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1.0 Introduction:

One of the most important factors in cable routing is to have the correct information in the correct places. Make sure to take the necessary time to set up your data with a clear plan. This document is going to explain how to use CableMatic to develop that type of data for cable routing. That being said, keep in mind that the major focus of this document is CableMatic. There will, however, be some references made to TrayMatic throughout the document. The main purpose of this is to give you a better understanding of the information that’s gathered from TrayMatic to be used for cable routing.

2.0 Abstract:

Before we jump into the cable routing theory, let’s first talk a little about CableMatic as a program. CableMatic looks at many different things to decide whether or not a route can be found for your cable. For example, tray fill has to be considered, which also means that voltage class must be looked at; otherwise, an accurate tray fill can’t be found. What about the tray itself? Is it a solid bottom tray or the ladder type? How about the type of cable you’re routing? Is it a multi-conductor cable or a single conductor cable?

The program must look at all of these things, and many more, before it can decide the route of a particular cable. If just one of these factors doesn’t match up correctly to the rules that CableMatic must follow, the program can be set to abort the process; if that’s what you’d like.

CableMatic also tracks the entry and exit point of each cable through the cable tray system. This means, CableMatic can tell you the exact spot on the tray that the cable will enter or leave accurately within approximately six inches. Wow! That means trays don’t have to be “Cut up” into smaller segments to account for tray fill, so less of your time is going to be devoted to annotations.

In addition, CableMatic can search the area around an equipment to find the closest acceptable connection to a tray, and then connect it automatically for you. Not only that, but the GSN Suite includes TrayMatic, a program designed to assist you in the development of a 3D Raceway Network. Having a 3D model to combine with cable routing offers the ability to verify routes, analyze problems, and change the network quickly to accommodate routing; not to mention, when combined, that means a consistent set of documents for cable installation.

As a difference from other software, CableMatic permits errors and design violations, but offers audits to find them. Some significant errors could be:
1) A cable type was deleted for a cable that uses it.
2) A raceway was deleted or renamed for cable that uses it in a route.
3) A raceway was moved causing a discontinuous route.
4) A raceway service level was changed violating cable segregation rules
5) A man hole or stub up was moved so that a conduit has lost its connection to the raceway network.
6) A cable’s segregation was changed violating cable segregation rules
7) A cable type’s diameter was changed violating a raceway fill rule
8) A raceway size was changed violating a raceway fill rule

Any of these errors will raise a flag to the program when the respective audit is run. “Why not stop the error in the first place instead of fixing it after the fact?” you ask… here’s why.

There are some cases where different groups of people are assigned to different aspects of the project. If one designer is routing cable while another one is designing tray, they shouldn’t have to keep in total communication and synch in order to perform their jobs effectively. This way, they can make the changes required to do their part without obstruction. Later, when both are finished, the audits can be run to catch any missing links that designers might have left behind, as opposed to allowing the construction site to be our “Audit” feature; that means less R.F.I’s.

3.0 Information Needed:
Before we discuss exactly how to route a cable, we first have to look at the information associated with routing a cable. There are many things that CableMatic must evaluate in order to correctly route a cable. The following will explain the type of information the program will need, the places where the data can be found to manipulate, and the easiest ways to enter it. Keep in mind while reading this, when entering data directly into a table in CableMatic, the Smart Dropdown, or ‘F3’ key, can be utilized. Simply put the cursor in the desired cell, and press F3 to see a list of available choices for that field.

Let’s explore what it all means…

3.1 Project data
Before we begin it is important to be aware that there are several pieces of data that will be used for cable routing in the Project Data Form. Below, you will find a picture of this form. The areas that you should be concerned with for cable routing have been highlighted for you in the picture, and explained in detail under it.

**Additional Rt Len:**

The number entered here will be added to the calculated route of each cable, i.e. a maintenance loop.

**Pull Point Prefix Comma Delimited List:**

While this is not directly related to routing, this will affect your cable schedule. When the cable route is reported using the cable schedule, only raceways are listed;
meaning no pull points (Jbox’s, Manholes) will be seen in the route. If it’s your preference for some pull points to be visible as a part of the route, include their prefixes into this box; each separated by only a comma. When accessing a route, CableMatic will now cross reference this list with the list of pull points in your route. If one of the pull points contains one of the comma separated values in this list, it will be added to the route displayed on your cable schedule.

