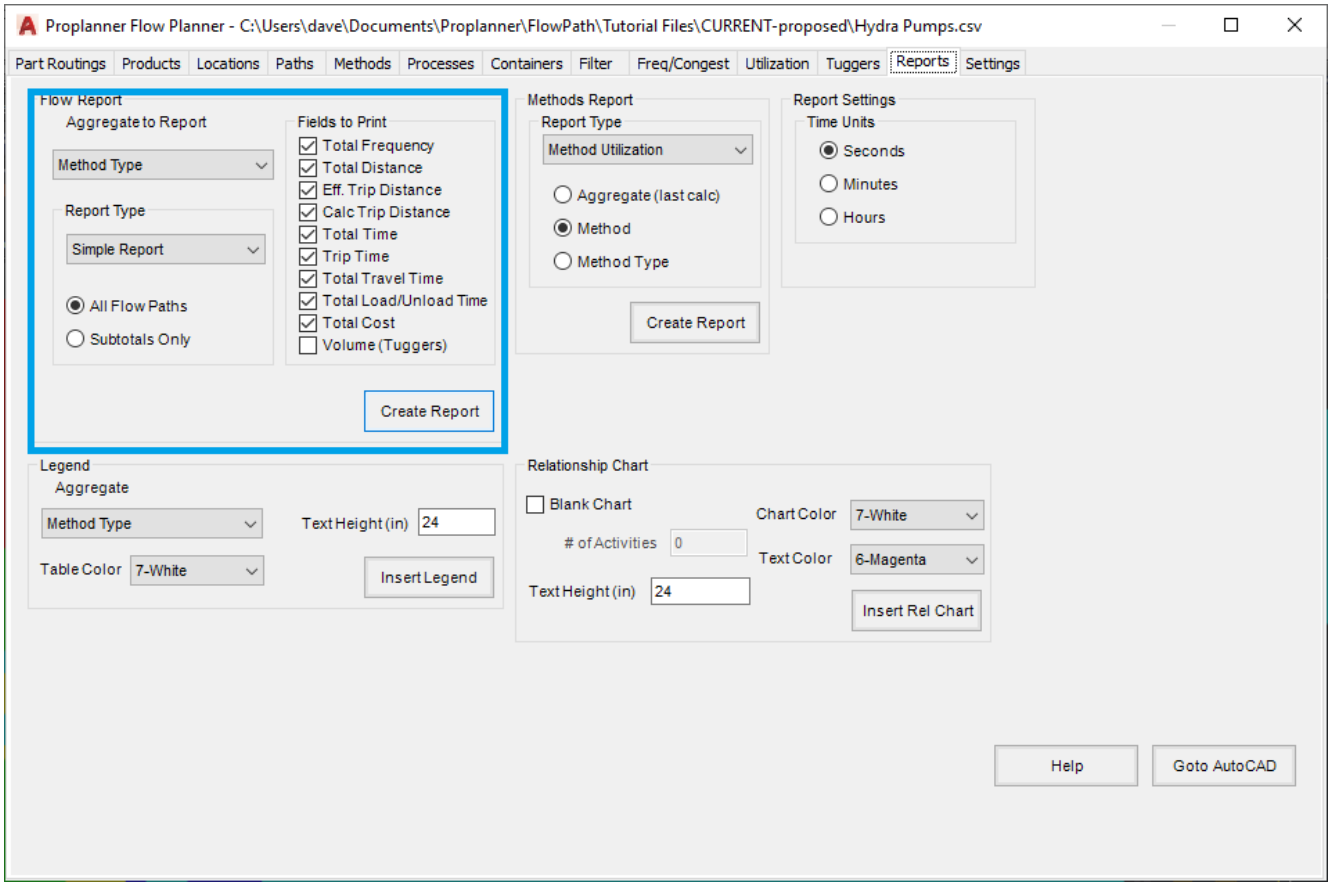
Next go to the Reports tab. Note: Since the last calculation should have been performed on Method Type, Method Type should already be selected as the aggregate in the Flow Report and Legend sections.

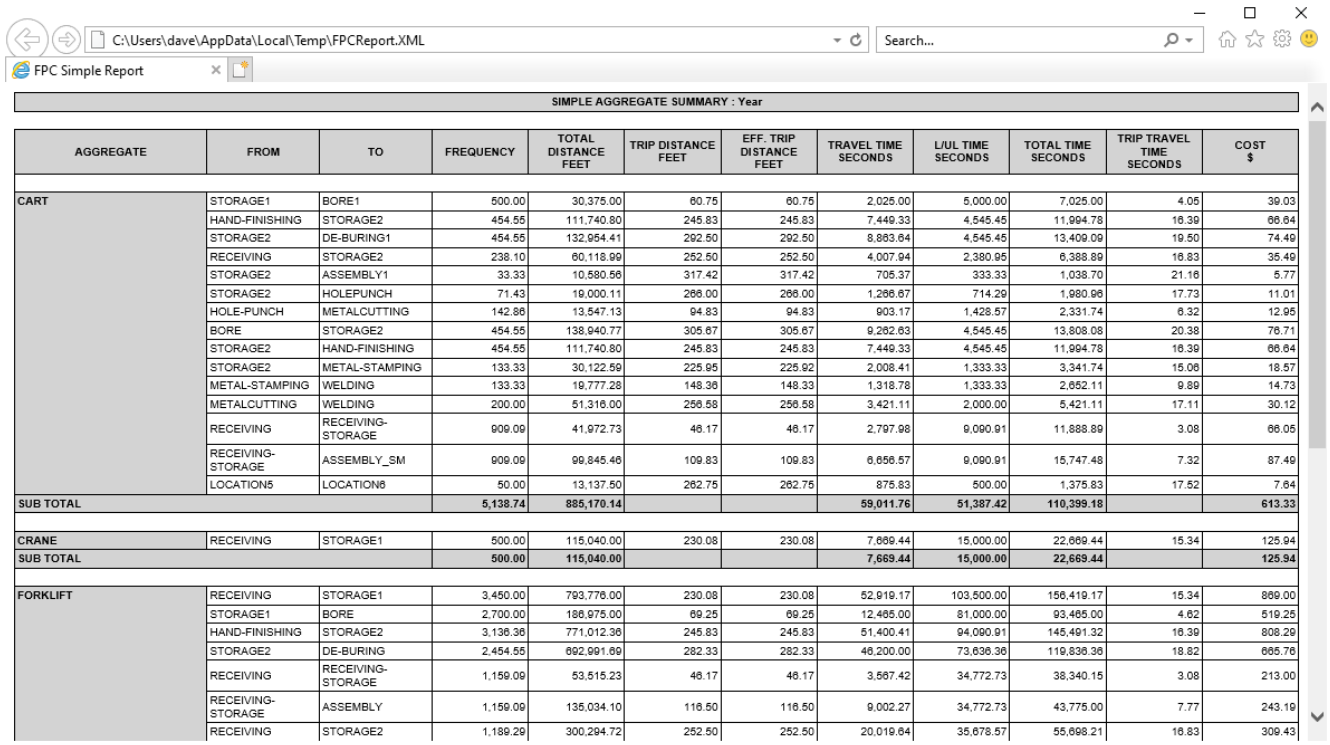
Select the appropriate fields to print by checking the box next to each field. Set the report type to All Flow Paths.

Clicking the "Create Report" button will create an XML-based report, including all of the path information in a well organized, easy to read web format.

If the time units, report type, or fields settings have been changed since creating a previous report, creating a new report will automatically display data according to the new settings.

A Material Handling Device report by method, method type, or the last aggregation can be created here also. This is produced in the same manner as the Flow Report and shows the Methods output specifically for Aggregate, Method, or Method Type.





SIMPLE AGGREGATE SUMMARY : Year

AGGREGATE	FROM	TO	FREQUENCY	TOTAL DISTANCE FEET	TRIP DISTANCE FEET	EFF. TRIP DISTANCE FEET	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	TRIP TRAVEL TIME SECONDS	COST $
CART	STORAGE1	BORE1	500.00	30,375.00	60.75	60.75	2,025.00	5,000.00	7,025.00	4.05	39.03
	HAND-FINISHING	STORAGE2	454.55	111,740.80	245.83	245.83	7,449.33	4,545.45	11,994.78	16.39	66.64
	STORAGE2	DE-BURING1	454.55	132,954.41	292.50	292.50	8,863.64	4,545.45	13,409.09	19.50	74.49
	RECEIVING	STORAGE2	238.10	60,118.99	252.50	252.50	4,007.94	2,380.95	6,388.89	16.83	35.49
	STORAGE2	ASSEMBLY1	33.33	10,580.56	317.42	317.42	705.37	333.33	1,038.70	21.16	5.77
	STORAGE2	HOLEPUNCH	71.43	19,000.11	266.00	266.00	1,266.67	714.29	1,980.96	17.73	11.01
	HOLE-PUNCH	METALCUTTING	142.86	13,547.13	94.83	94.83	903.17	1,428.57	2,331.74	6.32	12.95
	BORE	STORAGE2	454.55	138,940.77	305.67	305.67	9,262.63	4,545.45	13,808.08	20.38	76.71
	STORAGE2	HAND-FINISHING	454.55	111,740.80	245.83	245.83	7,449.33	4,545.45	11,994.78	16.39	66.64
	STORAGE2	METAL-STAMPING	133.33	30,122.59	225.95	225.92	2,008.41	1,333.33	3,341.74	15.06	18.57
	METAL-STAMPING	WELDING	133.33	19,777.28	148.36	148.33	1,318.78	1,333.33	2,652.11	9.89	14.73
	METALCUTTING	WELDING	200.00	51,316.00	256.58	256.58	3,421.11	2,000.00	5,421.11	17.11	30.12
	RECEIVING	RECEIVING-STORAGE	909.09	41,972.73	46.17	46.17	2,797.98	9,090.91	11,888.89	3.08	66.05
	RECEIVING-STORAGE	ASSEMBLY_SM	909.09	99,845.46	109.83	109.83	6,656.57	9,090.91	15,747.48	7.32	87.49
	LOCATION5	LOCATION6	50.00	13,137.50	262.75	262.75	875.83	500.00	1,375.83	17.52	7.64
SUB TOTAL			5,138.74	885,170.14			59,011.76	51,387.42	110,399.18		613.33
CRANE	RECEIVING	STORAGE1	500.00	115,040.00	230.08	230.08	7,669.44	15,000.00	22,669.44	15.34	125.94
SUB TOTAL			500.00	115,040.00			7,669.44	15,000.00	22,669.44		125.94
FORKLIFT	RECEIVING	STORAGE1	3,450.00	793,776.00	230.08	230.08	52,919.17	103,500.00	156,419.17	15.34	869.00
	STORAGE1	BORE	2,700.00	186,975.00	69.25	69.25	12,465.00	81,000.00	93,465.00	4.62	519.25
	HAND-FINISHING	STORAGE2	3,136.36	771,012.36	245.83	245.83	51,400.41	94,090.91	145,491.32	16.39	808.29
	STORAGE2	DE-BURING	2,454.55	692,991.69	282.33	282.33	46,200.00	73,636.36	119,836.36	18.82	665.76
	RECEIVING	RECEIVING-STORAGE	1,159.09	53,515.23	46.17	46.17	3,567.42	34,772.73	38,340.15	3.08	213.00
	RECEIVING-STORAGE	ASSEMBLY	1,159.09	135,034.10	116.50	116.50	9,002.27	34,772.73	43,775.00	7.77	243.19
	RECEIVING	STORAGE2	1,189.29	300,294.72	252.50	252.50	20,019.64	35,678.57	55,698.21	16.83	309.43

Create Reports

6.2 Tugger Add-on Tutorial

The Tugger Add-on is an optional upgrade when you purchase the full version of Flow Planner. The Tugger Add-on helps evaluate the benefits of material delivery using tow-train tuggers, which are able to pull multiple carts of material along prescribed routes.

In this module, you will need to specify which materials you wish to deliver and when the deliveries should happen. Then sit back and watch the Tugger route generator do the rest.

This tutorial focuses mostly on Tugger-specific features. It is assumed that you have worked through the regular Hydra Pumps tutorial and understand basic concepts of a Flow Planner study. To review how to add locations, add aisles and join locations to paths, please review the Hydra Pump tutorial. These concepts are important in the Tugger study as well.

Please note, this tutorial references the FootInch files. If you prefer to use the Metric files, make sure to open the drawing from the Metric folder, and when you're directed to open Flow Planner, go to the Settings tab and change the Line Delimiter to a semi-colon before loading the files from the Metric folder.

STEP 1: Preparing the Data

When beginning a new study, you will need to either create or import your delivery information into a spreadsheet, formatted as shown below. Once the fields are filled with their respective data, (described in the Tuggers section of the Flow Planner manual), this file will be ready to import into the Flow Planner Tugger module.

A1 *ID

	A	B	C	D	E	F	G	H	I	J	K
1	*ID	Part	Container	ContQty	From	Stage	To	ETD	Direction	Load	Unload
2	1	111456	BOX35	1	REC_2	STAGE	HOLEPUNCH	7.1	1		
3	2	111847	BOX36	1	REC_3	STAGE	DE-BURING	UFM(7/10/2/.5)	1		
4	3	111332	CRATE2	1	REC_4	STAGE	BORE	7.3	-1		
5	4	111445	CRATE2	1	REC_5	STAGE	DE-BURING1	UFM(7/10/1/1)	-1		
6	5	235448	FLAT	2	REC_14	STAGE	DE-GREASING	7.5	1	15	10
7	6	235449	FLAT	1	REC_15	STAGE	METAL-FORMING	7.6	1		
8	7	235450	FLAT	1	REC_16	STAGE	METAL-STAMPING	7.7	1		
9	8	111456	BOX35	1	REC_17	STAGE	HOLEPUNCH	8.2	1		
10	9	111847	BOX36	2	REC_10	STAGE	DE-BURING	8.1	1		
11	10	111332	CRATE2	1	REC_11	STAGE	BORE	8.7	1		
12	11	111445	CRATE2	1	REC_12	STAGE	DE-BURING1	8	1		
13	12	235448	FLAT	1	REC_13	STAGE	DE-GREASING	8.8	-1		
14	13	235449	FLAT	2	REC_30	STAGE	METAL-FORMING	8.9	1		
15	14	235450	FLAT	1	REC_31	STAGE	METAL-STAMPING	8.7	1		
16	15	235988	FLAT	1	REC_32	STAGE	METALCUTTING	8.7	-1		
17	16	235989	FLAT	1	REC_17	STAGE	HAND-FINISHING	8.5	1		
18	17	851001	CRATE2	1	REC_18	STAGE	WELDING	8.3	1		
19	18	851002	CRATE3	1	REC_19	STAGE	WELDING3	8.6	-1		
20	19	851003	CRATE4	1	REC_20	STAGE	WELDING4	7.3	1		
21	20	851004	CRATE5	1	REC_21	STAGE	SUB-ASSEMBLY	8.5	1		
22	21	851005	FLAT	1	REC_14	STAGE	ASSEMBLY1	8.3	1		

Tugger File Spreadsheet

This is an example of the route file which is saved in a .CSV format.

This file contains the part movements, pick/drop information, and delivery times.

In this example, you will use a set of input files provided with the software installation. These files can be found in the directory where the program is installed (most commonly "C:\Program Files\Proplanner\FlowPlanner").

This analysis is set up to analyze a material handling person starting at a STAGE location and then leaving to pick up containers in a receiving area to fill their tugger's carts (in the shortest path order). Next, this person returns to the STAGE location, then drives out to the shop floor to deliver those containers (in the shortest path order). When completed, this person will return to the STAGE location.

If you intended to do a smaller study and only analyze deliveries to the shop floor, or only the filling of tugger carts in the receiving area, then leave the FROM or TO columns blank, respectively.

About the Sample File

The example has Estimated Times of Delivery (ETD) specified as decimal hour values (from 0 to 24), with the exception of two containers. The ETD of the two exceptions is statistically determined as any time between 7am and 10am.

The second container in the file (row 3) specifies that two container deliveries must be individually performed and each of them has a 50% probability of being delivered (UFM/7/10/2/0.5).

The fourth container (row 5) specifies that one delivery will be scheduled with a 100% probability of happening.

The ContQty column (column D) specifies how many containers will be delivered per scheduled delivery. Most of the time, this column will have a value of 1 since containers are often delivered to the line individually (as opposed to in lots of 2, 3, 4, etc).

The Direction column (column I) in this file specifies where containers are loaded and unloaded. The default value of 1 means that containers are LOADED in the FROM location and UNLOADED in the TO location. A value of -1 means that the containers are UNLOADED at the FROM location and LOADED at the TO location, which is often done when picking up empty containers. The only valid values for this column are 1 and -1.

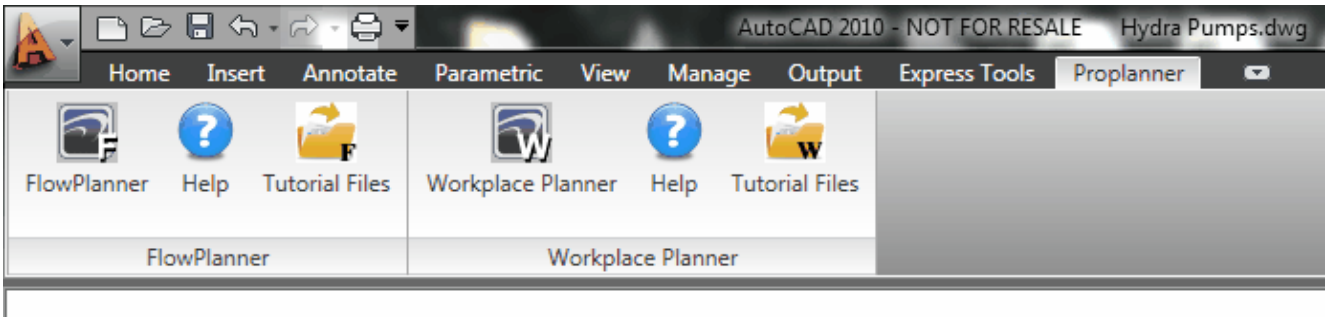
Finally, the TUG device has a specified handling time. However, this can be overridden with the LOAD and UNLOAD columns (column J and column K, respectively). Any entries in this column will be used instead of the specified TUG handling time. In the example, only one container (row 6) has a LOAD and UNLOAD time specified.

Note: For a more detailed explanation of the inputs and data definitions, see the Tuggers Tab section of the Flow Planner manual.

STEP 2: Open AutoCAD and Launch Flow Planner

To begin, start AutoCAD. Open the Hydra Pumps.DWG file. This file is provided in the HELP directory within the directory where the Flow Planner application was installed. (Most commonly, it will be in "C:\Program Files\Proplanner\FlowPlanner").

Select the Flow Planner icon button in the Proplanner ribbon of AutoCAD to open the main Flow Planner application window.

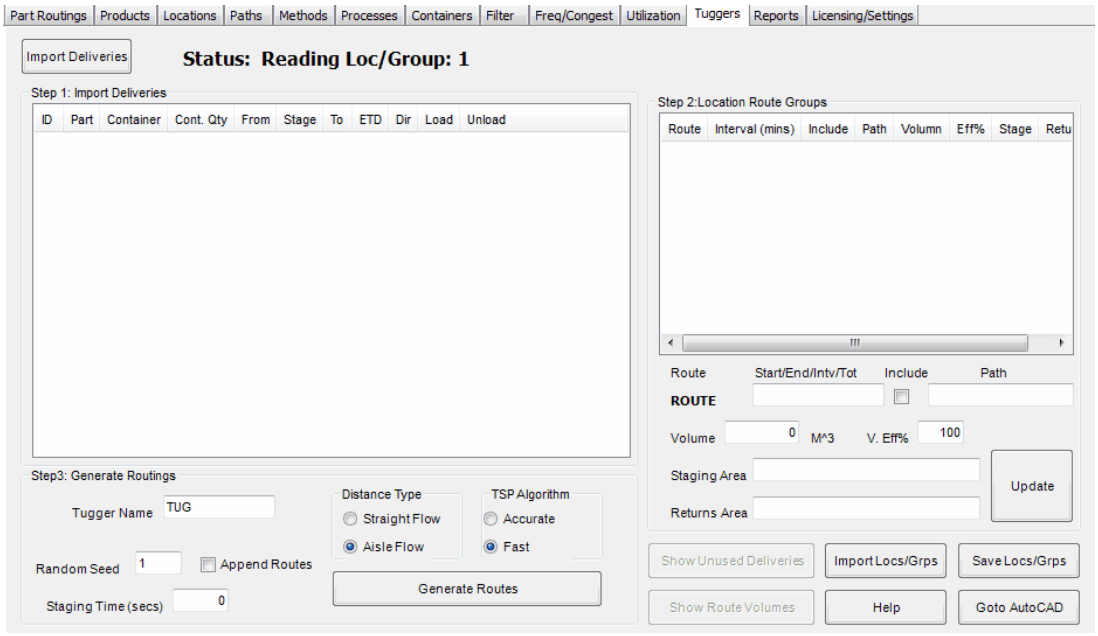


Flow Planner In Proplanner Tab

STEP 3: Opening the Tugger Delivery File

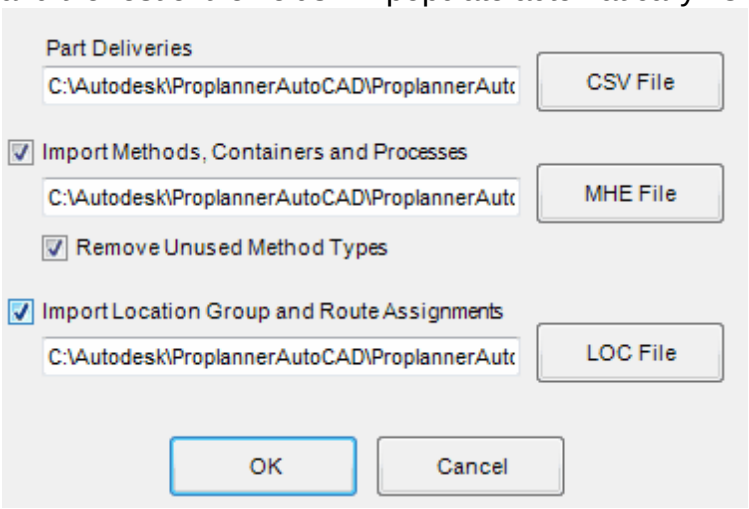
Then go to the Tuggers Tab (shown below).

Select "Import Deliveries" (top left) to open the delivery information files.



Tuggers Tab - Import Deliveries

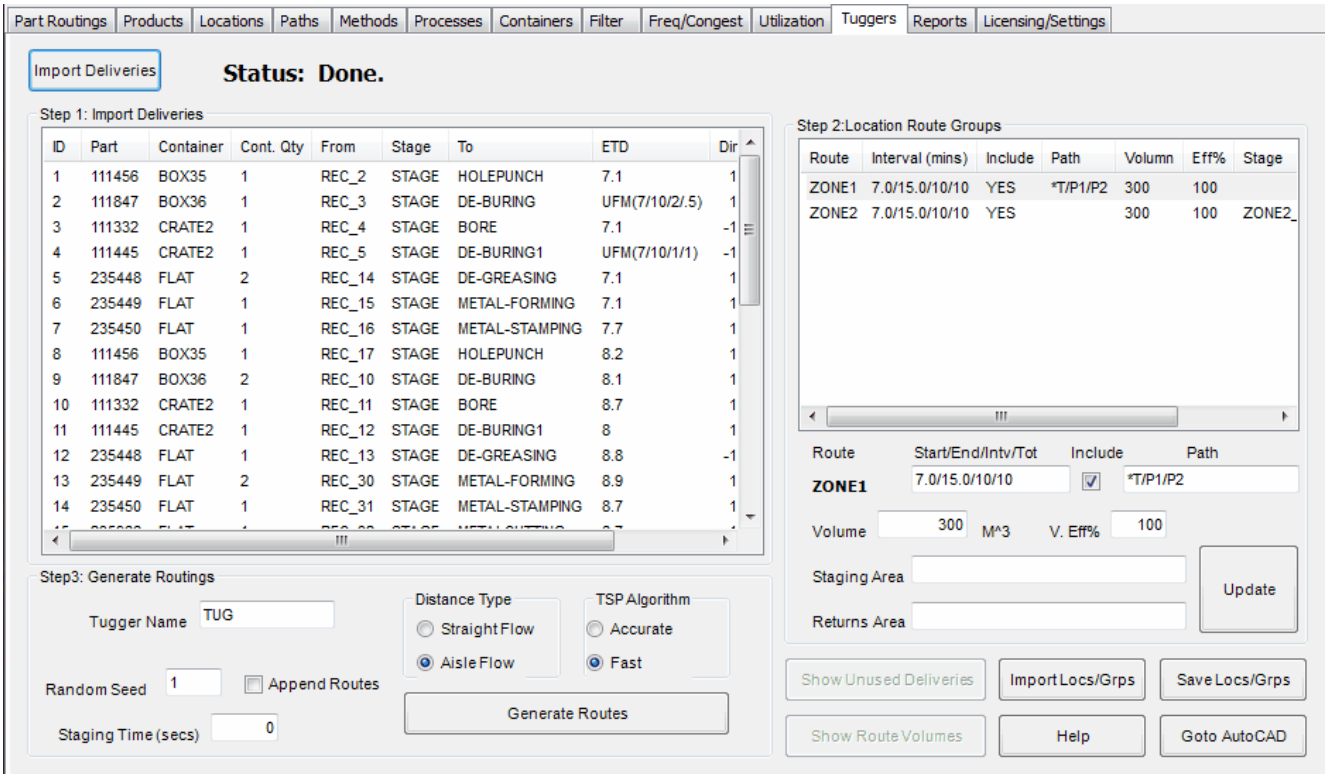
A window like the one below will come up, prompting the user to select the delivery files to be imported. Select the CSV file button, find 'Hydra Pumps Tugger.csv' from the folder where the program is installed, and the rest of the fields will populate automatically. Click "OK".



File Location Window

Step 4: Double Checking the Data

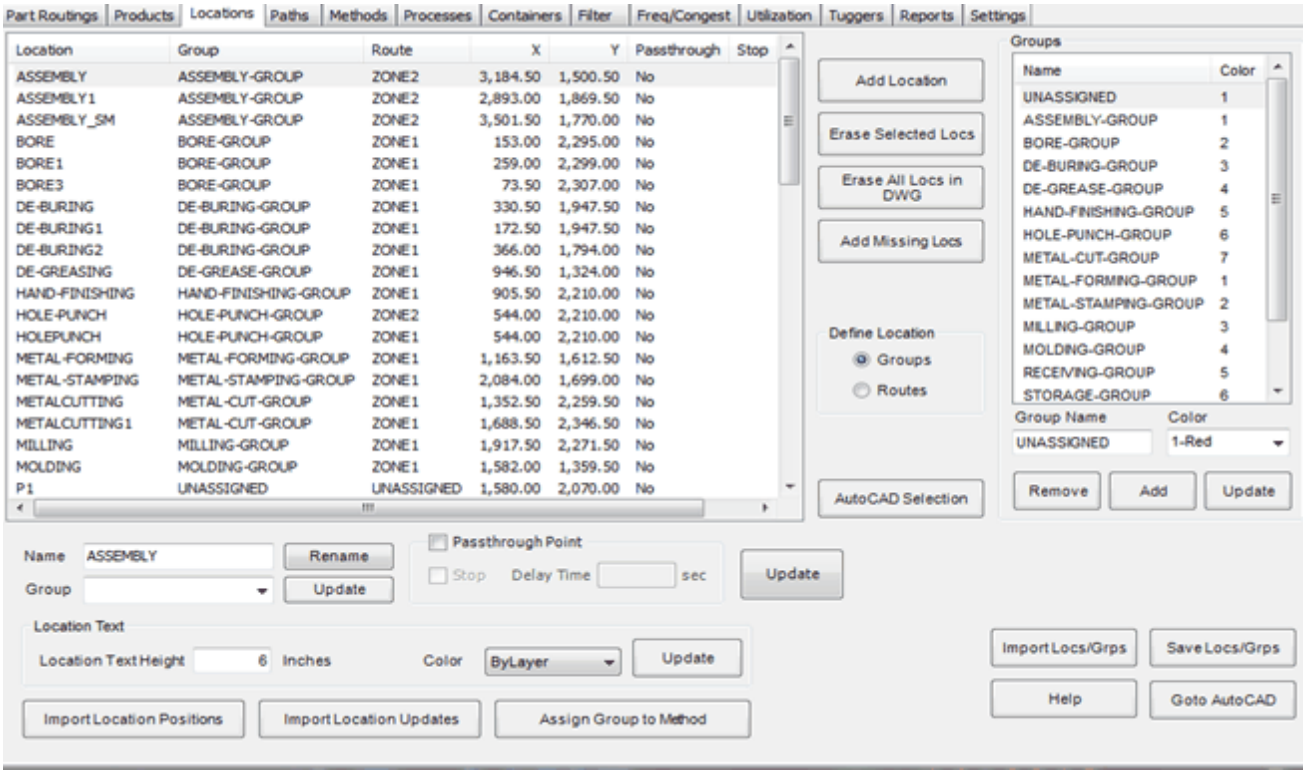
At this point, check to see that delivery and location route group information has been imported correctly. Then go to the Locations Tab to ensure that each location referenced in the delivery information has coordinates tied to it. This ensures that Flow Planner knows where the location exists in the AutoCAD drawing.



Delivery & Location Import Successful

By clicking "Add Missing Locs", the program will check if locations are tied to the coordinates. If not, the user will be prompted to place missing locations on the drawing.

Notice that the ROUTE column in the Locations list box has a value of either ZONE1 or ZONE2. This example has two tugger drivers, and each of them are restricted to certain locations. One driver serves ZONE1 and the other serves ZONE2. Locations can be assigned to routes either with the list box or graphically. To assign locations to zones graphically, draw a window around the appropriate locations in the AutoCAD drawing then assign them to a particular route driver (for this tutorial, ZONE1 or ZONE2).



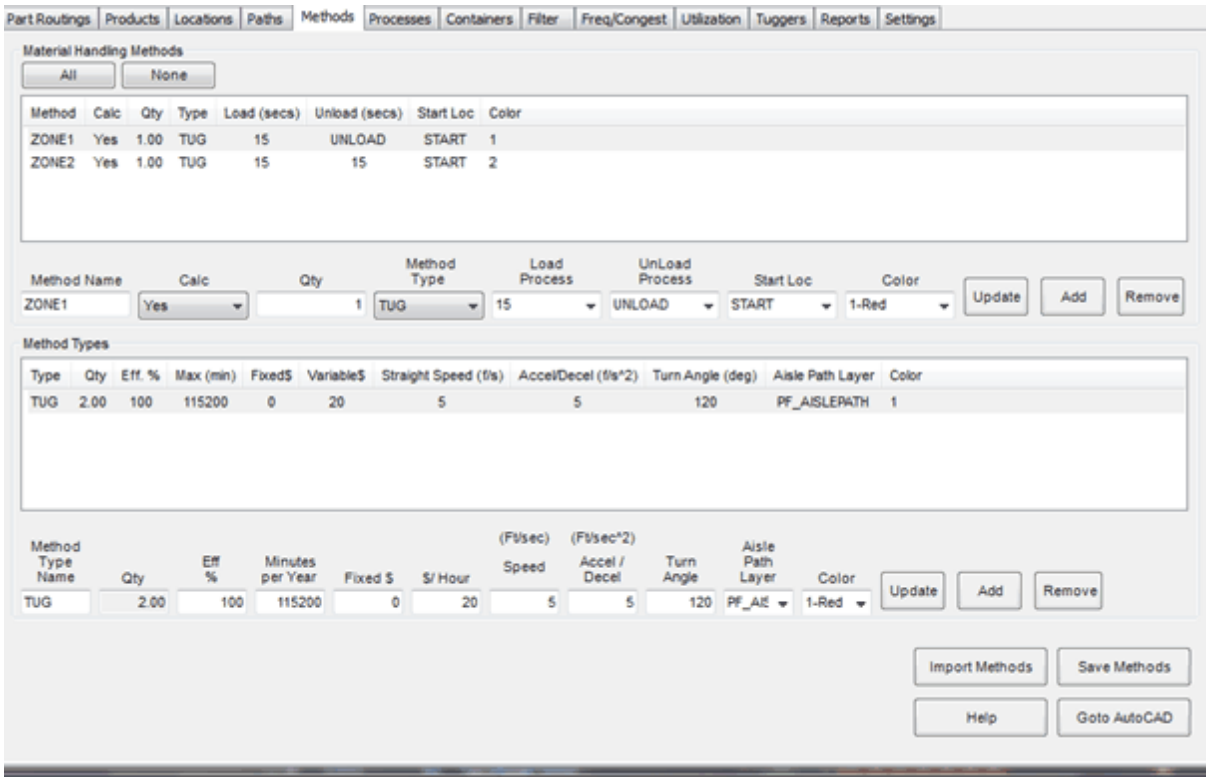
Tuggers - Route Column

STEP 5: Methods for Tuggers

In the Methods Tab, we can view and change the information for the material handling devices. Each route driver has a load time and an unload time and a Method Type.

You can see in this example that the load time is 15 seconds for both ZONE 1 and ZONE2. However, the two drivers differ in unload time. The ZONE1 driver's unload time is specified with a Process name (UNLOAD), but the ZONE2 driver's unload time is 15 seconds.

Both drivers use a Method Type (device) of TUG and this device is set to have a speed of 5 feet/second.

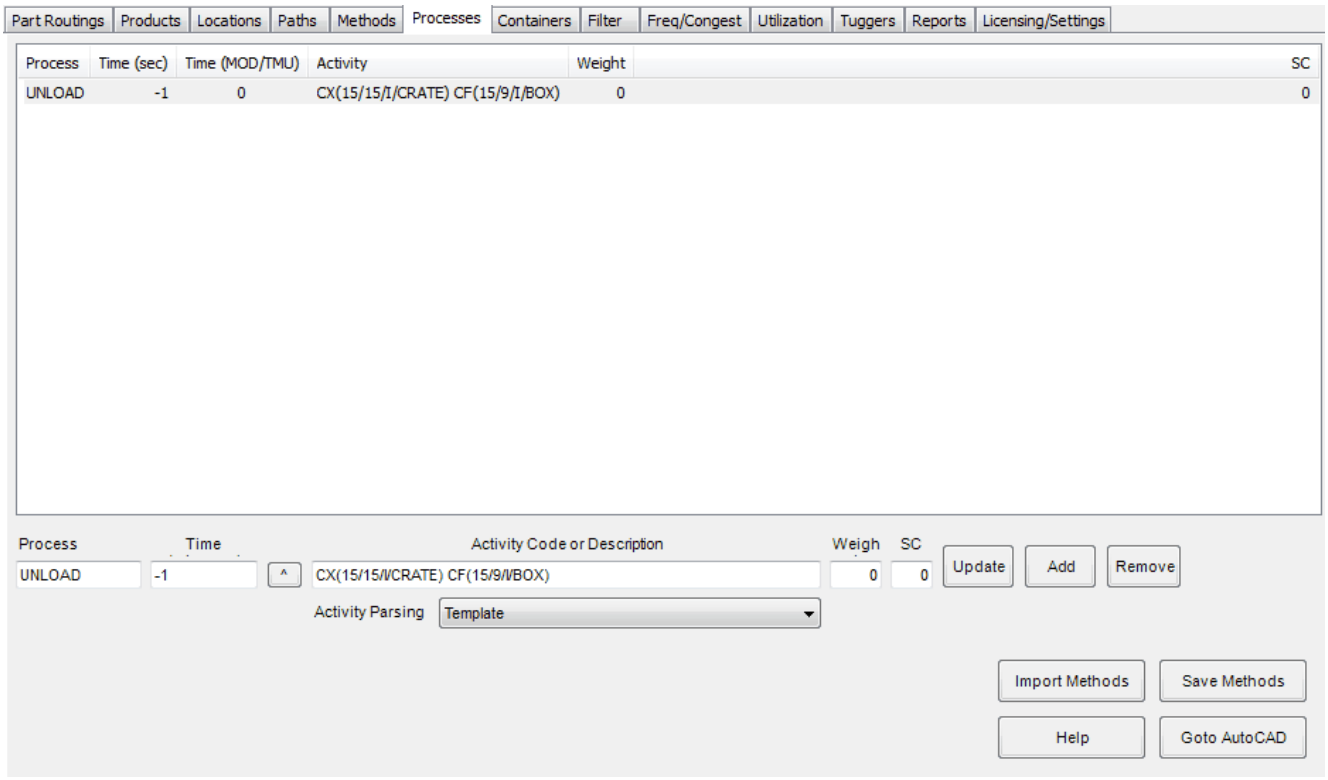


Method Type of TUG & Information

Using Processes To Specify Method Times*

To see the UNLOAD process used for the ZONE1 driver's unload time, go to the Process Tab. Processes are essentially an equation you build and use to calculate time based on the current trip parameters, which may include the type of container that is being moved.

In this case, the UNLOAD equation gives the driver a time of 15 seconds per location visited, plus an additional 15 seconds per CRATE or an additional 9 seconds per BOX.



Processes Tab - Method Times

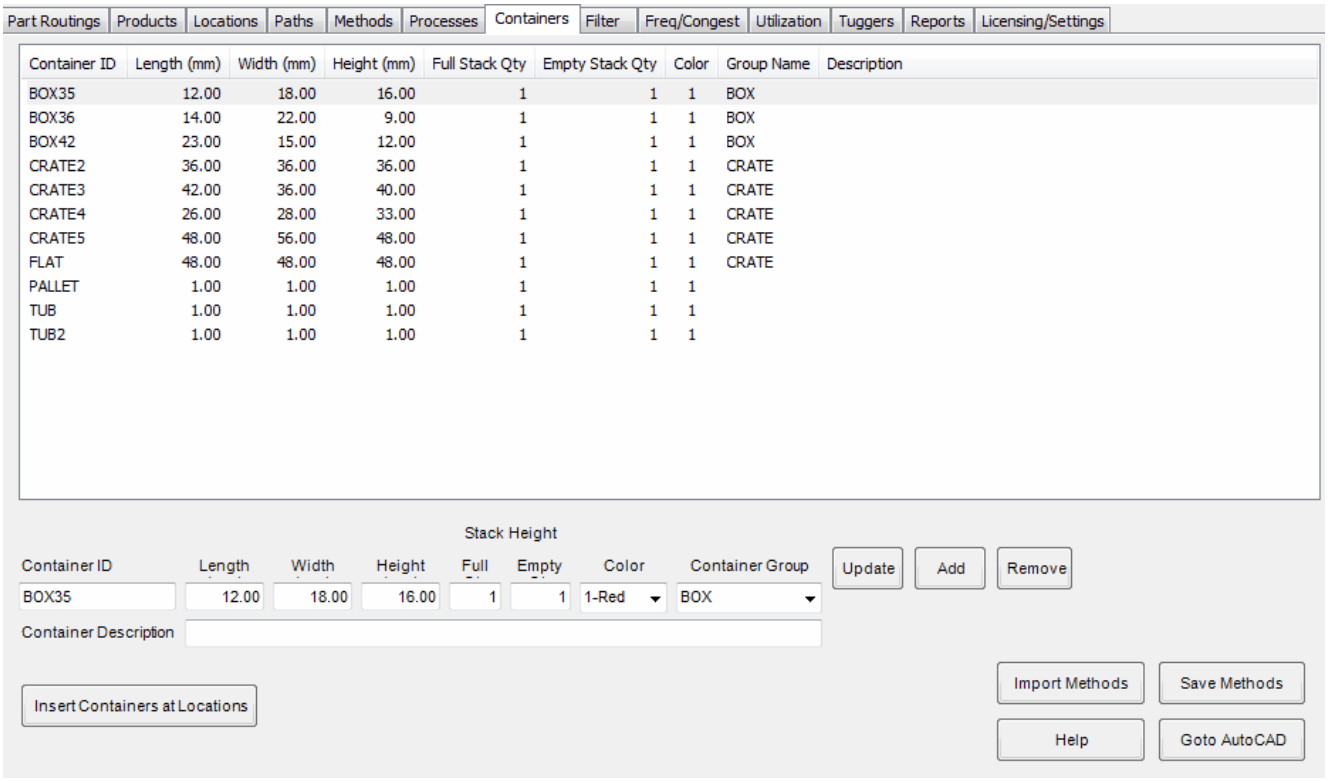
**To learn more about specifying times with processes, see the Process Tab section and review the Process information for the UNLOAD task.*

Step 6: Reviewing Container Information

Select the Containers Tab to view information on the containers that hold the parts as they are transported. This list is populated from the information in the Deliveries file.

Note that the CRATE and BOX container types referred to in the Process Tab are here, and you can see sizes of individual containers that belong to those groups. You can specify your sizes here in the Container Tab or you can load the correct sizes via the Methods file (MHE), which can be edited in Microsoft Excel. If no size is specified, the default value for containers is set at 1 by 1 by 1.

Container sizes are used by the tugger module to determine the available volume capacity on the tugger carts.



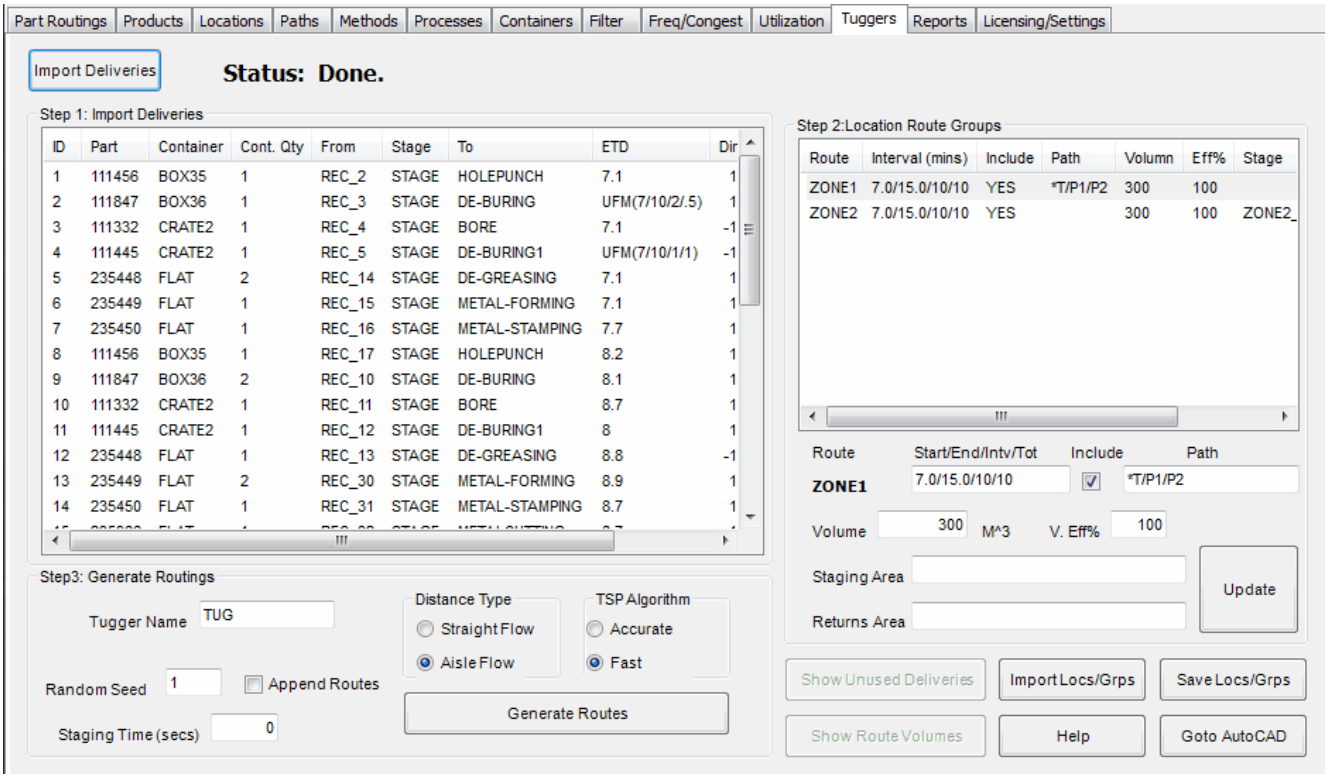
Containers Tab - Tugger Volume Capacity Information

Step 7: Creating Routings

After importing and verifying information about delivery, locations and routes, it is time to create the routes the tugger trains will travel. This takes place in the Tugger Tab.

The first thing to do is to provide a time for the staging activity (e.g. the hookup of carts). Type the time in the staging time box on the lower left. Next, select the Aisle Flow option for the Distance Type. Then click Generate Routes.

The Aisle Flow option computes the shortest path between delivery locations using the aisles. This option takes longer than the Straight Flow option, but produces more realistic delivery sequences. It may be helpful to do a couple of preliminary runs with Straight Flow to validate your data; Straight Flow will help you see if you have misplaced a location or if something is missing. However, for a useable analysis, select the Aisle Flow option.



Creating Tugger Routes

Finally, specify how the tugger will run. You will need to specify the time the tugger route will run and when it will end. You also state how long each trip is and how long the tugger has to return. Information about the capacity of the tugger train and expected utilization is also needed.

To illustrate, look at our example. ZONE1 operates from 7am to 3pm, which, in military time is 1500. So the (Start/End/Intv/To) begins (7/15/Intv/To).

A tugger train is dispatched every 10 minutes. It has 10 minutes to return from its delivery before it is expected to go out again for the next delivery run. This completes our ZONE1 route equation: (7/15/10/10).

This driver also has a cart capacity of 300 cubic feet (Volume=300 ft^3) and is expected to be able to use all available space and obtain a 100% packing efficiency (V. Eff%=100).

The ZONE1 route driver also has two Passthru points along the aisle network that he/she must visit sometime during their delivery from STAGE to the TO locations. You will notice that the

ZONE2 driver has no Passthru points, and thus can take the most efficient path through the plant for each delivery. (You will need to adjust the column widths in the Route Groups list box on the right in order to see all of the fields of data.)

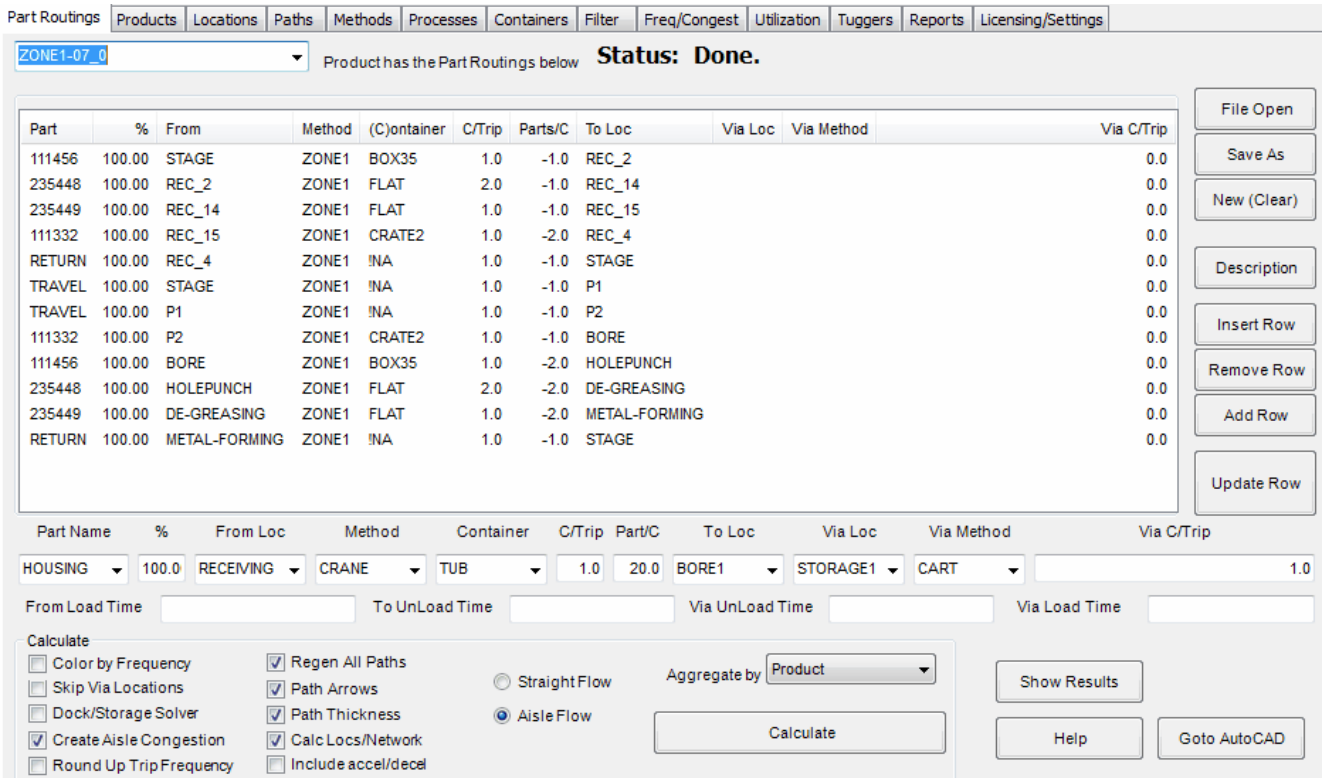
NOTE: If the you wish to assign mandatory Passthru points to the devices, it is necessary to enter the names of these Passthru points into the Location Route Groups section (under Tugger Route). These Passthru points must be entered in the order that you want the application to visit them, and the location names must be separated by forward slashes. The user will be prompted for these points when selecting the "Calculate" or "Add Missing Locs" commands.

When you have set your preferences for the calculation, click "Generate Routes" to assign all deliveries to a specific route. The assignments are made based on the FROM and TO information given in the Locations Tab. After the route is assigned, Flow Planner will then assign each delivery to a specific delivery time for the given route. When the routes have been generated, Flow Planner will automatically take you to the Part Routings Tab.

Reviewing the Generated Routings

Each of the deliveries for a given route is listed individually; you can switch from one to another by selecting from the Product drop-down menu. The route is named by listing the route and then the time of dispatch. In the screenshot below, you can see that ZONE1 is the currently selected route and the time of dispatch is 07_0 or 7 am and 0 minutes. If you click on the drop-down menu, you chould choose to look at ZONE1-07_50, or the zone one deliveries that are dispatched at 7:50 am.

If there are times of day when a delivery could take place but does not, it is likely because no deliveries were required at that time. For example, ZONE1-07_20 does not exist. This means that no deliveries were necessary between the ZONE1-07_10 and ZONE1-07_30 deliveries.



Reviewing Routes

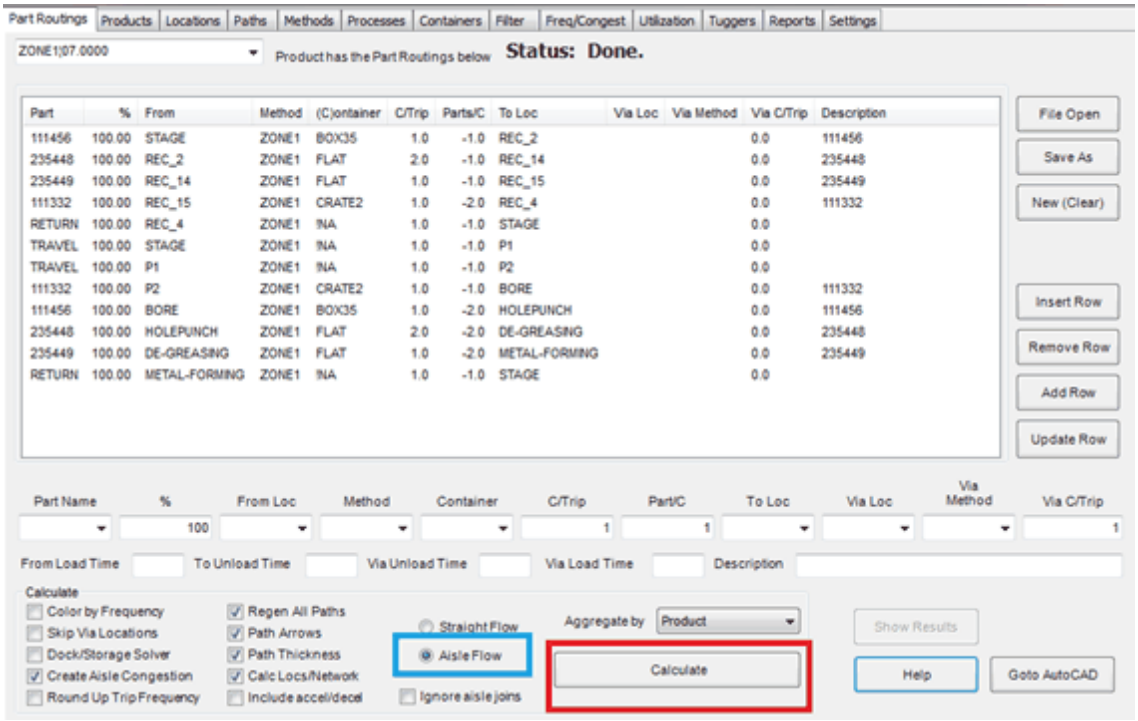
Let us look at the deliveries scheduled for ZONE1 at 7:00 am. This particular route begins in the staging area, STAGE. It then proceeds to REC_2, REC_14, REC_15, REC_4 before returning to STAGE. There are two Passthru points, P1 and P2, that are visited. Next, the tugger delivers to BORE, HOLEPUNCH, DE-GREASING and METAL-FORMING. After these deliveries, it returns again to STAGE to prepare for the next delivery.

This route was created and sequenced by the tugger route generator to minimize the total distance required to visit all of the listed locations.

Step 8: Generate Tugger Flow Diagrams

Now that the Tugger Tab has generated the routings for every time increment, it is time to create flow diagrams. This portion of the process works like a regular study.

The flow diagram is created in the Part Routings Tab. Select Aisle Flow (see blue box in the screenshot below). Then click the Calculate button (in the red box in the screenshot below).

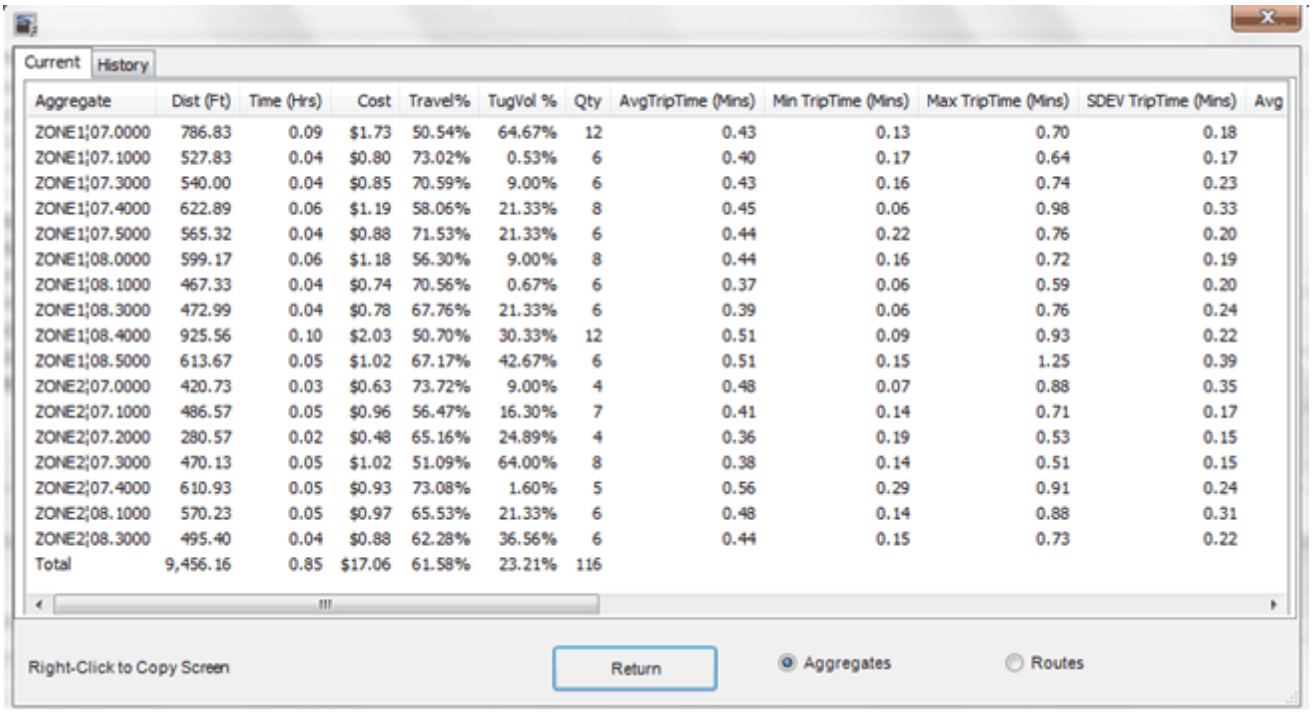


Creating Flow Diagrams - Calculate

Results Screen

When the calculations are complete, the Results screen will pop up. You will see data for each delivery time, including the distance traveled, how long the trip took, the cost, and information about the utilization of the tugger. The aggregate (all routes) results are displayed by default.

If you select the Routes radio button at the bottom of the screen, you may view results broken down by route.



Aggregate	Dist (Ft)	Time (Hrs)	Cost	Travel%	TugVol %	Qty	AvgTripTime (Mins)	Min TripTime (Mins)	Max TripTime (Mins)	SDEV TripTime (Mins)	Avg
ZONE1¦07.0000	786.83	0.09	$1.73	50.54%	64.67%	12	0.43	0.13	0.70	0.18	
ZONE1¦07.1000	527.83	0.04	$0.80	73.02%	0.53%	6	0.40	0.17	0.64	0.17	
ZONE1¦07.3000	540.00	0.04	$0.85	70.59%	9.00%	6	0.43	0.16	0.74	0.23	
ZONE1¦07.4000	622.89	0.06	$1.19	58.06%	21.33%	8	0.45	0.06	0.98	0.33	
ZONE1¦07.5000	565.32	0.04	$0.88	71.53%	21.33%	6	0.44	0.22	0.76	0.20	
ZONE1¦08.0000	599.17	0.06	$1.18	56.30%	9.00%	8	0.44	0.16	0.72	0.19	
ZONE1¦08.1000	467.33	0.04	$0.74	70.56%	0.67%	6	0.37	0.06	0.59	0.20	
ZONE1¦08.3000	472.99	0.04	$0.78	67.76%	21.33%	6	0.39	0.06	0.76	0.24	
ZONE1¦08.4000	925.56	0.10	$2.03	50.70%	30.33%	12	0.51	0.09	0.93	0.22	
ZONE1¦08.5000	613.67	0.05	$1.02	67.17%	42.67%	6	0.51	0.15	1.25	0.39	
ZONE2¦07.0000	420.73	0.03	$0.63	73.72%	9.00%	4	0.48	0.07	0.88	0.35	
ZONE2¦07.1000	486.57	0.05	$0.96	56.47%	16.30%	7	0.41	0.14	0.71	0.17	
ZONE2¦07.2000	280.57	0.02	$0.48	65.16%	24.89%	4	0.36	0.19	0.53	0.15	
ZONE2¦07.3000	470.13	0.05	$1.02	51.09%	64.00%	8	0.38	0.14	0.51	0.15	
ZONE2¦07.4000	610.93	0.05	$0.93	73.08%	1.60%	5	0.56	0.29	0.91	0.24	
ZONE2¦08.1000	570.23	0.05	$0.97	65.53%	21.33%	6	0.48	0.14	0.88	0.31	
ZONE2¦08.3000	495.40	0.04	$0.88	62.28%	36.56%	6	0.44	0.15	0.73	0.22	
Total	9,456.16	0.85	$17.06	61.58%	23.21%	116					

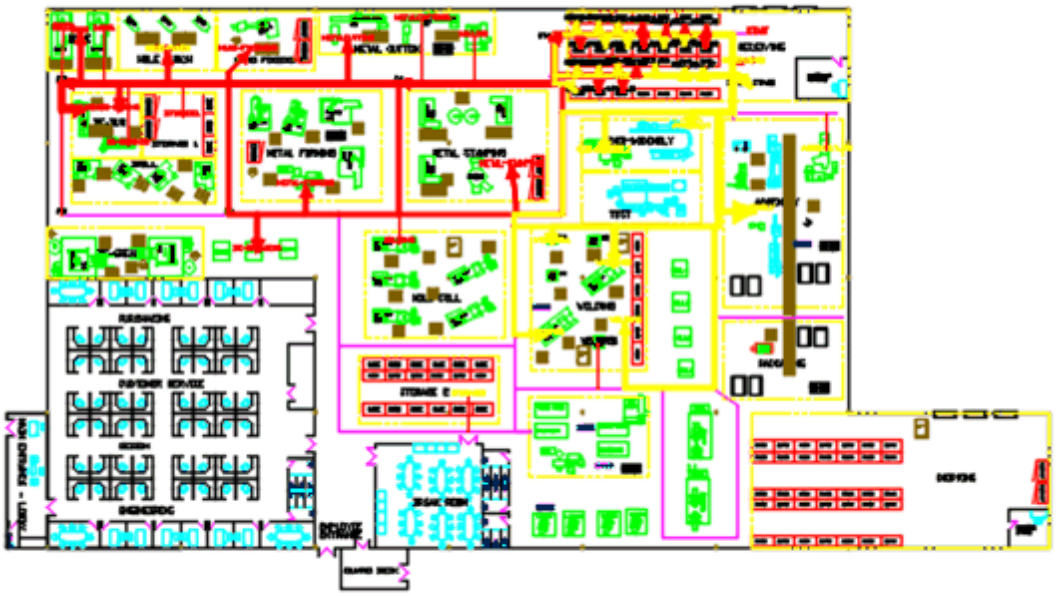
Results

After reviewing the numerical results, click "Return". You will be taken to the AutoCAD drawing.

Changing Path Thickness

You can see the flow lines in the AutoCAD drawing. It will look something like the image below.

The flow lines may be difficult to see because they are very thin. To change this, go to the Paths Tab and set the "Flow Path Thickness Scale" to 1000 and select the "UPDATE" button. The lines will show up much thicker.

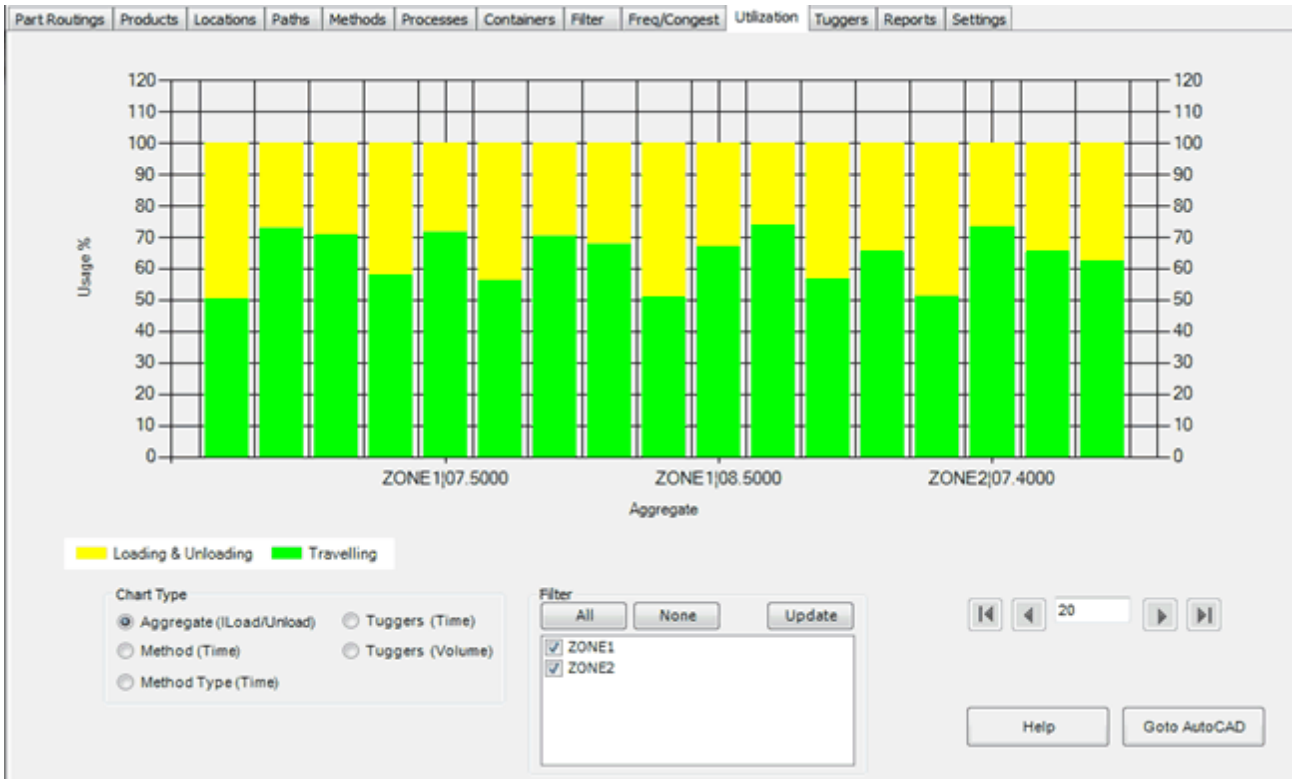


Paths Tab - Changing Path Thickness

Reviewing Utilization

In addition to seeing numerical results, there are graphical depictions of the utilization for each route. To see these, go to the Utilization Tab.

The Aggregate (Load/Unload) chart type shows the amount of time spent traveling versus the time spent loading and unloading. The data comes from the last calculation, so whichever aggregation type was used is displayed. In the screenshot below, the data is for the by Route/Product aggregation.



Utilization Tab - Route/Product Aggregation

The Tuggers (Time) chart type shows the proportion of time that the operator is busy, idle and over utilized for each route. This shows you whether or not more deliveries can be made during a given route, at least as far as time utilization is concerned.

To change chart type, change the radio button selection at the bottom middle of the screen.

The Tuggers (Volume) chart shows the utilization of the tugger train by volume. It breaks down the tugger capacity by full, empty or over utilized. This is based on the specified total volume.

Comparing this chart to the time chart helps you see that some of the deliveries have too much container volume, but there is extra time. In your future studies, it may be the case that there is extra volume capacity, but the operator is already over utilized according to the time available. These two charts work well together to give you a comprehensive picture of the tugger's workload.

Volume percentages are calculated from the available volume information; this is found on the Tuggers Tab. Each route shown below has a cubic unit volume (with respect to the drawing units) that specifies the space available on the handling device. Also taken into consideration is the volume efficiency of the tugger carts.

Step 9: Validating with Straight Flow

Since the tugger routes get drawn over each other with the Aisle Flow option, it is recommended you also run a calculation with the Straight Flow technique. The numerical results will obviously not be as precise, but the Straight Flow gives you a clear idea of where parts are traveling to or from. It is much easier to spot a part that is originating in an incorrect location, for example.

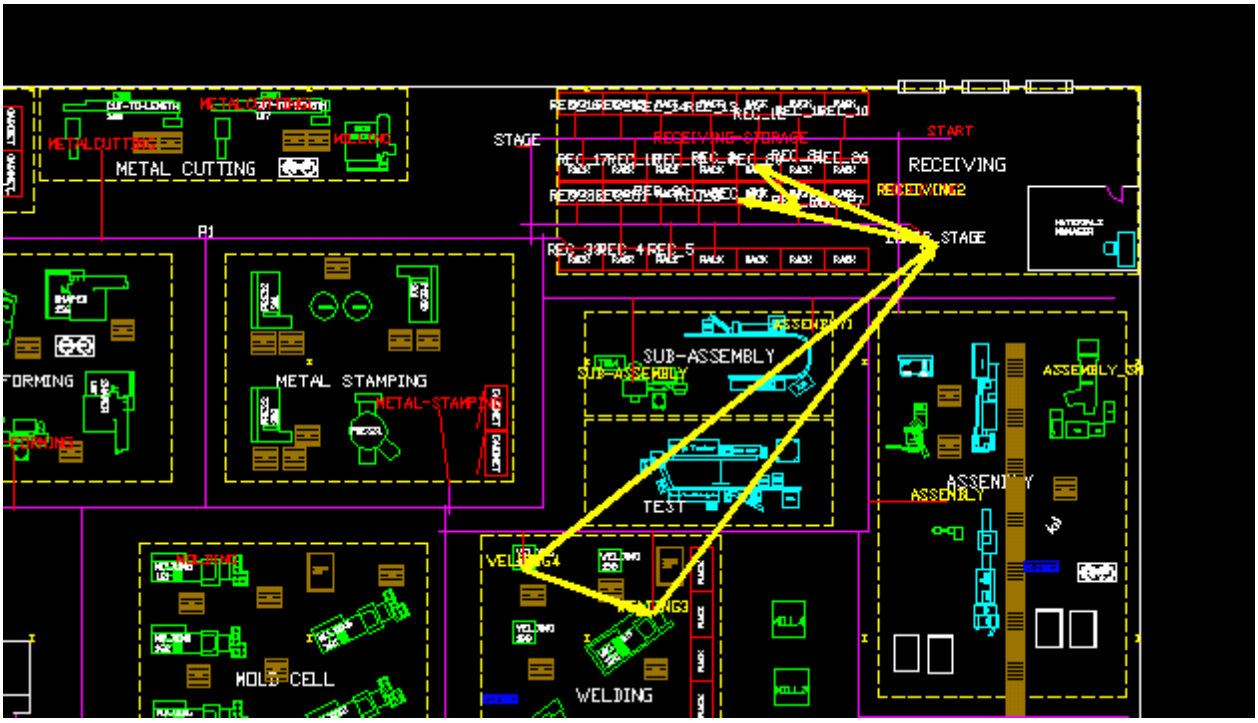
To create the Straight Flow diagram, return to the Part Routings Tab. Select Straight Flow instead of Aisle Flow, and then click "Calculate".

Filtering the Straight Flow

The Filter Tab allows you to select specific items to show or hide. Using some filters will make the Straight Flow picture even more helpful. We are going to filter the flows for a selected route and set of locations.

Go to the Filter Tab. Select ZONE2 at 7:10 am from all locations and to all locations. Then click the Filter Flows button.

When you click Filter Flows, only the selected items will be shown. Below, you see the flows for ZONE2 at 7:10 am. The rest of the flow has been filtered out.

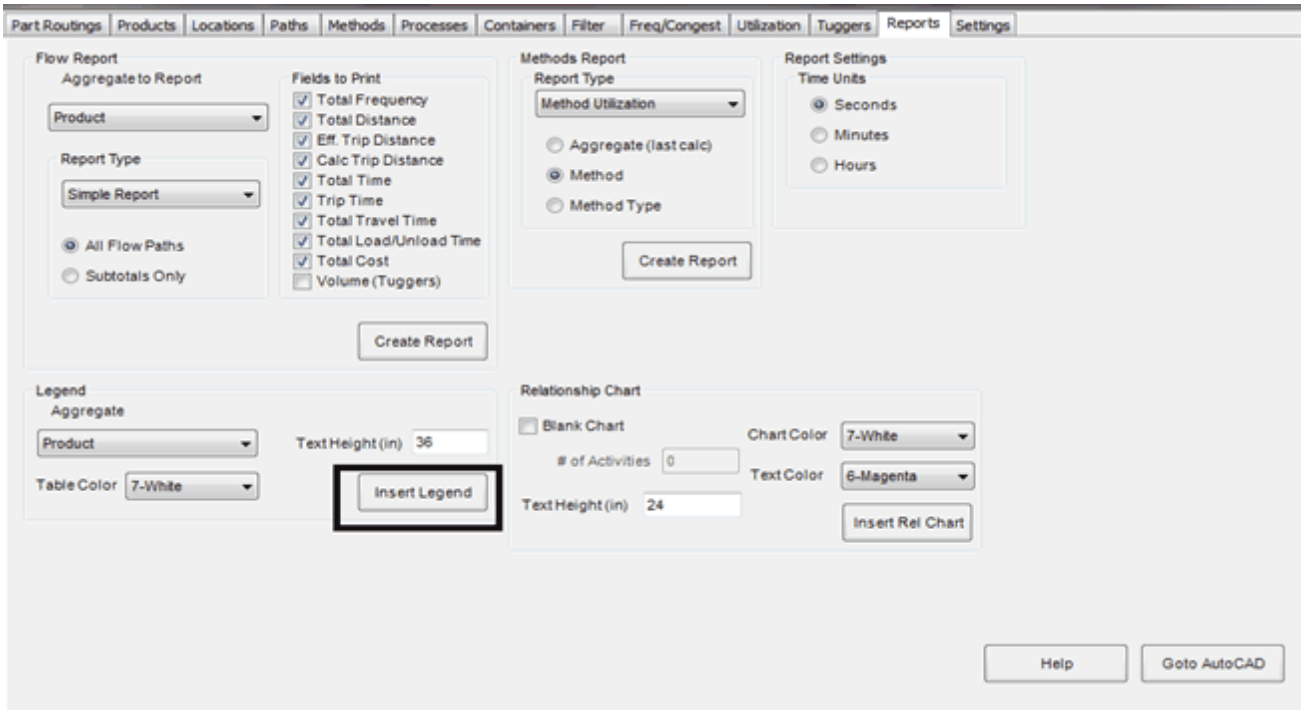


Filtering Straight Flow

Step 10: Inserting a Legend

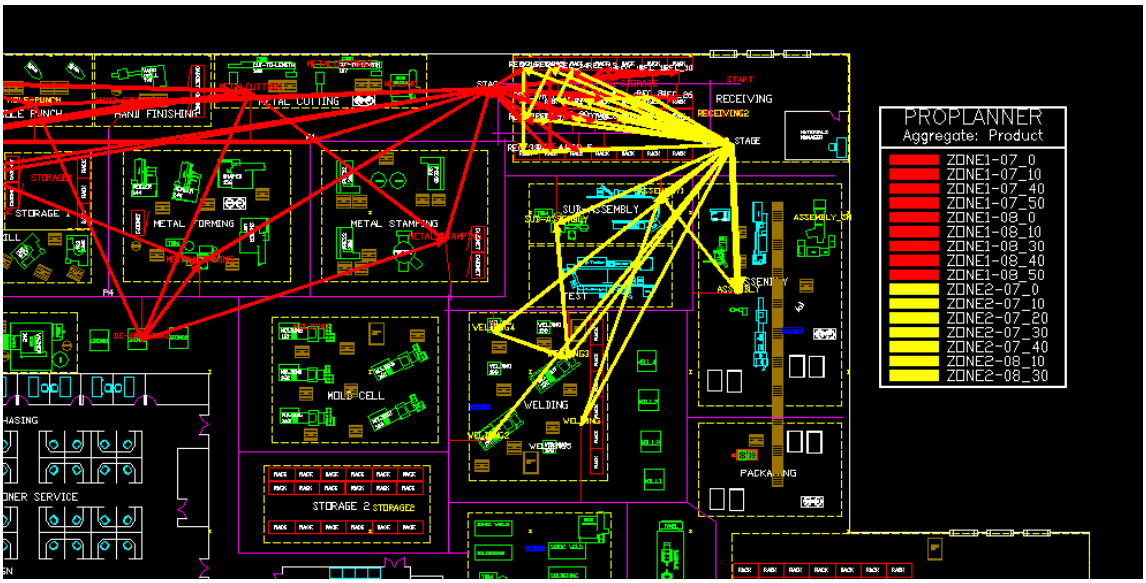
Flow Planner allows you to add legends in the AutoCAD drawing. These legends can be used to explain the path color. They can also be used to assign colors to represent different aggregates.

To insert a legend in the drawing, go to the Reports Tab. Select a text size (try 36 inches). Then click "Insert Legend". Next, click the location in the drawing where the legend should be inserted.



Inserting A Legend

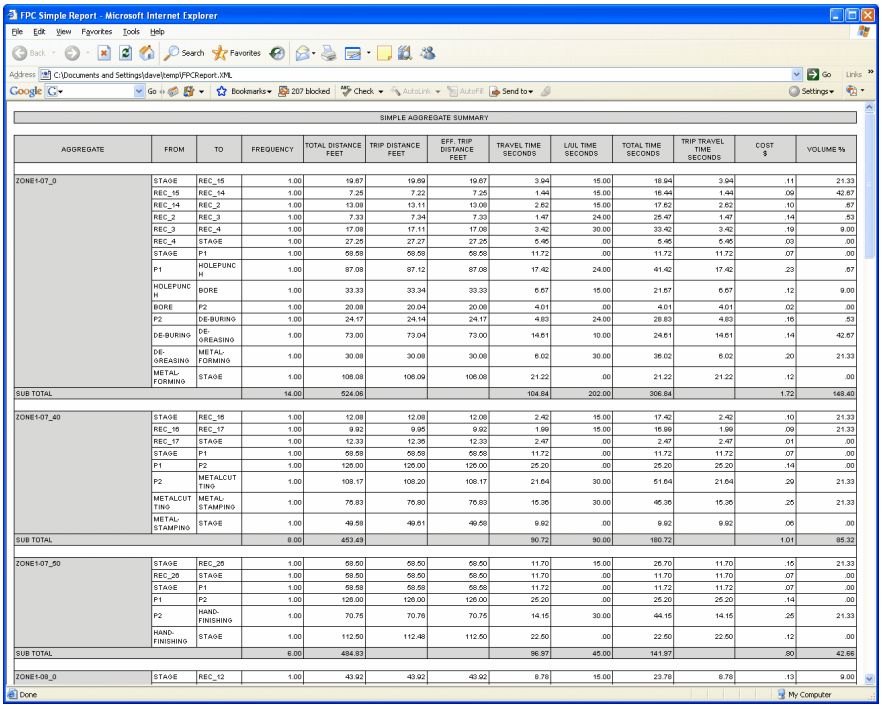
You can see the legend at the right of the drawing below.



Legend (Right Side)

Step 11: Creating Reports

There are several types of reports that can be generated for your tugger study. In the Reports Tab, select the type of report and the aggregate type. Then select the fields that should be printed. Finally, generate the report by clicking "Create Report".



Creating Reports

Congratulations! You have completed your first Proplanner Tugger analysis flow study.

Please refer to the Flow Planner manual Tugger Tab section for details on Tugger module options not covered in this tutorial.

6.3 Relationship Planning Tutorial

Richard Muther developed a type of layout planning, Systematic Layout Planning, which involves defining relationships between different areas and arranging the facility based on the relationships. The theory can also be used to examine how well the existing layout observes these relationships. For example, if two areas share a supervisor, it is fairly important that they be near each other.

Other examples include relationships that require building features; it is important that both receiving and shipping be near the exterior of the building. These relationships are qualitative–they don't have a numeric value and are somewhat subjective–but Muther's approach gives us a way to examine how the layout performs regarding the relationships.

Muther defined four positive relationships and two negative relationships that can be applied to any interaction. They are outlined in the chart below, along with the Flow Planner notation.

Flow Planner Notation	Relationship is
A_RELS	Absolutely Necessary
E_RELS	Especially Important
I_RELS	Important
O_RELS	Ordinary
X_RELS	Importantly Negative
Z_RELS	Absolutely Negative

The goal of relationship planning is to get the positive relationships to be 'short' or close together, and the negative relationships to be 'long' or as far apart as possible.

Further reading on relationship planning methods and techniques: Systematic Relationship Planning by Richard Muther or Simplified Systematic Relationship Planning, also by Muther.

Flow Planner can be used to perform relationship-based studies in addition to regular flow studies. Relationship-based studies change the meaning of some of Flow Planner's entities. For example, since we are measuring relationships, distance has no actual absolute meaning. Instead, distance is a relative measure of the performance between any two layout alternatives. And instead of having a tangible product, our 'products' are going to be things like "A_RELS" ('A' relationships).

This tutorial will walk you through the process of loading, performing, and modifying a relationship-based study in Flow Planner.

Please note, this tutorial references the FootInch files. If you prefer to use the Metric files, make sure to open the drawing from the Metric folder, and when you're directed to open Flow Planner, go to the Settings tab and change the Line Delimiter to a semi-colon before loading the files from the Metric folder.

STEP 1: Load the Study

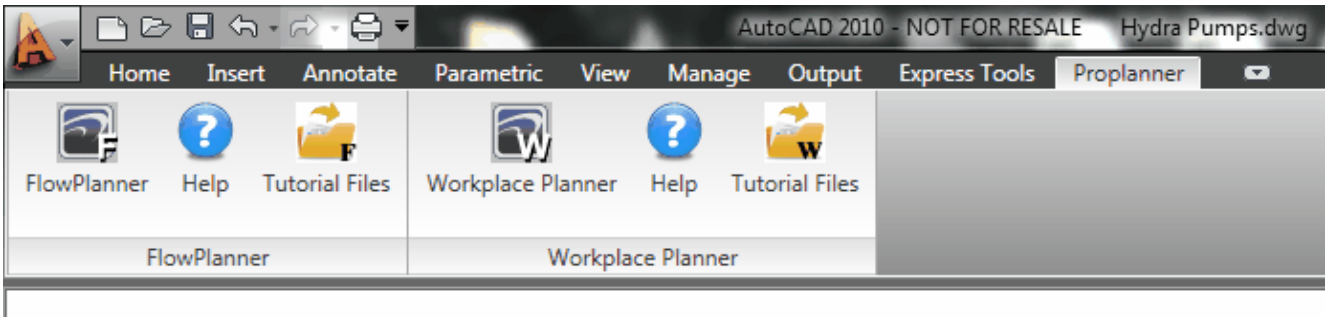
Getting Started

Begin by launching the AutoCAD program. In AutoCAD, you should be able to see the Proplanner Applications menu on your screen. If not, you will need to load this menu using the Menu Installation Guide named INSTALL.PDF.

Open the RELATIONS.DWG file provided with Flow Planner. To find it, navigate to the directory where Flow Planner is installed (typically, "C:\Program Files\Proplanner\FlowPlanner"). Go to Tutorial Files > Relationship Tutorial.

Launch Flow Planner

Select the Flow Planner icon button in the Proplanner ribbon of AutoCAD to open the main Flow Planner application window.



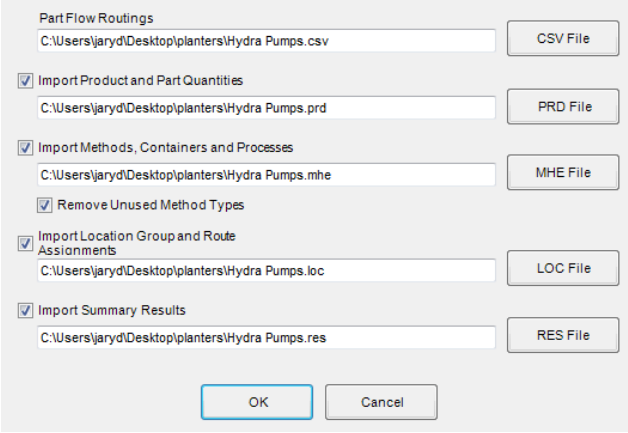
Flow Planner Application

Load Files

To import an existing relationship routing file, select the File Open button from the top right corner of the Part Routings tab that comes up when the program first starts.

Go to the directory where the Flow Planner application is installed (the same place where you found the RELATIONS.DWG file). Open RELATIONS.CSV.

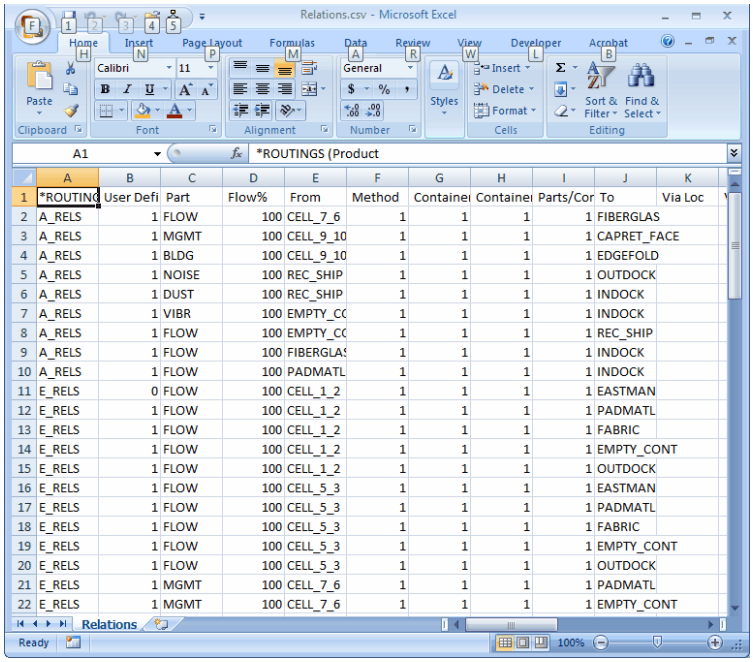
Once the file is selected, click OK to load it. The application will now fill in the default names for the additional files.



Import File Window

Modifying CSV Files Externally

You may have noticed that the Relations file has the extension of CSV. This extension indicates that the file is a comma separated ASCII file that can be easily created or edited with MS Excel or any text editor. At this point, you may wish to load this file into MS Excel and look at the fields and formatting.



	A	B	C	D	E	F	G	H	I	J	K
1	*ROUTING	User Defi	Part	Flow%	From	Method	Containe	Containe	Parts/Cor	To	Via Loc
2	A_RELS	1	FLOW	100	CELL_7_6	1	1	1	1	FIBERGLAS	
3	A_RELS	1	MGMT	100	CELL_9_10	1	1	1	1	CAPRET_FACE	
4	A_RELS	1	BLDG	100	CELL_9_10	1	1	1	1	EDGEFOLD	
5	A_RELS	1	NOISE	100	REC_SHIP	1	1	1	1	OUTDOCK	
6	A_RELS	1	DUST	100	REC_SHIP	1	1	1	1	INDOCK	
7	A_RELS	1	VIBR	100	EMPTY_CC	1	1	1	1	INDOCK	
8	A_RELS	1	FLOW	100	EMPTY_CC	1	1	1	1	REC_SHIP	
9	A_RELS	1	FLOW	100	FIBERGLAS	1	1	1	1	INDOCK	
10	A_RELS	1	FLOW	100	PADMATL	1	1	1	1	INDOCK	
11	E_RELS	0	FLOW	100	CELL_1_2	1	1	1	1	EASTMAN	
12	E_RELS	1	FLOW	100	CELL_1_2	1	1	1	1	PADMATL	
13	E_RELS	1	FLOW	100	CELL_1_2	1	1	1	1	FABRIC	
14	E_RELS	1	FLOW	100	CELL_1_2	1	1	1	1	EMPTY_CONT	
15	E_RELS	1	FLOW	100	CELL_1_2	1	1	1	1	OUTDOCK	
16	E_RELS	1	FLOW	100	CELL_5_3	1	1	1	1	EASTMAN	
17	E_RELS	1	FLOW	100	CELL_5_3	1	1	1	1	PADMATL	
18	E_RELS	1	FLOW	100	CELL_5_3	1	1	1	1	FABRIC	
19	E_RELS	1	FLOW	100	CELL_5_3	1	1	1	1	EMPTY_CONT	
20	E_RELS	1	FLOW	100	CELL_5_3	1	1	1	1	OUTDOCK	
21	E_RELS	1	MGMT	100	CELL_7_6	1	1	1	1	PADMATL	
22	E_RELS	1	MGMT	100	CELL_7_6	1	1	1	1	EMPTY_CONT	

Editing in MS Excel

While all of the data fields in this file can be created or modified within the Flow Planner Editor, you will find that Excel is a far superior environment for the creation and mass editing of large relationship routing data sets.

All of the data files used by Flow Planner (such as files ending in MHE, LOC, and PRD) are CSV formatted files and thus can be easily modified with Excel, Notepad, or any text editor.

STEP 2: Modifying Data

Remember, there are four positive relationships and two negative relationships available within a relationship planning study. Each of these relationships are defined in Flow Planner as "Products" and should be given the following names:

Flow Planner Notation	Relationship is
A_RELS	Absolutely Necessary
E_RELS	Especially Important
I_RELS	Important
O_RELS	Ordinary
X_RELS	Importantly Negative
Z_RELS	Absolutely Negative

When you opened the CSV file, the "A" relationships (A_RELS) were automatically selected in the product list. This means that all of the relationships that are currently displayed are those that must absolutely be satisfied for the layout to be considered valid.

The "Part Name" column is re-purposed in relationship-based studies; it now contains the REASON for the relationship between the areas. Common reasons for a relationship are Material Flow, People Flow, Supervision, Shared Utilities, and Required Building Features (outside wall, reinforced floor, exhaust fan, etc). You can create your own relationship reasons, but take care to be consistent with how you spell them. This consistency will allow you to color code and report on these relationship reasons during your analysis.

Entering Relationship Data: Add, Update and Remove

Next, enter relationship information into the input boxes shown below. The following is an A relationship with a REASON of "Building Feature" between locations "CELL_9_10" and "CARPET_FACE".

Give the following details for the Part Routing:

Part name = “BLDG”

% = “100”

From Loc = “CELL_9_10”

Method = “1”

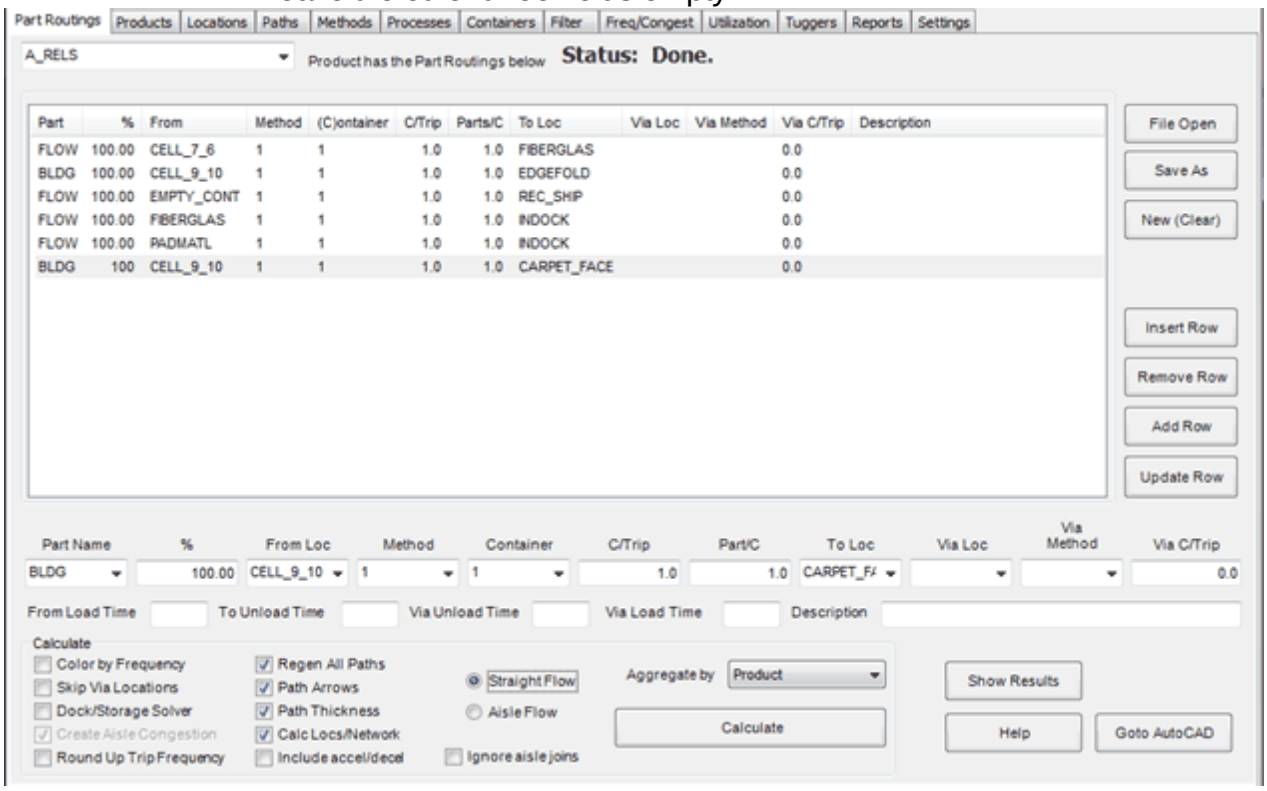
Container = “1”

C/Trip = “1”

Part/C = “1”

To Loc = “CARPET_FACE”

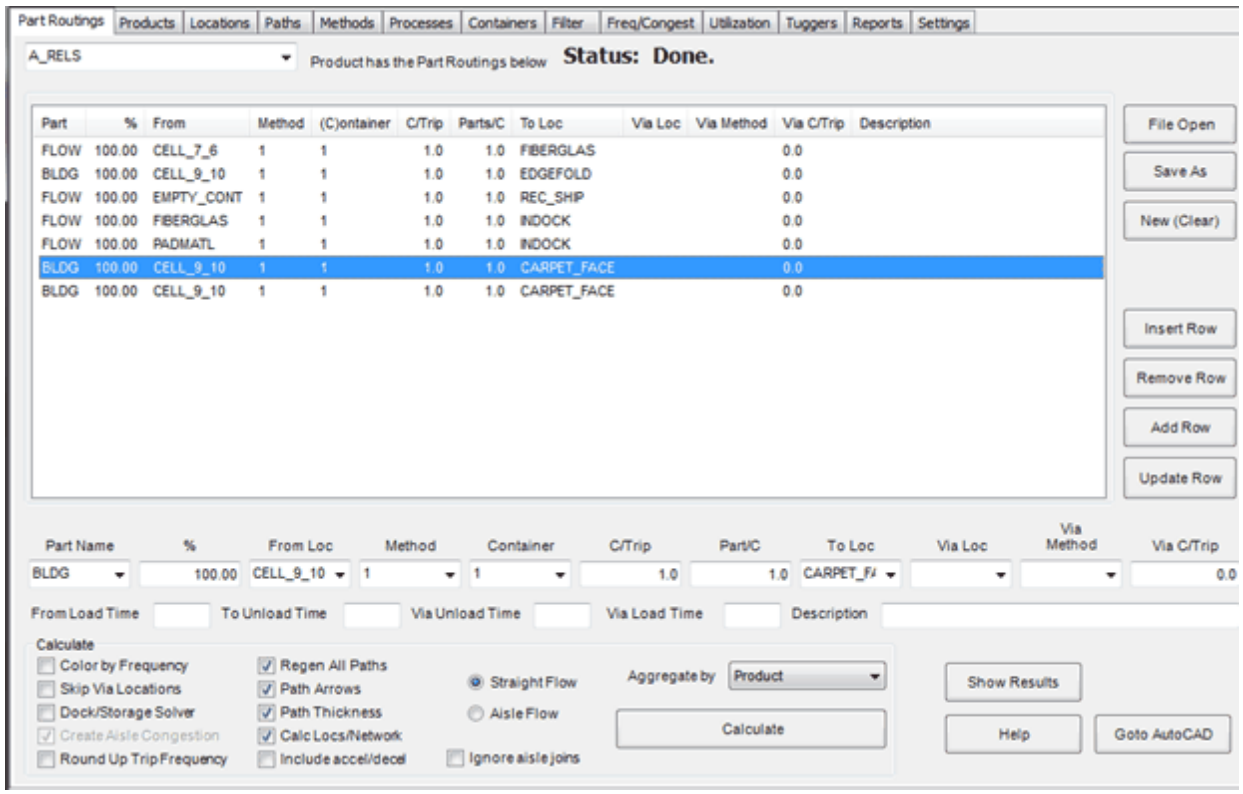
Leave the other three fields empty



Adding, Updating, & Removing Relationship Data

After entering these values, click on the “Add Row” button (on the right).

The added row is outlined. Now click on the “Insert Row” button. The information for this relationship is inserted above the previously highlighted row (i.e. we have inserted a copy of this relationship which we will edit in the next step).



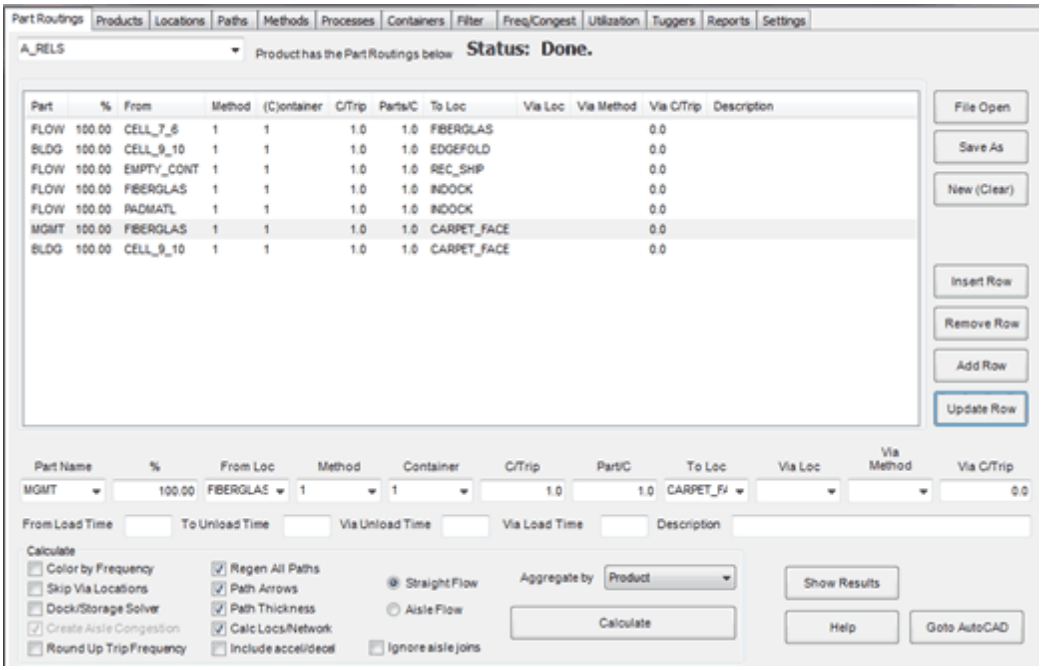
Adding/Inserting A Row

Change only the following details in the inserted row and select the "Update Row" button to the right.

Part Name = “MGMT”

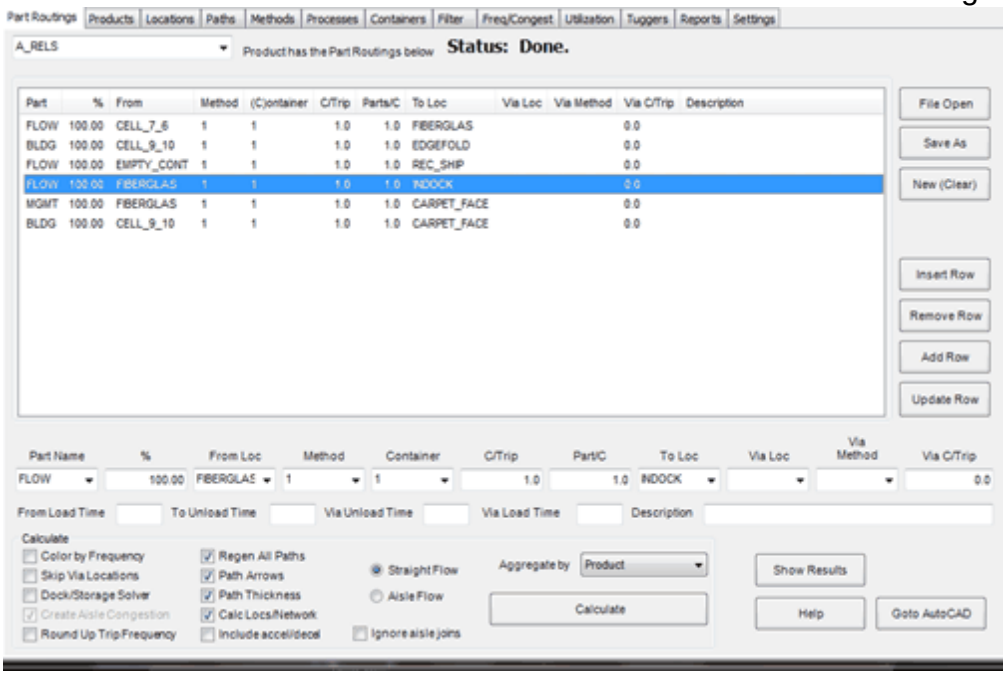
From Loc = “FIBERGLAS”

With this row selected, click the "Update Row" button. This will update the row with the new information. This was just to get you familiar with the update function.