**Max Auto Size for Cond:**

This is the maximum size a CableMatic will upgrade a conduit to when calculating its Fill percentage. If it is your choice not to have your conduits auto sized by the program, make sure to enter a “Y” into the appropriate size lock (refer to Section 4.2 (Hybrid Conduits) for an explanation of Size Locks) field in the Raceway Data Table.

**Cable Area Tolerance %:**

The value entered here is used to calculate the maximum fill reserve for conduits. For example, let’s say we have a cable with a cross sectional area of 1.00 sq inches and a tolerance of 5%; the conduit fill would be 1.05 sq inches.

**Default Cond Type:**

When Auto-Do-Its are created, this will tell the program which conduit type to use when creating them.

**Data View used for Cable Data Form and Routing:**

This combo box can be used to select the Cable Data table view that you want to use on the Cable Data Form and the Routing Form.

### 3.2 Raceway Service Levels:

What is a service level? To answer that question, first we need to know what a ‘Segregation Code’ is. A Segregation Code is a code used to indicate certain properties of a cable, such as, its insulation, voltage levels, or the current type that the cable will carry. What does this mean; basically, it’s one or two characters (i.e. letter(s), number(s)) that help to separate, or segregate, cables by their purpose. This is done in order to be consistent with the National Electric Code (NEC) or with client requirements.

Now that we know what a Segregation Code is, it’ll be much easier to explain what a ‘Raceway Service Level’ is. This is a term used by GSN for the CableMatic program. The service level of a raceway is its classification system used by GSN to determine the types of Segregation Codes that each individual raceway will accept. So again, what does this mean? Simply put, Service Levels tell the program which cables are allowed in which raceways; setting rules into play on which cables may touch each other and which cannot.
In addition, as we all know, there are plenty of cases where we would have more than one type of cable in a tray; this is allowed by the NEC because of tray separators. Their purpose is to separate cables that have different voltage classifications; because these situations exist in real life, they also exist in CableMatic. When a separator is added to a tray, it’s record in the Raceway Data Table is slightly different than a tray that does not have separators. Looking at the table below, we can see three different records:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>RACEWAY TAG</th>
<th>SERV LVL</th>
<th>RAC CAT NMBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0T22-I-002</td>
<td>2</td>
<td>CA075</td>
</tr>
<tr>
<td>2</td>
<td>0T22-L1-010/3</td>
<td>3</td>
<td>SEP= 18</td>
</tr>
<tr>
<td>3</td>
<td>0T22-L1-010/4</td>
<td>4</td>
<td>SEP= 6</td>
</tr>
</tbody>
</table>

At a closer look we see that while there are three different records, two of them are from the same tray. Notice there is a forward slash at the end of two of the raceway tags followed by another number. This slash signifies that this particular tray has a separator in it. The number following the slash indicates the service level that particular row represents. Furthermore, looking at the far column, labeled “RAC CAT NMBR”, we can see two of the records are represented by a “SEP=” with a number following. This is telling you that current record has a separator. The number after indicates the width of the portion of tray that has that separator. For instance, “SEP= 18” tells the user that particular section has 18 inches dedicated to it’s particular service level; which in this case is 3.

So, tray 0T22-L1-010 has two service levels in it; Service Level 3 and Service Level 4. Service Level 3 is dedicated 18 inches of the tray in question; Service Level 4 is dedicated 6 inches. Using that information we are also able to deduce the total width of the tray is 24 inches; 18 + 6 = 24

*Table Name: [ACRS-DB] ACRS_SERV_LEVEL_CODES*
Above we see a picture of our table. Moving left to right by column name, let’s explore the information that each field needs.

**Serv Lvl:**

The character(s) used to represent each service level.

**Serv Lvl Descr:**

A description of the service level itself.

**Compat Segr Codes:**

The types of cable segregation codes that the service level will allow to route through it.

**Voltage Class:**

Defines an NEC voltage class for the service level. The program will only recognize four values:

- **Contr/Signal:** Control or Signal
- **Any Mixture:** No restraints
- **<=2Kv Power:** Cable carrying less than or equal to 2000 V
- **>2Kv Power:** Cable carrying more than 2000 V
*Tray Reserve Pct:*

Enter a percentage of fill as a reserve. This is often used when the cable size is unknown, or when holding space for future cables. So, if we have our reserve set for 20%, when the tray reaches 80% full, it’s considered full. Keep in mind, percentage fill calculated is not affected by this value.