Updated Row

Now we select the row with the reason “FLOW”, between the locations "PADMATL" and "INDOCK" and select the “Remove Row” button. This will leave us with the following:

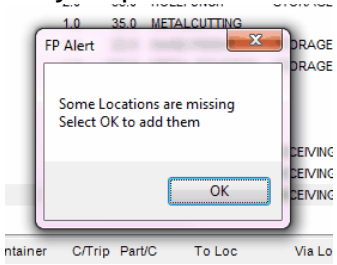


Removed Row

Step 3: Generating the Basic Study

Since all relationship analyses involve straight flow diagrams, you will want to ensure that the "Straight Flow" radio button is selected in the lower right corner of the Part Routings Tab. Now to generate your relationship study, click the “Calculate” button.

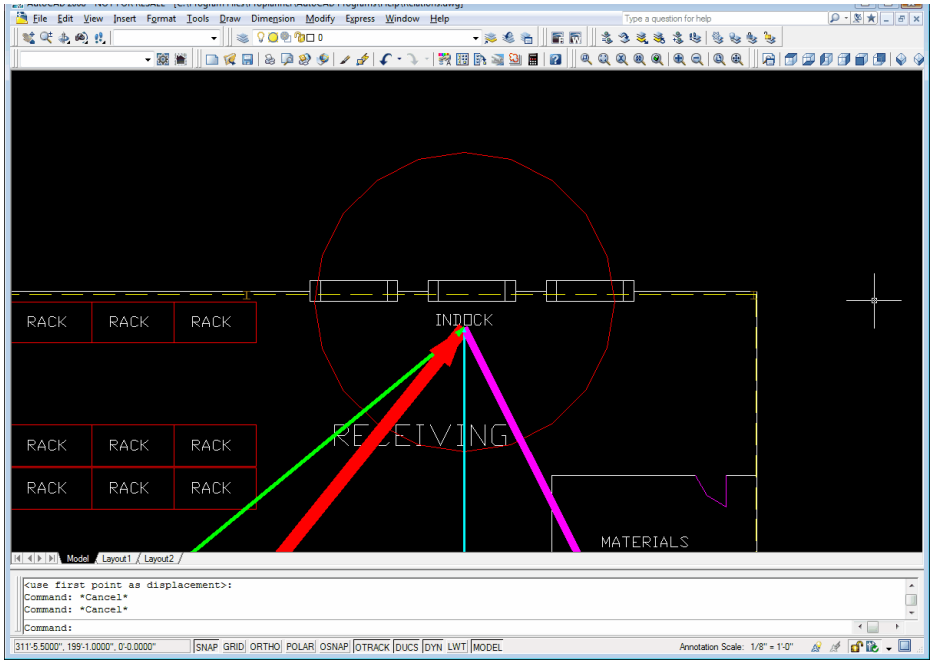
A Flow Path Alert message shows up to indicate that one or more of the location names referenced in your routings list is missing on the location layer in your drawing (the application looks for AutoCAD text objects on the layer specified in the "Licensing/Settings" tab).



Flow Path Alert Message

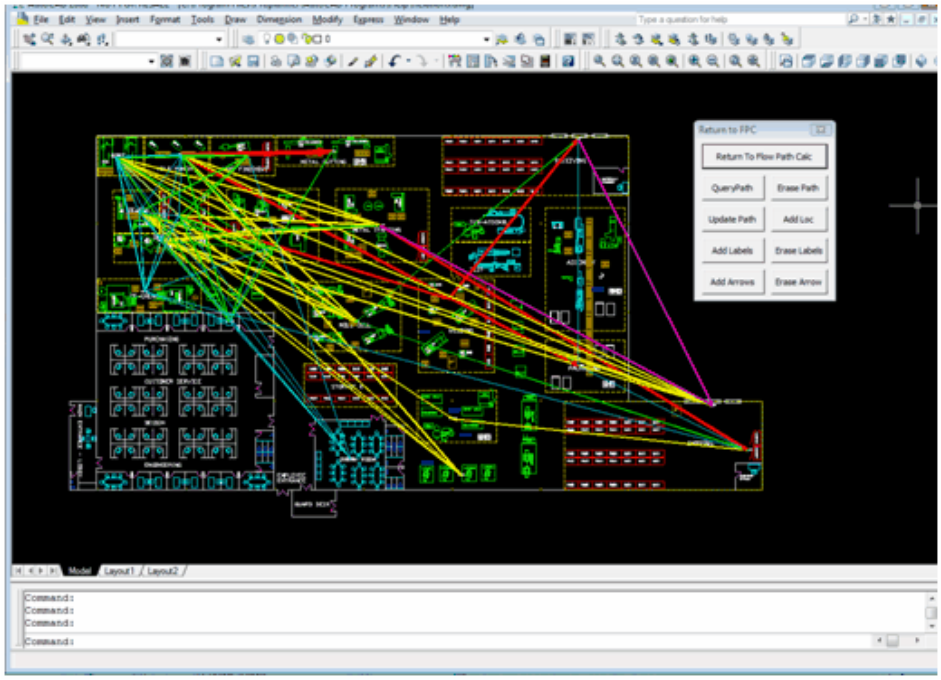
Click OK. At the command line of AutoCAD you will note a prompt for adding the location called INDOCK.

Select a point on the drawing in the upper right corner next to the dock doors (See picture below - note colored relationship lines will not be shown until after the calculation has finished).



Generating A Basic Study - Selecting A Point

After entering the INDOCK location point, the relationship lines are drawn on the AutoCAD drawing. A report will appear that reports the costs for each of the different types of the relationships. Click "Return" to go to the AutoCAD drawing and look at the lines. To return to Flow Planner, click on "Return to Flow Path Calc" button.*Note: If your location labels are not sized as desired, you can go to the Locations tab and edit the Location Text Height and Update.*

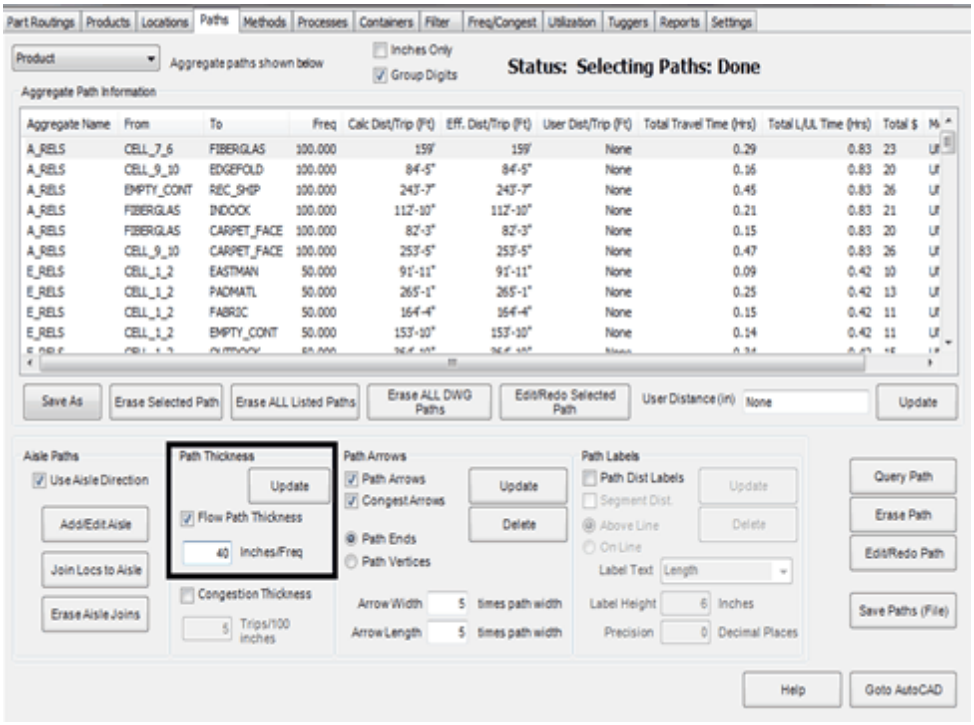


Generating A Basic Study - Drawing

Changing Path Thickness

To change the relative thickness of the relationship lines, select the "PATHS" tab. Increase the path thickness factor if you want the paths to be thicker, or decrease the path thickness factor if you want the paths to be thinner.

Once you have set your path thickness value, click "Update" button to change the paths in the drawing. Select the "Go to AutoCAD" button in the bottom-right of the screen to see the changes.

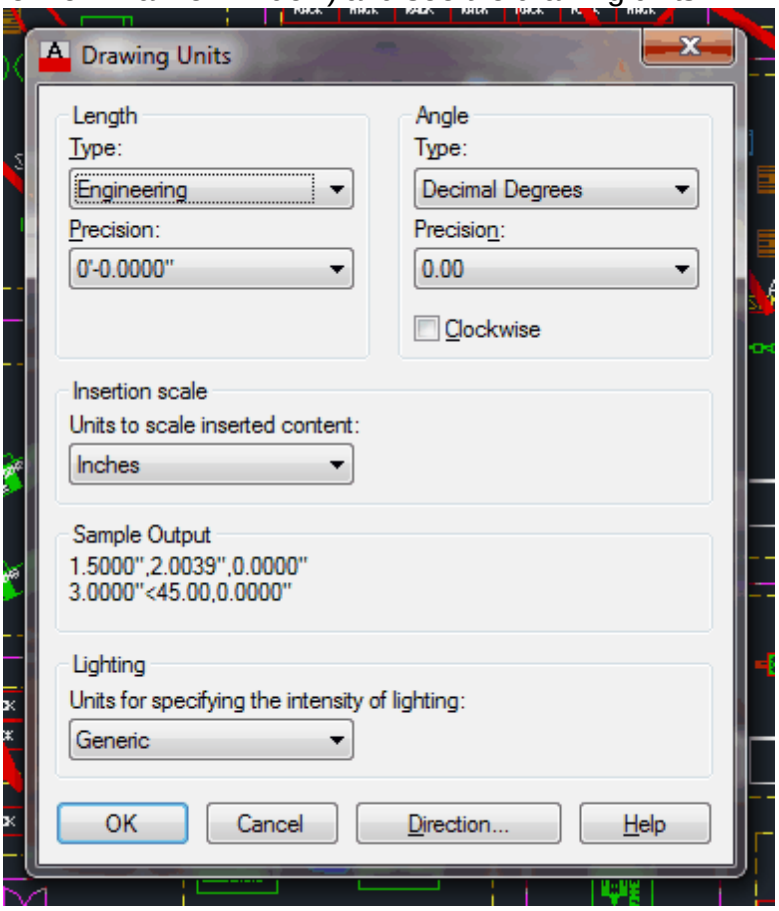


Paths Tab - Changing Path Thickness

Special Note

If the drawing shows very big arrows overlapping each other after you click the “Calculate” button, then it is likely that the units of the drawing and the units used by Flow Planner are different.

You can type "units" in the AutoCAD command line (you will need to select the "Goto AutoCAD" button if you are in the Flow Planner window) and see the drawing units.



Drawing Units Window Editor

Then return to Flow Planner and go to the "Licensing/Settings" Tab to change the units used by Flow Planner.

STEP 4: Interpreting the Study (or: How Did We Get Here?)

Once a calculation is complete, a results window will appear.

You may select any row in this window and copy this table to the clipboard for subsequent paste in MS Word or Excel (all rows will be copied).

In relationship studies, only the distances are used; the cost, time, and utilization values are meaningless and should be ignored. Also remember that the distance here isn't a straight numerical factor, but a relative measure for performance. A more accurate way to think about the distance is to consider it a performance-weighted distance.

Distance Calculations

Distance values for each row in the routing are computed by multiplying a relationship factor by the actual distance between the locations specified. The relationship factor is defined in the 'quantity value' cell in the Products tab.

If the A_RELS are assigned a quantity value of 100 and the I_RELS are assigned a quantity of 10, the A_RELS will have ten times the impact of the I_RELS. Then if two locations that have an 'A' relationship are 50 feet apart, they will contribute 5000 feet to the total sum. However, two locations the same distance apart with an 'I' relationship would only contribute 500 feet. Since the goal is to have a low total distance score, we can see that it is desirable to have the locations with A_RELS as close to each other as possible.

Also note that X_RELS and Z_RELS contribute *negatively* to the total. The further apart two locations with an 'X' relationship, the bigger the negative number contributed. This is a desirable thing, since the low total distance is the goal.

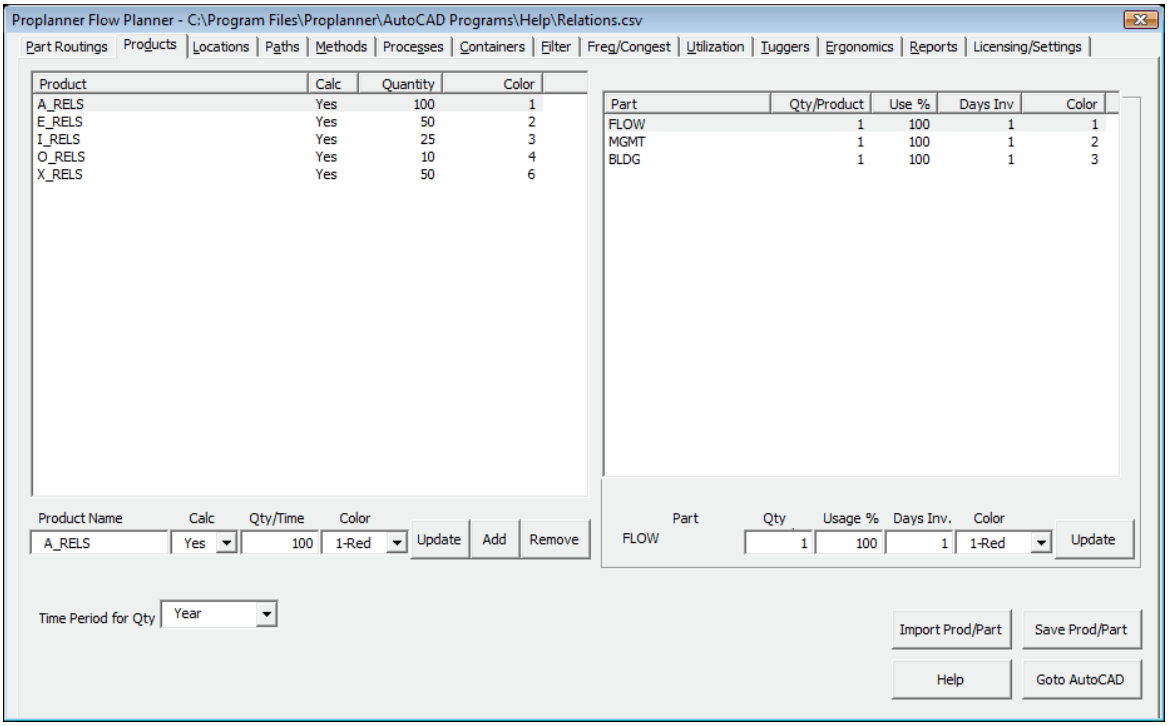
Specifying Relationship Factors (Quantity)

As previously mentioned, the "Products Tab" is where you specify the relationship type names and their relative importance factors (specified in the Quantity column).

The Product names here are not tangible products, but the relationships. There are four positive relationships (A, E, I, O) and one negative relationship (X). In other relationship planning studies, you may also use Z_RELS to indicate an absolutely negative relation, but this particular study did not have any Z relationships.

Each of these relationships has a quantity value and a color assigned. You should set the relations to match the colors and values shown below.

When performing a relationship study in the same data file set as a flow study, you may wish to adjust the relationship quantity values so that the highest relationship quantity (i.e. the A_RELS) is equal to the highest production quantity, then you can adjust the E_RELS to be 1/2 of the A_RELS, and so on, for the other relationships.

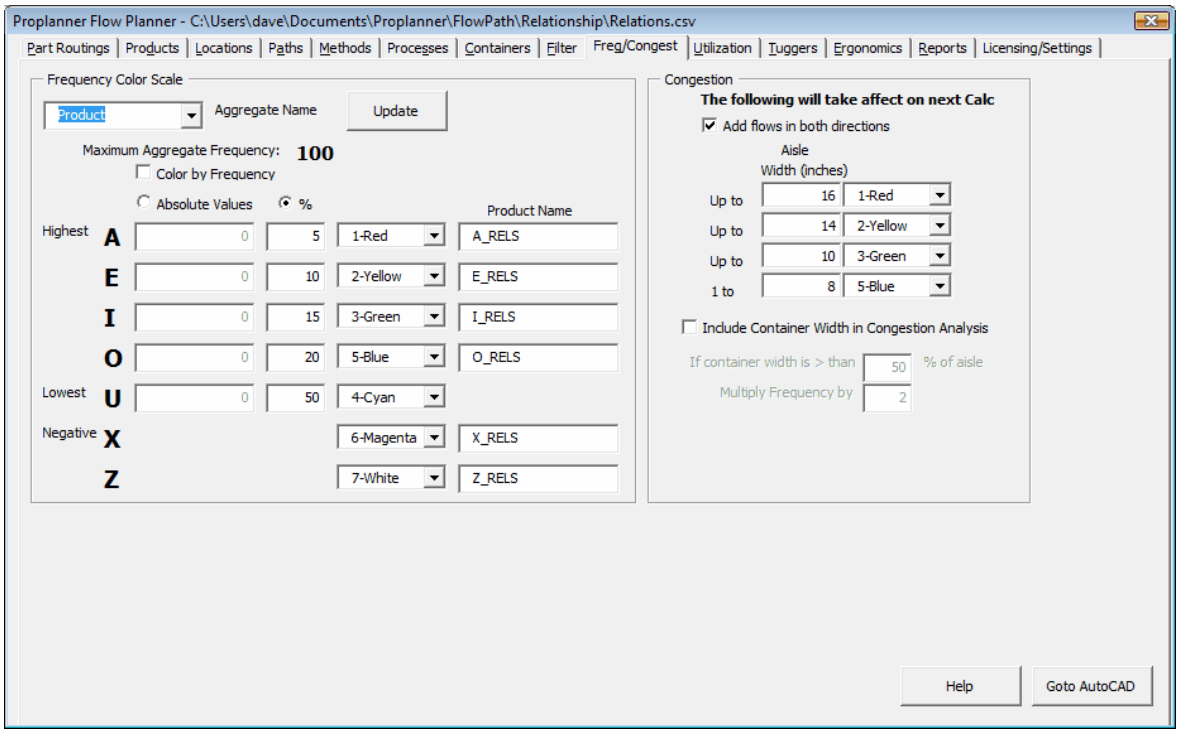


Relationship Reasons List

Also notice that instead of real "Parts", the Relationship Reasons (i.e. Flow, Mgmt, Bldg, etc) are modeled as Parts. This list is created from the entries you make in the Part Routing Tab; enter the reasons for the given relationship in the Part field. The only value for Parts that you will want to edit in the Products tab is the color. The color-coded diagram created will help you to visually quantify the layout.

Changing Relationship Names

The relationships are defined in the Freq/Congest tab (shown below). The product name (e.g. A_RELS) is entered in the text box for the row of the appropriate relationship type (e.g. A).

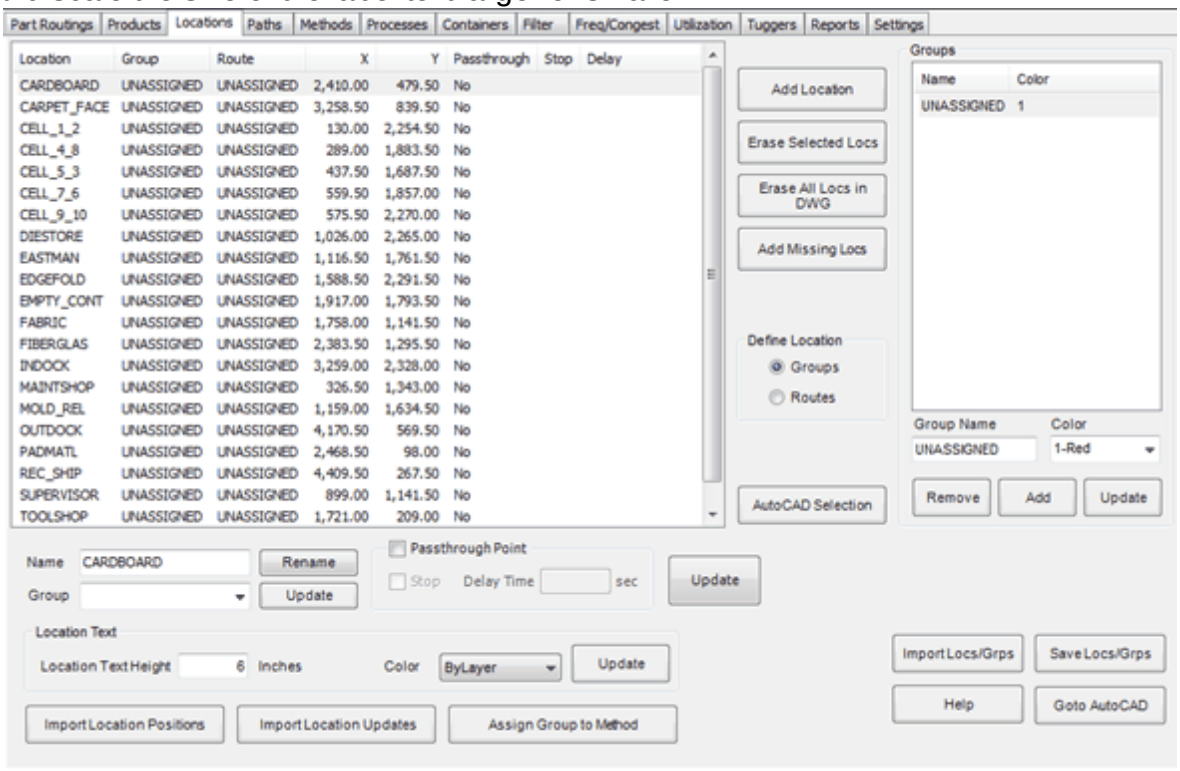


Changing Relationship Names Window

You may notice the ability to set absolute values or percentages to the relationships in this tab. This feature is used when automatically creating a relationship diagram from an actual unit-load material flow routing study, and thus is not used when working with relationship-based diagramming and analysis. As you are now aware, in a relationship study, the relationships have initially been set to the product fields and the quantities have already been factored according to relative relationship weights.

STEP 5: Locations Tab

The locations tab is where you will find the actual coordinates of your location labels (i.e. AutoCAD text objects which are inserted on the layer specified in the Licensing/Settings tab - Default layer is PP_LOCATIONS). For the purpose of relationship planning, the only options you will use on this tab are the ability to Erase location text labels, Add new labels, Color code label text, and scale the size of the label text larger or smaller.



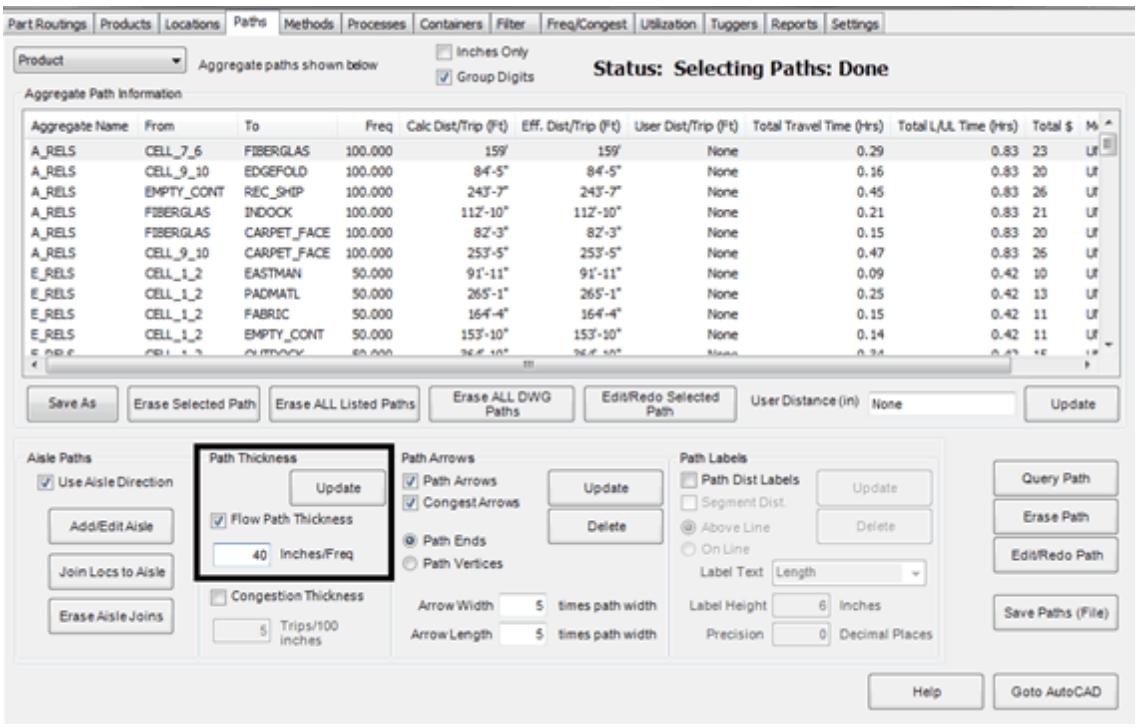
Locations Tab - Relationship Planning

STEP 6: Paths Tab

As mentioned previously, the Paths tab is where you will Scale the relative thickness of these paths larger or smaller. This tab is also where you Erase the drawing paths or Select the viewing of either relationship coded paths or reason coded paths.

Currently, we have only created Relationship Coded paths where the colors and scores correspond to the Relationship values (A, E, I, O, X and Z). Relationship coded paths are referred to in Flow Planner as Product Flow Paths, since the relationships are entered as Product names. You will notice that the Aggregate paths being shown are set to "Product" (reference the combo-box in the top left corner).

Also note that you can change the thickness of your paths by typing a new Path Thickness and clicking Update.

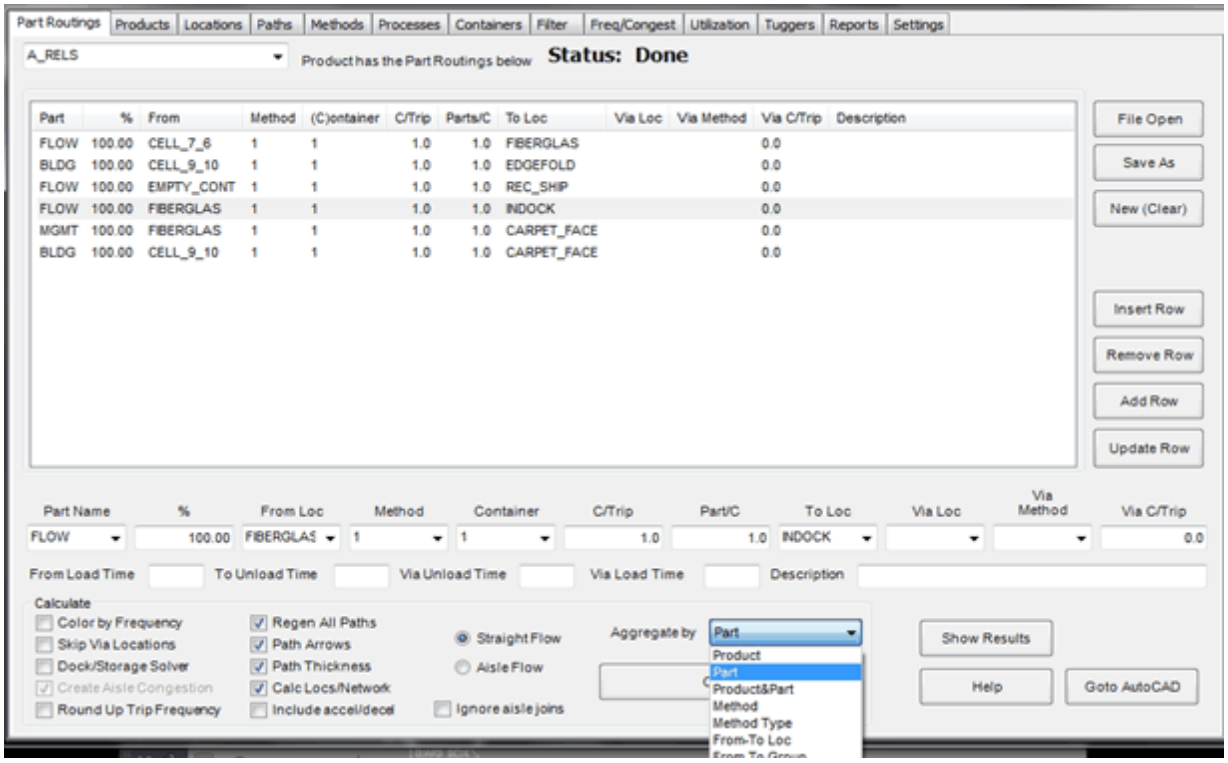


Paths Tab - Scale Editing

STEP 7: Creating Reason Coded Paths

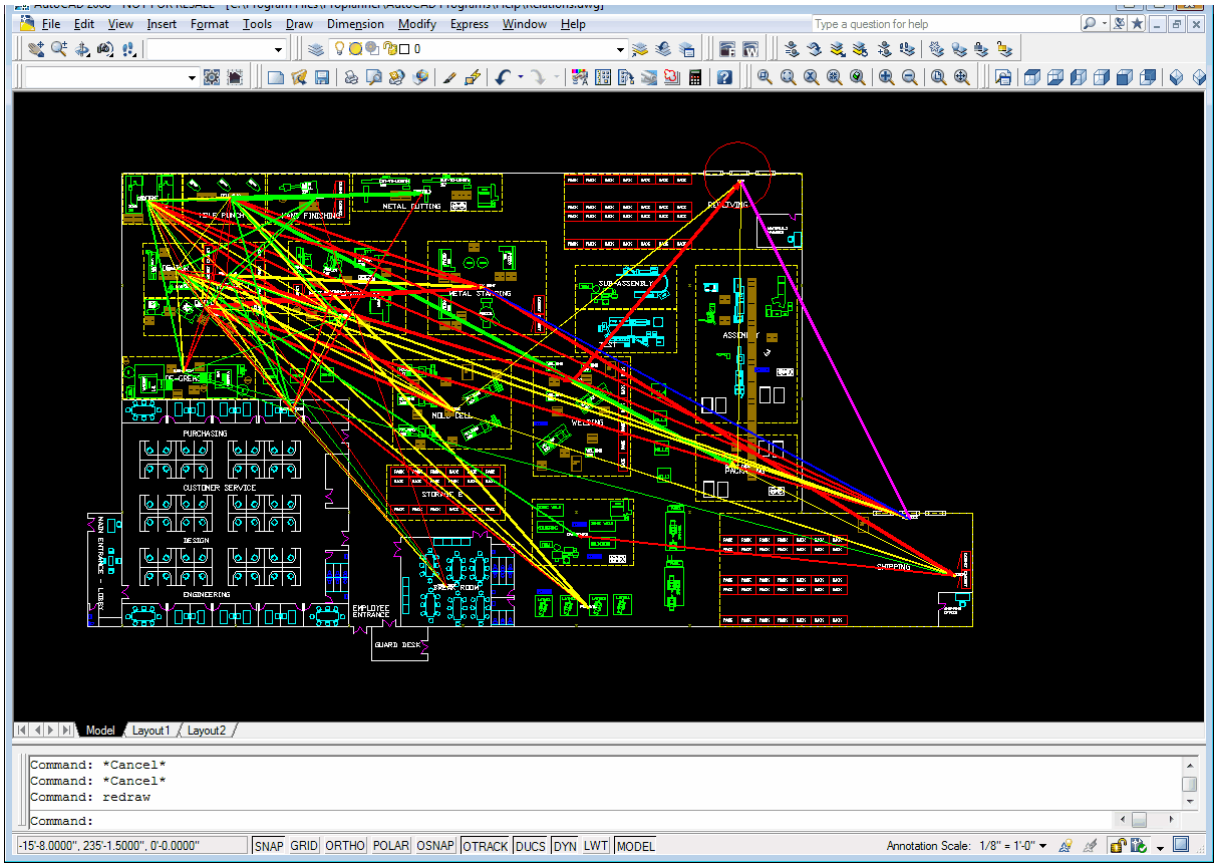
In this step, you will create a relationship diagram whereby the diagram lines are color coded by Reason (i.e. color assigned to parts in the Products tab) and the scoring is summarized by Reason.

Go to the Part Routings Tab and choose the "Aggregate by Part" option in the combo box located just above the Calculate button (see below). Now select the "Calculate" button.



Part Routings Tab - Reason Coded Paths

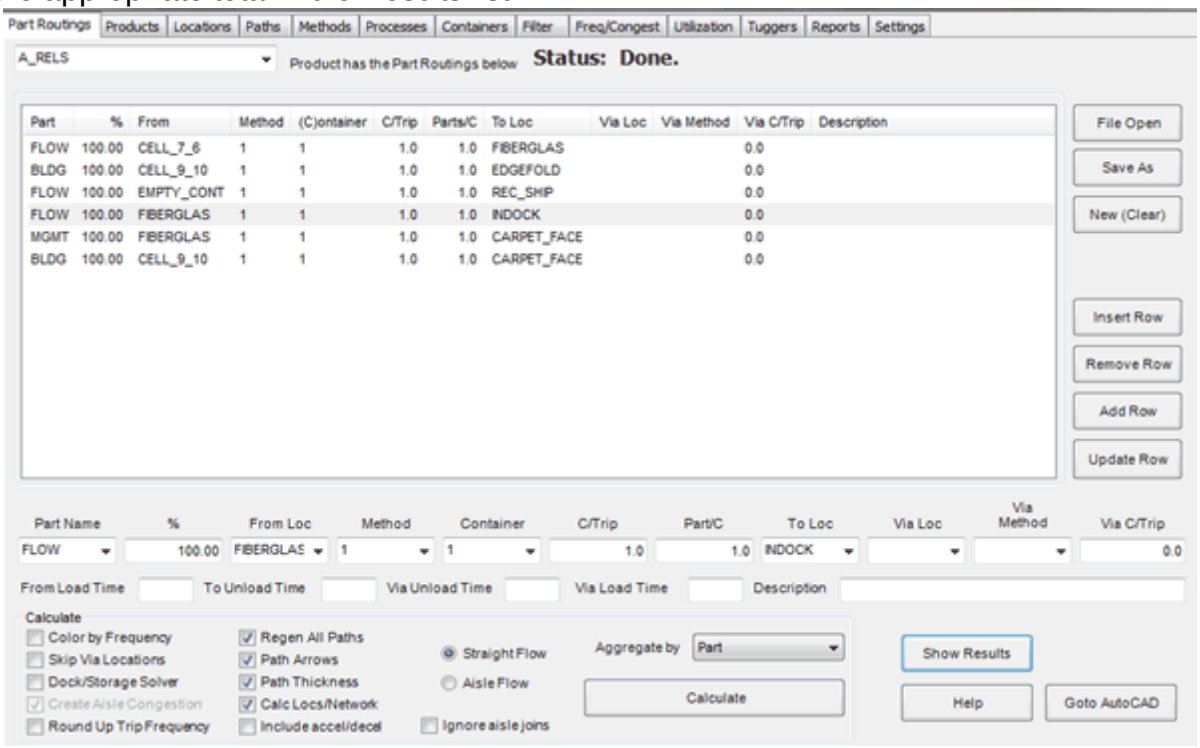
The diagram will now be color-coded according to the colors assigned to the various Parts (i.e. reasons) within the Products tab.



Color-Coded Diagram

Selecting the button "Return to Flow Planner" will bring you back to the Routings screen, where you can click on "Show Results" and see that the distances are automatically tallied according to the reasons. These distances are still factored according to their relationship weights, however those factors associated to negative weights will not have negative distance values, and therefore the total distance generated with this method will be larger than that generated with the Product Calculate method.

Optionally, users could include the names of the Reasons in the Negative Relationships list (Freq/Congest tab) that are primarily associated to negative relationships (i.e. Vibration, Noise, Dust, Fumes, etc.), and thereby have those distances factored with a negative value to compute a more appropriate total in the Results list.

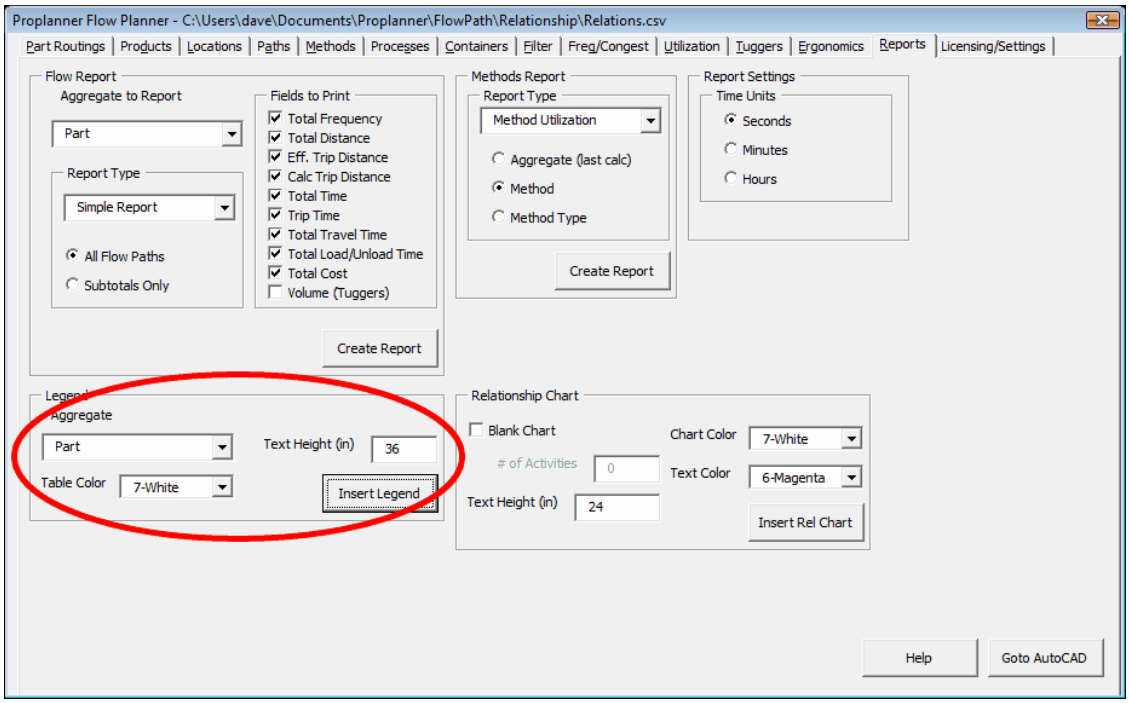


Factoring In Negative Relationships

Step 8: Creating Legends and Reports

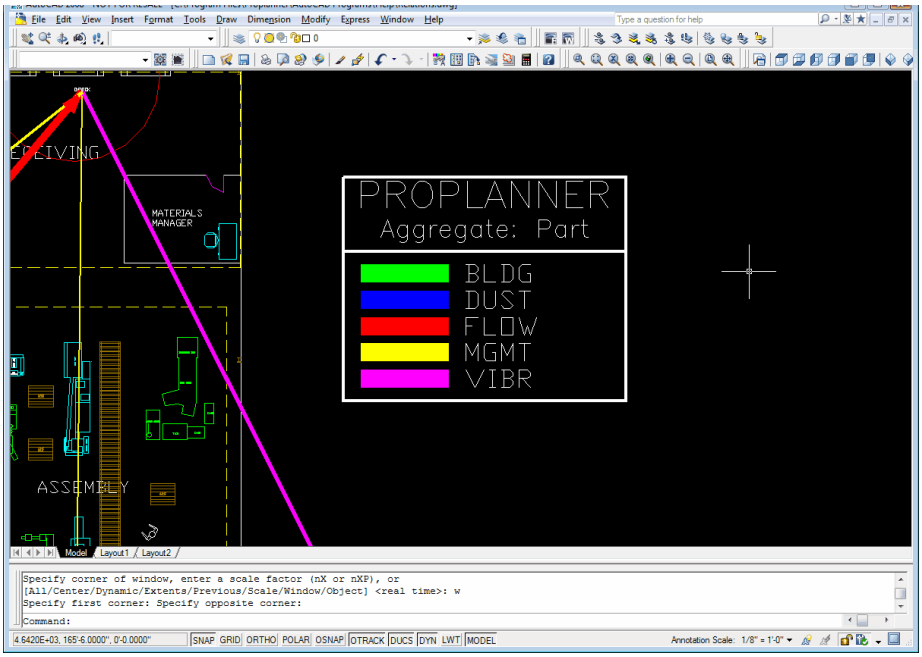
You may notice that it is difficult to remember which colors are assigned to which reasons for the lines in the diagram. As such, it is recommended you create a legend.

Go to the Reports tab, and set the text height for the legend at 36 inches. Then select the "Insert Legend" button and select a point in the upper right drawing area (in a blank space to the right of the layout drawing).



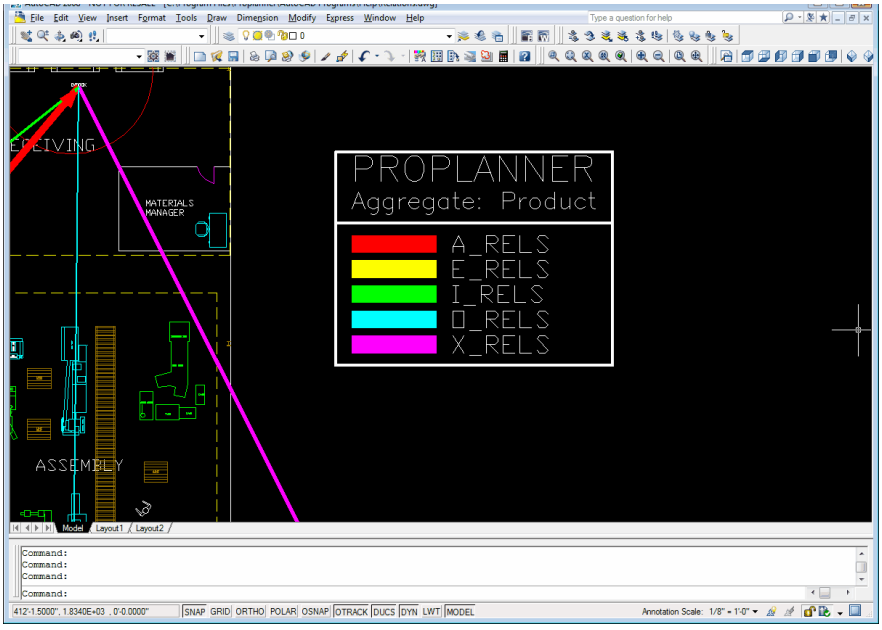
Creating A Legend

A legend will automatically be created, and as relationship colors are changed or relationships are added, this legend will update after every new calculation.



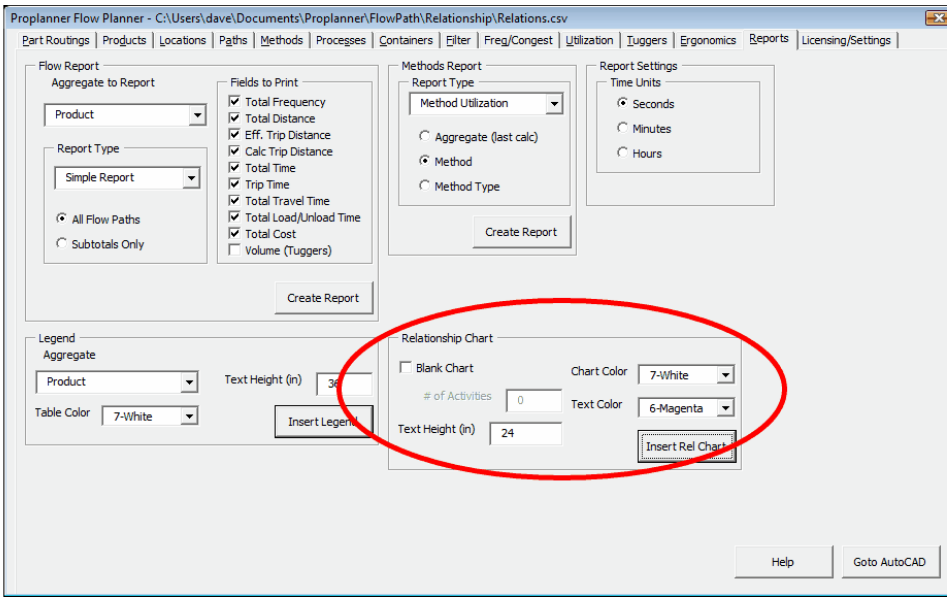
Updated Legend

You may have noticed that this legend was created for the Reason (i.e. part) Coded diagram. If you now select the Product aggregate (legend combo box), you will then be looking at the Relationship Coded diagram which we initially generated. You can generate a legend for this diagram (select "Insert Legend"), and it will look as shown below.



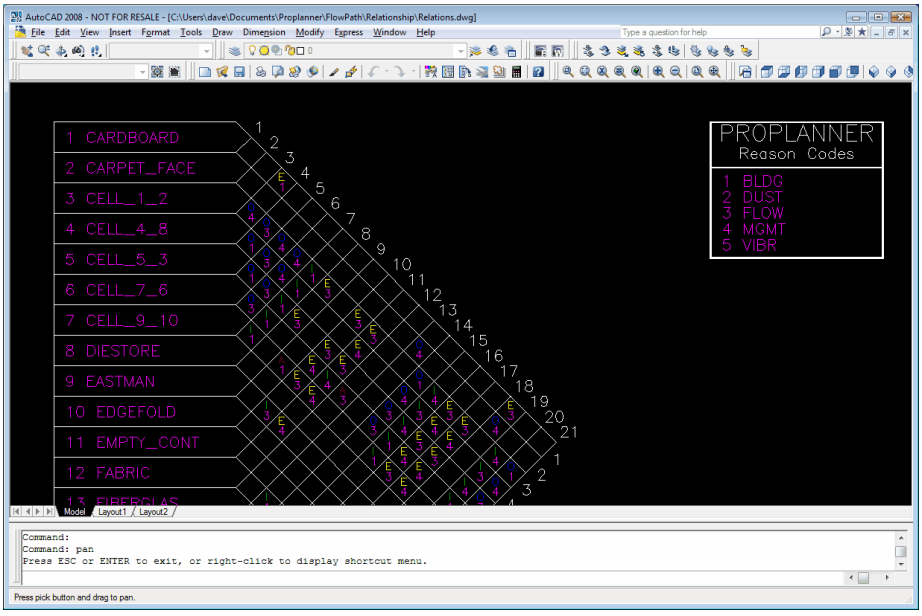
Relationship Coded Diagram Legend

You can create a relationship chart by selecting the "Insert Rel Chart" button and selecting a location in the drawing under your legend. Since these charts can get very large, you will want to keep the text size at the 24 inch default for this example.



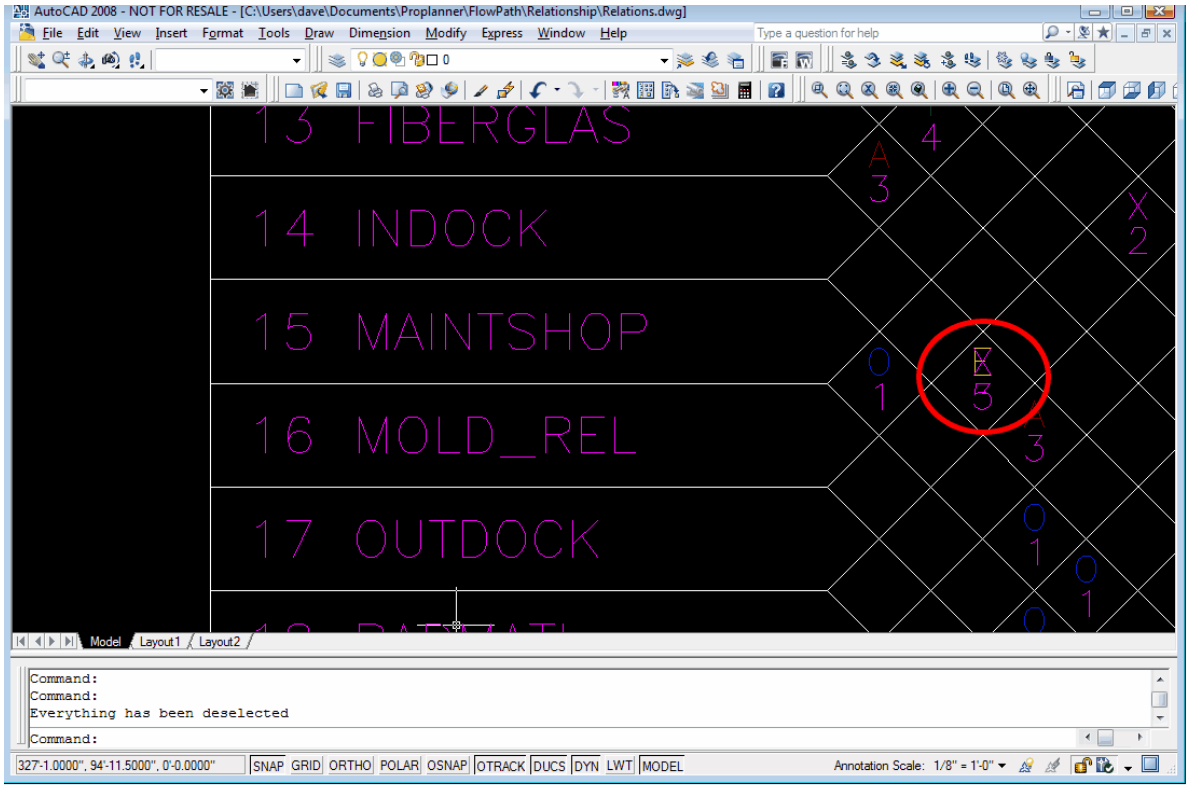
Creating A Relationship Chart

Flow Planner will create the relationship chart and generate a corresponding Reason Codes table. Each relationship in the chart has a number that corresponds to a reason in the reasons table. Location names and Reason codes are listed in alphabetical order.



Reason Codes Table

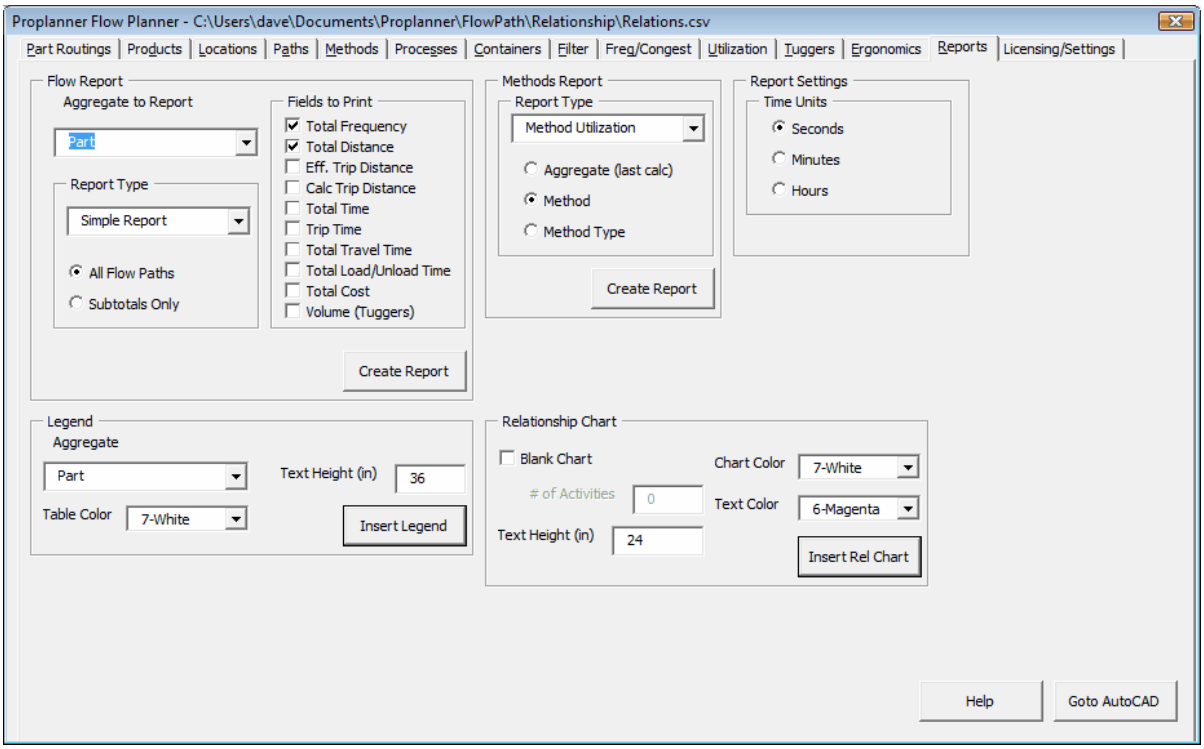
In a relationship study, there should only be one relationship between any two locations. Sometimes a mistake will be made and two or more relationships will be defined between locations. These errors will be easy to find by visually checking that only one relationship is entered within each box in the relationship chart. In this tutorial example, both an "E" and an "X" relationship were specified between the areas INDOCK and OUTDOCK. Obviously, one of these relationships will need to be removed from the routings.



Spotting Errors

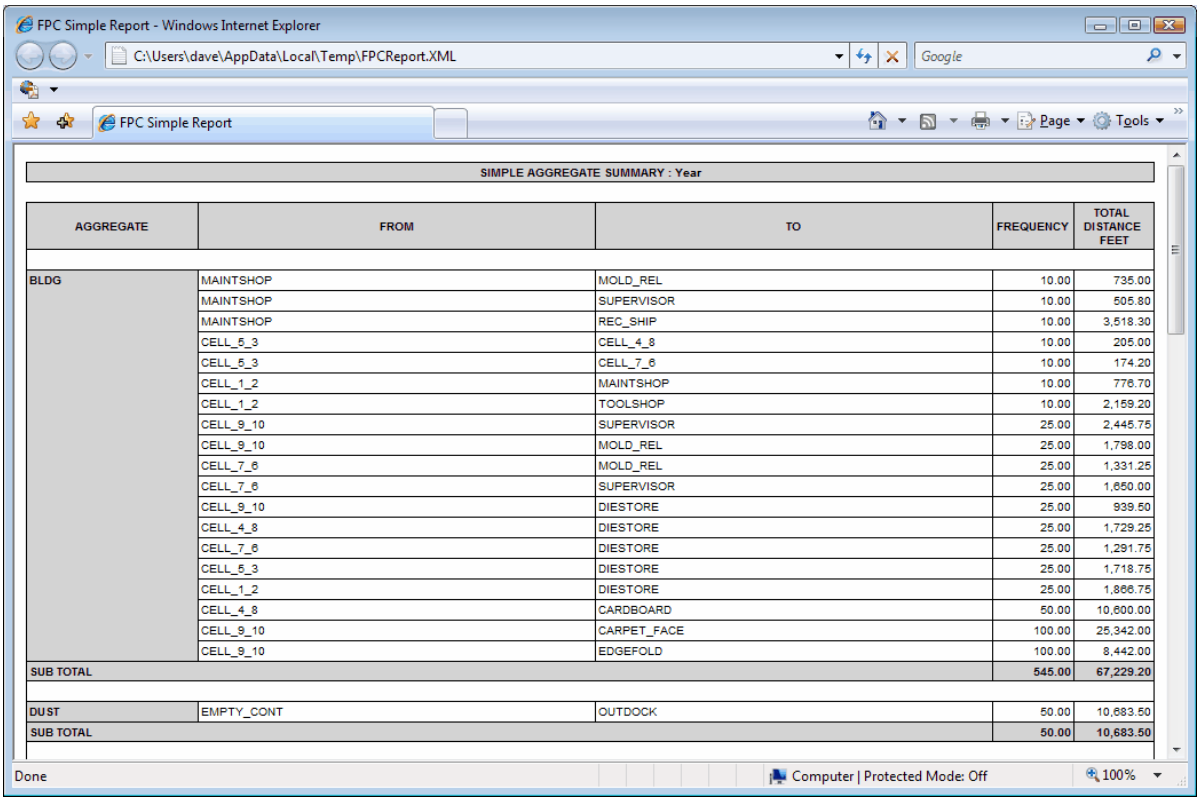
While in the Reports tab, you will be able to generate a detailed report of your relationship weights and distances. To do this, select only the Total Frequency and Total Distance fields in the "Simple Report" for a "Part" Study (i.e. Reasons) and then select the "Create Report" button.

You may notice that you can change the combo-box for the Aggregate "Product" and subsequently generate a Relationship-based report as well.



Generating Detailed Reports

After selecting the "Create Report" button, your report should display as follows. You may copy and paste any data from this report into applications like MS Excel or Word.



SIMPLE AGGREGATE SUMMARY : Year

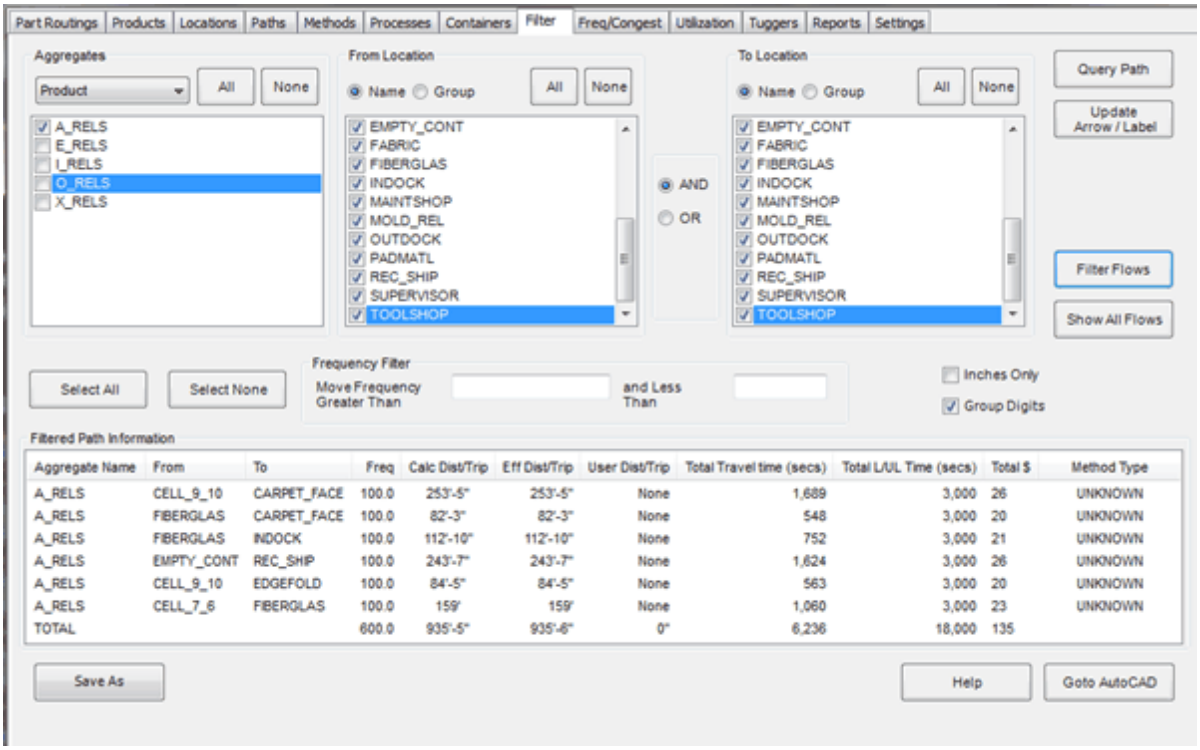
AGGREGATE	FROM	TO	FREQUENCY	TOTAL DISTANCE FEET
BLDG	MAINTSHOP	MOLD_REL	10.00	735.00
	MAINTSHOP	SUPERVISOR	10.00	505.80
	MAINTSHOP	REC_SHIP	10.00	3,518.30
	CELL_5_3	CELL_4_8	10.00	205.00
	CELL_5_3	CELL_7_6	10.00	174.20
	CELL_1_2	MAINTSHOP	10.00	776.70
	CELL_1_2	TOOLSHOP	10.00	2,159.20
	CELL_9_10	SUPERVISOR	25.00	2,445.75
	CELL_9_10	MOLD_REL	25.00	1,798.00
	CELL_7_6	MOLD_REL	25.00	1,331.25
	CELL_7_6	SUPERVISOR	25.00	1,650.00
	CELL_9_10	DIESTORE	25.00	939.50
	CELL_4_8	DIESTORE	25.00	1,729.25
	CELL_7_6	DIESTORE	25.00	1,291.75
	CELL_5_3	DIESTORE	25.00	1,718.75
	CELL_1_2	DIESTORE	25.00	1,866.75
	CELL_4_8	CARDBOARD	50.00	10,600.00
	CELL_9_10	CARPET_FACE	100.00	25,342.00
	CELL_9_10	EDGEFOLD	100.00	8,442.00
SUB TOTAL			545.00	67,229.20
DUST	EMPTY_CONT	OUTDOCK	50.00	10,683.50
SUB TOTAL			50.00	10,683.50

Report Data

Step 9: Filtering the Diagrams

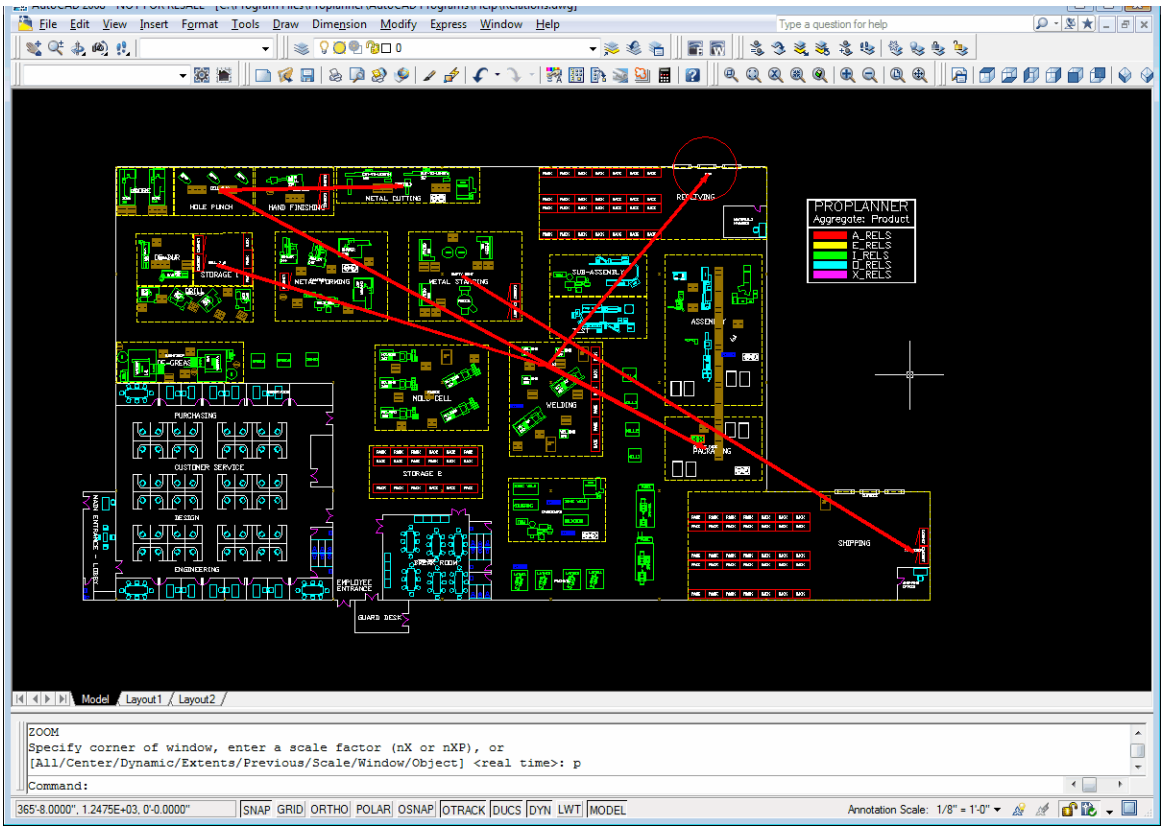
In this step, you will selectively display specific lines in your diagram. Diagrams may be filtered according to Reasons or Relationships. For this example, we will filter Relationships.

Go to Filter Tab, and select the "Product" Aggregate from the combo box in the top right corner. You may notice that the diagram in the background will switch back to the Relationship Coded diagram (just as if you went to the Paths tab and selected Product). Now select the A_RELS aggregate and select the "ALL" button for both the From and To location lists. Finally, select the "Filter Flows" button in the middle-right side of the window.



Filtering Diagrams

Your diagram will now be filtered to show only the "A" coded relationships within your drawing (see below). Upon returning to the Flow Planner, you will notice that a list of the filtered relationships also appears in the list box at the bottom of this window (see above). You may copy and paste this information into MS Excel or Word if you wish.



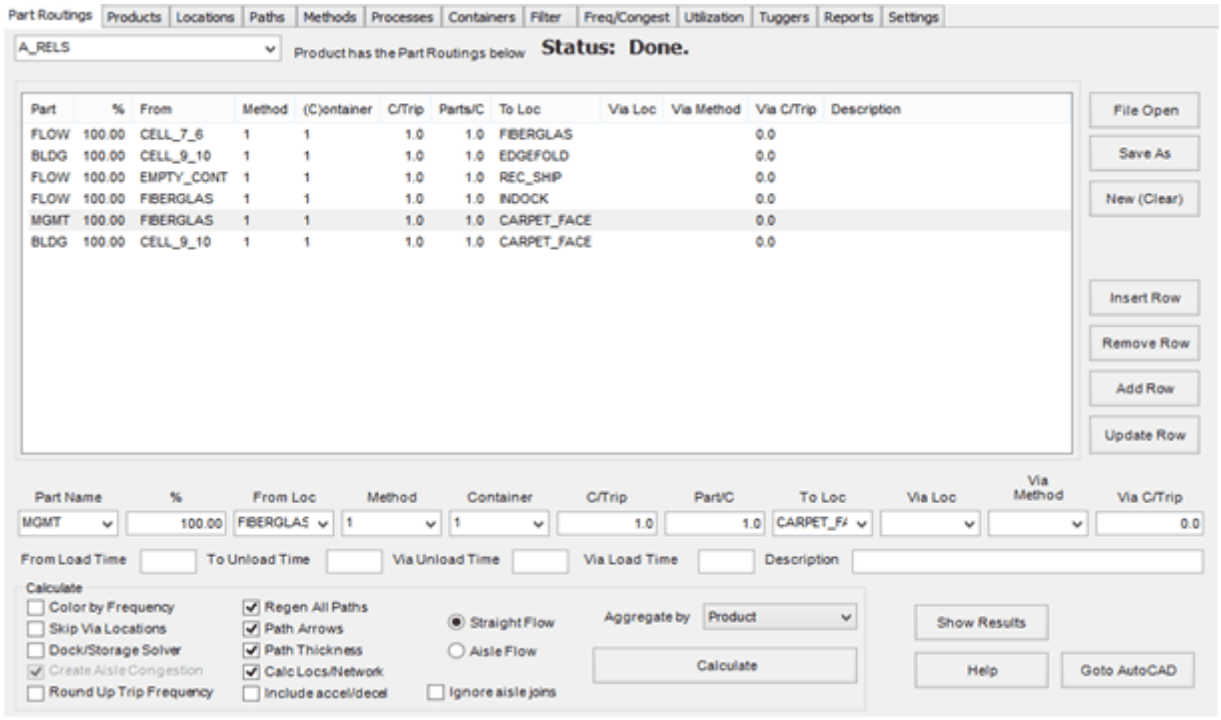
Filtered Drawing

From this filtered diagram, it is easy to see that the "A" relationships are not located close to one another. In fact, these relationships could hardly be further apart. We will correct this problem in the next step.

STEP 10: Evaluating a Layout Change

Prior to making a layout change, it is best to calculate the current state of your layout so that you have a baseline from which to measure improvement. Since we have calculated our current layout already, you can simply go to the Part Routings Tab and look in the Results list box. Currently our score for the A relationships (which we will work to improve initially) is 93,800, and our total score is 378,000. Remember that this is simply a relative score (it has no absolute meaning), and that smaller values are better.

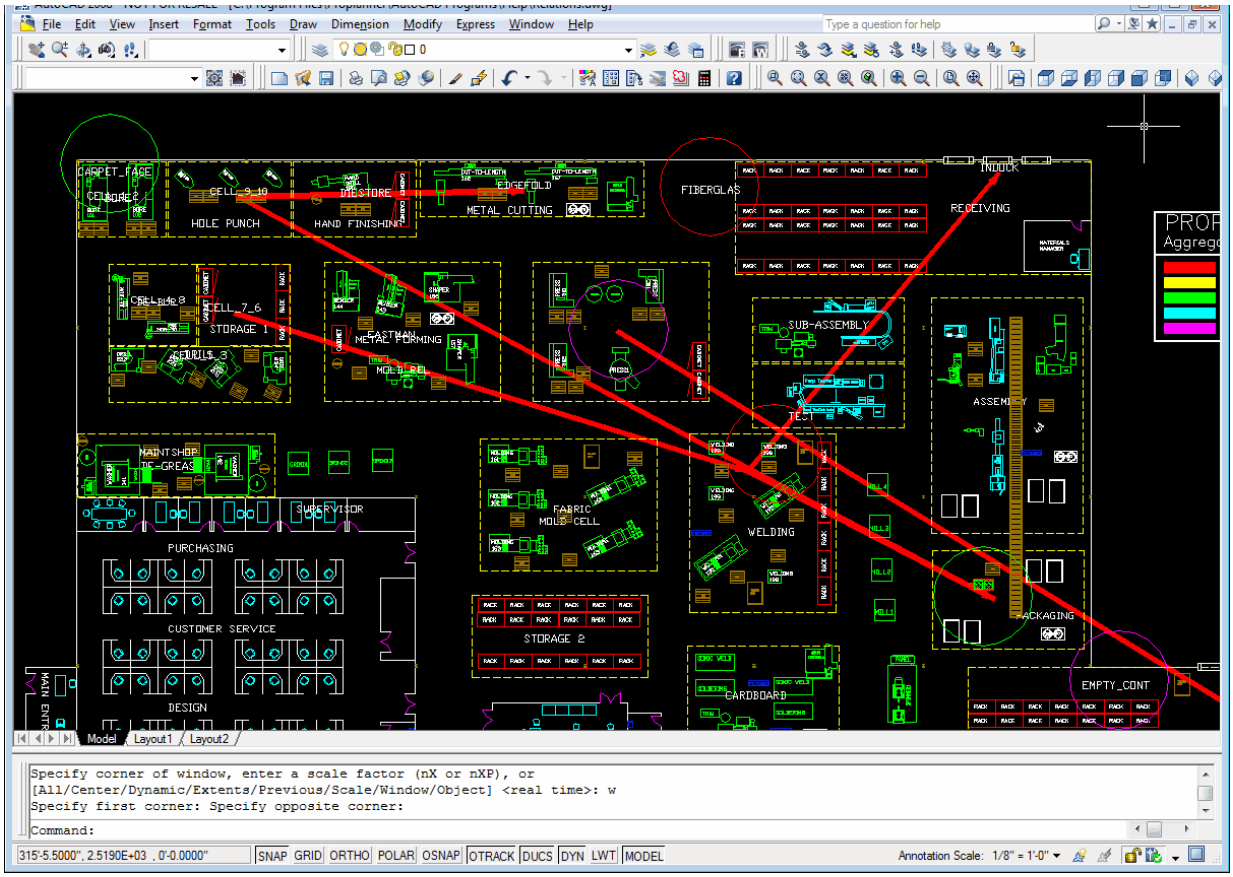
To improve the layout, you will want to move the location text labels in the drawing (using the AutoCAD Move command) to better locations (i.e. reduce the length of the Red lines). Flow Planner only looks at these text labels when evaluating a layout, so you need not move any other geometry in the layout drawing.



Evaluate & Improve Layout Changes

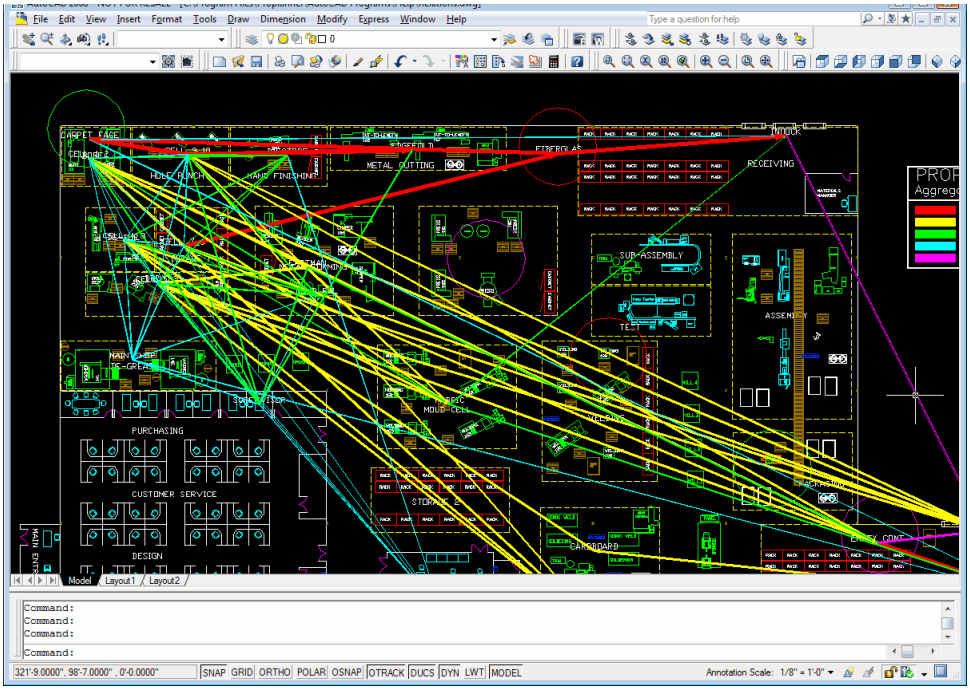
In the diagram below, you can see that:

- The CARPET_FACE Location has been moved from the Green circle area in the lower right to the Green circle area in the upper left.
- The FIBERGLAS location has been moved from the Red circle area in the middle to the Red circle area in the upper middle.
- The EMPTY_CONT location has been moved from the Magenta circle area in the middle to the Magenta circle area in the lower right.



Changing Layout Diagram

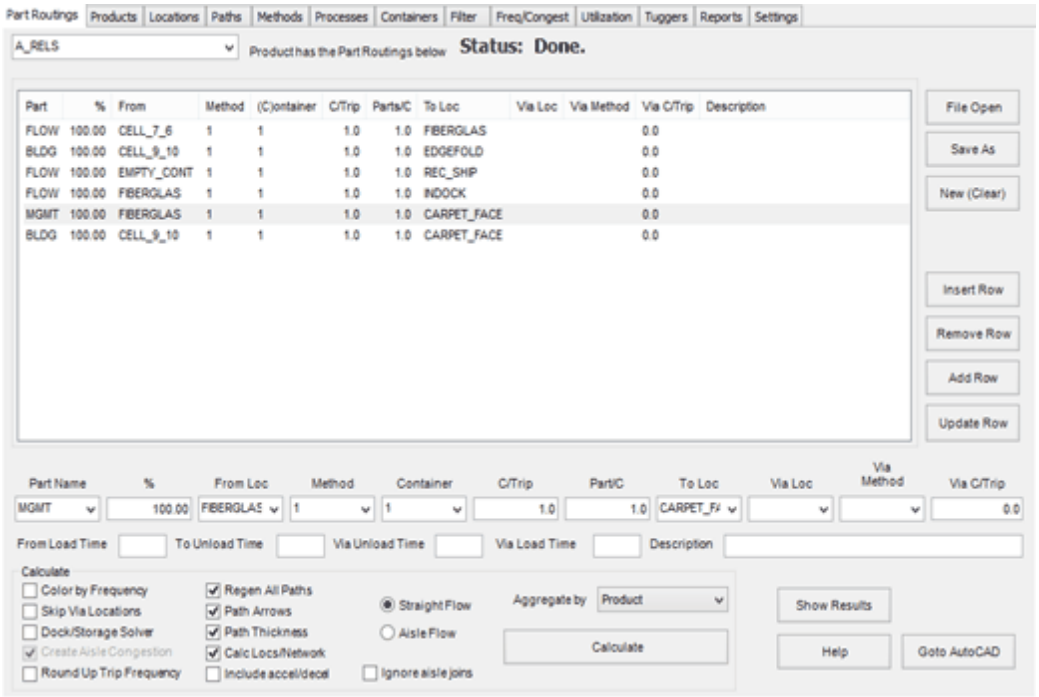
Now select the "Return to Flow Planner" button and go to the Part Routings Tab and select the "Calculate" Button. Ensure that you are generating "Straight Flow" diagrams of the Aggregate type "Product".



Recalculating Flows

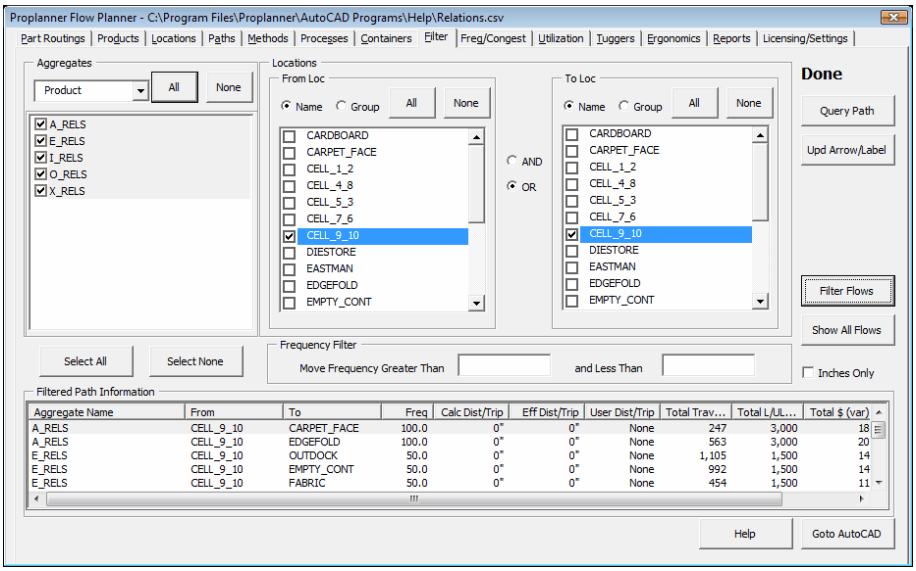
You can see that Flow Planner has regenerated the Relationship Diagram using these new locations (above) and has recomputed the Relationship score in the Results window on the Part Routings Tab (below). Notice that in this situation the score for the A_Relations was reduced from 93,800 to 59,000 but that the overall score increased from 378,000 to 395,000. This means that there are several E, I and O relationships that were made longer and possibly even some X relationships that were made shorter by this change.

To finish this layout improvement project, you will next want to filter your E relationships and find ways to improve them. Then you will filter and improve your I, O and X relationships.



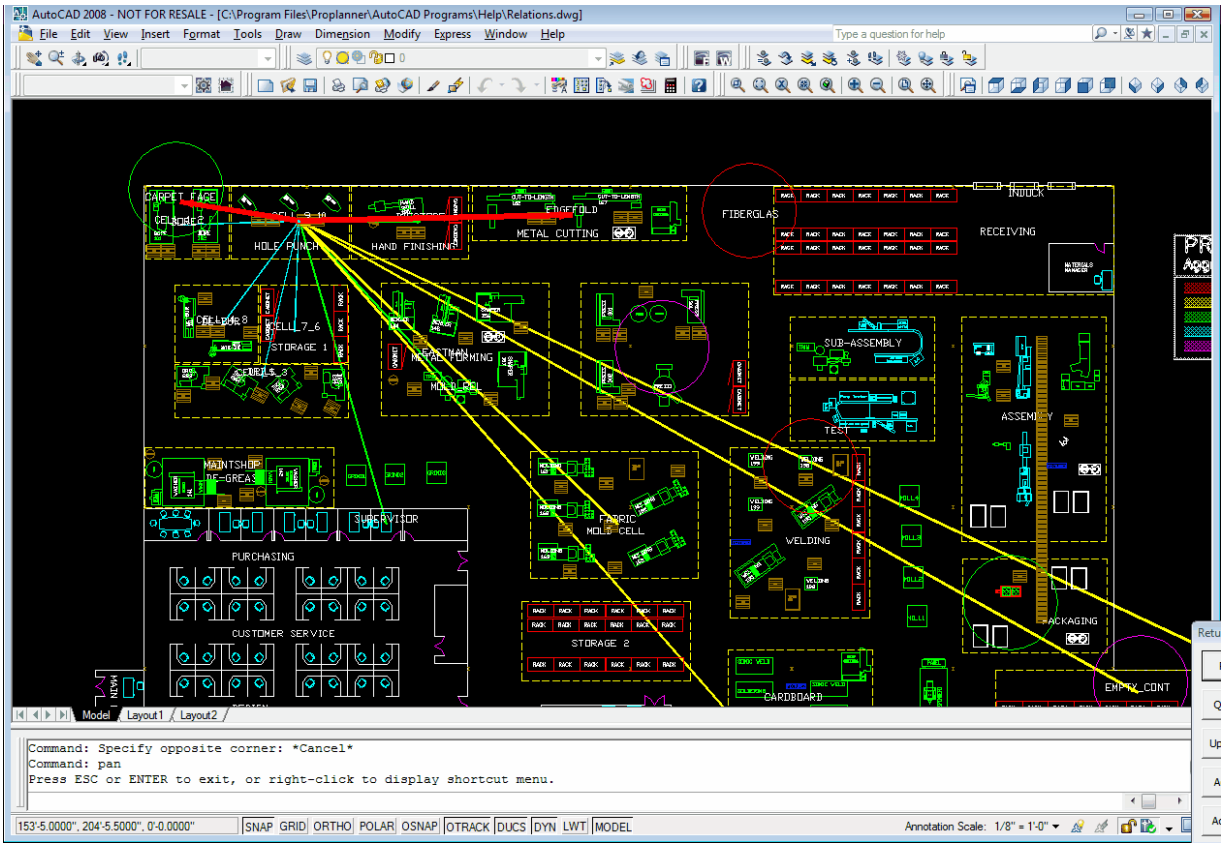
Filtering Remaining Relationships

You will also find it helpful to filter by location (select a specific location instead of ALL locations) and evaluate how that location is impacted by a move. In the example below, All relationships were selected for lines going into "OR" out of "CELL_9_10".



Filtering Locations

In the diagram generated below, it is easy to see that there are several key "E" relationships that are trying to drive this location to a spot in the lower-right portion of the factory. To improve the layout, you would want to see if you could move any of those locations closer to this workstation.



Evaluating Final Diagram

Congratulations!

You have now completed your first Relationship Planning study.

7 Exercises

Plant-Wide Material Flow Analysis

Special thanks to Dr. Beverly Jaeger at Northeastern University in Boston for creating these exercises.

The objective of this exercise will be to use the techniques learned in the Tutorial, along with the aid of the How To Guide and **Sample FP Input** (in Flow Planner folder \Tutorial Files\FootInch Tutorials), to take a simple set of material flow data and perform a complete Flow Planner analysis.

Exercise One: Format a data set for importing to Flow Planner

Use the FP1 **Excel Spreadsheet** (in Flow Planner folder \Tutorial Files\FootInch Tutorials\FP1.xls) of flow and part data along with the **Sample FP Input** to create a CSV and MHE file to import into Flow Planner.

1. To do this, extract the data and format it similar to the sample input.
2. Include routing, product, and part information in the CSV and material handling information in the MHE. It will need to be picked out of the original spreadsheet and re-organized.
3. We will treat quantity of products per day as an input for which we know the target value. 1500 will be the goal for MOTOR and 1000 will be the target for TURBINE.
4. The Start Location for the HILO1 method will be RECEIVING and for HILO2 will be SHIPPING. These locations do not matter in the calculation unless referenced in the routings but are needed in the MHE file.
5. Make sure there are no special characters in the CSV data by opening it in notepad. Also remove any superfluous commas at the end of the routing lines. The Sample FP Input has more details on this. Most common errors include spaces and quotation marks.
6. Once the data is set up correctly, open Flow Planner within AutoCAD and try opening the CSV. If done correctly the files will open flawlessly.
7. If the files cause an error, consult your instructor or the Troubleshooting Guide.

Results – Flow Planner will open the files with no errors.

Exercise Two: Prepare layout drawing

1. Create layer PF_AISLEPATH by opening FP_Ex.dwg in Flow Planner folder \Tutorial Files\FootInch Tutorials by opening Flow Planner while the drawing is open.
2. Insert the names of the locations using Flow Planner's Add Location command. The location names can be found in the CSV file or in the Locations tab.
3. Add the aisle path lines with the Add/Edit Aisle Path button on the Paths tab.
4. Attach the locations to aisles with the Join Locs to Aisle button on the Paths tab.
5. Once this is done, open FP2.csv and FP2.mhe in Flow Planner folder \Tutorial Files\FootInch Tutorials to run an aisle flow calculation.

Results – Flow Planner will not ask the user to place locations when a calculation is run. The Aisle Path calculation will not send any straight lines as long as all locations have been joined to the aisle.

Exercise Three: Perform a Euclidean flow study

Using FP_Ex_LOC_AISLE.dwg in Flow Planner folder \Tutorial Files\FootInch Tutorials instead of the drawing file just created, along with FP2.csv and FP2.mhe in Flow Planner folder \Tutorial Files\FootInch Tutorials will ensure that we get the same results when this exercise is complete.

1. Open the drawing and notice that all the locations have been placed as in Exercise Two.
2. Start Flow Planner and open the CSV and MHE files mentioned above. They should be identical to the files created in the first exercise.
3. Check the Routings, Products, and Methods tabs to make sure all the data has been imported.
4. Go to the Options tab to ensure that the units are in feet and inches.
5. Return to the Part Routings Tab and select the Straight Flow radio button.

6. Run the calculation. A Euclidean or straight line study will now be drawn on the AutoCAD drawing.
7. Because there is more work than one transport device can do in the week, the program will say it is over utilized and offer to automatically increase the number of appropriate devices. Click yes.
8. Now that the calculation is complete, return to the Part Routings Tab and look at the Results Window in the lower left side of the Flow Planner window.

Results – The results window should equal those below if the calculation has been run correctly.

Results

Aggregate	Dist (Ft)	Time (H:M:S)	Cost	Travel%
MOTOR	527122'-4"	44:38:11	$893	22
TURBINE	354825'-2"	26:1:45	$521	25
Total	881947'-5"	70:39:56	$1,633	23

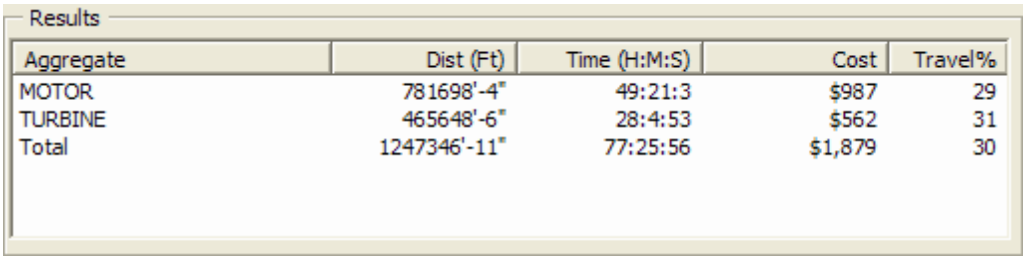
Results - Euclidean Flow Study

Exercise Four: Perform an aisle-based flow study

Using \Tutorial Files\FootInch Tutorials\FP_Ex_LOC_AISLE.dwg" instead of the drawing just created, along with \Tutorial Files\FootInch Tutorials\FP2.csv" and \Help Files\PPFP_Exercise_Samples\FP2.mhe" will ensure that we get the same results when this exercise is complete. If you just completed exercise three, skip to step five.

1. Open the drawing and notice that all the locations have been placed as in Exercise Two.
2. Start Flow Planner and open the CSV and MHE files mentioned above. They should be identical to the files created in the first exercise.
3. Check the Routings, Products, and Methods tabs to make sure all the data has been imported.
4. Go to the Options tab to ensure that the units are in feet and inches.
5. Return to the Part Routings Tab and select the Aisle Flow radio button.
6. Run the calculation. An Aisle Path study will now be drawn on the AutoCAD drawing.
7. Because there is more work than one transport device can do in the week, the program will say it is over utilized and offer to automatically increase the number of appropriate devices. Click yes.
8. Now that the calculation is complete, return to the Part Routings Tab and look at the Results Window in the lower left side of the Flow Planner window.

Results – The results window should equal those below if the calculation has been run correctly.



Results

Aggregate	Dist (Ft)	Time (H:M:S)	Cost	Travel%
MOTOR	781698'-4"	49:21:3	$987	29
TURBINE	465648'-6"	28:4:53	$562	31
Total	1247346'-11"	77:25:56	$1,879	30

Results - Aisle-Based Flow Study

Exercise Five: Analyze the congestion diagram created by the Flow Planner

Using \Tutorial Files\FootInch Tutorials\FP_Ex_LOC_AISLE.dwg" instead of the drawing just created, along with \Tutorial Files\FootInch Tutorials\FP2.csv" and \Tutorial Files\FootInch Tutorials\FP2.mhe" will ensure that we get the same results when this exercise is complete. If you just completed exercise four, skip to step six.

1. Open the drawing and notice that all the locations have been placed as in Exercise Two.
2. Start Flow Planner and open the CSV and MHE files mentioned above. They should be identical to the files created in the first exercise.
3. Check the Routings, Products, and Methods tabs to make sure all the data has been imported.
4. Go to the Options tab to ensure that the units are in feet and inches.
5. Return to the Part Routings Tab and select the Aisle Flow radio button.
6. Make sure that the check box for Create Aisle Congestion is checked.
7. Run the calculation. An Aisle Path study will now be drawn on the AutoCAD drawing and the congestion data has been created.
8. Go to the Freq/Congestion tab to switch the view to congestion and hit update to be taken to the drawing with congestion data drawn on the aisle paths.

Results – You will see the top five percent of flows located on the incoming/outgoing path from the shipping and receiving docks. If you do a Query Path on the line you will see that it has 3,535 trips as its frequency.

This amount of traffic over such a large aisle path can be a safety risk for the operators. This can also cause handling devices to need unnecessary amounts of maintenance or delays, depending on aisle width, and raise their costs. This kind of problem requires a layout or aisle path redesign.

Exercise Six: Rearrange layout to reduce congestion and improve throughput

You may wish to alter the drawing in a few ways. For the sake of matching output, do a calculation on the drawing \Tutorial Files\FootInch Tutorials\FP_Ex_LOC_AISLE_2.dwg" using the same \Tutorial Files\FootInch Tutorials\FP2.csv" and \Tutorial Files\FootInch Tutorials\FP2.mhe" as before.

There are several ways to improve layout, the most obvious being to push locations closer together. In this case the product assembly areas were assumed to be monumental. Only the aisle paths and dock input/output sides have been changed to take advantage of being closer to their use locations and avoid aisle crossovers between the shipping and receiving dock traffic.

Results – The area of highest congestion has now been minimized to a small area near receiving and the congestion over which is only 2952.5 trips. That's over a 16% reduction of congestion in the area of highest concentration and a drastic reduction in space in which the major congestion lies.

Additionally, the results which should match those given below have been improved by 128840.4 feet in reduced travel distance and nearly fifteen minutes of total time saved.

Results

Aggregate	Dist (Ft)	Time (H:M:S)	Cost	Travel%
MOTOR	670367'-6"	47:17:21	$946	26
TURBINE	448139'	27:45:26	$555	30
Total	1118506'-7"	75:2:47	$1,831	28

Results - Reducing Congestion & Improving Throughput

Exercise Seven: Adjust product/part quantities and method information to predict future state

Looking at this data, the engineer can see that there is significant room for improvement or altering the product quantities produced. Assuming that demand for this product will grow, what happens when the amount manufactured needs to be increased? To do this analysis the user only needs to alter the product information to have the new quantities. With these changes, the program will automatically change the number of handling devices used after informing the user that the route is over utilized.

1. Open the drawing \Tutorial Files\FootInch Tutorials\FP_Ex_LOC_AISLE.dwg" and \Tutorial Files\FootInch Tutorials\FP2.csv" and\Tutorial Files\FootInch Tutorials\FP2.mhe".
2. On the Products tab increase the quantity of MOTOR to 3000 and TURBINE to 2000 to simulate increase in production quantities. This can also be used to simulate a reduction in available method time by altering the Method Type available minutes on the Methods tab.
3. Run an Aisle Flow calculation to best evaluate the real distance.
4. Select Yes when the over utilization dialogue boxes pop up. This will change the number of material handling devices as necessary.
5. View the changes to the method handling device quantities on the Methods tab.
6. Save the routing files as different file names to save that alternative scenario for future analysis.

Results – The user can see that despite drastic increases in demand, the optimized material flow patterns only require an increase of two operators by looking at the Methods tab. Additionally, they have all the distance, time, and cost evaluation data figured without doing a test run on the line.

Results

Aggregate	Dist (Ft)	Time (H:M:S)	Cost	Travel%
MOTOR	1340735'	94:34:42	$1,892	26
TURBINE	896278'-1"	55:30:52	$1,110	30
Total	2237013'-1"	150:5:34	$3,552	28

Results - Adjusted Quantities and Method Information

This method can be used to determine the outcome of several different material information changes. Additionally for all the devices, the operator can track their utilization percentages and decide how much time they can spend doing other tasks. Assuming the work locations are movable, large amounts of plant space can be saved as well.

8 How-To Guide

Perform a Plant-Wide Material Flow Analysis

1. Input routing information by either A.) or B.):

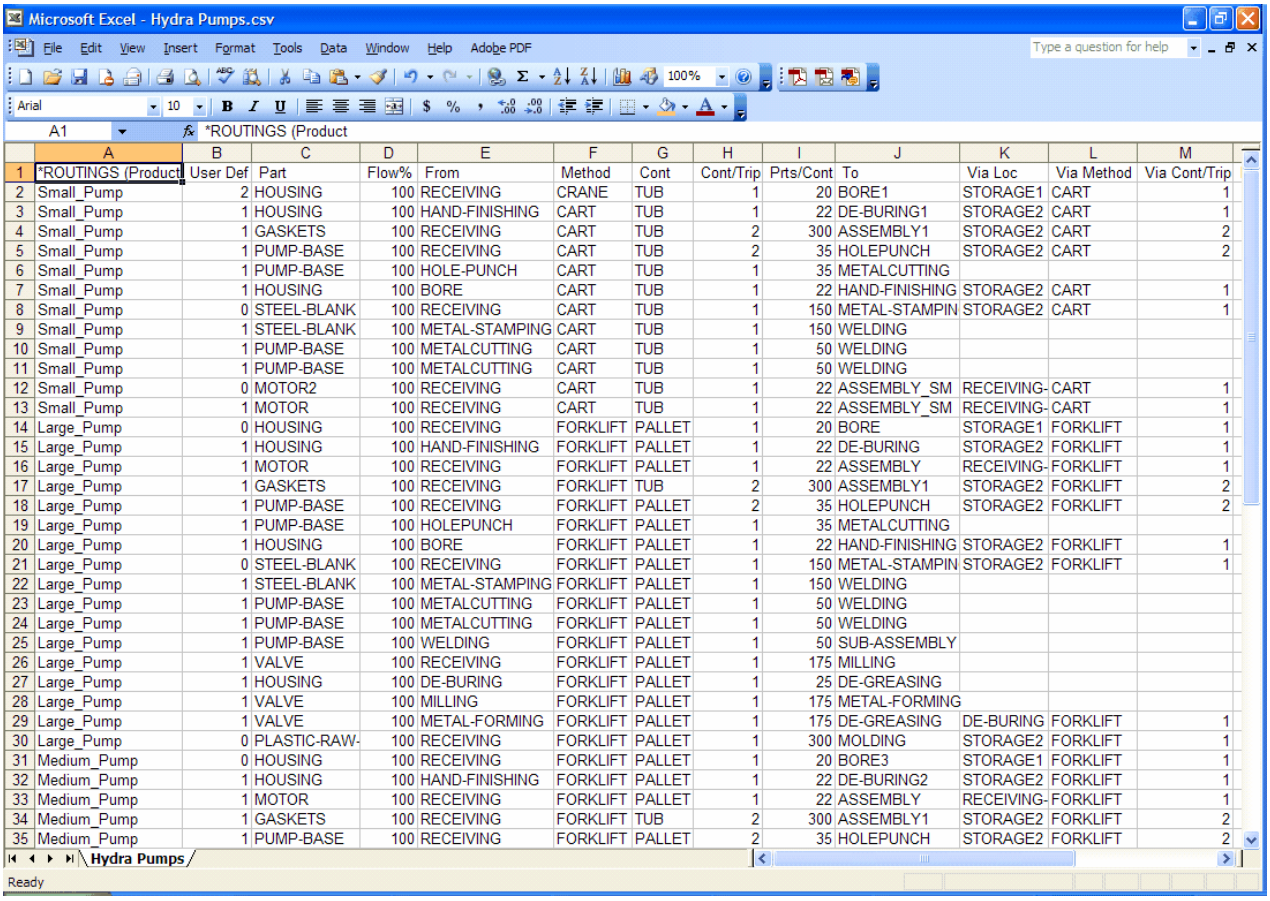
A.) Using Excel to copy and paste larger quantities of information into the import template for Flow Planner

1.) In the Import template, enter the following information into the import template columns.