*Max Conductors:*

Limits the numbers of cables allowed in a specific conduit. The reasoning behind this stems from the NEC Guidelines. One of the rules restricts the number of current carrying conductors in power cables to three. As a result of this rule, many clients often set this to three, though your project may have different rules to consider.

---

### 3.3 Cable types

As we’re learning, there are many things that go into routing a cable correctly; another one of these things is your Cable Type information. There are two
places in the program where cable type information is entered, the Project Data table and the Cable Type table. Below is your Project Data table...

The Project Data table plays an important role in terms of CableMatic. For here though, we’re only going to discuss the information regarding Cable Types. If you’d like more information on the other data entered into this table, refer to the “Making a New Project” documentation.

As we talked about earlier, this isn’t the only table that is going to need Cable Type information. Some of the information, however, will be filled out for you during the initial project set up. You can see from the picture above, the Project Data table has 4 columns. For our purposes and intents, you only need to be aware that this table is creating rules based on the information entered into the table. For instance:
The record shown is telling the program that a #24 AWG size conductor is smaller than a 1/0 size conductor. Since the NEC specifies different fill calculations based on cable size ranges, this information is necessary to make the correct NEC fill calculations.

The Cable Type table is also used during the process; it will also be used for NEC calculations. Below is your Cable Type table;

Since this document is focused solely on cable routing, we’re only going to focus on eight of the fields in particular. That’s not to say that the other fields aren’t important, we’re just not going to discuss them here. The columns that will be discussed are used for your cable’s various calculations:

**Number of Cable Jackets – Column C:**

The value placed here will be used by the program for various calculations; for example, the software’s method that calculates the cable footage to be purchased/installed. Keep in mind that external ground conductors should not play a role here, and if your project is using Composite Cable Types (CCT) then enter a “1”. A Composite Cable type is a bundle of cables not sharing the same size that are grouped together as one. If you’re not sure what this is, chances are good you’re not using it. You can still find more information on the specifics of CCT in Section B.8 of Making a New Project.

**Number of Conductors – Column D:**

This value illustrates the amount of conductors in the main jacket of the cable. Having any other value than 1 entered tells the program that you have a Multi-
Conductor Cable. If an internal ground exists, it must be counted as a conductor. Keep in mind, the NEC has special fill calculation rules if a cable is a single conductor. For example, if you have multi-conductor cables in a tray and add one or more single conductor cable, the tray fill will be calculated as the sum of all the diameters of the cables divided by the tray width.

Conductor Size – Column E:

This is where you’ll put the conductor size of the cable type. Below this paragraph is a list of possible sizes and their explanations. Make note that if you are using Triplexed cable, enter TRIPLEXED into this field; otherwise tray fill will be miscalculated. Again, if CCT is being used, please refer to the detailed help section in “Making A New Project”, for more detailed assistance on the setup.

e. **<1/0:**
   Smaller than 1 Aught

f. **1/0 – 4/0:**
   Between 1 Aught and 4 Aught

g. **>=1000:**
   Greater than or equal to 1000 KCMil

h. **250-900:**
   Between 250 KCMil and 900 KCMil

i. **SPACED:**
   For “>2Kv Power”;
   Width used = (2 x O.D. x NumberOfCableJackets)

j. **TRIPLEXED:**
   For “>2Kv Power”;
   Width used = ((2 x O.D.) + (2.15 x O.D.))

k. **TRIPLEXED 0X:**
   For “<=2Kv Power” and “>2Kv Power”;
   This accommodates cable types with “3-1/c” and “1/c”. The calculation simulates a “Tri-foil” configuration; each group of 3 cables is laid without a space.

l. **TOUCHING:**
For “<2Kv Power” and “>2Kv Power”;  
This is the same as a “Single Layer” rule, except the pull ticket will 
read “Touching” instead of “Single Layer”.

**External Ground Conductor – Column F:**

It’s easiest to think of this field as if it’s asking you the question, “Does your 
cable have a ground wire outside of the main jacket?” Enter either an “N” or a 
“Y” respectively; if left blank, “N” is assumed.