Import Template Column	Description
Routings (Product)	The product or model
User Defined	Blank space
Part	Item number
Flow%	Percentage of total part flow for the given Part in the product line
From	The origin of the part (the FROM location.)
Method	The transport device (fork truck, AGV, hand cart, etc.) used to move the material from the FROM location to the TO location or the VIA location.
Container	Name of container (pallet, tub, barrel, rack, etc.) used for holding the parts.
Containers/Trip	The quantity of containers that will typically fit in one trip for the method.
Parts/Container	Quantity of Parts that will fit in the normally-loaded container
To	The final destination of the part for the flow path analysis (the TO location).
Via Loc	An (optional) intermediate travel location as the part moves between the FROM and TO locations. This may be an intermediate storage point or a pass through point, etc.
Via Method	(Use only if Via Loc used). The transport device used to move the material from the VIA location, to the TO location
Via Containers/Trip	(Use only if Via Loc used). The name of container used for holding the parts as they move from the VIA location to the TO location.
Description	Optional
From Load (sec)	Optional
To Unload (sec)	Optional
Via Unload (sec)	Optional
Via Load (sec)	Optional

Import Template

2.) The final file should look like this:



Microsoft Excel - Hydra Pumps.csv

File Edit View Insert Format Tools Data Window Help Adobe PDF

A1 *ROUTINGS (Product

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	*ROUTINGS (Product	User Def	Part	Flow%	From	Method	Cont	Cont/Trip	Prts/Cont	To	Via Loc	Via Method	Via Cont/Trip
2	Small_Pump	2	HOUSING	100	RECEIVING	CRANE	TUB	1	20	BORE1	STORAGE1	CART	1
3	Small_Pump	1	HOUSING	100	HAND-FINISHING	CART	TUB	1	22	DE-BURING1	STORAGE2	CART	1
4	Small_Pump	1	GASKETS	100	RECEIVING	CART	TUB	2	300	ASSEMBLY1	STORAGE2	CART	2
5	Small_Pump	1	PUMP-BASE	100	RECEIVING	CART	TUB	2	35	HOLEPUNCH	STORAGE2	CART	2
6	Small_Pump	1	PUMP-BASE	100	HOLE-PUNCH	CART	TUB	1	35	METALCUTTING			
7	Small_Pump	1	HOUSING	100	BORE	CART	TUB	1	22	HAND-FINISHING	STORAGE2	CART	1
8	Small_Pump	0	STEEL-BLANK	100	RECEIVING	CART	TUB	1	150	METAL-STAMPIN	STORAGE2	CART	1
9	Small_Pump	1	STEEL-BLANK	100	METAL-STAMPING	CART	TUB	1	150	WELDING			
10	Small_Pump	1	PUMP-BASE	100	METALCUTTING	CART	TUB	1	50	WELDING			
11	Small_Pump	1	PUMP-BASE	100	METALCUTTING	CART	TUB	1	50	WELDING			
12	Small_Pump	0	MOTOR2	100	RECEIVING	CART	TUB	1	22	ASSEMBLY_SM	RECEIVING-	CART	1
13	Small_Pump	1	MOTOR	100	RECEIVING	CART	TUB	1	22	ASSEMBLY_SM	RECEIVING-	CART	1
14	Large_Pump	0	HOUSING	100	RECEIVING	FORKLIFT	PALLET	1	20	BORE	STORAGE1	FORKLIFT	1
15	Large_Pump	1	HOUSING	100	HAND-FINISHING	FORKLIFT	PALLET	1	22	DE-BURING	STORAGE2	FORKLIFT	1
16	Large_Pump	1	MOTOR	100	RECEIVING	FORKLIFT	PALLET	1	22	ASSEMBLY	RECEIVING-	FORKLIFT	1
17	Large_Pump	1	GASKETS	100	RECEIVING	FORKLIFT	TUB	2	300	ASSEMBLY1	STORAGE2	FORKLIFT	2
18	Large_Pump	1	PUMP-BASE	100	RECEIVING	FORKLIFT	PALLET	2	35	HOLEPUNCH	STORAGE2	FORKLIFT	2
19	Large_Pump	1	PUMP-BASE	100	HOLEPUNCH	FORKLIFT	PALLET	1	35	METALCUTTING			
20	Large_Pump	1	HOUSING	100	BORE	FORKLIFT	PALLET	1	22	HAND-FINISHING	STORAGE2	FORKLIFT	1
21	Large_Pump	0	STEEL-BLANK	100	RECEIVING	FORKLIFT	PALLET	1	150	METAL-STAMPIN	STORAGE2	FORKLIFT	1
22	Large_Pump	1	STEEL-BLANK	100	METAL-STAMPING	FORKLIFT	PALLET	1	150	WELDING			
23	Large_Pump	1	PUMP-BASE	100	METALCUTTING	FORKLIFT	PALLET	1	50	WELDING			
24	Large_Pump	1	PUMP-BASE	100	METALCUTTING	FORKLIFT	PALLET	1	50	WELDING			
25	Large_Pump	1	PUMP-BASE	100	WELDING	FORKLIFT	PALLET	1	50	SUB-ASSEMBLY			
26	Large_Pump	1	VALVE	100	RECEIVING	FORKLIFT	PALLET	1	175	MILLING			
27	Large_Pump	1	HOUSING	100	DE-BURING	FORKLIFT	PALLET	1	25	DE-GREASING			
28	Large_Pump	1	VALVE	100	MILLING	FORKLIFT	PALLET	1	175	METAL-FORMING			
29	Large_Pump	1	VALVE	100	METAL-FORMING	FORKLIFT	PALLET	1	175	DE-GREASING	DE-BURING	FORKLIFT	1
30	Large_Pump	0	PLASTIC-RAW-	100	RECEIVING	FORKLIFT	PALLET	1	300	MOLDING	STORAGE2	FORKLIFT	1
31	Medium_Pump	0	HOUSING	100	RECEIVING	FORKLIFT	PALLET	1	20	BORE3	STORAGE1	FORKLIFT	1
32	Medium_Pump	1	HOUSING	100	HAND-FINISHING	FORKLIFT	PALLET	1	22	DE-BURING2	STORAGE2	FORKLIFT	1
33	Medium_Pump	1	MOTOR	100	RECEIVING	FORKLIFT	PALLET	1	22	ASSEMBLY	RECEIVING-	FORKLIFT	1
34	Medium_Pump	1	GASKETS	100	RECEIVING	FORKLIFT	TUB	2	300	ASSEMBLY1	STORAGE2	FORKLIFT	2
35	Medium_Pump	1	PUMP-BASE	100	RECEIVING	FORKLIFT	PALLET	2	35	HOLEPUNCH	STORAGE2	FORKLIFT	2

Hydra Pumps

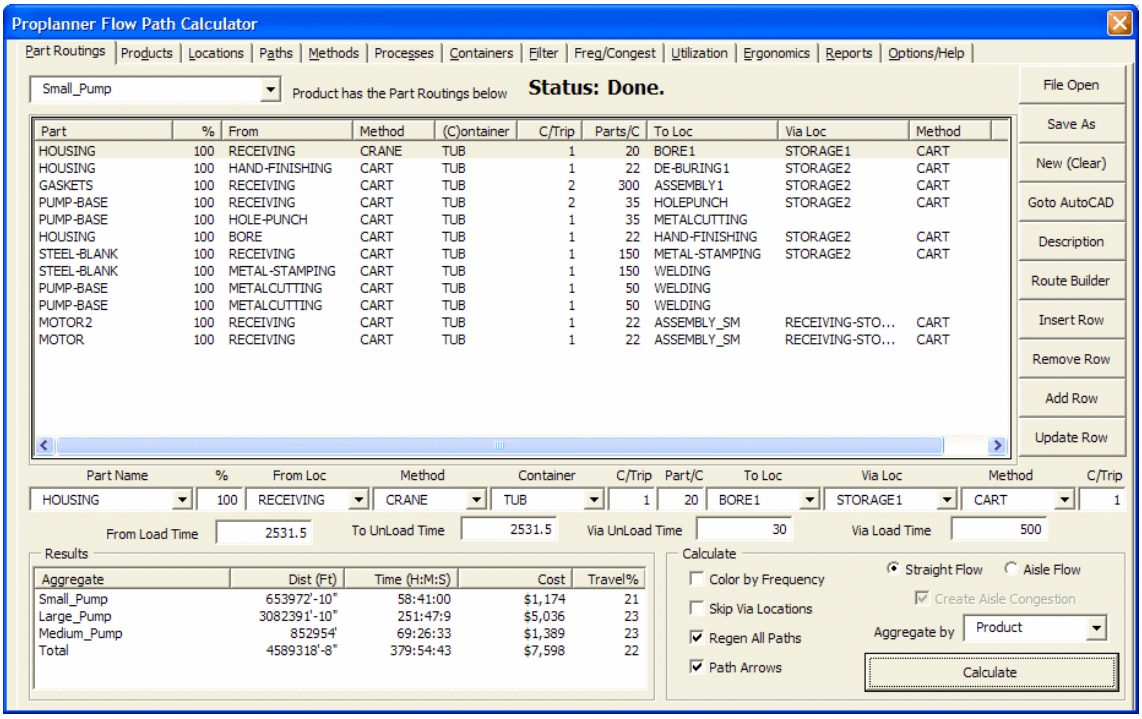
Ready

Excel Worksheet

3.) Save the import template as a .CSV file and remember the file location.

4.) Close the document (must be closed before you can move to the next step.)

B.) Using FlowPlanner Route Building Editor by clicking on the Route Builder button.



Route Building Editor

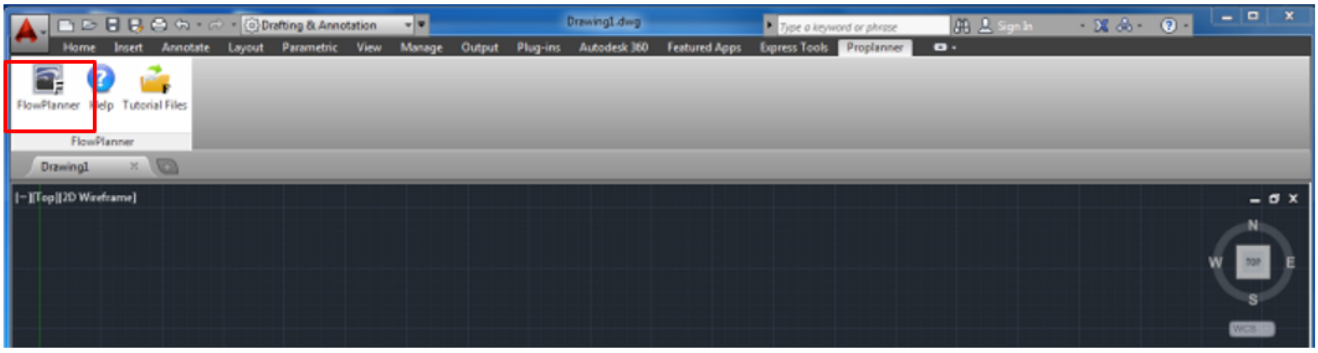
2. Open AutoCAD drawing:

   A.) Open AutoCAD on the computer.

   B.) Import the AutoCAD plant drawing to be used on the Flow Planner analysis.

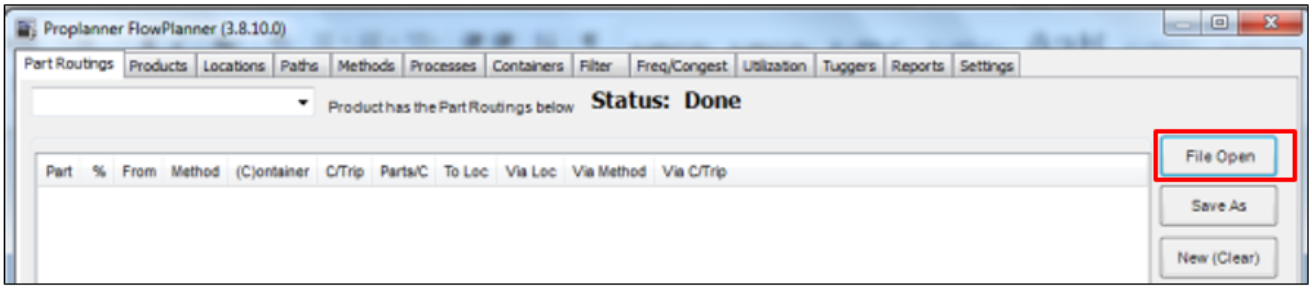
   C.) Click on the *Proplanner* tab.

   D.) Click the *FlowPlanner* button.



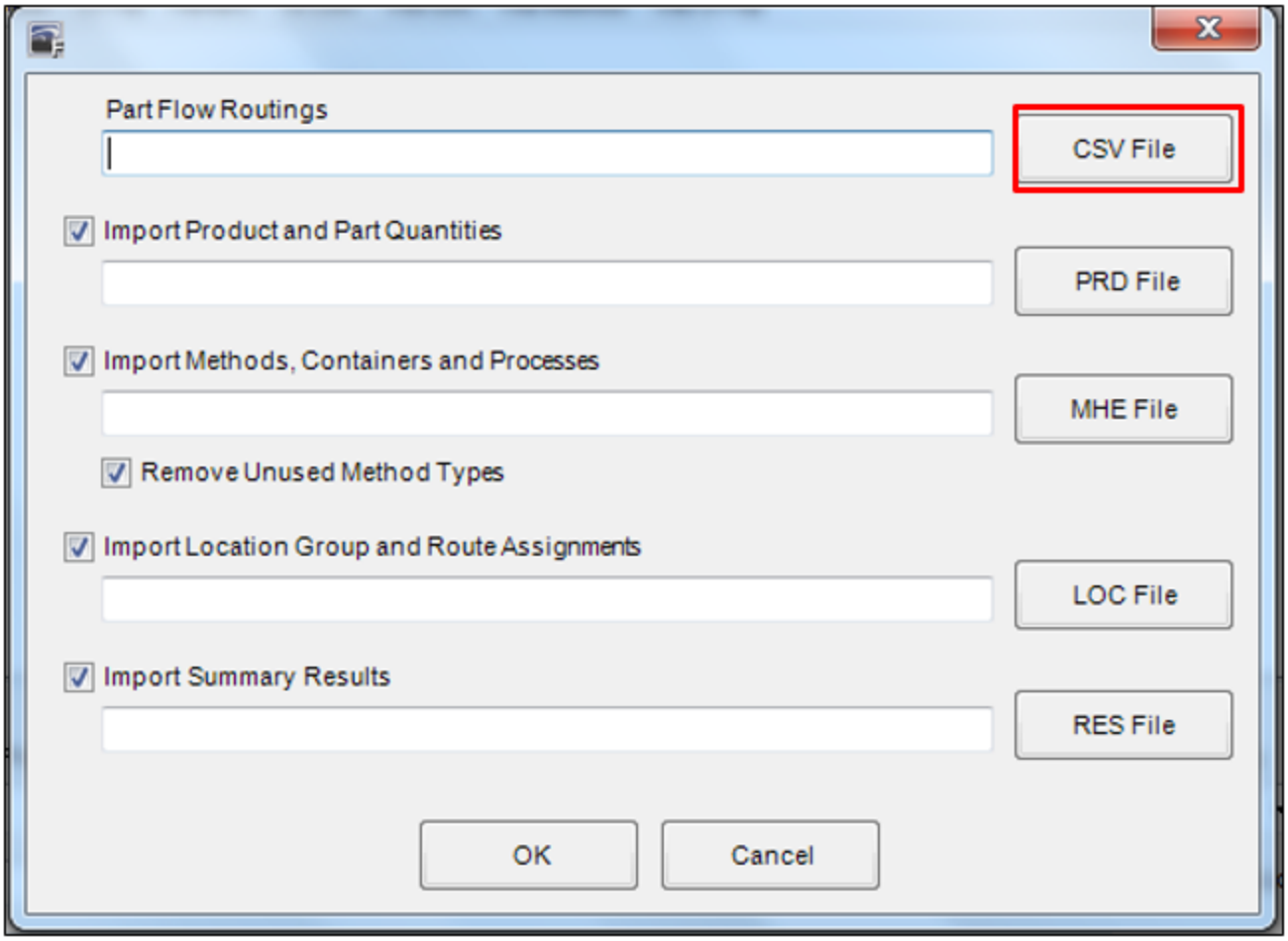
Flow Planner Application

3. If the FlowPlanner Route Building editor was used to build the routes, skip to Step 6, otherwise, click the File Open button.



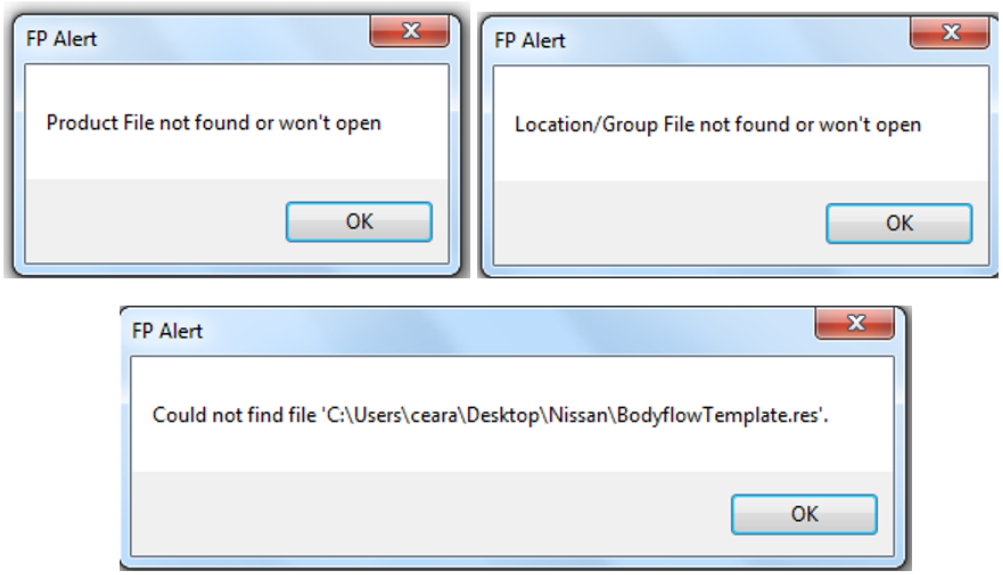
File Open Button

4. Click the .CSV File button, browse to the location that the Import Template file was saved, and click OK.



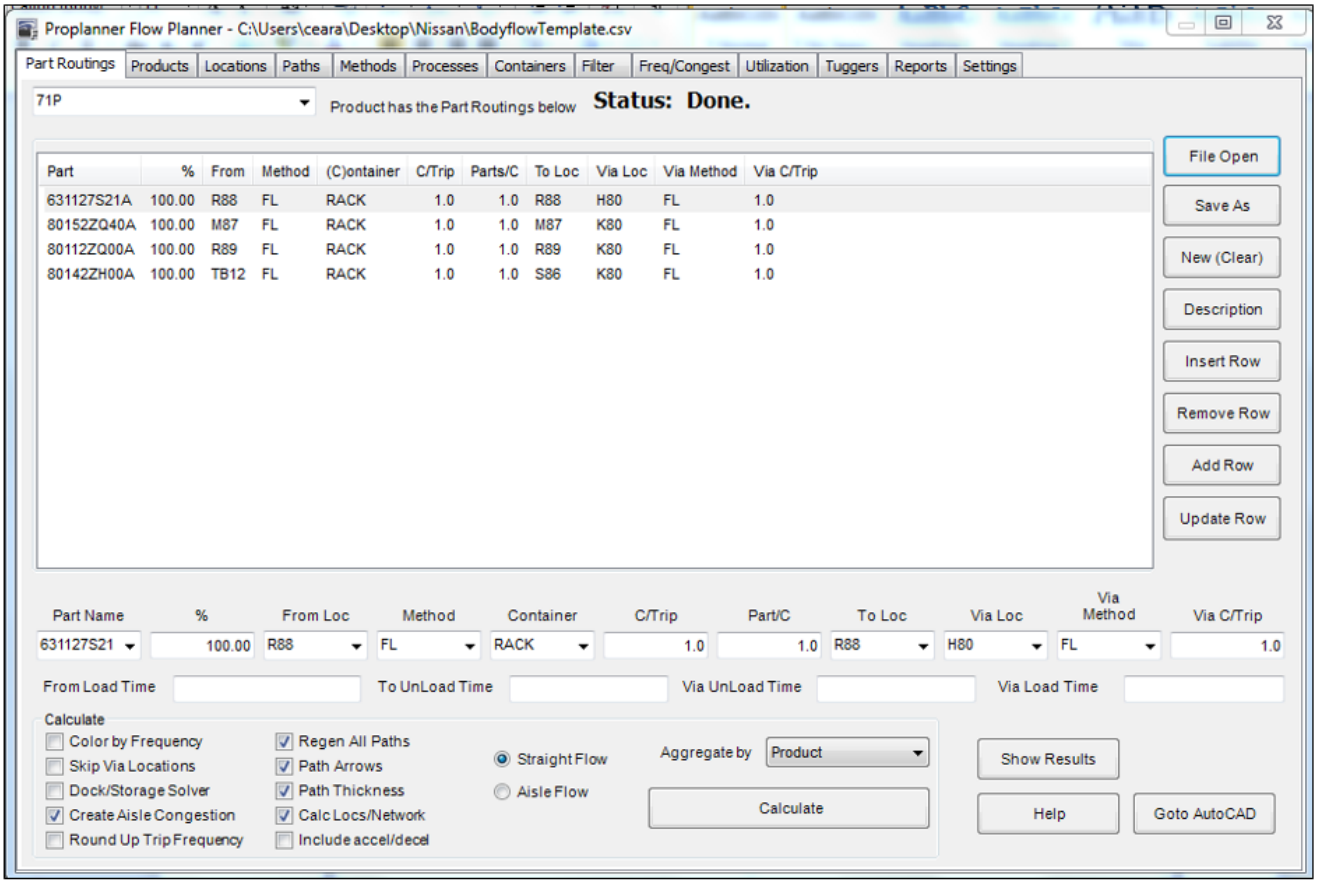
CSV File Import Button

5. "FP Alerts" will pop up one at a time (due to using the same CSV file for all the import files above), click OK on all alerts.



FP Alerts

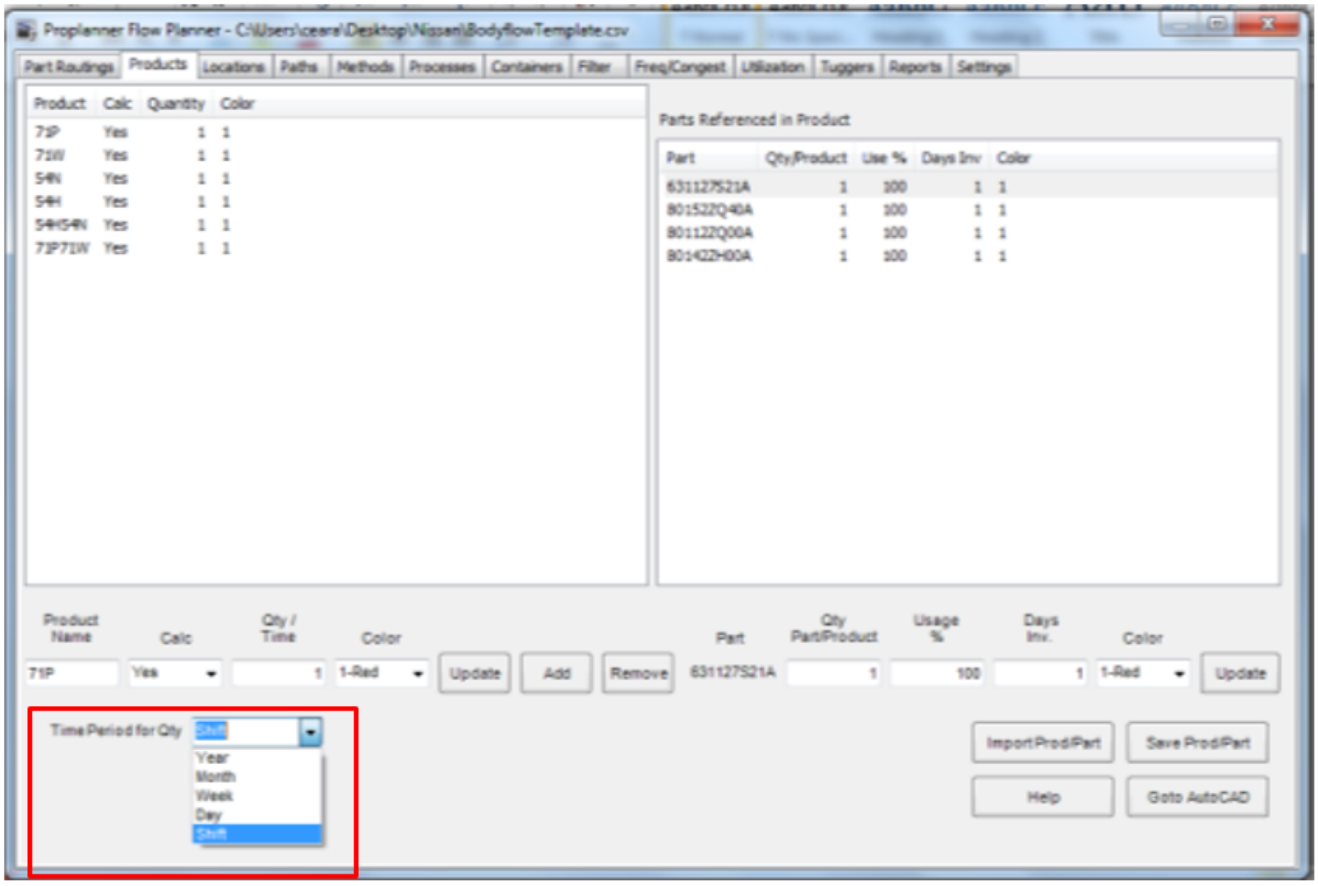
6. The *Part Routings* file will be displayed:



Part Routings Window

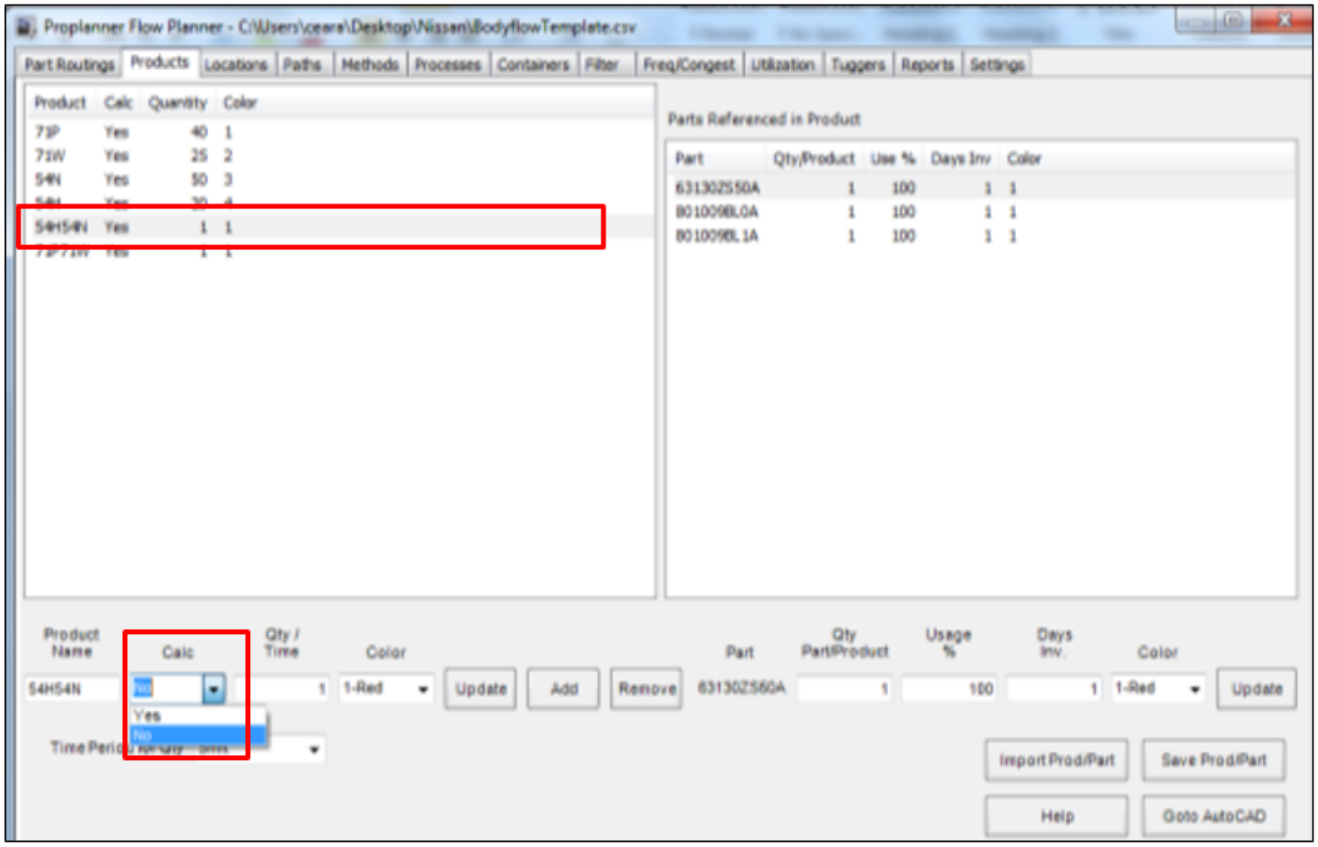
7. Select the *Products* tab.

8. Determine the Work Time Period to be used for analysis. In the *Time Period for Qty* field, select the appropriate time period:



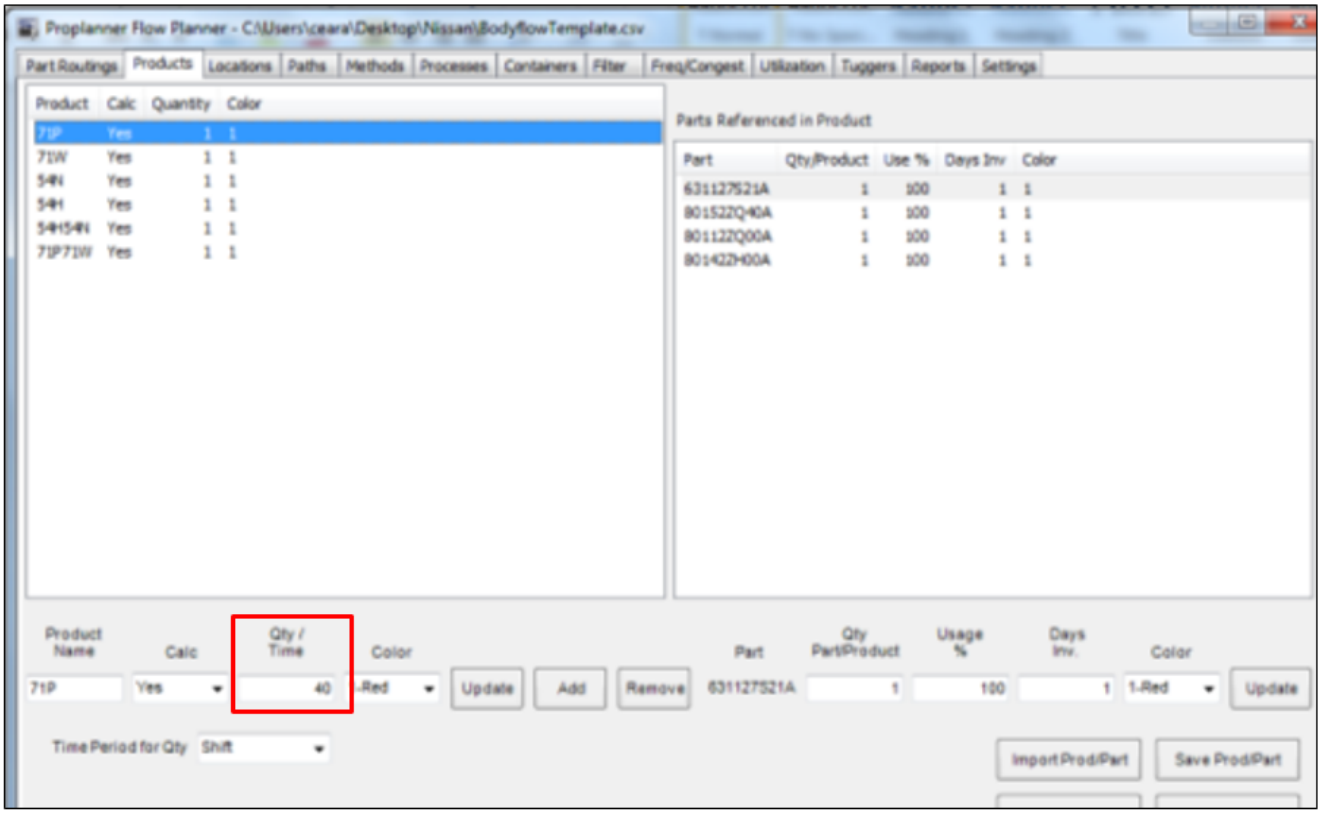
Products Tab - Selecting Time Period

9. In the *Products* section, click a Product line to edit it.
10. In the *Calc* field; select NO if you do NOT want to include that product line in the calculations.



Calc Field Drop Down Field

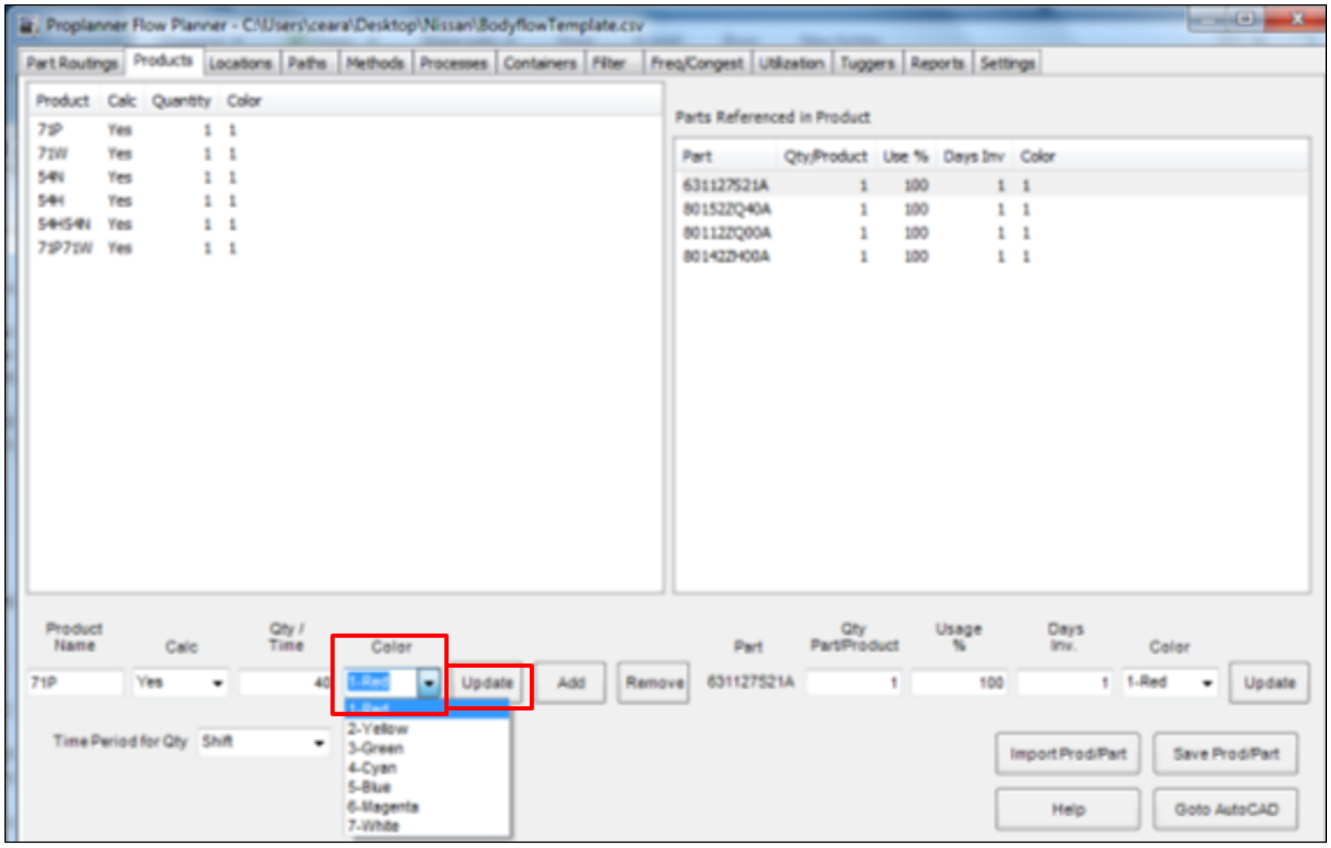
11. In the *Qty/Time* field, type in the quantity of that product that will be produced in the determined Time Period for Qty field.



Qty/Time Field

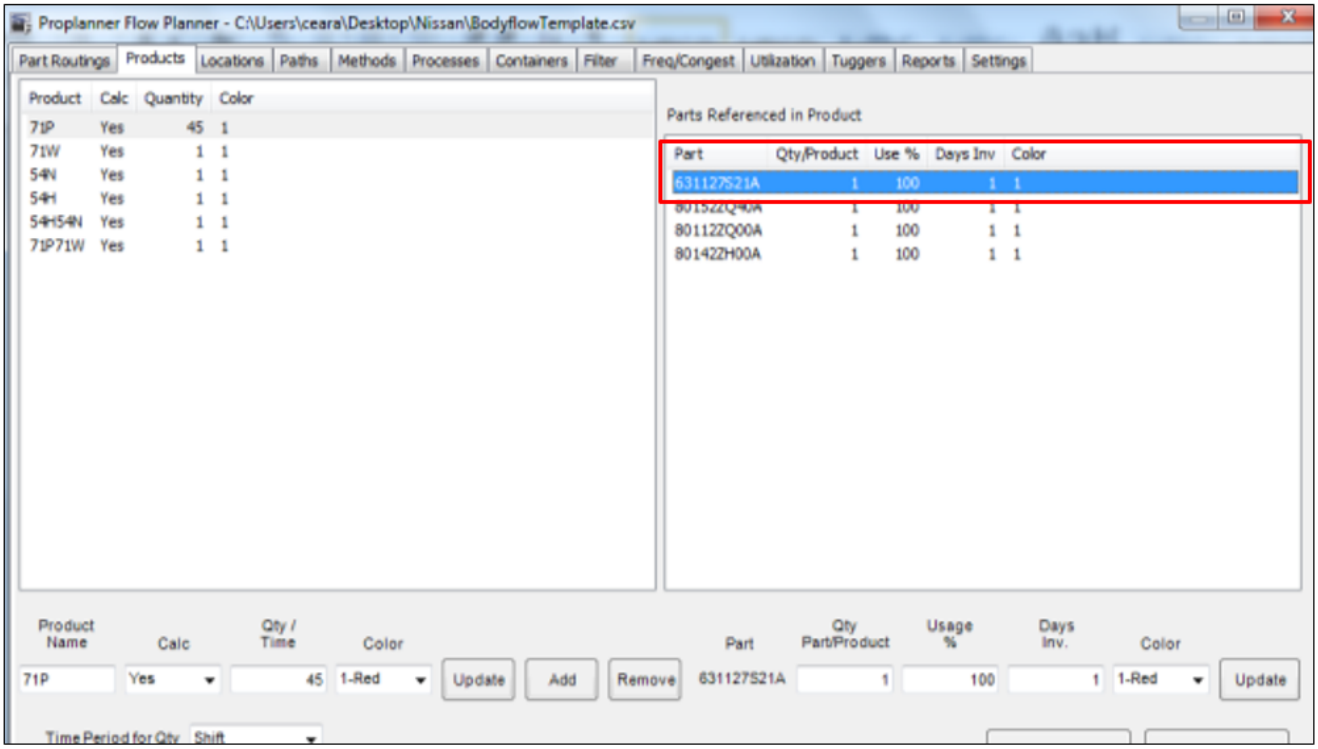
12. In the *Color* dropdown field, select the color of line that will show in the AutoCAD drawing for that product flow.

13. Click the *Update* button.



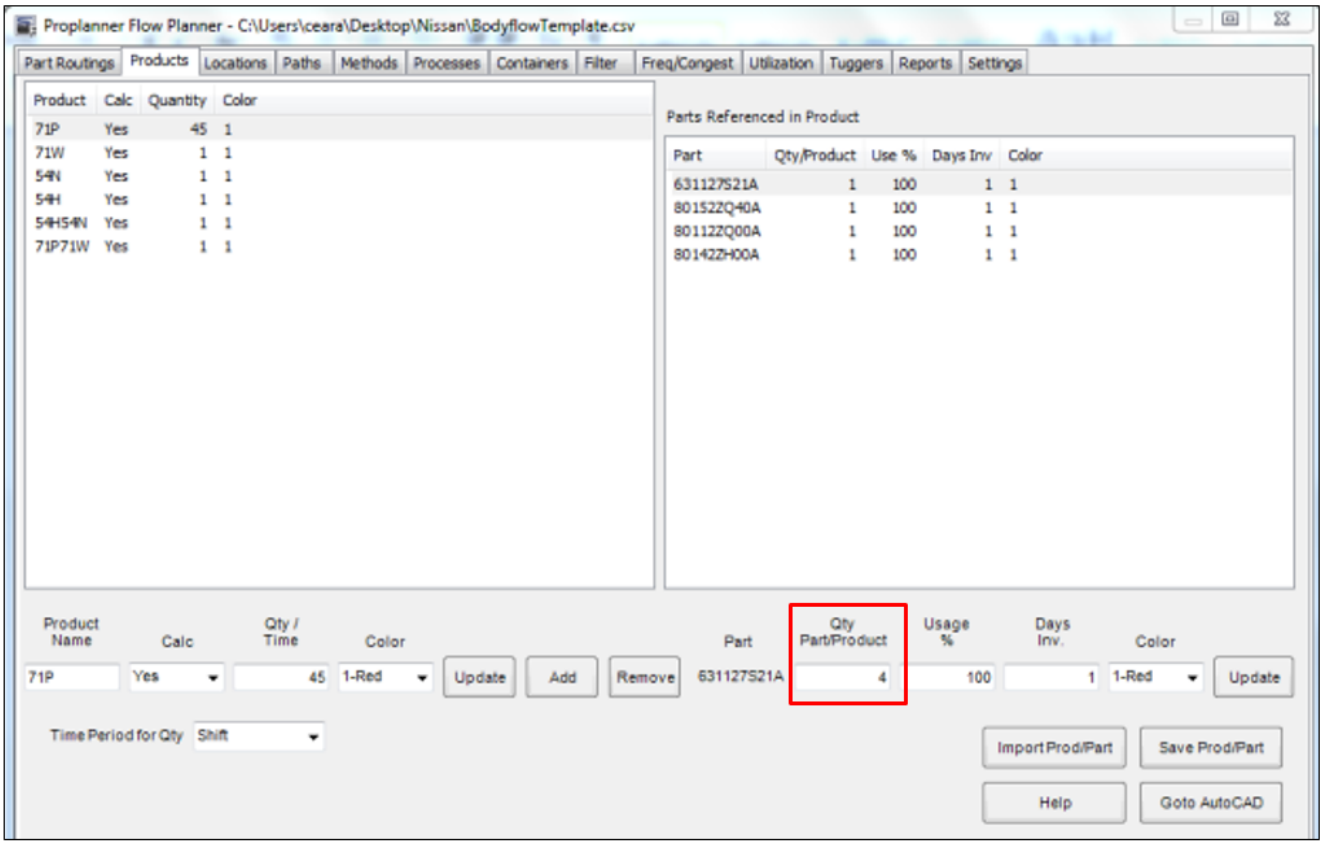
Color Drop Down Field

14. On the right hand side of the screen for the selected Product, click the *Part* line to edit.



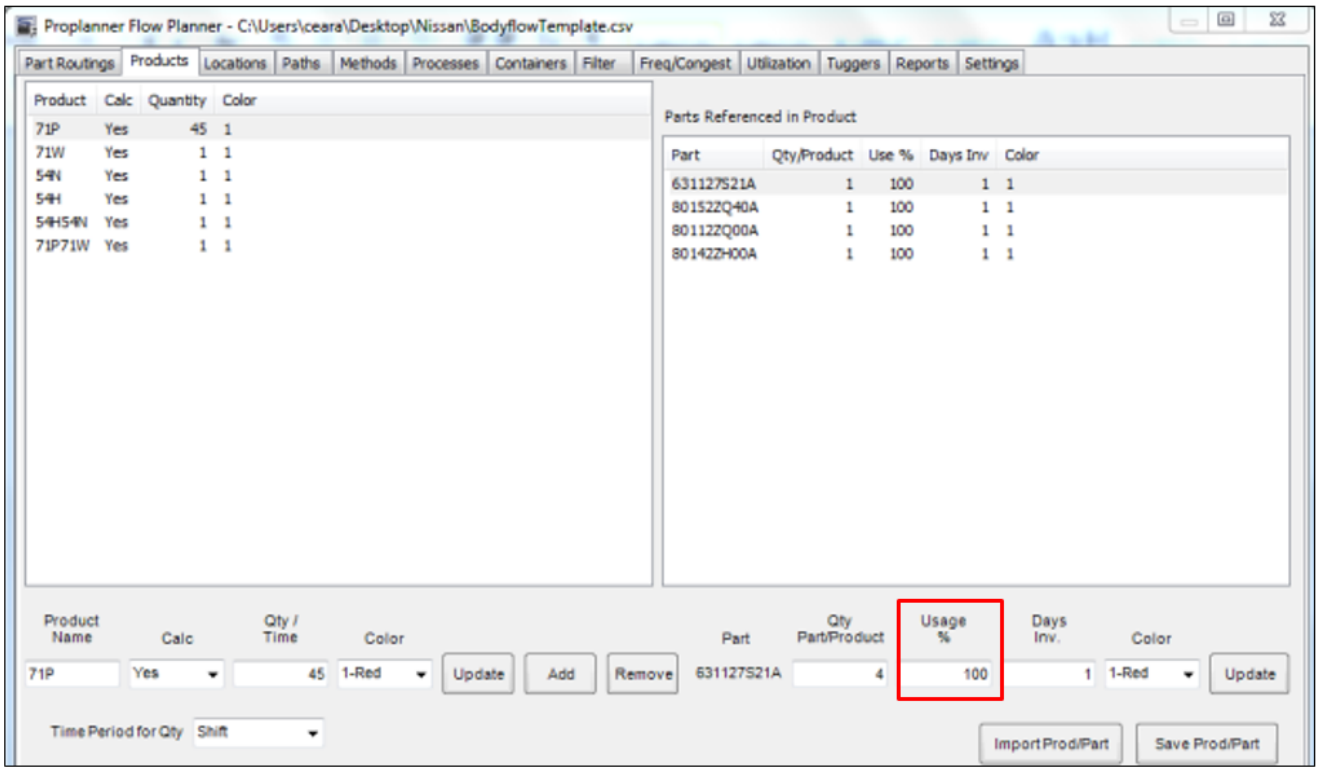
Part Line

15. In the *Qty Parts/Product* field, type the quantity of the selected part used per selected Product.



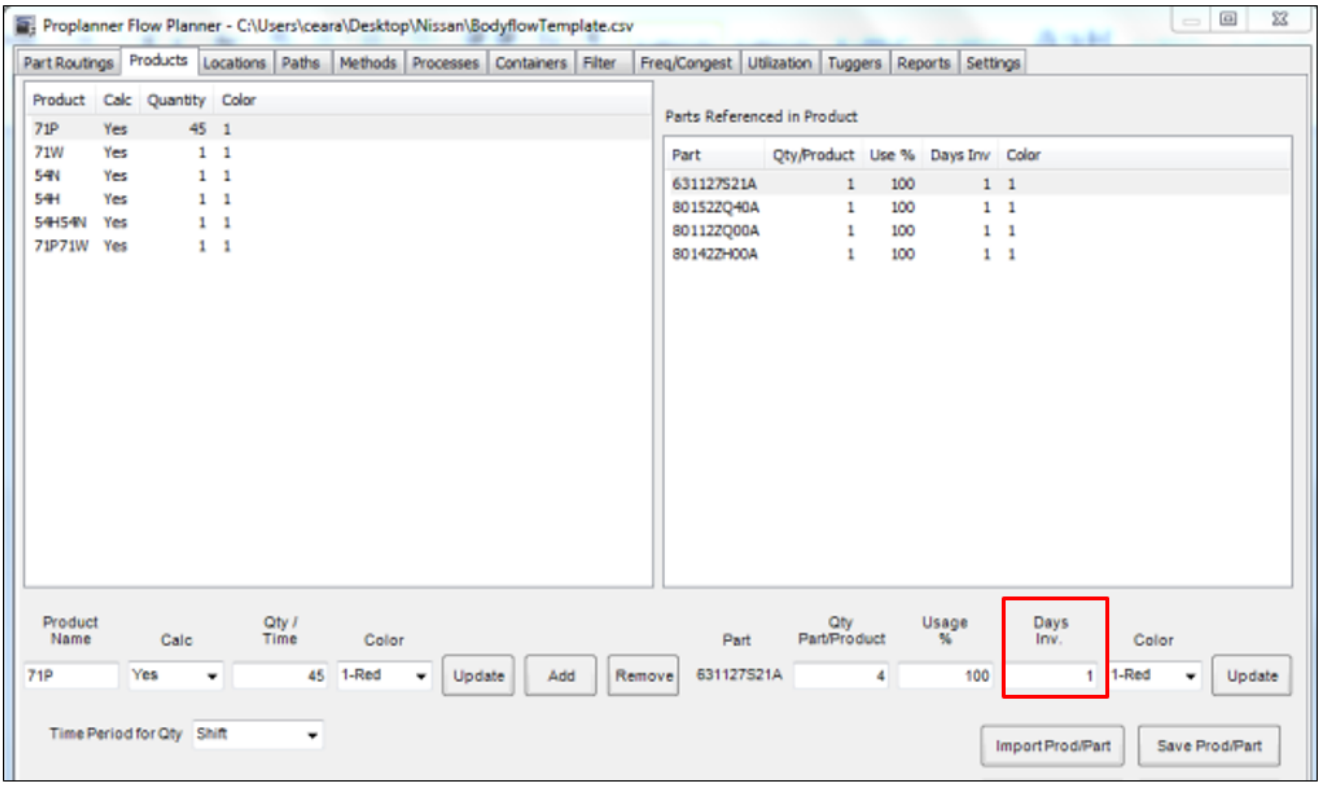
Qty Part/Product Field

16. In the *Usage %* field, type the percentage of time the selected part is used in the Product over the Time Period (e.g. if the part is an option on the Product line and the option is put on 50% of the time the Product is built, type 50 in this field.)



Usage % Field

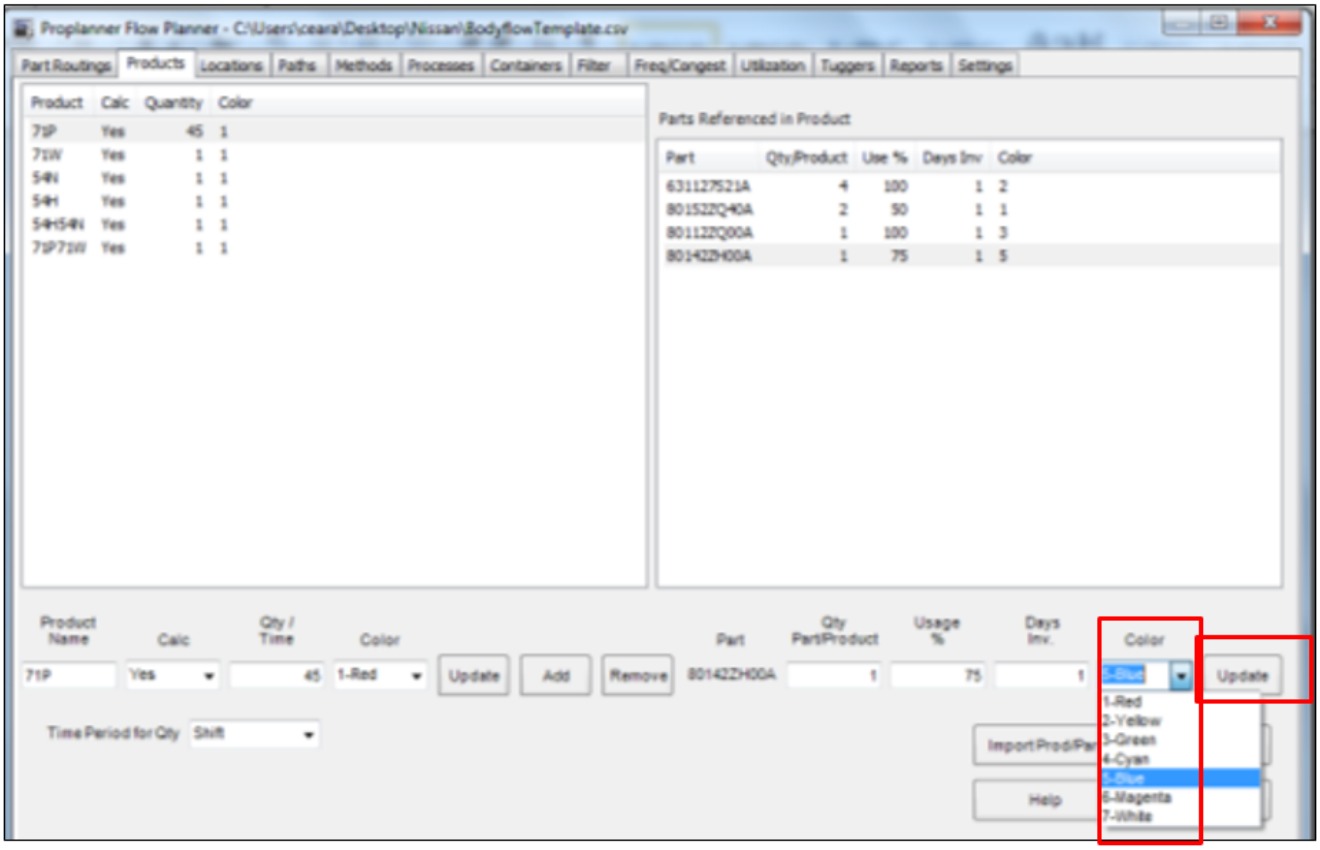
17. In the *Days Inv.* field, leave as 1 (this should always be 1.)