**Diameter – Column G:**

As you would assume, this is the diameter of the cable itself. The first thing 
to ask before entering any information here is, “Am I on an English job or a 
Metric job?” If you answered English, than this will be entered in inches; metric 
jobs will use millimeters. CableMatic will use this information to figure tray fill. 
It will also be used for conduit fill if you do not have the Cable Area (Col H) 
filled in.

**Cable Area – Column H:**

This data is used for conduit and wireway fill only. The cable area can be 
defined as the sum of the area of all cable jackets and any external ground 
conductors (if they exist). It’s used to calculate raceway fill for conduit and 
wireways; trays on the other hand rely on the diameter of a cable to make the 
calculations. Keep in mind that if data is not placed in this field the program will 
use the diameter of the cable as a default to calculate cable area for all fill 
computations; regardless of raceway type. This is done by multiplying the 
number of cable jackets by the area of one cable jacket; if there is an external 
ground, the area of it is assumed to be identical to one cable jacket. If you need 
进一步解释这种方法，请联系GSN.

This data will over ride any existing diameter information. Meaning, if you 
already have an outside diameter set for a particular cable type, then set a cable 
type’s area, the area data will be used in conduit/wireway fill calculations, not the 
O.D. By summing the areas of each cable jacket and the external ground 
conductors (if they exist), the program is able to figure the fill of a conduit or a 
wireway. Again, if you are working on an English job, use inches; for Metric, use 
millimeter.

**Permissible Segregation Codes – Column I:**
For this field, know that information entered here will NOT be used for cable routing. Of course, that doesn’t mean the information isn’t going to be used. Instead, this information is utilized by a series of ‘Audits’ under the “Audit, Calcs, and Tools” button of the program. This could sound familiar, and it should be, since we’ve already touched on it briefly during the ‘Abstract’ of this document. If you need to refresh your memory a bit, find the definition of “Segregation Codes” under the “Raceway Service Level” section. Otherwise, keep in mind that whatever segregation codes that your project has decided on will be entered here as a comma separated list. The program uses the data entered to verify that the routing rules you’ve previously set up are correct. Refer to the “Making a New Project” document for help on setting up a new project.

**Chart Name – Column P:**

While this field isn’t directly related to routing, it is used when preparing your wiring data. The information entered will tell the program which color information to use for the cable type being defined. You can see the actual chart information in the ACRS_WIRE_COLORS table.

### 3.4 Raceway types:

![ACRS_RACEWAY_TYPE](image)

This is your Raceway Type Table. After data is entered here it will be used for raceway fill calculations and routing through the raceway network. Once you’ve entered the data, the program will use it where it’s needed; for instance, when preparing raceway data directly through CableMatic using the **Smart Drop Down**. This data is also used by other programs, such as TrayMatic; when a tray is being designed for example. While selecting various tray properties using the drop down menus, you’ll have to select a “Type” as well. The “Type” dropdown box will list the values from here to select from. Let’s take a look at what the data means specifically to the program.
**Raceway Type:**

When entering data into the ‘Raceway Type’ field, it must follow a very specific set of guidelines. Keep in mind you are not able to create new raceway types. The acceptable types are:

**Airway:**

Airways are special to GSN. It’s important to point out that Airways don’t actually exist in the world. Instead, they were designed specifically for the cable routing aspects of the program. Let’s say there are three trays; a vertical tray, or “Riser”, and two horizontal tray runs of similar service level. The ‘Riser’ will likely have cables entering and leaving the tray at the top and bottom; serving as a pathway between the similar horizontal runs. The Airway would be used to ‘connect’ the end points of each of the trays at their center line. By doing this, the program no longer sees a broken path, but a complete route that a cable could pass through. For more help, refer to the [Designer Guide](#).

**Drop-Out:**

The purpose of a Drop-Out is to create a connection between cable tray and a piece of equipment where a commodity doesn’t actually exist. In this way it is very similar to the Airways mentioned above. However, they will follow the same rules as a conduit, with a single exception: drop-outs do not have a size, so any amount of cables can be routed through them.

**Guide Cond:**

‘Guide Conduits’ are also special to GSN and can be seen as a virtual conduit. The ‘Guide Conds’ primary use is to build conduit cross sections automatically around itself. Once a Guide Cond is modeled using TrayMatic, you can elect to automatically arrange your service level conduits around or next to the guide conduit.