Days Inv. Field

18. In the *Color* dropdown field, select the color of line that will show in the AutoCAD drawing for the movement flow of that Part (it is OK if they are all the same color, then only the product line flows will show in AutoCAD.)

19. Click *Update* button.



Color Drop Down Field & Update

20. Repeat steps 14-19 until all Parts listed for that Product have been updated.

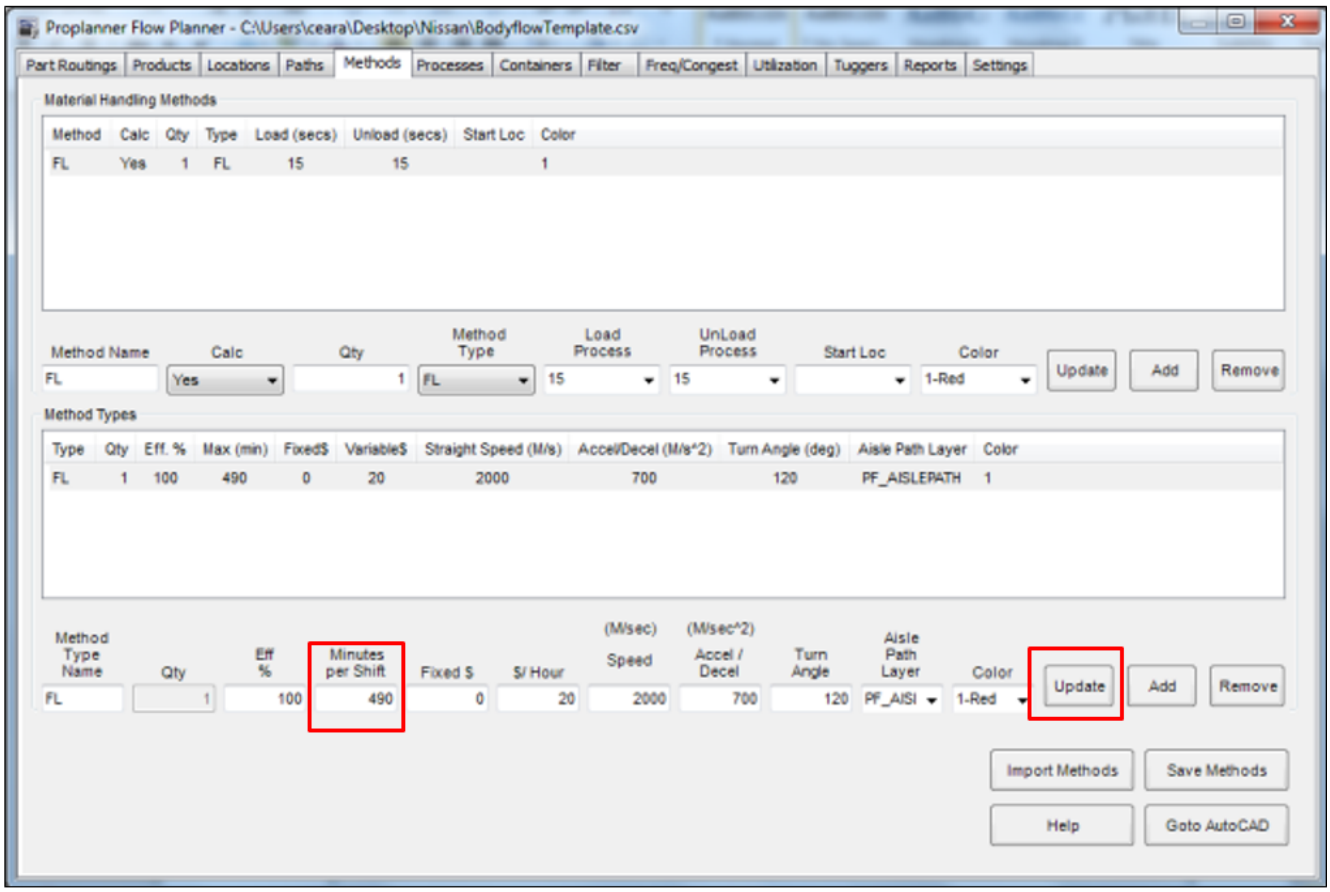
21. Repeat steps 9-20 until all Products listed have been updated

22.Click the *Methods* tab.

23. In the *Minutes* field, enter the number of Minutes per Shift.

24. The other field boxes along the row are optional for the Method Type selected. Change as needed, otherwise defaults will be used.

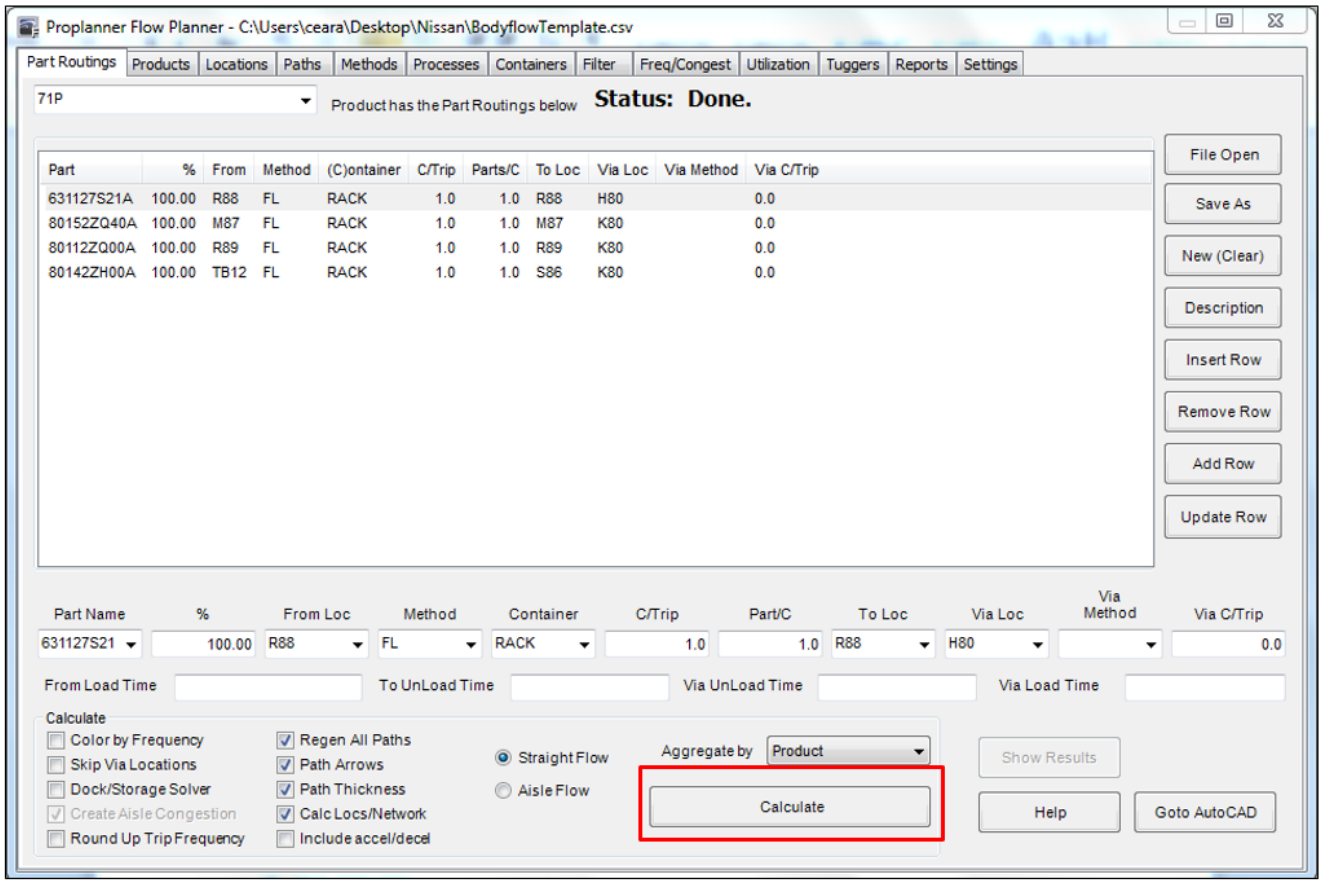
25. Click *Update* button on the row.



Methods Tab - Minutes per Shift & Update

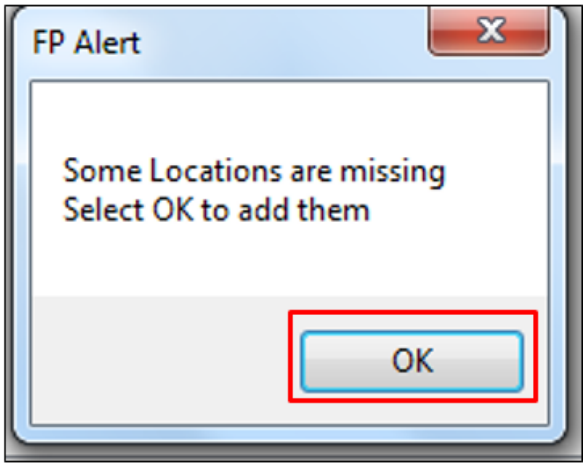
26. Click the *Part Routings* tab.

27. Click the *Calculate* button.



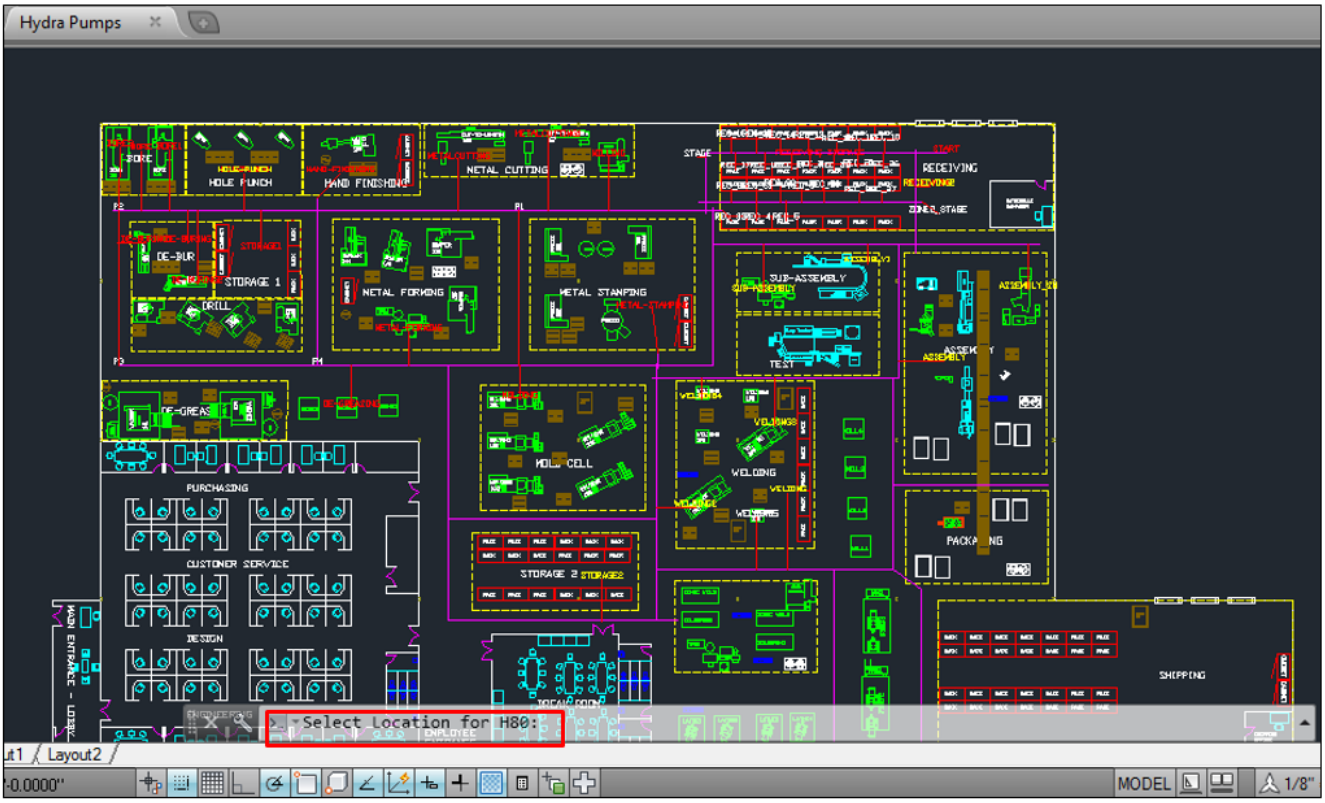
Calculate

A.) If locations have not been selected, this prompt will appear. Click *OK*.



Missing Locations

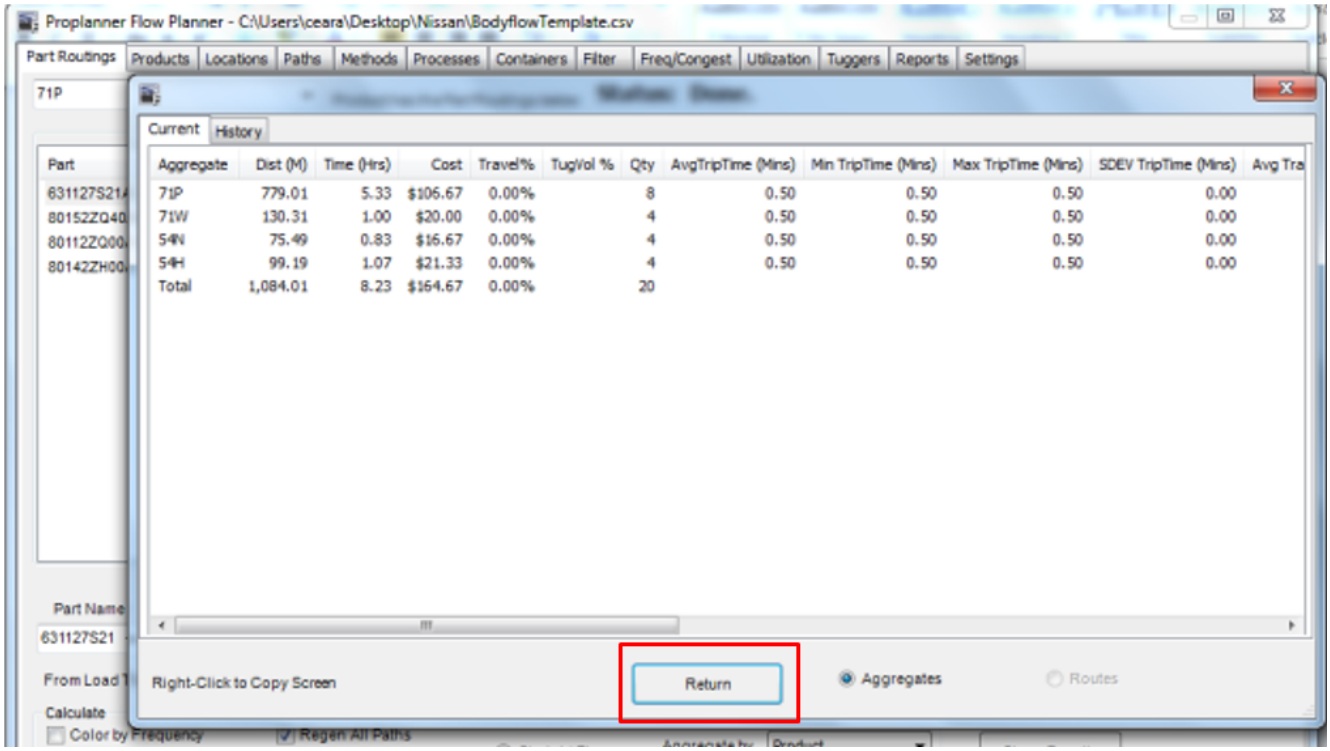
B.) Follow the prompts at the bottom of AutoCAD to set the locations in the AutoCAD drawing (i.e. “Select location for H80”.)



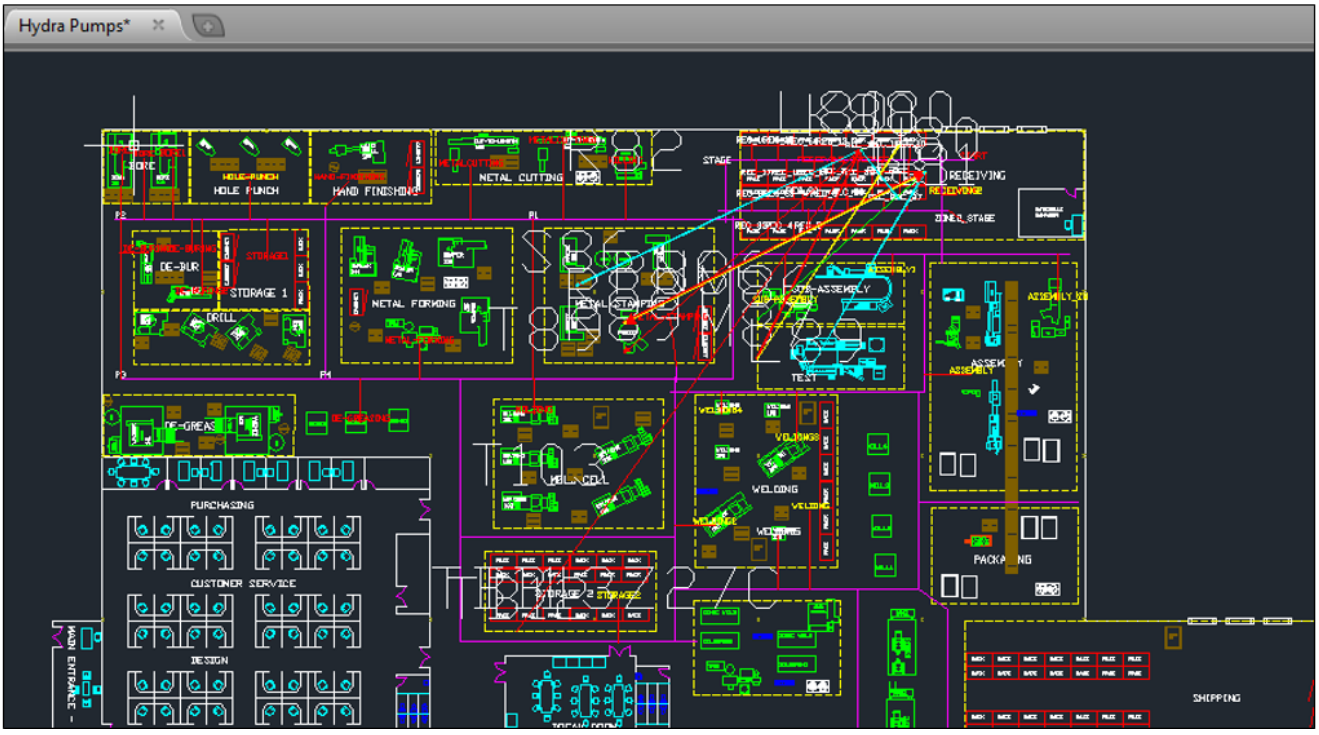
AutoCAD Drawing

28. When all the locations have been set, the program will automatically set the part flow paths for the product and calculate the results and a screen with calculated information will pop up.

29. Click the *Return* button to go back to the Flow Planner and AutoCAD screen with straight flow path lines.

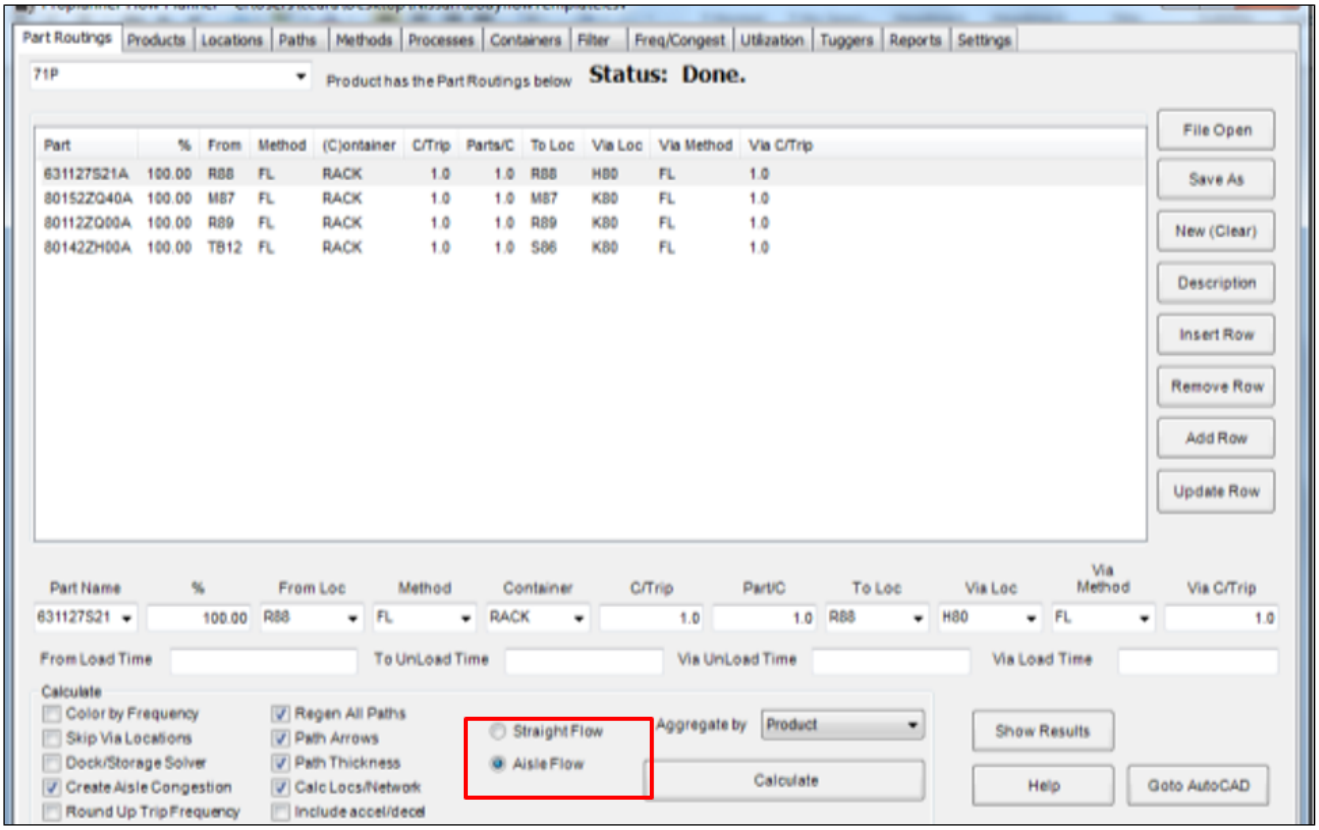


Return Button



AutoCAD Drawing - Straight Flow

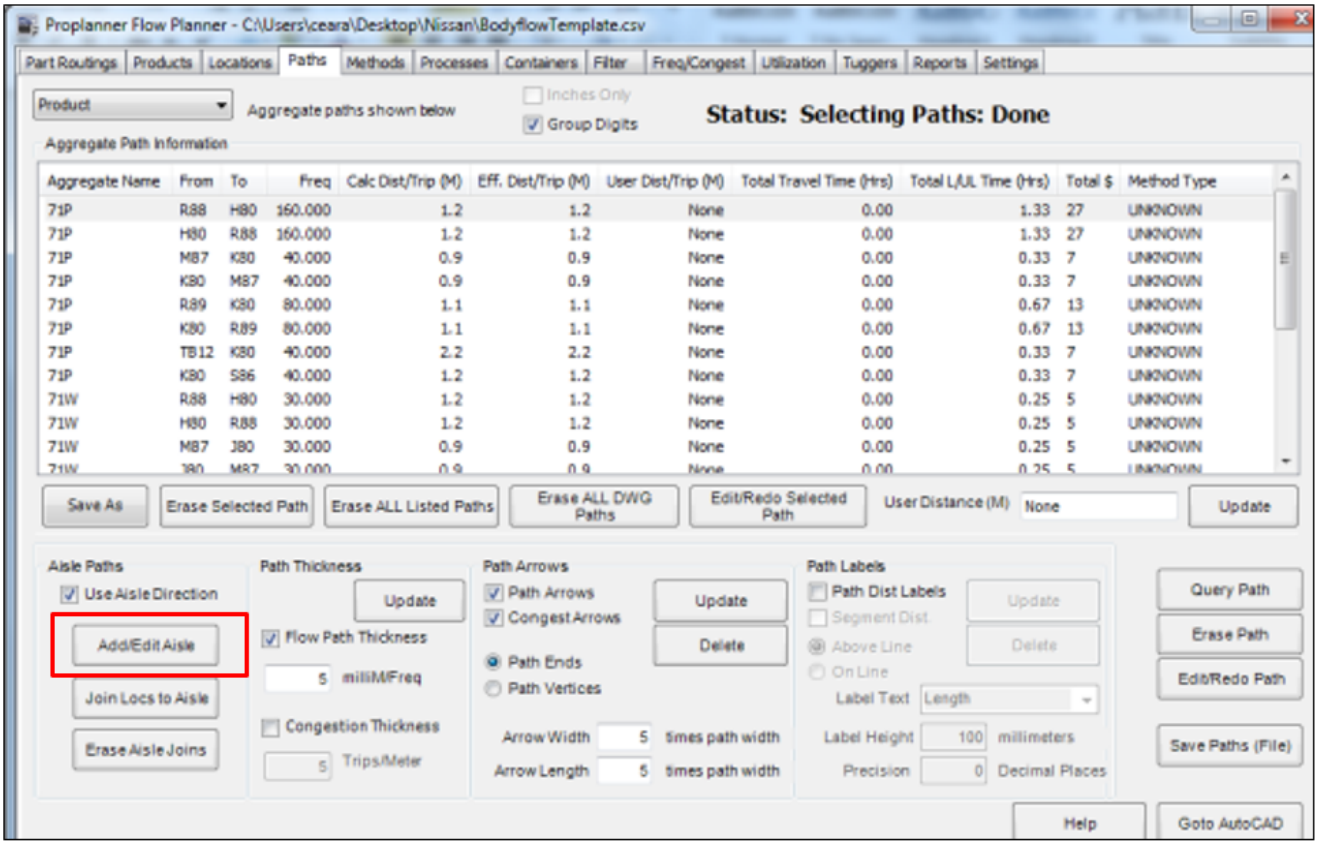
30. To force the paths to use aisles, on the Flow Planner Part Routings tab, select the *Aisle Flow* option.



Aisle Flow Option

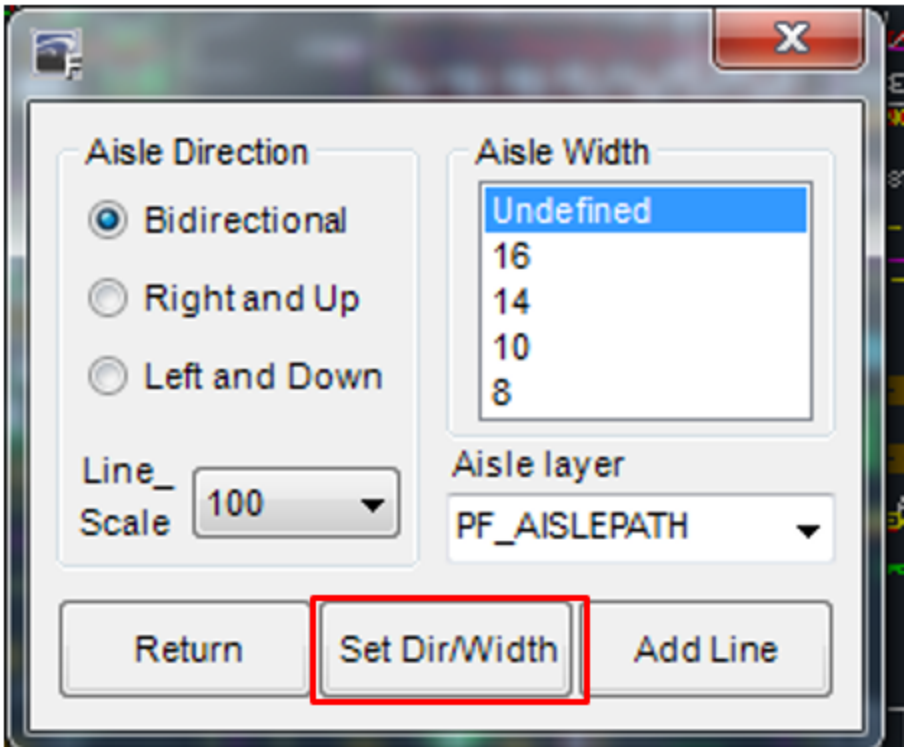
31. Click the *Paths* tab.

32. Click the *Add/Edit Aisle* button.



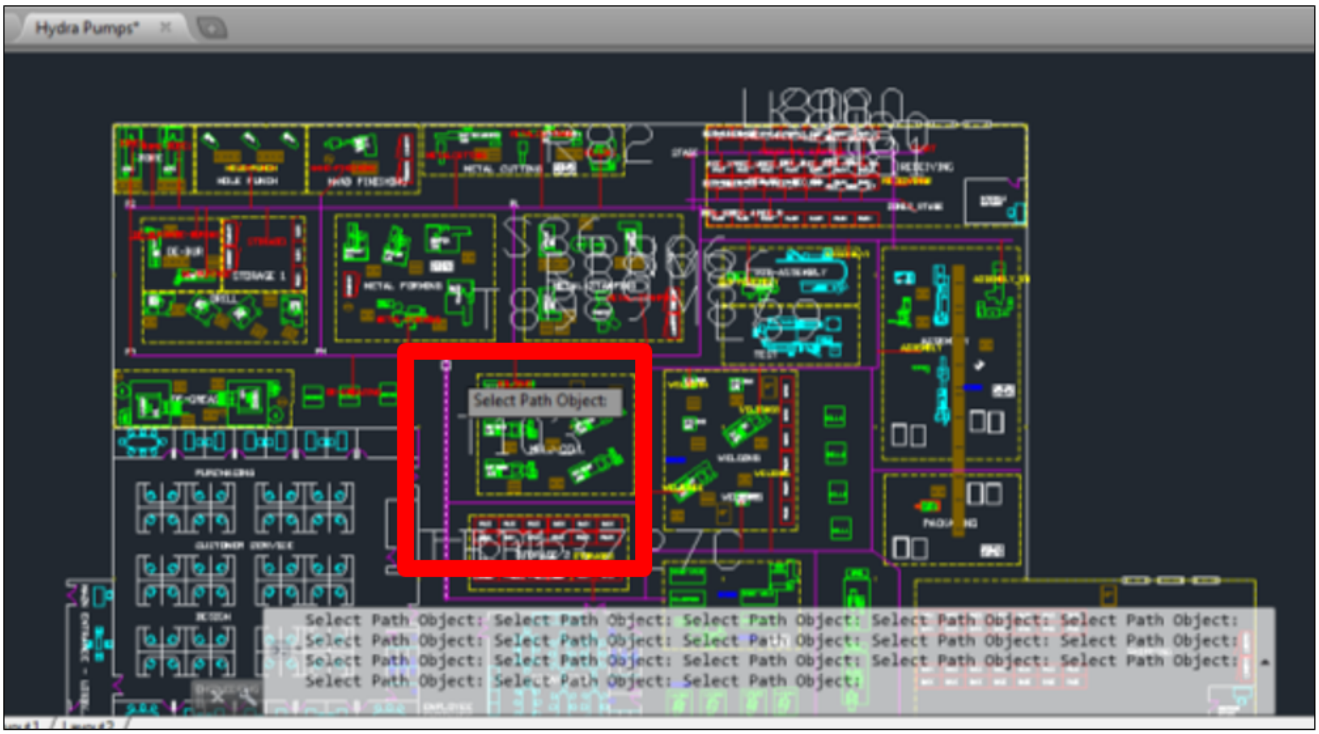
Paths Tab - Add/Edit Aisle Button

33. If aisle lines already exist on the AutoCAD drawing, click on the *Set Dir/Width* button. If an aisle does not exist, skip to step 35.



Set Dir/Width Button

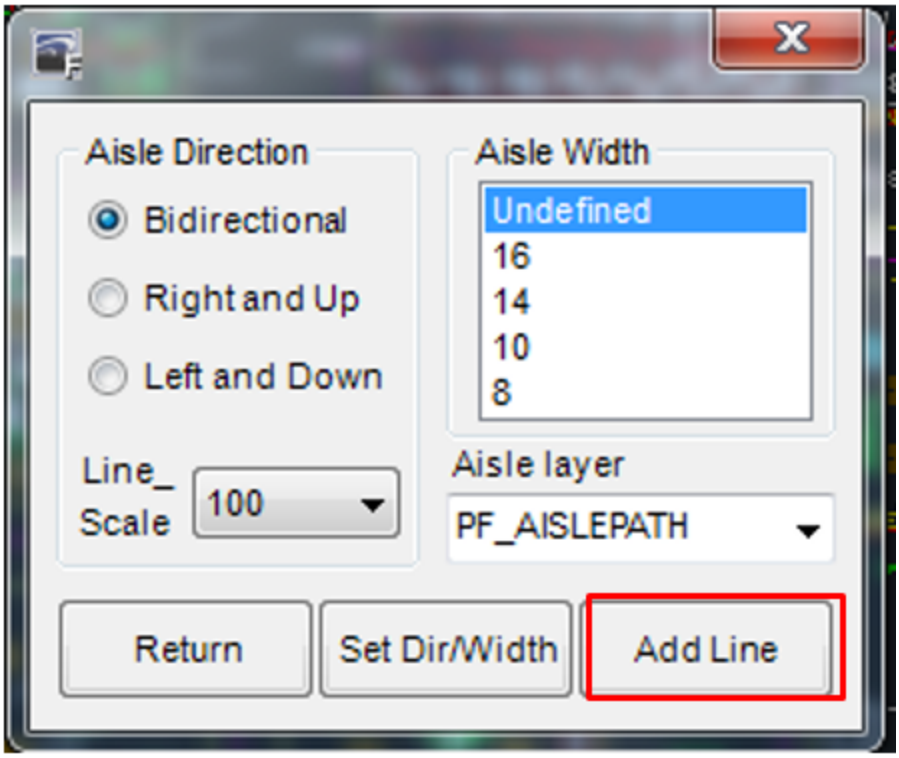
A.) On the the AutoCAD drawing, select the center line tied to the aisle (purple lines.)



Aisle Center Line

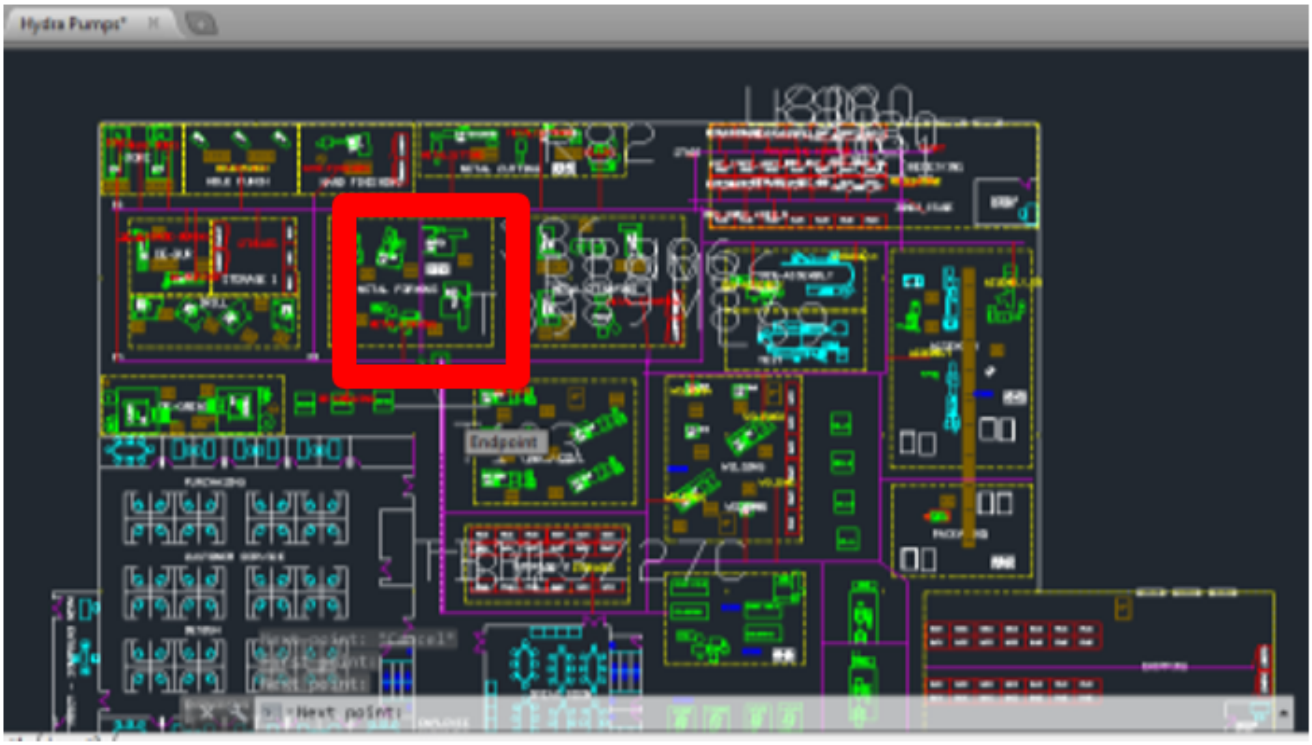
34. Repeat step 33 until all applicable aisle center lines have been set.

35. To add an aisle line (center aisle line) on the AutoCAD drawing, click on the *Add Line* button. If not needed, skip to step 37.



Adding An Aisle Line

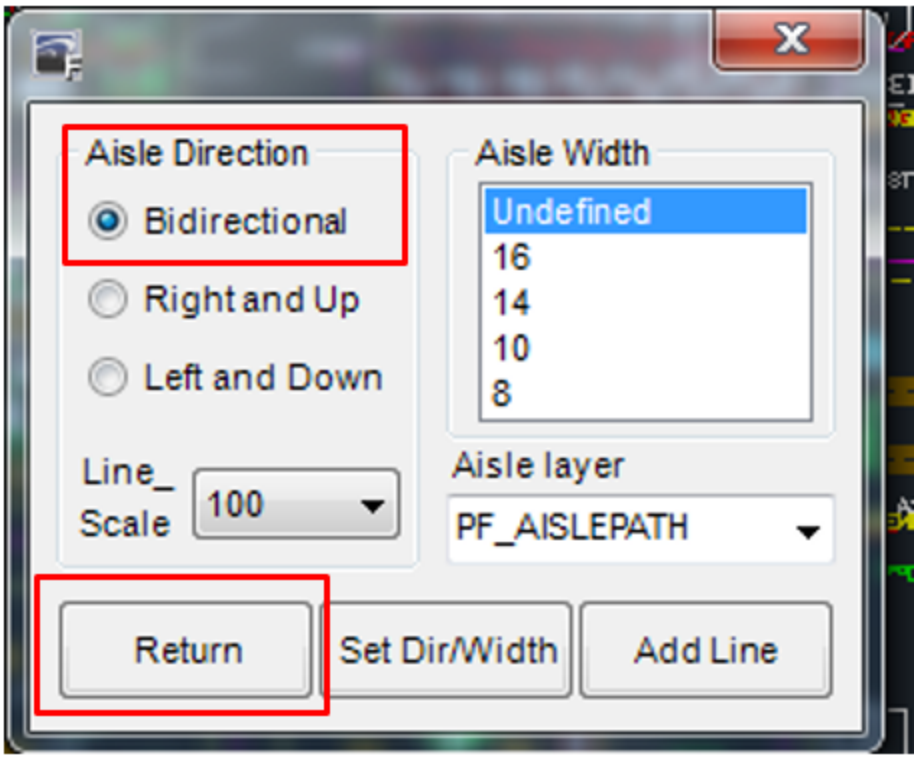
36. Click on a current line in the AutoCAD drawing for the start of the aisle, then select the ending point of the aisle on a current line in the drawing. When the new aisle is complete in the AutoCAD drawing, hit ESC on the keyboard, or continue drawing an intesecting aisle. Repeat until all aisles have been added. Make sure that aisle lines intersect with one another; don't create accidental "dead ends" by not having the aisle lines intersect.



Adding Aisles On AutoCAD Drawing

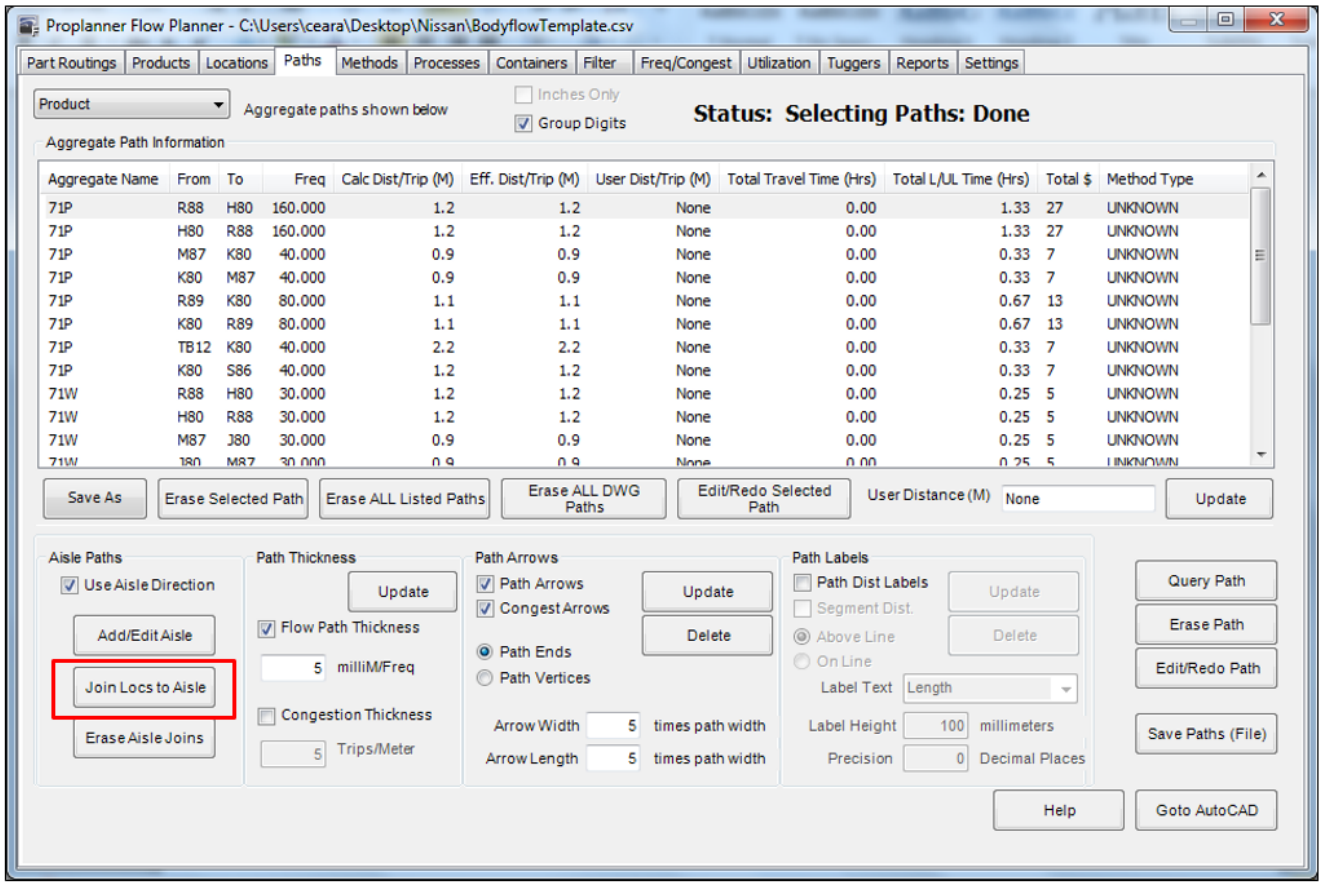
37. In the *Aisle Direction* section, select the appropriate aisle direction (bidirectional, right and up, etc.)

38. Click *Return* button.



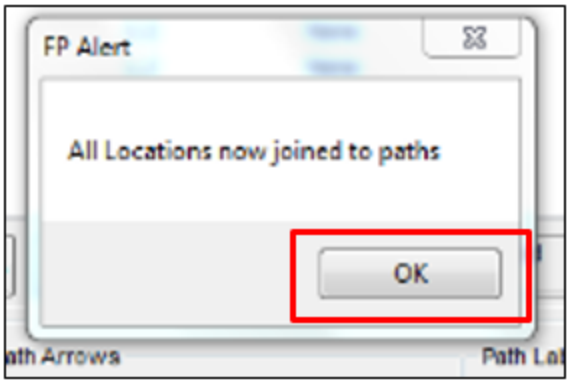
Return Button

39. Click the *Join Locs to Aisle* button (this tells the software to find the closest aisle path to each location when doing the calculations.)