In the picture below the conduit automatically created is represented in blue, while the ‘Guide Cond’ is represented by yellow. In this case, the conduits were created using the Guide Cond as a center point. Also, looking at the automatically generated Cross Section next to it, we can see that the guide cond is not represented at all. It represents a group of underground conduit that follow the same path; as if in the same duct bank. The idea being that all cables following that path can be temporarily routed through the guide conduit without restriction to fill rules or service levels. CableMatic will then help you to decide how many conduits to route for each service level.
**Nipple:**

The ‘Nipple’ type is viewed similarly to a conduit type with the exception of the percentage of fill that’s allowed. While the maximum allowable fill area in a Nipple is 60%, the amount allowed in a conduit will vary depending on the number of cable jackets inside it. For any further questions or concerns, refer to the **NEC**.

**Cond:**

All conduit types begin with “COND” followed by a space and the material type. Refer to the picture of the Raceway Type Table above for an example.

**Tray:**

There are four types of Tray accepted by the program; each must be followed by a space, a height (no decimals), and then the letter ‘H’: as seen in the picture above:

- Tray Ladder
- Tray Solid
- Tray Vented
- Tray Wireway

**Permissible Segregation Codes:**

This will be the list of segregation codes allowed into their respective raceway types. For more help with **Segregation codes**, refer to the Raceway Type Section of this document.
**Tray Useable Height:**

While not to be confused with the physical height of the tray, the useable height references how much space in inches the tray itself is permitted to have cables routed through it. Whereas this height is less than, or equal to, the tray’s physical height, there is an NEC rule that does not permit more than six inches of useable height for CONTR/SIGNAL cables.

### 3.5 Raceway Catalog:

Your raceway catalog (ACRS_RACEWAY_CAT) is used to define the different characteristics of your raceways, such as its type, material, and cross sectional dimensions. Below we can see a picture of what the raceway catalog looks like…

<table>
<thead>
<tr>
<th>Raceway Type</th>
<th>Material</th>
<th>Cross Sectional Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5” AL</td>
<td>Cord</td>
<td>2.042</td>
</tr>
<tr>
<td>2” PVC-60</td>
<td>Cord</td>
<td>1.029</td>
</tr>
<tr>
<td>2” PVC-90</td>
<td>Cord</td>
<td>0.535</td>
</tr>
<tr>
<td>2” RUS</td>
<td>Cord</td>
<td>1.042</td>
</tr>
<tr>
<td>2” PVC-30</td>
<td>Cord</td>
<td>1.684</td>
</tr>
<tr>
<td>3” PVC-40</td>
<td>Cord</td>
<td>1.590</td>
</tr>
<tr>
<td>3” PVC-60</td>
<td>Cord</td>
<td>1.476</td>
</tr>
<tr>
<td>4” PVC-40</td>
<td>Cord</td>
<td>1.468</td>
</tr>
<tr>
<td>4” PVC-60</td>
<td>Cord</td>
<td>2.082</td>
</tr>
<tr>
<td>5” PVC-60</td>
<td>Cord</td>
<td>2.042</td>
</tr>
<tr>
<td>5” PVC-80</td>
<td>Cord</td>
<td>3.923</td>
</tr>
<tr>
<td>5” RUS</td>
<td>Cord</td>
<td>2.083</td>
</tr>
<tr>
<td>6” PVC-60</td>
<td>Cord</td>
<td>3.090</td>
</tr>
<tr>
<td>6” PVC-80</td>
<td>Cord</td>
<td>3.042</td>
</tr>
<tr>
<td>6” PVC-100</td>
<td>Cord</td>
<td>2.964</td>
</tr>
<tr>
<td>8” PVC-80</td>
<td>Cord</td>
<td>2.900</td>
</tr>
<tr>
<td>8” PVC-100</td>
<td>Cord</td>
<td>2.930</td>
</tr>
<tr>
<td>10” PVC-100</td>
<td>Cord</td>
<td>5.416</td>
</tr>
<tr>
<td>10” PVC-125</td>
<td>Cord</td>
<td>5.583</td>
</tr>
<tr>
<td>12” PVC-125</td>
<td>Cord</td>
<td>6.785</td>
</tr>
<tr>
<td>12” PVC-150</td>
<td>Cord</td>
<td>6.905</td>
</tr>
<tr>
<td>12” PVC-175</td>
<td>Cord</td>
<td>6.951</td>
</tr>
<tr>
<td>14” PVC-175</td>
<td>Cord</td>
<td>7.990</td>
</tr>
<tr>
<td>16” PVC-175</td>
<td>Cord</td>
<td>8.090</td>
</tr>
<tr>
<td>18” PVC-175</td>
<td>Cord</td>
<td>8.033</td>
</tr>
<tr>
<td>20” PVC-175</td>
<td>Cord</td>
<td>6.224</td>
</tr>
</tbody>
</table>