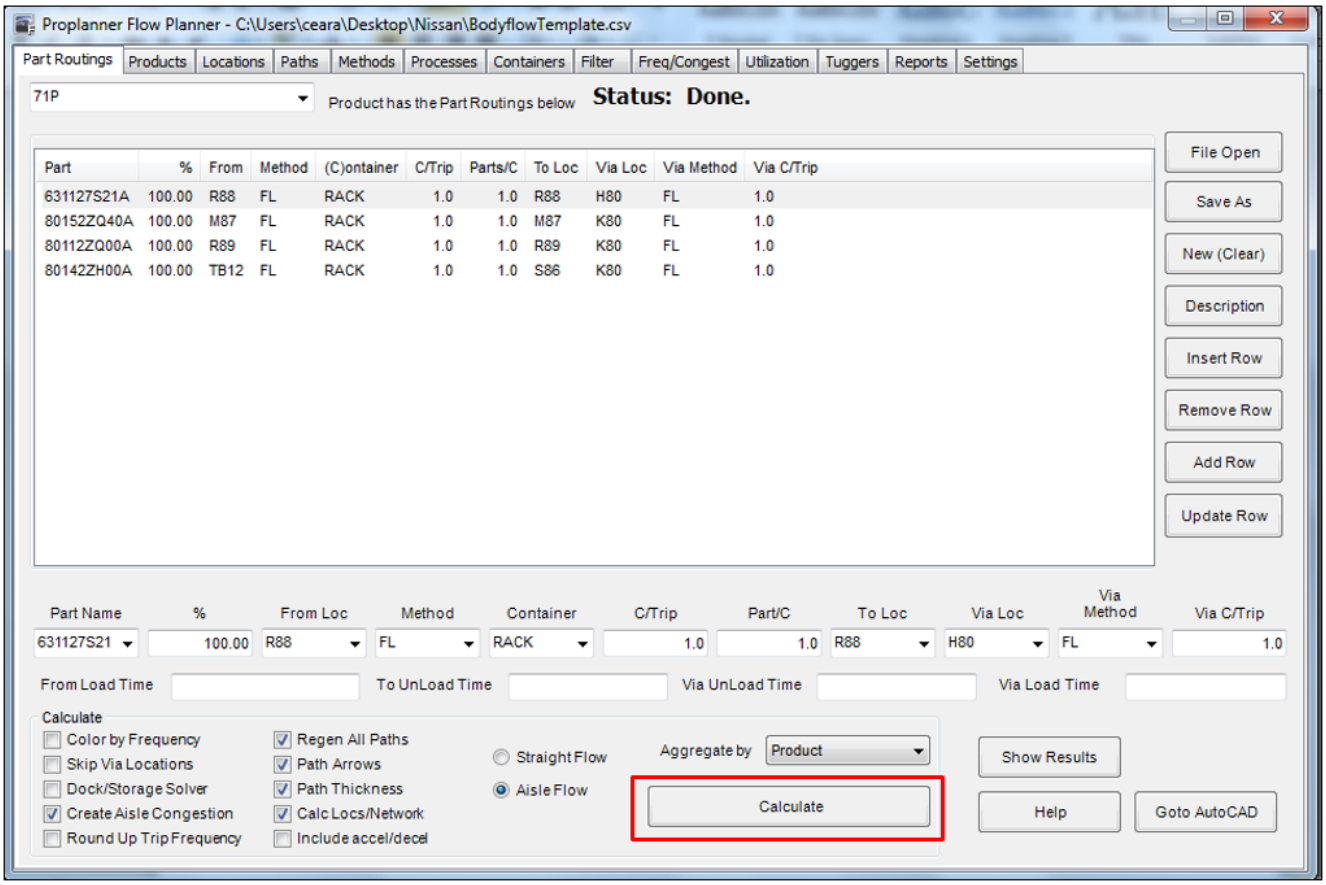
Join Locs to Aisle Button

40. Click *OK* on the FP Alert.



FP Alert

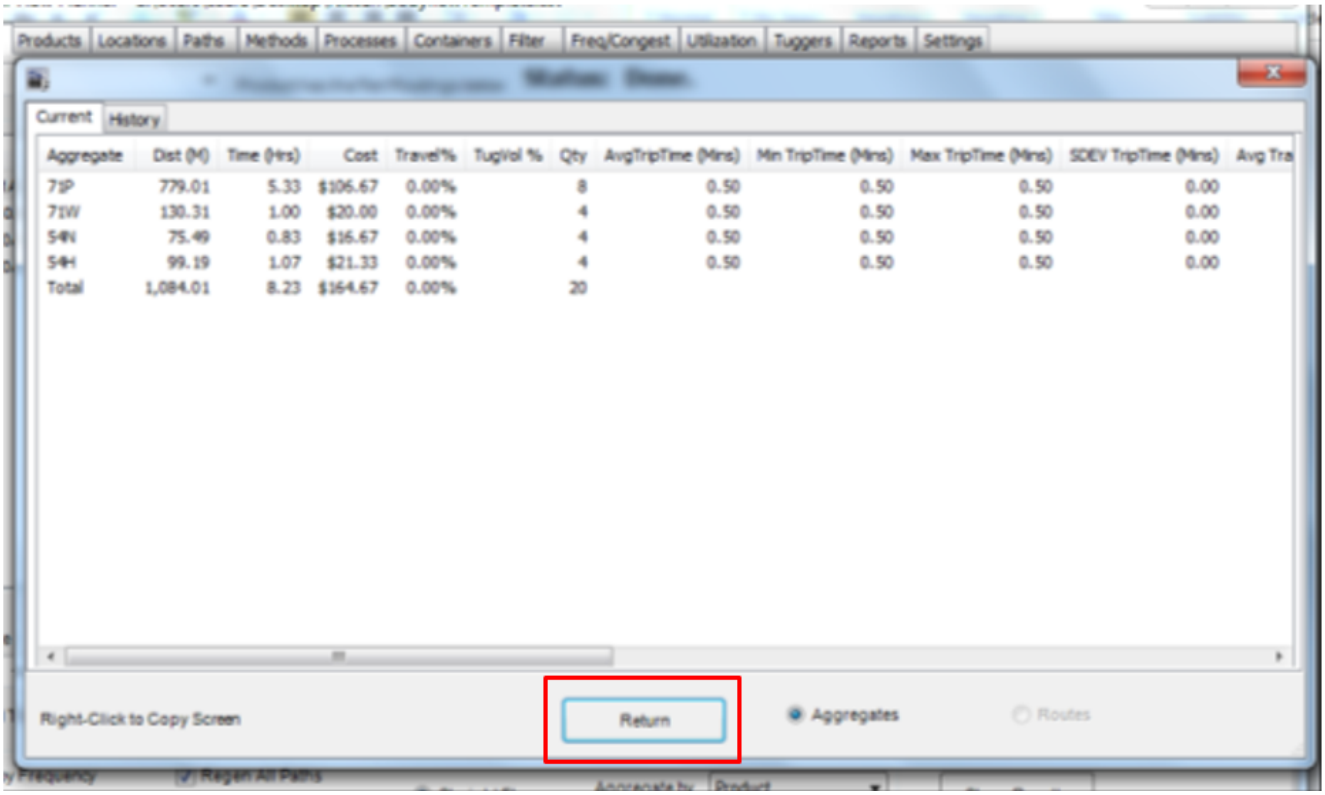
41. Click the *Part Routings* tab. Click the *Calculate* button.



Part Routings Tab - Calculate

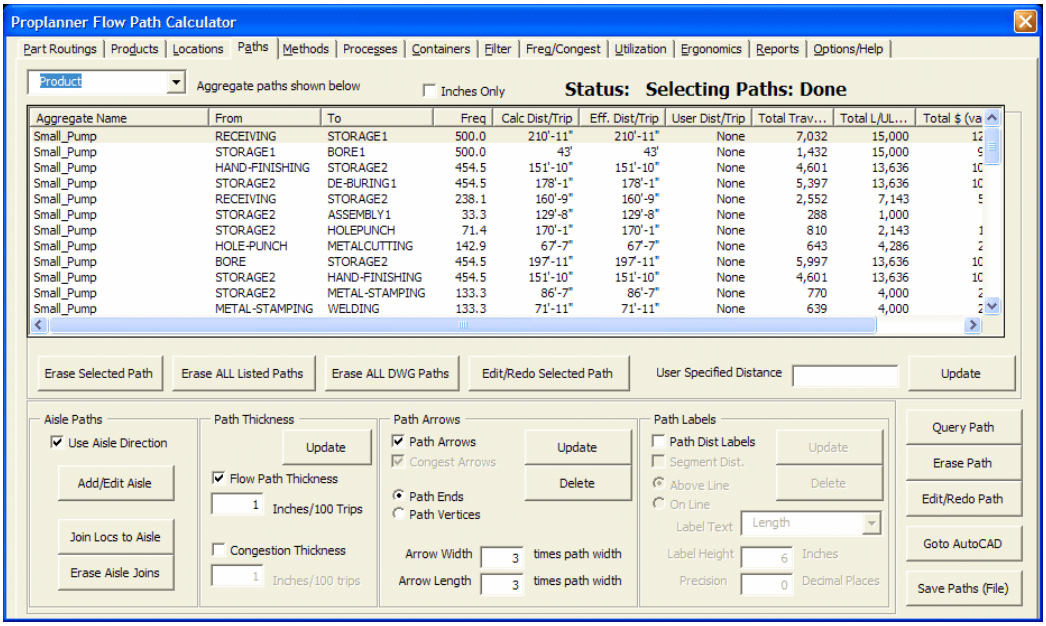
42. The program will automatically set the part flow paths for the product using the closest set aisles routes only and calculate the results. A screen with calculated information will pop up.

43. Click the *Return* button to go back to the Flow Planner or AutoCAD screen.

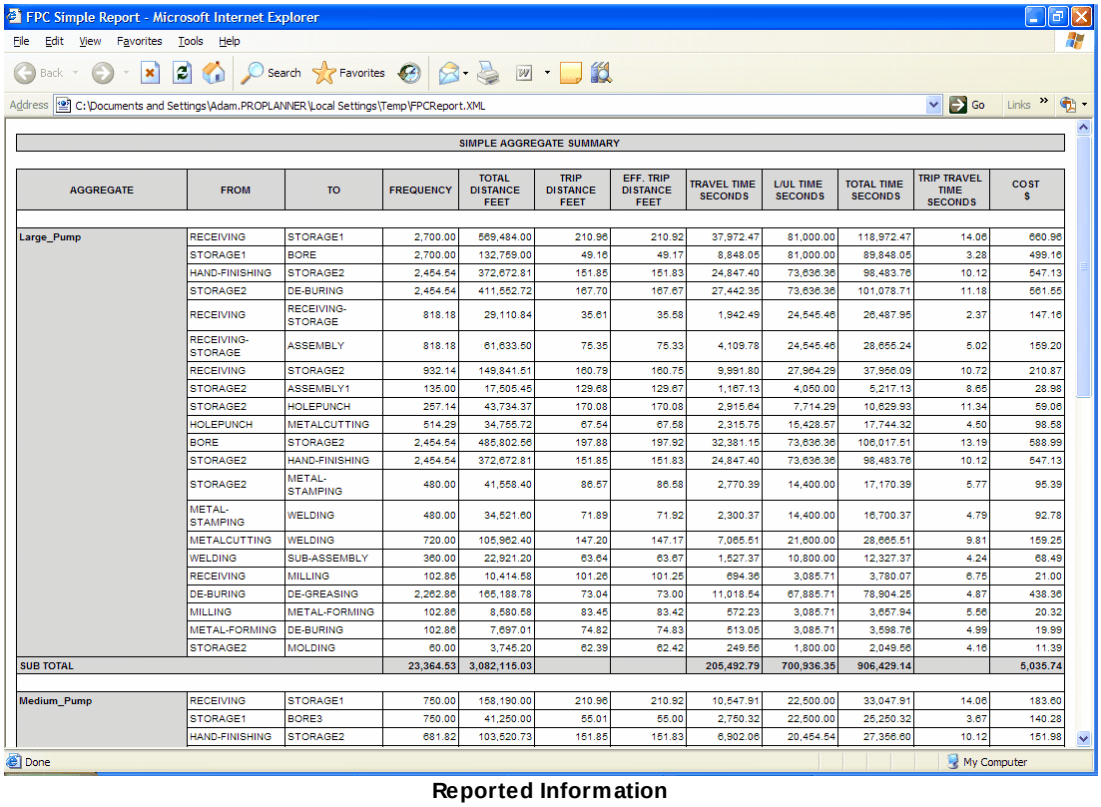


Return Button

44. Observe summary results on the Part Routings Tab, Paths Tab, Reports Tab, and/or Utilization Tab.



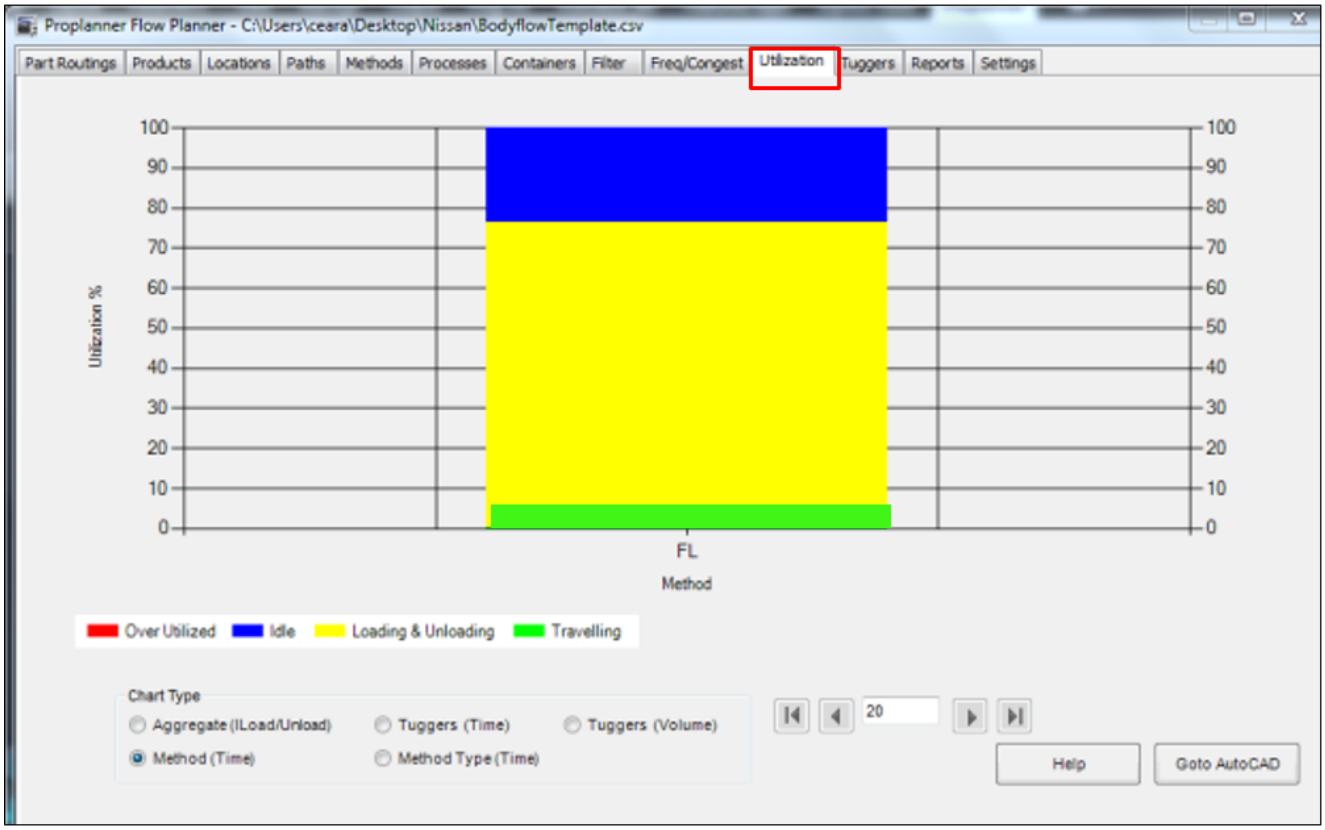
Path Information



SIMPLE AGGREGATE SUMMARY

AGGREGATE	FROM	TO	FREQUENCY	TOTAL DISTANCE FEET	TRIP DISTANCE FEET	EFF. TRIP DISTANCE FEET	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	TRIP TRAVEL TIME SECONDS	COST $
Large_Pump	RECEIVING	STORAGE1	2,700.00	569,484.00	210.96	210.92	37,972.47	81,000.00	118,972.47	14.06	660.96
	STORAGE1	BORE	2,700.00	132,759.00	49.16	49.17	8,848.05	81,000.00	89,848.05	3.28	499.16
	HAND-FINISHING	STORAGE2	2,454.54	372,672.81	151.85	151.83	24,847.40	73,636.36	98,483.76	10.12	547.13
	STORAGE2	DE-BURING	2,454.54	411,552.72	167.70	167.67	27,442.35	73,636.36	101,078.71	11.18	561.55
	RECEIVING	RECEIVING-STORAGE	818.18	29,110.84	35.61	35.58	1,942.49	24,545.46	26,487.95	2.37	147.16
	RECEIVING-STORAGE	ASSEMBLY	818.18	61,633.50	75.35	75.33	4,109.78	24,545.46	28,655.24	5.02	159.20
	RECEIVING	STORAGE2	932.14	149,841.51	160.79	160.75	9,991.80	27,964.29	37,956.09	10.72	210.87
	STORAGE2	ASSEMBLY1	135.00	17,505.45	129.68	129.67	1,167.13	4,050.00	5,217.13	8.65	28.98
	STORAGE2	HOLEPUNCH	257.14	43,734.37	170.08	170.08	2,915.64	7,714.29	10,629.93	11.34	59.06
	HOLEPUNCH	METALCUTTING	514.29	34,755.72	67.54	67.58	2,315.75	15,428.57	17,744.32	4.50	98.58
	BORE	STORAGE2	2,454.54	485,802.56	197.88	197.92	32,381.15	73,636.36	106,017.51	13.19	588.99
	STORAGE2	HAND-FINISHING	2,454.54	372,672.81	151.85	151.83	24,847.40	73,636.36	98,483.76	10.12	547.13
	STORAGE2	METAL-STAMPING	480.00	41,568.40	86.57	86.58	2,770.39	14,400.00	17,170.39	5.77	95.39
	METAL-STAMPING	WELDING	480.00	34,521.60	71.89	71.92	2,300.37	14,400.00	16,700.37	4.79	92.78
	METALCUTTING	WELDING	720.00	105,962.40	147.20	147.17	7,065.51	21,600.00	28,665.51	9.81	159.25
	WELDING	SUB-ASSEMBLY	360.00	22,921.20	63.64	63.67	1,527.37	10,800.00	12,327.37	4.24	68.49
	RECEIVING	MILLING	102.86	10,414.58	101.26	101.25	694.36	3,085.71	3,780.07	6.75	21.00
	DE-BURING	DE-GREASING	2,262.86	165,188.78	73.04	73.00	11,018.54	67,885.71	78,904.25	4.87	438.36
	MILLING	METAL-FORMING	102.86	8,580.58	83.45	83.42	572.23	3,085.71	3,657.94	5.56	20.32
	METAL-FORMING	DE-BURING	102.86	7,697.01	74.82	74.83	513.05	3,085.71	3,598.76	4.99	19.99
	STORAGE2	MOLDING	60.00	3,745.20	62.39	62.42	249.56	1,800.00	2,049.56	4.16	11.39
SUB TOTAL			23,364.53	3,082,115.03			205,492.79	700,936.35	906,429.14		5,035.74
Medium_Pump	RECEIVING	STORAGE1	750.00	158,190.00	210.96	210.92	10,547.91	22,500.00	33,047.91	14.06	183.60
	STORAGE1	BORE3	750.00	41,250.00	55.01	55.00	2,750.32	22,500.00	25,250.32	3.67	140.28
	HAND-FINISHING	STORAGE2	681.82	103,520.73	151.85	151.83	6,902.06	20,454.54	27,356.60	10.12	151.98

Reported Information



Utilization Information

Continue on for more in-depth analyses:

From the Part Routings tab, choose a different Aggregate and rerun the Calculation.

Aggregate methods of calculation:

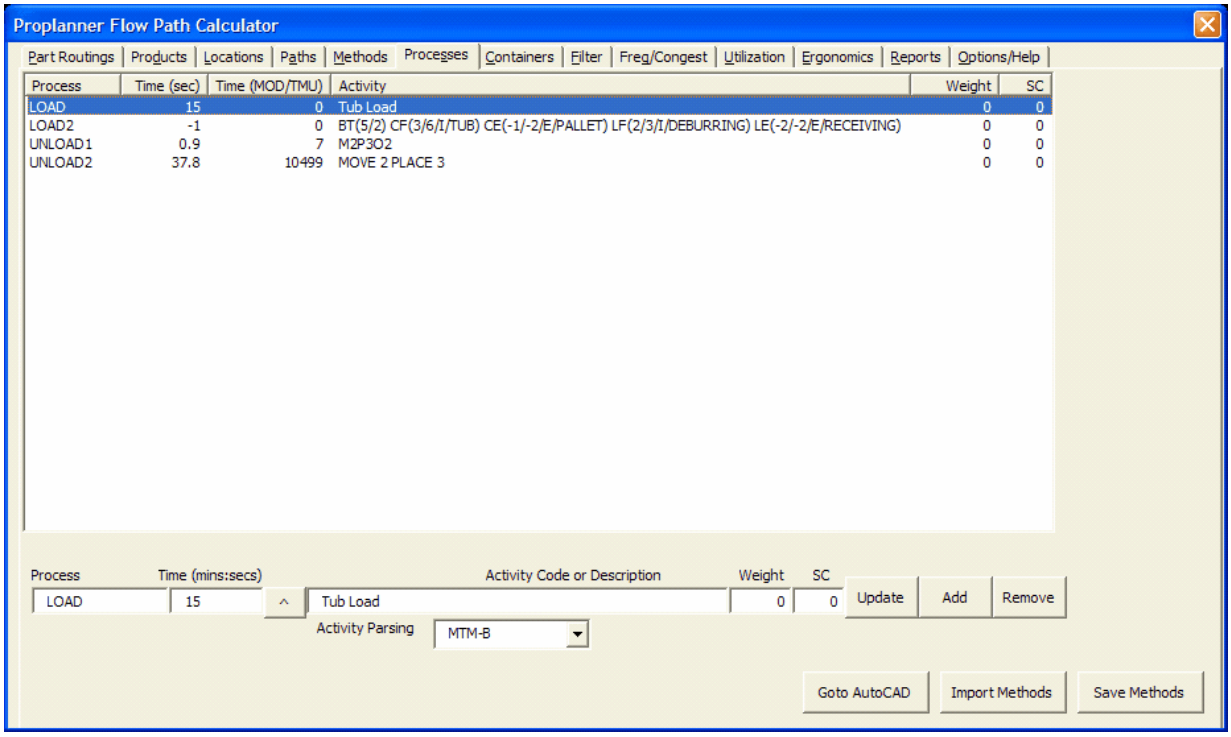
1. Product - Accounts for movements belonging to each product. Path colors are dependent upon the colors assigned to the product.
2. Part - Uses quantities of each part as well as each product to show results specific to each part name. Colors for the assigned lines are dependent upon the colors assigned to the individual parts.
3. Product + Part - Calculates movements for each unique combination of product and part. Colors for the assigned lines are dependent upon the colors assigned to the individual parts.
4. Method - Sums the flows for the method, such as each time a specific forklift or cart moves. Colors for the assigned lines are dependent upon the colors assigned to the methods.
5. Method Type - Looks at the flow information for general method types such as forklift, cart, or truck. Path colors are dependent upon the colors assigned to the method types.

6. From To-Loc - Calculates flow results for each movement between different sets of from and to locations. Colors for the assigned lines are dependent upon the colors assigned to the from location's group color.
7. From To-Group - Calculates flow results for movements between each unique combination of from and to groups. Colors for the assigned lines are dependent upon the colors assigned to the from location's group color.
8. Container - This calculation takes into account the movements for each individual container type. Colors for the assigned lines are dependent upon the colors assigned to the container.

Define processes for load/unload times:

Predetermined time parsing:

This example shows a plain Load/Unload process as well as the three most popular predetermined time parser codes.



Processes Tab - Time Parsing

Example

1. Template - This rule will be applied to each routing using the method that references this "template" load/unload process. This process string allows the user to define a rule for load/unload times that can take into account the from and to locations, container, and if the containers or locations are empty or full for each individual routing. A base time can also be

set for the other rules in this process string to add or subtract from, dependent upon the container and location status. This example shows a base time that changes if there are additional containers, time added for full containers and locations, and time subtracted for empty containers and locations. This is Load2 in the example.

2. MODAPTS - Uses MODAPTS predetermined time codes to parse the activity times. Output can be seen in minutes or seconds. This is Unload1 in the example.

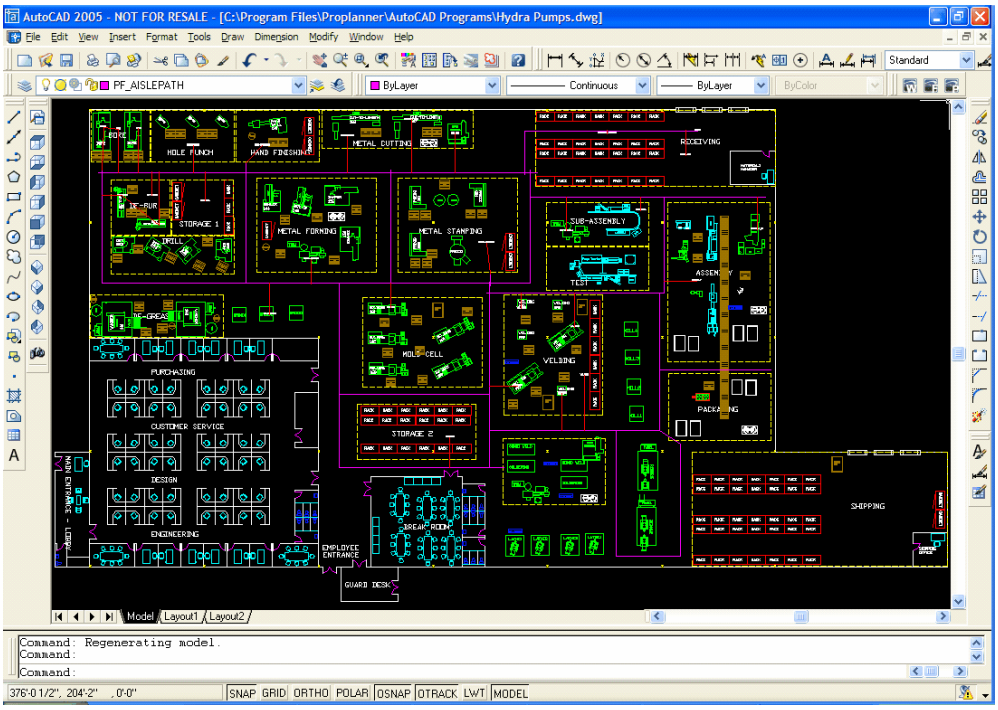
3. MTM-B - Uses MTM-B predetermined time codes to parse the activity times. Output can be seen in minutes or seconds. This is Unload2 in the example.

4. "User Defined" - User can define a list of time codes and their respective values that can be used to parse the activity times.

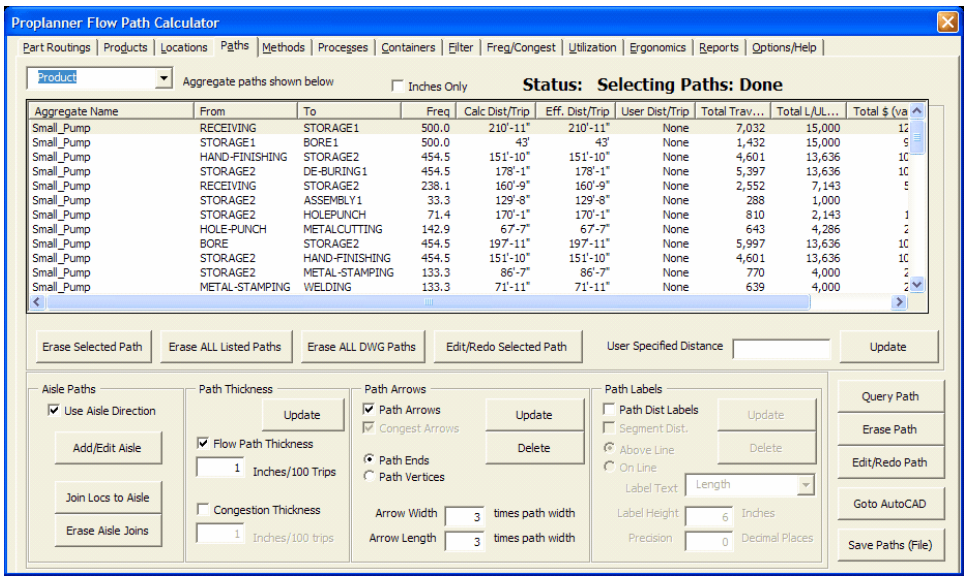
View the congestion analysis:

Congestion diagrams:

1. Load your drawing and make sure that the aisle paths are defined by a line on the appropriate aisle path layer. The aisle path lines can be drawn by going to the paths tab and selecting Add/Edit Aisle Path.

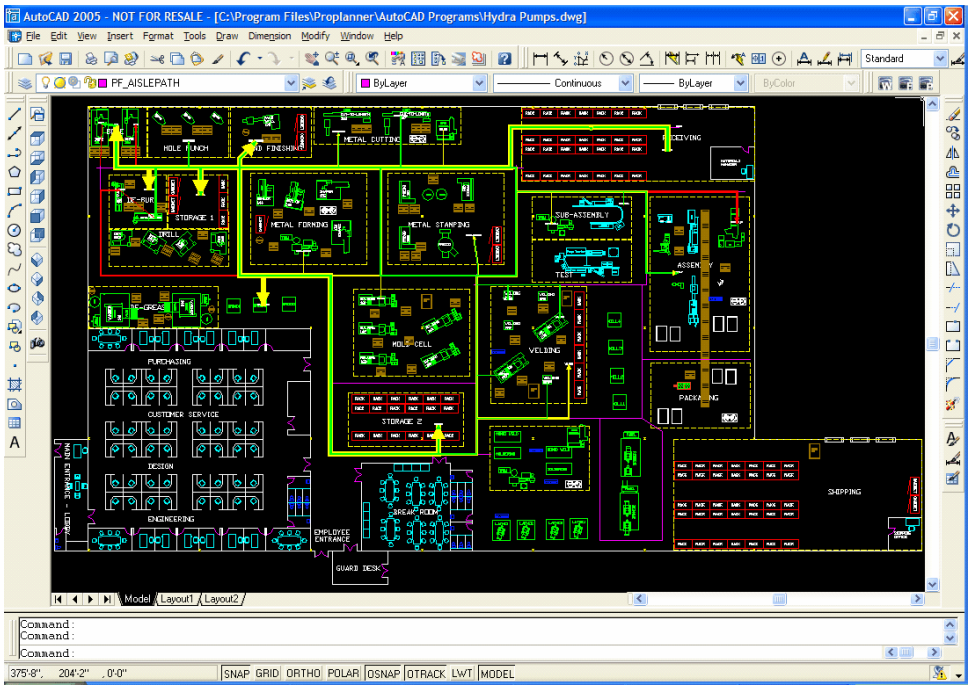


Drawing



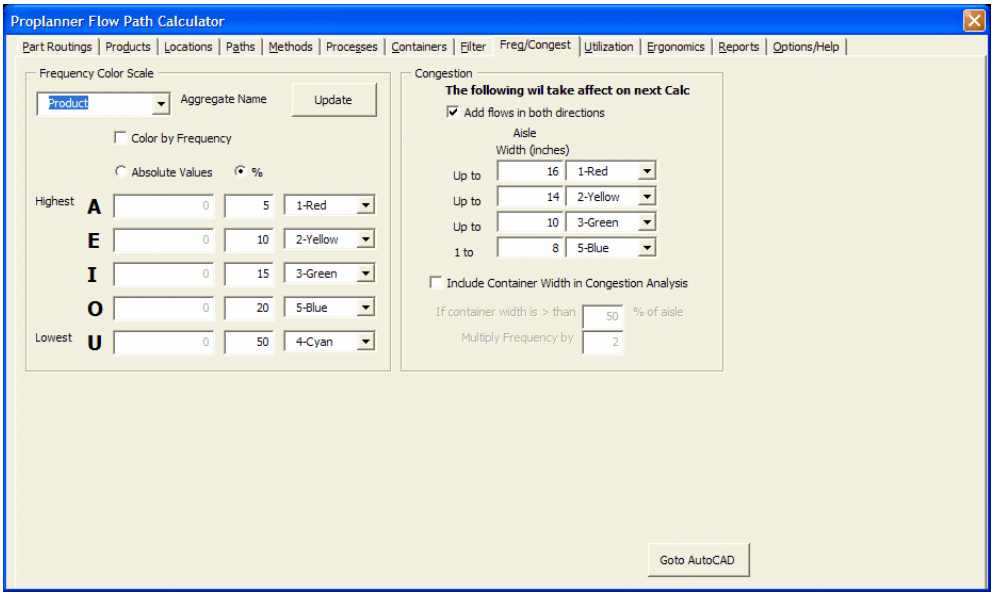
Paths Tab

2. Once your path lines exist, attach the locations to the aisle so that all parts have a complete aisle path network.
3. Perform an aisle flow analysis by selecting the aisle flow radio button near calculate on the Part Routings tab and then hitting calculate.
4. When this is finished, Flow Planner will create an alert saying that the congestion diagram has been drawn and will take you to the drawing with the regular aisle flows.



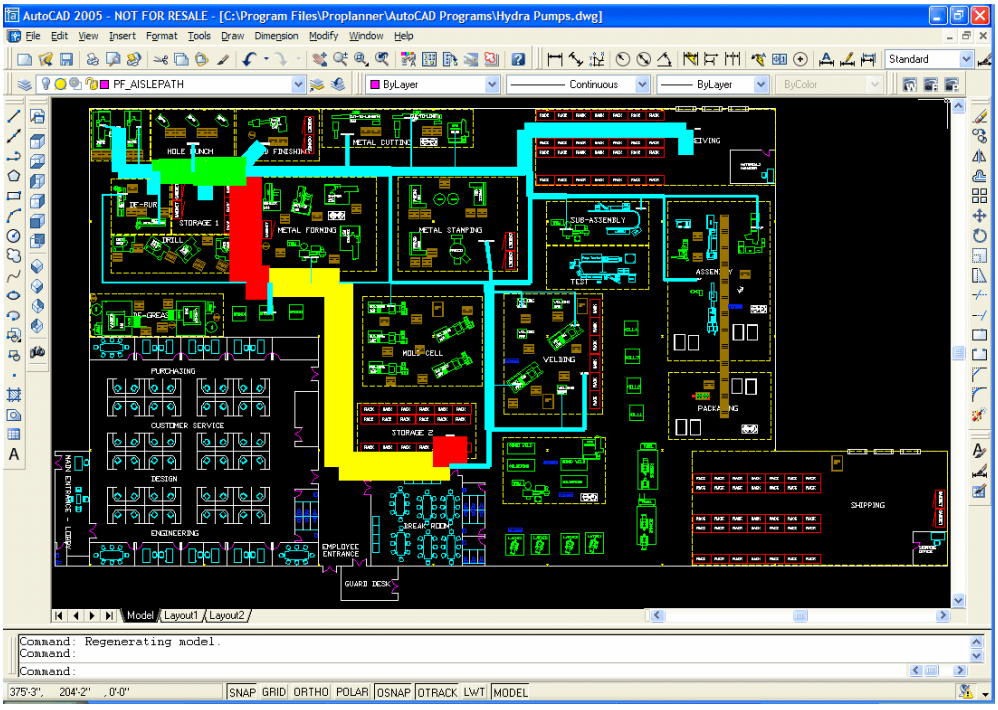
Aisle Flow Diagram

5. To see the congestion data that was created, select Congestion as the aggregate name from Frequency/Congestion tab and hit the update button.



Frequency/Congestion

6. The drawing will now display the flow congestion calculated for each aisle section with the highest areas being shown with the greatest thickness and red or yellow lines. Initially it will be set to a percentage so there will always be paths that can show up red.

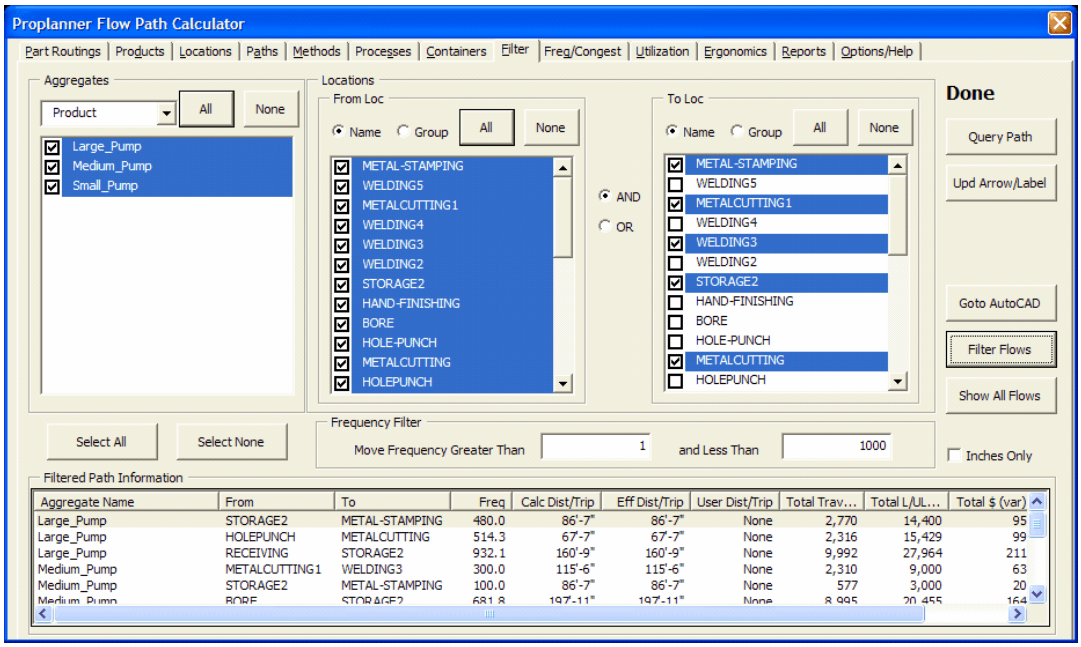


Flow Congestion

7. If the user wants to see congestion of specific amounts they can return to the Frequency/Congestion tab and select the Absolute Values radio button and define custom breakpoints for the colors to show up on the drawing. This will help eliminate flows with more specific troublesome congestion numbers.

Filtering:

Filtering helps single out the flow lines that you wish to see without letting other less important lines interfere. The paths filtered out still exist, but are simply hidden until "Show All Flows" is clicked.

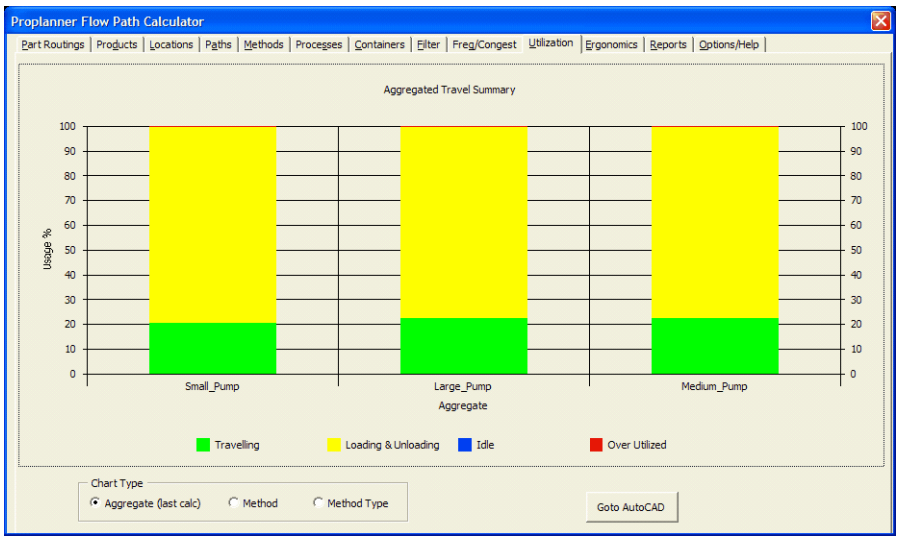


Filtering

1. Aggregate - Selects what aggregate/s to filter. This selection will only show flows for this aggregate. There must have been a calculation done for that aggregation method prior to doing a filter.
2. From and To Locs - Selects which locations to show flows between.
3. And versus. Or - The "And" radio button says that both the selected locations or groups for "from and to" must be true for the same path for it to be displayed. The "or" radio button says that either the selected locations or groups for "from and to" must be true for a path for it to be displayed.
4. Frequency - Sets the high and low range between which a path's frequency must fall to be displayed after the filter has been applied.
5. Aggregate, from and to locations, and frequency can all be used at the same time to more specifically filter the calculate flow paths.

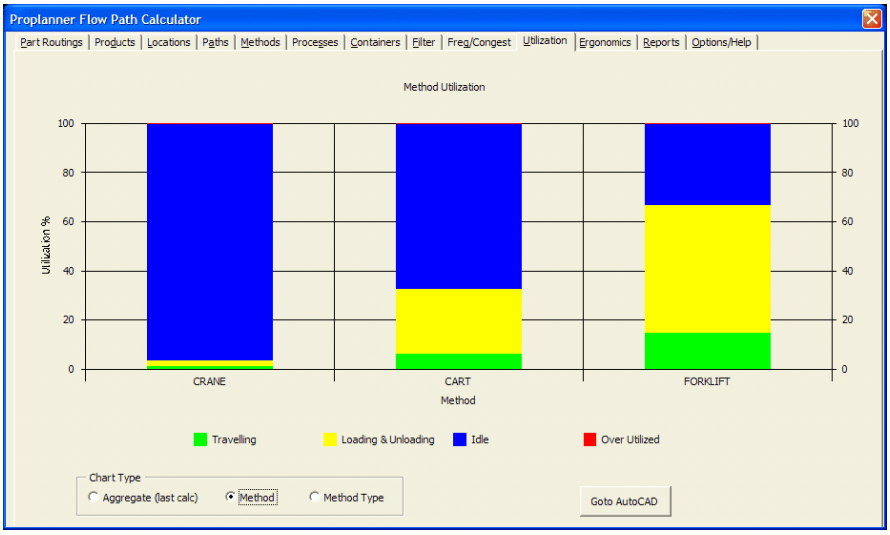
Utilization charts:

1. Aggregate - Displays a bar chart showing Travel, Load/Unload, Idle, and Over Utilization times for each unique aggregate.



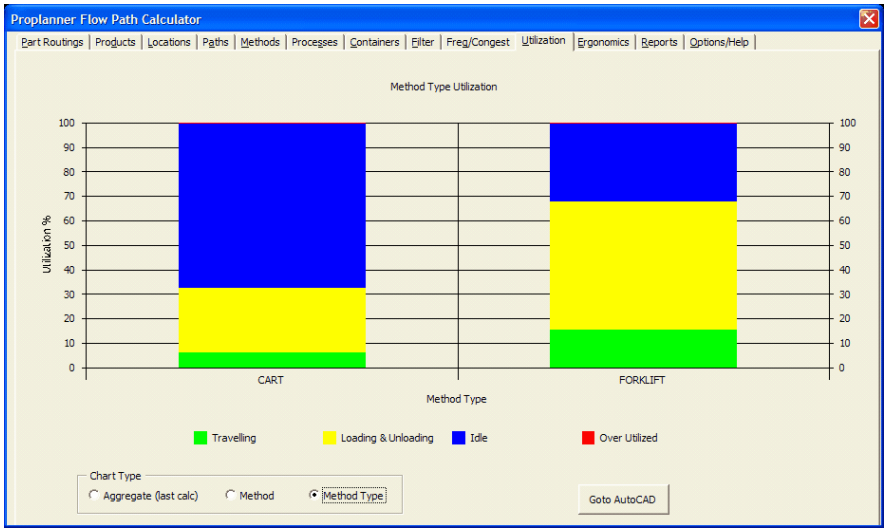
Aggregate

2. Method - Displays a bar chart showing Travel, Load/Unload, Idle, and Over Utilization times for each unique method name, ie. fork1, fork2, fork3.



Method

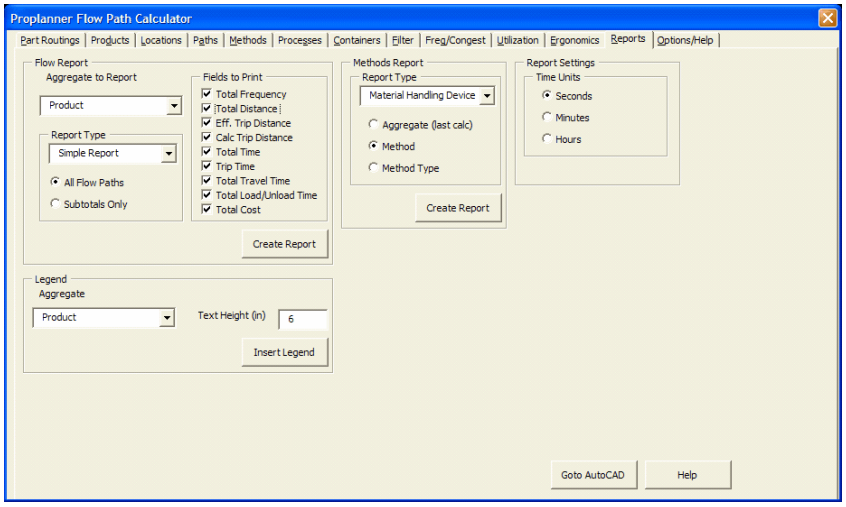
3. Method type - Displays a bar chart showing Travel, Load/Unload, Idle, and Over Utilization times for each unique method type, ie. forklift, cart, pull_cart.



Method Type

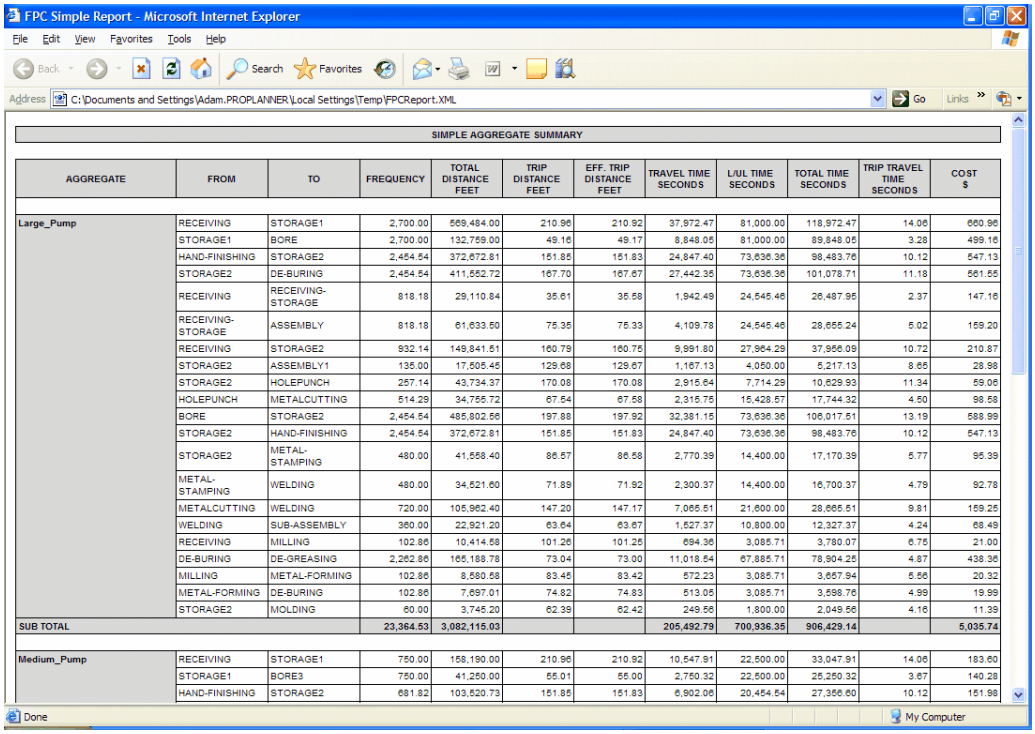
Advanced reporting:

Reports are generated after a calculation by hitting the "Generate" button next to it's corresponding report type on the Reporting tab. A calculation must have been performed to create the reports.



Reporting Tab

1. Simple Report - This report displays all the general path information that was calculated from the drawing in one pre-formatted page that looks like an Excel spreadsheet. The user can shut off selected columns of data by selecting their appropriate check boxes and re-selecting "Generate"

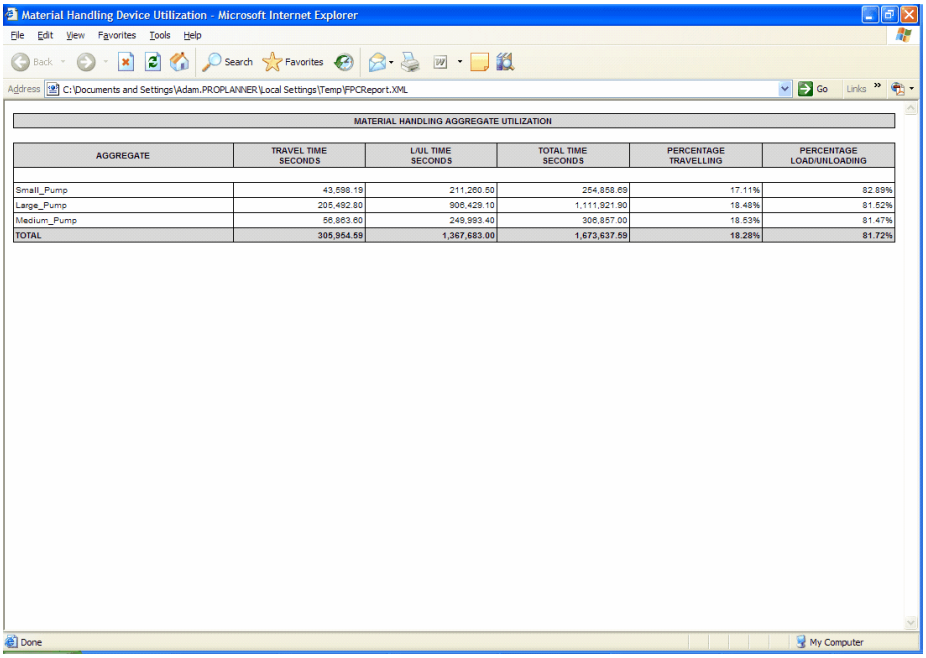


SIMPLE AGGREGATE SUMMARY

AGGREGATE	FROM	TO	FREQUENCY	TOTAL DISTANCE FEET	TRIP DISTANCE FEET	EFF. TRIP DISTANCE FEET	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	TRIP TRAVEL TIME SECONDS	COST $
Large_Pump	RECEIVING	STORAGE1	2,700.00	569,484.00	210.96	210.92	37,972.47	81,000.00	118,972.47	14.06	660.96
	STORAGE1	BORE	2,700.00	132,759.00	49.16	49.17	8,848.05	81,000.00	89,848.05	3.28	499.16
	HAND-FINISHING	STORAGE2	2,454.54	372,672.81	151.85	151.83	24,847.40	73,636.36	98,483.76	10.12	547.13
	STORAGE2	DE-BURING	2,454.54	411,552.72	167.70	167.67	27,442.35	73,636.36	101,078.71	11.18	561.55
	RECEIVING	RECEIVING-STORAGE	818.18	29,110.84	35.61	35.58	1,942.49	24,545.46	26,487.95	2.37	147.16
	RECEIVING-STORAGE	ASSEMBLY	818.18	61,633.50	75.35	75.33	4,109.78	24,545.46	28,655.24	5.02	159.20
	RECEIVING	STORAGE2	932.14	149,841.51	160.79	160.75	9,991.80	27,964.29	37,956.09	10.72	210.87
	STORAGE2	ASSEMBLY1	135.00	17,505.45	129.68	129.67	1,167.13	4,050.00	5,217.13	8.65	28.98
	STORAGE2	HOLEPUNCH	257.14	43,734.37	170.08	170.08	2,915.64	7,714.29	10,629.93	11.34	59.06
	HOLEPUNCH	METALCUTTING	514.29	34,755.72	67.54	67.58	2,315.75	15,428.57	17,744.32	4.50	98.58
	BORE	STORAGE2	2,454.54	485,802.56	197.88	197.92	32,381.15	73,636.36	106,017.51	13.19	588.99
	STORAGE2	HAND-FINISHING	2,454.54	372,672.81	151.85	151.83	24,847.40	73,636.36	98,483.76	10.12	547.13
	STORAGE2	METAL-STAMPING	480.00	41,558.40	86.57	86.58	2,770.39	14,400.00	17,170.39	5.77	95.39
	METAL-STAMPING	WELDING	480.00	34,521.60	71.89	71.92	2,300.37	14,400.00	16,700.37	4.79	92.78
	METALCUTTING	WELDING	720.00	105,962.40	147.20	147.17	7,065.51	21,600.00	28,665.51	9.81	159.25
	WELDING	SUB-ASSEMBLY	360.00	22,921.20	63.64	63.67	1,527.37	10,800.00	12,327.37	4.24	68.49
	RECEIVING	MILLING	102.86	10,414.58	101.26	101.25	694.36	3,085.71	3,780.07	6.75	21.00
	DE-BURING	DE-GREASING	2,262.86	165,188.78	73.04	73.00	11,018.54	67,885.71	78,904.25	4.87	438.36
	MILLING	METAL-FORMING	102.86	8,580.58	83.45	83.42	572.23	3,085.71	3,657.94	5.56	20.32
	METAL-FORMING	DE-BURING	102.86	7,697.01	74.82	74.83	513.05	3,085.71	3,598.76	4.99	19.99
	STORAGE2	MOLDING	60.00	3,745.20	62.39	62.42	249.56	1,800.00	2,049.56	4.16	11.39
SUB TOTAL			23,364.53	3,082,115.03			205,492.79	700,936.35	906,429.14		5,035.74
Medium_Pump	RECEIVING	STORAGE1	750.00	158,190.00	210.96	210.92	10,547.91	22,500.00	33,047.91	14.06	183.60
	STORAGE1	BORE3	750.00	41,250.00	55.01	55.00	2,750.32	22,500.00	25,250.32	3.67	140.28
	HAND-FINISHING	STORAGE2	681.82	103,520.73	151.85	151.83	6,902.06	20,454.54	27,356.60	10.12	151.98

Simple Report

2. Aggregate - Displays a detailed report of calculations performed for the methods handling device by Aggregate.

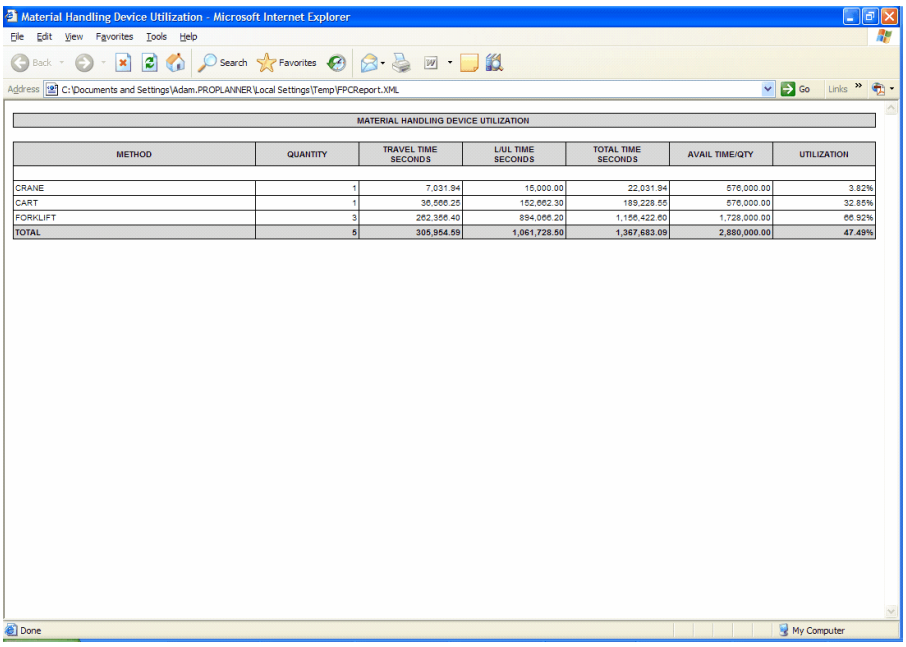


MATERIAL HANDLING AGGREGATE UTILIZATION

AGGREGATE	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	PERCENTAGE TRAVELLING	PERCENTAGE LOAD/UNLOADING
Small_Pump	43,698.19	211,260.50	254,858.69	17.11%	82.89%
Large_Pump	205,492.80	906,429.10	1,111,921.90	18.48%	81.52%
Medium_Pump	56,863.60	249,993.40	306,857.00	18.53%	81.47%
TOTAL	305,954.59	1,367,683.00	1,673,637.59	18.28%	81.72%

Aggregate

3. Method - Displays a detailed report of calculations performed for the methods handling device by Method.

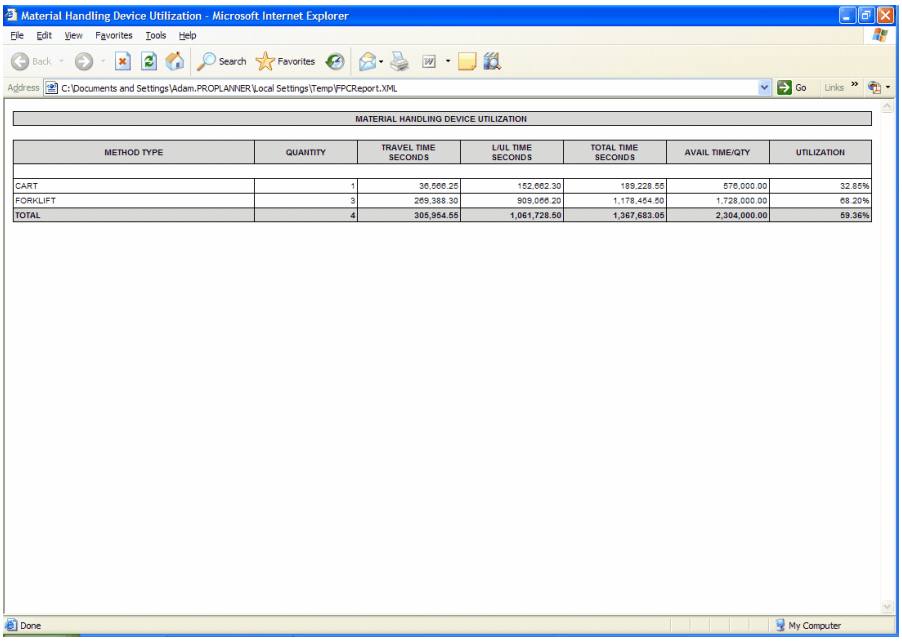


MATERIAL HANDLING DEVICE UTILIZATION

METHOD	QUANTITY	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	AVAIL TIME/QTY	UTILIZATION
CRANE	1	7,031.94	15,000.00	22,031.94	576,000.00	3.82%
CART	1	36,566.25	152,662.30	189,228.55	576,000.00	32.85%
FORKLIFT	3	262,356.40	894,066.20	1,156,422.60	1,728,000.00	66.92%
TOTAL	5	305,954.59	1,061,728.50	1,367,683.09	2,880,000.00	47.49%

Method

4. Method type - Displays a detailed report of calculations performed for the methods handling device by Method Type.

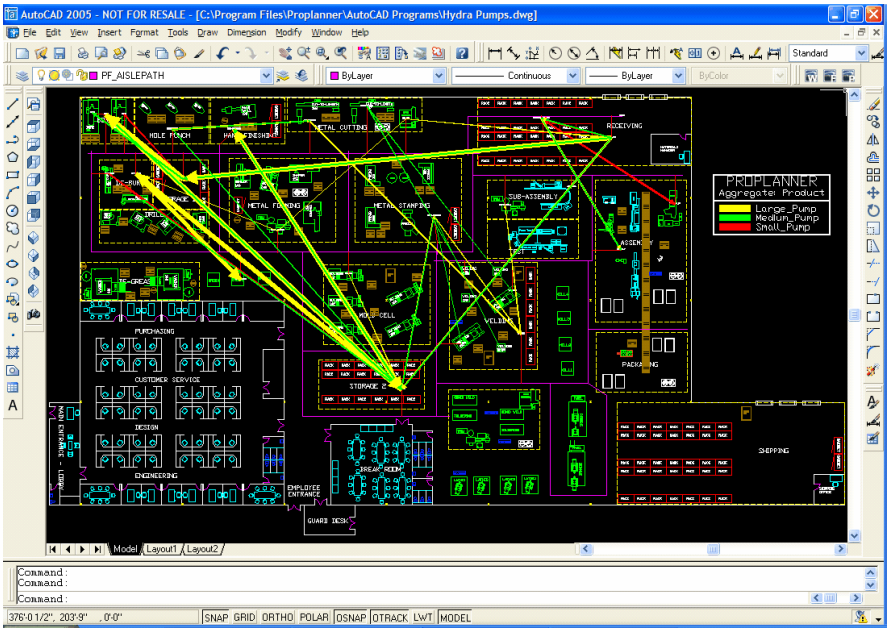


MATERIAL HANDLING DEVICE UTILIZATION

METHOD TYPE	QUANTITY	TRAVEL TIME SECONDS	L/UL TIME SECONDS	TOTAL TIME SECONDS	AVAIL TIME/QTY	UTILIZATION
CART	1	36,566.25	152,662.30	189,228.55	576,000.00	32.85%
FORKLIFT	3	269,388.30	909,066.20	1,178,454.50	1,728,000.00	68.20%
TOTAL	4	305,954.55	1,061,728.50	1,367,683.05	2,304,000.00	59.36%

Method Type

5. Legend - Besides the reports, the drawing itself can be used as a valuable output tool. On the Reporting tab, a legend can be added to the drawing at any desired scale once the calculations have been performed. This legend displays the line color and name of each unique aggregation line. Once added, the legend will update with new information. The legend, however, must be added for each aggregation for which the user wishes to display it.



Legend

9 Troubleshoot

Symptom	Possible Causes	Solution
1. Flow Planner will not start up.	Proplanner Ribbon did not load properly.	Try entering 'ppfp' in the command line to open the program.
	Previous version was not uninstalled before this installation.	Uninstall by going to Add/Remove Programs in the control panel, selecting Proplanner AutoCAD Programs and selecting remove. When done, install from the disk.
2. .csv, .prd, .loc, .mhe files do not open.	Excel by default saved the files as a tab-delimited .csv or an .xls instead of a comma-delimited .csv.	In Excel, select “Save As” and choose .csv (comma-delimited) from the “Save As Type” pull down menu. If dealing with the files which do not end in .csv make sure that there are single quotes around the filename such as ‘expl.loc’ Note that there is also an option to save as .csv(tab-delimited). This is sometimes the default .csv setting within Excel and is what causes this problem most often.
	An extra comma has been placed in the document, making the program think there is an extra column of information.	Open the file in Excel and do a “Find and Replace” or “ctrl + h”. Replace the comma symbol with nothing.
	Files are not sorted alphabetically by Product.	Open the file in Excel and select only the data rows that are not being read correctly, i.e. routing information or the product/part list. Sort the data ascending alphabetically.
	Files may be delimited by a semicolon (;) instead of a comma.	This is allowed for in the Flow Planner and can be corrected by going to the Licensing/Settings Tab and changing the Default Setting for the Line Delimiter from a comma (,) to a semicolon (;).
3. Aisle-based flow is being calculated as straight line.	Aisle paths are not actually joined to each other.	In AutoCAD select and make sure all lines are actually

		touching, making use of the "Snap to Object" Osnap ability which is activated or deactivated with F3.
	No aisle path has been defined.	On the Paths tab select "Add/Edit Aisle". This will take you to AutoCAD and show a modeless window with Flow Planner options. Selecting "Add Line" will allow the user to draw the aisle paths just like a regular AutoCAD line. It is recommended to draw as much of the aisle paths at once, without breaking the line, to avoid disconnections and overlaps.
	Locations have not been attached to aisles.	On the Paths tab select "Join Locs to Aisle".
	Duplicate or overlapping lines exist on the same aisle path, most commonly caused by backtracking while creating the path lines originally.	In AutoCAD look for any obvious overlapping lines and delete or redraw them with the "Add Line" command within the Flow Planner modeless window. Next select the lines one by one until you have the whole aisle structure selected. Do not select them all at once because that will include the hidden overlapped lines. Once they are all selected, copy them with base point 0,0 and then delete them. This will show any that were hidden. Delete the lines that were covered up. Right click and insert the copied paths as a block with insert point 0,0. Make sure that the layer is the PP_Aislepath layer when you insert the lines.
4. Distances and times are drastically different than expected and obviously incorrect.	Proplanner units differ from drawing units.	Go to the "Options/Help" tab and select the appropriate units, "feet, inches, meters, and millimeters". If you do not know the drawing units, go to AutoCAD and type "UNITS" into the command line. This will bring up a window where you can get or enter the desired units.

5. Load and Unload times are zero when using Processes.	Methods referenced by routes do not have their Load or Unload times specified to the processes. Also, if you are using the process Templates where the Load and Unload times are dynamically computed by route, then the TIME field on these processes must be set to -1.	Ensure that each Method's Load and Unload time is referencing the correct Process, and that all TEMPLATE-based processes have a -1 specified for their process TIME field.
6. No paths, reports, or output information is shown.	Calculation has not been performed for that aggregation. All this information is stored on the drawing or in the input files once the calculation is run, but this is not automatically created until the first calculation is run or any time there is a change in information.	Make sure the output tab you are on is set to the aggregation type you are wishing to show and that the calculation has been run for that aggregation on the Part Routings Tab.
7. Reports are showing no information or format is being distorted when opened.	User is using old version of Internet Explorer with which some of the reporting functions are not compatible. or The default setting to open XML files on the user's computer is conflicting with the program Flow Planner uses.	Go to Windows Update, for which a link is usually located in the Control Panel under Settings and update to the latest version. To change which program opens, follow these steps: 1. Open Windows Explorer by right-clicking the **Start** button, and then click **Explore**. 2. Click a folder that contains a file of the type that you want Windows to open in a program that you select. 3. Right-click the file and, depending on the programs installed on your computer, complete one of the following steps: o Click **Open With** to choose the program that you want. o Point to **Open With**, and then click **Choose Program** to choose the program that you want.

		4. The **Open With** dialog box is displayed. Use one of the following methods to select the program that you want to use for this file type: o In the **Programs** list, click the program that you want to use. o Click **Browse**, locate and then click the program that you want to use, and then click **Open**. o Click **Look for the appropriate program on the Web** to browse the Internet for the program that you want to use. 5. Click to select the **Always use the selected program to open this kind of file** check box if it is not selected. Click **OK**.
8. Path lines are either too small or too large.	These do not automatically scale and the line size must be set manually.	These can be set manually on the Paths tab in the Path Thickness/100 trips. This thickness is scaled in the drawing units.

10 Appendix

This section deals with the naming conventions, sample routing files, and limitations of Flow Planner.

10.1 Application Limitations

These application limitations have been defined in order to limit potentially excessive memory requirements of the application. If these limits prove constraining for certain situations, please contact your Proplanner representative with your specific request.

Maximum Input Routing Lines (file length) = 30,000 [Note that the Free version is limited to only 50 routing lines]

Maximum Products (unique names) = 10,000

Maximum Parts (a unique Product – Part pair is one part) = 10,000

Maximum Unique Aggregate Names (per aggregate) = 10,000

Maximum Flow Paths (unique From-To polylines per aggregate) = 20,000

Maximum Locations (unique names) = 20,000

Maximum Nodes (line intersections and endpoints per aisle path layer) = 30,000

Maximum Groups (unique names) = 250

Maximum Methods (unique names) = 250

Maximum Method Types (unique names) = 50

Maximum Processes (unique names) = 100 [Note that the Free version cannot import Processes]

Maximum Containers (unique names) = 100

Maximum Length of Keyword User-defined time standard = 500 lines

10.2 Application Layers

All Flow Planner layers begin with “PF_” with the exception of the Locations layer which has the “PP_” designation which is the same as the Workplace Planner application. Flow Planner will consistently add and remove text, lines, blocks and polylines from those layers. Proplanner will not alter any graphics on layers other than those beginning with “PP_” or “PF_”.

Note: aggname is the aggregate name specified in the routing file (i.e. the Product names or the Part names, or the Method names, etc)

aggtype is the aggregate type. The following options are valid:

PROD - Product

PART - Part

PDPT – Product&Part

MTHD – Method

MTYP – Method Type

FLOC – From-To Location

FGRP – From-To Group

CONT - Container

Layer Names

PP_LOCATIONS (contains the location text)

PF_CONG – Contains congestion flow diagram

PF_FPTH-aggtype-aggname (contains the flow paths for the specified operator)

PF_AISLEPATH (contains the lines that define the aisles available for the method types to use for Aisle Path Flows)

PF_AISLEPATH-JOIN (contains the lines linking the Location text to the aisle network)

NOTE: AISLEPATH is the default name for the aisle lines in the factory, however you can specify your own layer names (or multiple layers – one for each method type).

10.3 Input File Format

The input file is a comma delimited file with a CSV extension. As such, no commas, spaces, tabs, plus signs, forward-slashes or back-slashes are allowed within the text in a field. Proplanner can also read the output files as input files.

NOTE: The input file must be sorted by PRODUCT NAME (column 1). All entries for one product must be located next to each other in the file.

Column	Data Value
1	Product name
2	User field (ignored by program but must exist)
3	Part name
4	Percent Flow on Part on route (integer from 1 to 100)
5	From Location name
6	Method name
7	Container name
8	Containers per Trip (real number greater than 0)
9	Parts per Container (real number greater than 0)
10	To Location name
11	Via Location name [optional but field must exist]
12	Via Method [only if Via Loc Name specified – field must exist]
13	Via Containers Per Trip (real number greater than 0) [only if via name – field must exist]
14	Description (field must exist and can contain anything)

Sample Routing File (Hydra Pumps.csv)

Sample Product/Parts File (Hydra Pumps.prd)

Sample Methods/Processes/Containers File (Hydra Pumps.mhe)

Sample Locations/Groups File (Hydra Pumps.loc)

Sample Paths File (Hydra Pumps.pth)

10.3.1 Sample routing file(Hydra Pumps.csv)

Product and part information at bottom is optional. If there is Product and Part information in the CSV file, the PRD file will be ignored but can still be written out to. Dist (in), Freq, L/UL time, Travel Time, Via Dist (in), Via Freq, Via L/UL Time, and Via Travel Time are outputs, added to the CSV after calculations and are not needed for input use.

```
*ROUTINGS (Product, User Defined, Part, Flow%, From, Method, Container,
Containers/Trip, Parts/Container, To, Via Loc, Via Method, Via Containers/Trip,
Description, Dist (in), Freq, L/UL Time, Travel Time, Via Dist (in), Via Freq, Via
L/UL Time, Via Travel Time)

SMALL_PUMP, 0, HOUSING, 100, RECEIVING, CART, TUB, 1, 20, BORE1, STORAGE1, CART, 1, , 2531.4978,
500, 10, 17.5798, 515.6086, 500, 10, 3.5806

SMALL_PUMP, 1, HOUSING, 100, HAND-FINISHING, CART, TUB, 1, 22, DE-
BURING1, STORAGE2, CART, 1, , 1822.1433, 454.5454, 10, 12.6538, 2137.3606, 454.5454, 10, 14.84
28

SMALL_PUMP, 1, GASKETS, 100, RECEIVING, CART, TUB, 2, 300, ASSEMBLY1, STORAGE2, CART, 2, , 1929.
4518, 33.33333, 10, 95.7069, 1556.1726, 33.33333, 10, 10.8068

SMALL_PUMP, 1, PUMP-
BASE, 100, RECEIVING, CART, TUB, 2, 35, HOLEPUNCH, STORAGE2, CART, 2, , 1929.4518, 71.42857, 10,
44.6632, 2040.9498, 71.42857, 10, 14.1733

SMALL_PUMP, 1, PUMP-
BASE, 100, HOLEPUNCH, CART, TUB, 1, 35, METALCUTTING, , , , , 810.513, 142.8571, 10, 5.6286, , , ,

SMALL_PUMP, 1, HOUSING, 100, BORE, CART, TUB, 1, 22, HAND-
FINISHING, STORAGE2, CART, 1, , 2374.6179, 454.5454, 10, 16.4904, 1822.1433, 454.5454, 10, 12.
6538

SMALL_PUMP, 0, STEEL-BLANK, 100, RECEIVING, CART, TUB, 1, 150, METAL-
STAMPING, STORAGE2, CART, 1, , 1929.4518, 133.3333, 10, 23.9267, 1038.896, 133.3333, 10, 7.214
6

SMALL_PUMP, 1, STEEL-BLANK, 100, METAL-
STAMPING, CART, TUB, 1, 150, WELDING, , , , , 862.639, 133.3333, 10, 5.9905, , , ,

SMALL_PUMP, 1, PUMP-
BASE, 100, METALCUTTING, CART, TUB, 1, 50, WELDING, , , , , 1766.3767, 100, 10, 24.533, , , ,

SMALL_PUMP, 1, PUMP-
BASE, 100, METALCUTTING, CART, TUB, 1, 50, WELDING, , , , , 1766.3767, 100, 10, 24.533, , , ,

SMALL_PUMP, 0, MOTOR2, 100, RECEIVING, CART, TUB, 1, 22, ASSEMBLY_SM, RECEIVING-
STORAGE, CART, 1, , 427.3479, 454.5454, 10, 5.9354, 933.4389, 454.5454, 10, 12.9644

SMALL_PUMP, 1, MOTOR, 100, RECEIVING, CART, TUB, 1, 22, ASSEMBLY_SM, RECEIVING-
STORAGE, CART, 1, , 427.3479, 454.5454, 10, 5.9354, 933.4389, 454.5454, 10, 12.9644

Large_Pump, 0, HOUSING, 100, RECEIVING, FORKLIFT, PALLET, 1, 20, BORE, STORAGE1, FORKLIFT, 1, ,
2531.4978, 2700, 22, 28.1278, 589.8697, 2700, 22, 6.5541

Large_Pump, 1, HOUSING, 100, HAND-FINISHING, FORKLIFT, PALLET, 1, 22, DE-
BURING, STORAGE2, FORKLIFT, 1, , 1822.1433, 2454.545, 22, 20.246, 2012.4394, 2454.545, 22, 22.
3604

Large_Pump, 1, MOTOR, 100, RECEIVING, FORKLIFT, PALLET, 1, 22, ASSEMBLY, RECEIVING-
STORAGE, FORKLIFT, 1, , 427.3479, 818.1818, 22, 4.7483, 904.1515, 818.1818, 22, 10.0461

Large_Pump, 1, GASKETS, 100, RECEIVING, FORKLIFT, TUB, 2, 300, ASSEMBLY1, STORAGE2, FORKLIFT,
2, , 1929.4518, 135, 22, 148.0267, 1556.1726, 135, 22, 17.2908

Large_Pump, 1, PUMP-
BASE, 100, RECEIVING, FORKLIFT, PALLET, 2, 35, HOLEPUNCH, STORAGE2, FORKLIFT, 2, , 1929.4518, 2
57.1429, 22, 77.714, 2040.9498, 257.1429, 22, 22.6772

Large_Pump, 1, PUMP-
BASE, 100, HOLEPUNCH, FORKLIFT, PALLET, 1, 35, METALCUTTING, , , , , 810.513, 514.2857, 22, 9.005
7, , 257.1429, 22,
```

Large_Pump, 1, HOUSING, 100, BORE, FORKLIFT, PALLET, 1, 22, HAND-FINISHING, STORAGE2, FORKLIFT, 1, , 2374.6179, 2454.545, 22, 26.3846, 1822.1433, 2454.545, 22, 20.246

Large_Pump, 0, STEEL-BLANK, 100, RECEIVING, FORKLIFT, PALLET, 1, 150, METAL-STAMPING, STORAGE2, FORKLIFT, 1, , 1929.4518, 480, 22, 41.6325, 1038.896, 480, 22, 11.5433

Large_Pump, 1, STEEL-BLANK, 100, METAL-STAMPING, FORKLIFT, PALLET, 1, 150, WELDING, , , , , 862.639, 480, 22, 9.5849, , 480, 22,

Large_Pump, 1, PUMP-BASE, 100, METALCUTTING, FORKLIFT, PALLET, 1, 50, WELDING, , , , , 1766.3767, 360, 22, 39.2528, , , ,

Large_Pump, 1, PUMP-BASE, 100, METALCUTTING, FORKLIFT, PALLET, 1, 50, WELDING, , , , , 1766.3767, 360, 22, 39.2528, , , ,

Large_Pump, 1, PUMP-BASE, 100, WELDING, FORKLIFT, PALLET, 1, 50, SUB-ASSEMBLY, , , , , 763.6838, 360, 22, 8.4854, , , ,

Large_Pump, 1, VALVE, 100, RECEIVING, FORKLIFT, PALLET, 1, 175, MILLING, , , , , 1215.1264, 102.8571, 22, 13.5014, , , ,

Large_Pump, 1, HOUSING, 100, DE-BURING, FORKLIFT, PALLET, 1, 25, DE-GREASING, , , , , 876.4749, 2160, 22, 10.2024, , , ,

Large_Pump, 1, VALVE, 100, MILLING, FORKLIFT, PALLET, 1, 175, METAL-FORMING, , , , , 1001.3975, 102.8571, 22, 11.1266, , , ,

Large_Pump, 1, VALVE, 100, METAL-FORMING, FORKLIFT, PALLET, 1, 175, DE-GREASING, DE-BURING, FORKLIFT, 1, , 897.8385, 102.8571, 22, 9.976, 876.4749, 102.8571, 22, 214.2495

Large_Pump, 0, PLASTIC-RAW-MATERIAL, 100, RECEIVING, FORKLIFT, PALLET, 1, 300, MOLDING, STORAGE2, FORKLIFT, 1, , 1929.4518, 60, 22, 333.0601, 748.6937, 60, 22, 8.3188

Medium_Pump, 0, HOUSING, 100, RECEIVING, FORKLIFT, PALLET, 1, 20, BORE3, STORAGE1, FORKLIFT, 1, , 2531.4978, 750, 22, 28.1278, 660.0758, 750, 22, 7.3342

Medium_Pump, 1, HOUSING, 100, HAND-FINISHING, FORKLIFT, PALLET, 1, 22, DE-BURING2, STORAGE2, FORKLIFT, 1, , 1822.1433, 681.8182, 22, 20.246, 1890.5375, 681.8182, 22, 21.006

Medium_Pump, 1, MOTOR, 100, RECEIVING, FORKLIFT, PALLET, 1, 22, ASSEMBLY, RECEIVING-STORAGE, FORKLIFT, 1, , 427.3479, 340.9091, 22, 4.7483, 904.1515, 340.9091, 22, 10.0461

Medium_Pump, 1, GASKETS, 100, RECEIVING, FORKLIFT, TUB, 2, 300, ASSEMBLY1, STORAGE2, FORKLIFT, 2, , 1929.4518, 50, 22, 110.2544, 1556.1726, 50, 22, 17.2908

Medium_Pump, 1, PUMP-BASE, 100, RECEIVING, FORKLIFT, PALLET, 2, 35, HOLEPUNCH, STORAGE2, FORKLIFT, 2, , 1929.4518, 107.1429, 22, 51.452, 2040.9498, 107.1429, 22, 22.6772

Medium_Pump, 1, PUMP-BASE, 100, HOLEPUNCH, FORKLIFT, PALLET, 1, 35, METALCUTTING, , , , , 810.513, 214.2857, 22, 9.0057, , 107.1429, 22,

Medium_Pump, 1, HOUSING, 100, BORE, FORKLIFT, PALLET, 1, 22, HAND-FINISHING, STORAGE2, FORKLIFT, 1, , 2374.6179, 681.8182, 22, 26.3846, 1822.1433, 681.8182, 22, 20.246

Medium_Pump, 0, STEEL-BLANK, 100, RECEIVING, FORKLIFT, PALLET, 1, 150, METAL-STAMPING, STORAGE2, FORKLIFT, 1, , 1929.4518, 100, 22, 55.1272, 1038.896, 100, 22, 11.5433

Medium_Pump, 1, STEEL-BLANK, 100, METAL-STAMPING, FORKLIFT, PALLET, 1, 150, WELDING2, , , , , 767.1911, 100, 22, 8.5243, , 100, 22,

Medium_Pump, 1, PUMP-BASE, 100, METALCUTTING1, FORKLIFT, PALLET, 1, 50, WELDING3, , , , , 1386.1671, 150, 22, 30.8037, , , ,

Medium_Pump, 1, PUMP-BASE, 100, METALCUTTING1, FORKLIFT, PALLET, 1, 50, WELDING4, , , , , 1146.7389, 150, 22, 25.4831, , , ,

```
Medium_Pump,1,STEEL-BLANK,100,METAL-
STAMPING,FORKLIFT,PALLET,1,150,WELDING5,,,,,882.5761,100,22,9.8064,,,,
Medium_Pump,1,PUMP-
BASE,100,METALCUTTING1,FORKLIFT,PALLET,1,50,WELDING3,,,,,1386.1671,150,22,30.8037,
,,,
Medium_Pump,1,PUMP-
BASE,100,METALCUTTING1,FORKLIFT,PALLET,1,50,WELDING4,,,,,1146.7389,150,22,25.4831,
,,,

*PRODUCTS (Name, Quantity, Color, Calc)
SMALL_PUMP,10000,1,Yes
Large_Pump,18000,2,Yes
Medium_Pump,7500,3,Yes

*PARTS (Product Name, Part Name, Qty Parts/Product, Use%, Days Inventory, Color)
SMALL_PUMP,HOUSING,1,100,1,1
SMALL_PUMP,GASKETS,2,100,1,3
SMALL_PUMP,PUMP-BASE,1,50,1,4
SMALL_PUMP,STEEL-BLANK,2,100,1,6
SMALL_PUMP,MOTOR2,1,100,1,1
SMALL_PUMP,MOTOR,1,100,1,2
Large_Pump,HOUSING,3,100,1,1
Large_Pump,MOTOR,1,100,1,2
Large_Pump,GASKETS,6,75,1,3
Large_Pump,PUMP-BASE,1,100,1,4
Large_Pump,STEEL-BLANK,8,50,1,6
Large_Pump,VALVE,1,100,1,1
Large_Pump,PLASTIC-RAW-MATERIAL,1,100,1,1
Medium_Pump,HOUSING,2,100,1,1
Medium_Pump,MOTOR,1,100,1,2
Medium_Pump,GASKETS,4,100,1,3
Medium_Pump,PUMP-BASE,1,100,1,4
Medium_Pump,STEEL-BLANK,4,50,1,6
```

10.3.2 Sample product/parts file (Hydra Pumps.prd)

```
* PRODUCTS
Small_Pump, 10000, 1, Yes
Large_Pump, 18000, 2, Yes
Medium_Pump, 7500, 3, Yes

* PARTS
Small_Pump, HOUSING, 1, 100, 1, 1
Small_Pump, GASKETS, 2, 100, 1, 3
Small_Pump, PUMP-BASE, 1, 50, 1, 4
Small_Pump, STEEL-BLANK, 2, 100, 1, 6
Small_Pump, MOTOR2, 1, 100, 1, 1
Small_Pump, MOTOR, 1, 100, 1, 2
Large_Pump, HOUSING, 3, 100, 1, 1
Large_Pump, MOTOR, 1, 100, 1, 2
Large_Pump, GASKETS, 6, 75, 1, 3
Large_Pump, PUMP-BASE, 1, 100, 1, 4
Large_Pump, STEEL-BLANK, 8, 50, 1, 6
Large_Pump, VALVE, 1, 100, 1, 1
Large_Pump, PLASTIC-RAW-MATERIAL, 1, 100, 1, 1
Medium_Pump, HOUSING, 2, 100, 1, 1
Medium_Pump, MOTOR, 1, 100, 1, 2
Medium_Pump, GASKETS, 4, 100, 1, 3
Medium_Pump, PUMP-BASE, 1, 100, 1, 4
Medium_Pump, STEEL-BLANK, 4, 50, 1, 6
```

10.3.3 Sample Methods/processes/containers file (Hydra Pumps.mhe)

```
*METHODS
"CART","1","HAND","5","5","100","RECEIVING","1","Yes"
"FORKLIFT","1","FORK","10","10","100","RECEIVING","2","Yes"

*METHODTYPES
"HAND","80","0","20","15","5","5","PF_AISLEPATH","1","115200","1"
"FORK","50","3000","40","15","5","5","PF_AISLEPATH","2","115200","1"

*CONTAINERS
"TUB","1","1","1","1","1","1"
"PALLET","1","1","1","1","1","2"

*PROCESSES
"LOAD","10","0","None","0","0"
"UNLOAD","12","0","None","0","0"
```

10.3.4 Sample Locations/Groups file (Hydra Pumps.loc)

```
*LOCATIONS (NAME X Y GROUP)
RECEIVING, 0, 0, UNASSIGNED
BORE1, 0, 0, MACHINING
STORAGE1, 0, 0, STORAGE
HAND-FINISHING, 0, 0, ASSEMBLY
DE-BURING1, 0, 0, MACHINING
STORAGE2, 0, 0, STORAGE
ASSEMBLY1, 0, 0, ASSEMBLY
HOLEPUNCH, 0, 0, STAMPING
METALCUTTING, 0, 0, MACHINING
BORE, 0, 0, MACHINING
METAL-STAMPING, 0, 0, STAMPING
WELDING, 0, 0, WELDING
ASSEMBLY_SM, 0, 0, ASSEMBLY
RECEIVING-STORAGE, 0, 0, STORAGE
DE-BURING, 0, 0, MACHINING
ASSEMBLY, 0, 0, ASSEMBLY
SUB-ASSEMBLY, 0, 0, ASSEMBLY
MILLING, 0, 0, MACHINING
DE-GREASING, 0, 0, UNASSIGNED
METAL-FORMING, 0, 0, STAMPING
MOLDING, 0, 0, UNASSIGNED
BORE3, 0, 0, MACHINING
DE-BURING2, 0, 0, MACHINING
WELDING2, 0, 0, WELDING
METALCUTTING1, 0, 0, MACHINING
WELDING3, 0, 0, WELDING
WELDING4, 0, 0, WELDING
WELDING5, 0, 0, WELDING

*GROUPS (NAME COLOR X Y)
UNASSIGNED, 1, 0, 0
WELDING, 2, 0, 0
MACHINING, 3, 0, 0
STAMPING, 4, 0, 0
ASSEMBLY, 6, 0, 0
STORAGE, 1, 0, 0

*DRAWING EXTENTS (MINX MINY MAXX MAXY) in INCHES
-222, -180, 4500.5, 2955.8183
```

10.3.5 Sample paths file (Hydra Pumps.pth)

```
Flow Path Type: Product

FLOW PATHS (PATHNUM, AGGREGATE, FROM LOC, TO LOC, CALC DISTANCE, FREQUENCY, USER
DISTANCE, L/UL TIME, TRAVEL TIME, TOTAL COST, METHOD TYPE NAME)

1, Medium_Pump, METAL-STAMPING, WELDING5, 1803.35, 100, None, 2000, 2003.72, 44.49, FORK

2, Medium_Pump, METALCUTTING1, WELDING4, 3386, 300, None, 6000, 11286.67, 192.07, FORK

3, Medium_Pump, METALCUTTING1, WELDING3, 3765, 300, None, 6000, 12550, 206.11, FORK

4, Medium_Pump, METAL-STAMPING, WELDING2, 906.35, 100, None, 2000, 1007.05, 33.41, FORK

5, Medium_Pump, STORAGE2, METAL-STAMPING, 2711.35, 100, None, 2000, 3012.61, 55.7, FORK

6, Medium_Pump, STORAGE2, HAND-
FINISHING, 3489.94, 681.82, None, 13636.36, 26438.91, 445.28, FORK

7, Medium_Pump, BORE, STORAGE2, 3838, 681.82, None, 13636.36, 29075.76, 474.58, FORK

8, Medium_Pump, HOLEPUNCH, METALCUTTING, 1138, 214.29, None, 4285.71, 2709.52, 77.72, FORK

9, Medium_Pump, STORAGE2, HOLEPUNCH, 3732, 107.14, None, 2142.86, 4442.86, 73.17, FORK

10, Medium_Pump, STORAGE2, ASSEMBLY1, 4370.97, 50, None, 1000, 2428.32, 38.09, FORK

11, Medium_Pump, RECEIVING, STORAGE2, 4450, 257.14, None, 5142.86, 12714.29, 198.41, FORK

12, Medium_Pump, RECEIVING-
STORAGE, ASSEMBLY, 2138, 340.91, None, 6818.18, 8098.49, 165.74, FORK

13, Medium_Pump, RECEIVING, RECEIVING-
STORAGE, 554, 340.91, None, 6818.18, 2098.48, 99.07, FORK

14, Medium_Pump, STORAGE2, DE-
BURING2, 3757.69, 681.82, None, 13636.36, 28467.37, 467.82, FORK

15, Medium_Pump, HAND-
FINISHING, STORAGE2, 2949.94, 681.82, None, 13636.36, 22348, 399.83, FORK

16, Medium_Pump, STORAGE1, BORE3, 2672.91, 750, None, 15000, 22274.22, 414.16, FORK

17, Medium_Pump, RECEIVING, STORAGE1, 3017, 750, None, 15000, 25141.67, 446.02, FORK

18, Large_Pump, STORAGE2, MOLDING, 2100, 60, None, 1200, 1400, 28.89, FORK

19, Large_Pump, METAL-FORMING, DE-BURING, 1666, 102.86, None, 2057.14, 1904, 44.01, FORK

20, Large_Pump, MILLING, METAL-FORMING, 1666, 102.86, None, 2057.14, 1904, 44.01, FORK

21, Large_Pump, DE-BURING, DE-GREASING, 1484, 1542.86, None, 30857.14, 25440, 625.52, FORK

22, Large_Pump, RECEIVING, MILLING, 1758, 102.86, None, 2057.14, 2009.14, 45.18, FORK

23, Large_Pump, WELDING, SUB-ASSEMBLY, 4108.97, 360, None, 7200, 16435.88, 262.62, FORK

24, Large_Pump, METALCUTTING, WELDING, 3619, 720, None, 14400, 28952, 481.69, FORK

25, Large_Pump, METAL-STAMPING, WELDING, 1780.35, 240, None, 4800, 4747.59, 106.08, FORK

26, Large_Pump, STORAGE2, METAL-STAMPING, 2711.35, 240, None, 4800, 7230.26, 133.67, FORK

27, Large_Pump, STORAGE2, HAND-
FINISH, 3489.94, 1636.36, None, 32727.27, 63453.4, 1068.67, FORK

28, Large_Pump, BORE, STORAGE2, 3838, 1636.36, None, 32727.27, 69781.84, 1138.99, FORK

29, Large_Pump, HOLEPUNCH, METALCUTTING, 1138, 514.29, None, 10285.71, 6502.86, 186.54, FORK

30, Large_Pump, STORAGE2, HOLEPUNCH, 3732, 257.14, None, 5142.86, 10662.86, 175.62, FORK

31, Large_Pump, STORAGE2, ASSEMBLY1, 4370.97, 120, None, 2400, 5827.96, 91.42, FORK

32, Large_Pump, RECEIVING, STORAGE2, 4450, 677.14, None, 13542.86, 33480.95, 522.49, FORK

33, Large_Pump, RECEIVING-
STORA, ASSEMBLY, 2138, 818.18, None, 16363.64, 19436.36, 397.78, FORK
```

34, Large_Pump, RECEIVING, RECEIVING-
STORAGE, 554, 818.18, None, 16363.64, 5036.36, 237.78, FORK

35, Large_Pump, STORAGE2, DE-BURING, 3928, 1636.36, None, 32727.27, 71418.2, 1157.17, FORK

36, Large_Pump, HAND-
FINISH, STORAGE2, 2949.94, 1636.36, None, 32727.27, 53635.22, 959.58, FORK

37, Large_Pump, STORAGE1, BORE, 2593, 1800, None, 36000, 51860, 976.22, FORK

38, Large_Pump, RECEIVING, STORAGE1, 3017, 1800, None, 36000, 60340, 1070.44, FORK

39, Small_Pump, RECEIVING-
STORA, ASSEMBLY_SM, 2186, 909.09, None, 9090.91, 13800.5, 127.17, HAND

40, Small_Pump, RECEIVING, RECEIVING-
STORAGE, 554, 909.09, None, 9090.91, 3497.47, 69.94, HAND

41, Small_Pump, METALCUTTING, WELDING, 3619, 400, None, 4000, 10052.78, 78.07, HAND

42, Small_Pump, METAL-
STAMPING, WELDING, 1780.35, 133.33, None, 1333.33, 1648.47, 16.57, HAND

43, Small_Pump, STORAGE2, METAL-
STAMPING, 2711.35, 133.33, None, 1333.33, 2510.51, 21.35, HAND

44, Small_Pump, STORAGE2, HAND-
FINISHING, 3489.94, 909.09, None, 9090.91, 22032.43, 172.91, HAND

45, Small_Pump, BORE, STORAGE2, 3838, 909.09, None, 9090.91, 24229.8, 185.12, HAND

46, Small_Pump, HOLEPUNCH, METALCUTTING, 1138, 285.71, None, 2857.14, 2257.94, 28.42, HAND

47, Small_Pump, STORAGE2, HOLEPUNCH, 3732, 142.86, None, 1428.57, 3702.38, 28.51, HAND

48, Small_Pump, STORAGE2, ASSEMBLY1, 4370.97, 66.67, None, 666.67, 2023.6, 14.95, HAND

49, Small_Pump, RECEIVING, STORAGE2, 4450, 342.86, None, 3428.57, 10595.24, 77.91, HAND

50, Small_Pump, STORAGE2, DE-BURING1, 3510, 909.09, None, 9090.91, 22159.09, 173.61, HAND

51, Small_Pump, HAND-
FINISHING, STORAGE2, 2949.94, 909.09, None, 9090.91, 18623.34, 153.97, HAND

52, Small_Pump, STORAGE1, BORE1, 729, 1000, None, 10000, 5062.5, 83.68, HAND

53, Small_Pump, RECEIVING, STORAGE1, 3017, 1000, None, 10000, 20951.39, 171.95, HAND

DRAWING EXTENTS (MINX, MINY, MAXX, MAXY) in INCHES

-180, -180, 4500.5, 2412

PATH VERTICES (PATHNUM, #VERTICES, node1, node2, node3, node4 ...)

1, 11, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11

2, 11, 12, 13, 14, 15, 16, 17, 7, 6, 5, 18, 19

3, 12, 12, 13, 14, 15, 16, 17, 7, 6, 5, 18, 20, 21

4, 7, 1, 2, 3, 4, 5, 6, 22

5, 11, 23, 24, 25, 17, 7, 6, 5, 4, 3, 2, 1

6, 11, 23, 24, 25, 17, 16, 15, 14, 26, 27, 28, 29

7, 13, 30, 31, 32, 33, 34, 35, 36, 37, 16, 17, 25, 24, 23

8, 6, 38, 39, 40, 27, 26, 41

9, 12, 23, 24, 25, 17, 16, 15, 14, 26, 27, 40, 39, 38

10, 17, 23, 24, 42, 8, 9, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54

11, 14, 55, 56, 57, 58, 59, 60, 13, 14, 15, 16, 17, 25, 24, 23

12, 11, 61, 57, 58, 59, 62, 63, 64, 53, 52, 51, 65

13, 4, 55, 56, 57, 61

14, 12, 23, 24, 25, 17, 16, 37, 36, 35, 34, 33, 66, 67

15, 11, 29, 28, 27, 35, 36, 37, 16, 17, 25, 24, 23

16, 10, 68, 40, 27, 35, 34, 33, 32, 31, 30, 69

17, 12, 55, 56, 57, 58, 59, 60, 13, 14, 26, 27, 40, 68

18, 8, 23, 24, 25, 17, 16, 15, 70, 71

19, 9, 72, 37, 36, 35, 27, 40, 39, 73, 74

20, 8, 75, 60, 13, 14, 15, 16, 37, 72

21, 8, 74, 73, 39, 40, 27, 35, 36, 76

22, 7, 55, 56, 57, 58, 59, 60, 75

23, 16, 77, 10, 9, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 64, 78

24, 11, 41, 26, 14, 15, 16, 17, 7, 8, 9, 10, 77

25, 11, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 77

26, 11, 23, 24, 25, 17, 7, 6, 5, 4, 3, 2, 1

27, 11, 23, 24, 25, 17, 16, 15, 14, 26, 27, 28, 29

28, 13, 30, 31, 32, 33, 34, 35, 36, 37, 16, 17, 25, 24, 23

29, 6, 38, 39, 40, 27, 26, 41

30, 12, 23, 24, 25, 17, 16, 15, 14, 26, 27, 40, 39, 38

31, 17, 23, 24, 42, 8, 9, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54

32, 14, 55, 56, 57, 58, 59, 60, 13, 14, 15, 16, 17, 25, 24, 23

33, 11, 61, 57, 58, 59, 62, 63, 64, 53, 52, 51, 65

34, 4, 55, 56, 57, 61

35, 13, 23, 24, 25, 17, 16, 15, 14, 26, 27, 40, 39, 73, 74

36, 11, 29, 28, 27, 35, 36, 37, 16, 17, 25, 24, 23

37, 9, 68, 40, 27, 35, 34, 33, 32, 31, 30

38, 12, 55, 56, 57, 58, 59, 60, 13, 14, 26, 27, 40, 68

39, 11, 61, 57, 58, 59, 62, 63, 64, 53, 52, 79, 80

40, 4, 55, 56, 57, 61

41, 11, 41, 26, 14, 15, 16, 17, 7, 8, 9, 10, 77

42, 11, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 77

43, 11, 23, 24, 25, 17, 7, 6, 5, 4, 3, 2, 1

44, 11, 23, 24, 25, 17, 16, 15, 14, 26, 27, 28, 29

45, 13, 30, 31, 32, 33, 34, 35, 36, 37, 16, 17, 25, 24, 23

46, 6, 38, 39, 40, 27, 26, 41

47, 12, 23, 24, 25, 17, 16, 15, 14, 26, 27, 40, 39, 38

48, 17, 23, 24, 42, 8, 9, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54

49, 14, 55, 56, 57, 58, 59, 60, 13, 14, 15, 16, 17, 25, 24, 23

50, 11, 23, 24, 25, 17, 16, 37, 36, 35, 34, 33, 66

51, 11, 29, 28, 27, 35, 36, 37, 16, 17, 25, 24, 23

52, 6, 68, 40, 39, 73, 81, 82

53, 12, 55, 56, 57, 58, 59, 60, 13, 14, 26, 27, 40, 68

NODE LOCATIONS (NODENUM Xloc Yloc)

10.3.6 Sample Tugger Delivery file (Hydra Pumps Tugger.csv)

```
*ID,Part,Container,ContQty,From,Stage,To,ETD,Direction,Load,Unload
Consumable1,111456,BOX35,4,RECEIVING,STORAGE1,HOLEPUNCH,7.1,1,,
Consumable2,111847,BOX36,4,RECEIVING,STORAGE1,DE-BURING,7.2,1,,
Consumable3,111332,CRATE2,6,RECEIVING,STORAGE1,BORE,7.3,1,,
Consumable4,111445,CRATE2,6,RECEIVING,STORAGE1,DE-BURING1,7.4,1,,
Casting1,235448,FLAT,5,RECEIVING,STORAGE1,DE-GREASING,7.5,1,,
Casting2,235449,FLAT,5,RECEIVING,STORAGE1,METAL-FORMING,7.6,1,,
Casting3,235450,FLAT,5,RECEIVING,STORAGE1,METAL-STAMPING,7.7,1,,
Casting4,235988,FLAT,5,RECEIVING,STORAGE1,METALCUTTING,7.8,1,,
Casting5,235989,FLAT,5,RECEIVING,STORAGE1,HAND-FINISHING,7.9,1,,
Subassembly1,851001,CRATE2,10,RECEIVING2,STORAGE2,WELDING,7.1,1,,
Subassembly2,851002,CRATE3,6,RECEIVING2,STORAGE2,WELDING3,7.2,1,,
Subassembly3,851003,CRATE4,8,RECEIVING2,STORAGE2,WELDING4,7.3,1,,
Subassembly4,851004,CRATE5,4,RECEIVING2,STORAGE2,SUB-ASSEMBLY,7.4,1,,
Subassembly5,851005,FLAT,2,RECEIVING2,STORAGE2,ASSEMBLY1,7.5,1,,
Subassembly6,851006,FLAT,2,RECEIVING2,STORAGE2,ASSEMBLY,7.6,1,,
Part-1234,999126,BOX42,1,RECEIVING2,STORAGE2,WELDING2,7.7,1
```

11 Glossary

A

Aggregation: To aggregate is to sum. In Flow Planner, the term 'aggregation' refers to the way in which the summing is done. For example, the total path distance could be summed for an entire product (eg, Small_Pump), including all parts that go into that product. However, the distance that one single part from a product travels could also be summed. Thus, Product and Part are two different ways Flow Planner results can be aggregated.

Aisle: A passageway on which material handling devices may travel. Aisles in Flow Planner are defined by using the Path Tab to draw aisle lines in a specific layer in the AutoCAD drawing. (More than one layer of aisle lines can exist if different aisle networks exist for different material handling devices.)

B

C

Container: An item that holds parts while the parts are transported (pallet, bin, crate, etc).

Container Block: A block is the AutoCAD term for a symbol; these blocks are single entities made up of text and lines. The container block is a symbol that represents where a container is delivered.

D

E

F

Frequency: The number of trips required to deliver a sufficient number of parts, given the parameters of the material handling device, the number of parts required, and the container and part sizes.

G

H

I

J

K

L

Location: Areas in the facility (receiving, storage, assembly, shipping, etc) where the parts need to go. Flow Planner recognizes locations from text labels on a specific AutoCAD layer.

M

N

O

P

Part: The components that are assembled to make a product. The Hydra Pump example has many different parts, including Pump Base, Gaskets, Motor, Steel Blank, Valve, and more.

Process: Something which takes place so that material can be moved (load, unload, etc) but which is not part of the actual transport time.

Product: A product is an entity that consumes parts; it is the end-item that the parts are creating. Routings may show how parts for a specific product move. The Hydra Pumps example has three products: Small_Pump, Medium_Pump, and Large_Pump.

Q

R

Relationship Study: A type of study for relationship planning that was developed by Richard Muther. Adapted from Muther's Systematic Layout Planning, which involves defining relationships between different areas, and arranging the facility based on the relationships.

Routing: Shows the summary of how parts move from one location to another by some process. Routings record the way that parts move through the plant.

S

T

Tugger: A delivery method where one vehicle is towing a train of carts and will follow a route making several deliveries per trip.

Tugger delivery: The tugger train delivers to multiple locations in one trip. Deliveries are complex because routes may change, meaning transport distance may not be exactly known. Additionally, the capacity of the tugger train will affect route trip frequency.

U

Unit Load deliveries: Deliveries are made to only one location per trip. For example, a forklift takes a tub of parts from Storage1 to Assembly3.

Utilization: In this context, utilization refers to the portions of time a material handling device spends in a certain state of work. It is desirable that the device (and operator) is busy delivering parts most of the time (not idle), but is not assigned so much work it (he) cannot keep up (not over-utilized).

V

W

X

Y

Z