**Raceway Type:**

The raceway type column references back to the Raceway Type table. Only a value that was previously defined in the Raceway Type table may be entered into this field.
Material:

The material column only pertains to tray. As you can see above, the material type ‘Aluminum’ has been entered.

Width:

This column will be used for trays and wireways. Be sure to include the inside and outside widths separated by a slash; for example, 12/13.5. The program will use the outside width to draw the tray in TrayMatic, while the inside width is used for NEC calculations; if the outside width is left out, it will be assumed as equal to the inside width.

Height:

This field is also used by TrayMatic to draw the tray, as was the case with the trays outside width. Keep in mind, the heights defined in this table must correlate with the heights used in TrayMatic.

Diameter:

As height and width only pertain to trays, diameter (meaning inside diameter) only affects conduits. CableMatic will use the inside diameter in order to calculate fill.

Outside Diameter:

Similar to the cable tray’s height property, the conduits outside diameter will be used by TrayMatic to draw the conduit. If an outside diameter is not entered by the user, the program will draw the conduit based on the inside diameter of the conduit.

3.6 Cable data

The cable data table contains your cables characteristics. Let’s discuss the important fields in this table as they pertain to cable routing.

Cable Type:
This field tells CableMatic the specific cable type of each cable listed. This information is entered directly into the Cable Type Table and should be selected using the Smart Drop Down.

**Segregation Code:**

For more help on Segregation Codes please refer to Section 3.2 under Raceway Service Levels

**Equip From/To Tag:**

As suggested by the name, this is the cable’s respective equipment. This information will be listed on pull tickets and cable schedules.

**From/To Section:**

This field is used to represent the compartment, or cubicle, of an MCC. The data in this field will also appear on a cable schedule, a pull ticket, and a termination ticket.

**Associated From/To:**

This field can be utilized in two different ways:

1) It can serve as a Virtual Equipment; equipment that doesn’t actually exist though has an X, Y, Z. Essentially, the ‘Virtual Equipment’ represents a point where multiple cables will be routed to, like an instrument rack, or an MCC stack number.

2) This field will also be used in terms of “Auto-Do-Its”. For more help on “Auto-Do-Its” please refer to Section 4.1 of this document.

**Utilization Code (Util Code):**

This data is used by the program to add certain cable restraints to conduits. “What does that mean?” Well, if I only want a particular cable to run through a particular conduit, I would assign them the same utilization code. Once the conduit has been assigned a value, a cable must share the same value to route through it. This is a useful feature when designing underground duct banks to steer away from ‘Rats Nesting’.

**NEC Rule Override:**
This field will be used on a situational basis depending on your companies needs. With your cursor in the cell, use your Smart Drop Down to select from a list of possibilities. The list will be generated from your “Project Data” Table. By selecting a value for this field, you’ll be telling CableMatic to use this value for the cable’s conductor size or it’s cable laying method.

3.7 Raceway Data:

The Raceway Data Table (ACRS_RACEWAY_DATA) stores the individual properties of each of your raceways; i.e. Service Level, From/To Location, Length, and Raceway Type. It’s important to know that, under most conditions, every record (or row) in your table represents a separate raceway. The exception to this rule extends toward trays having been designed with multiple service levels. For these cases, each service level of each tray will represent its own record (or row). You can populate this table by:

1) **Physical Design:** The act of selecting the desired properties and designing the tray via GSN’s TrayMatic.

2) **Conversion:** Taking pre-existing data from an outside source and using it to populate fields in your GSN Database.

3) **Auto-Do-Its or Hybrid Conduits:** These are features in CableMatic designed to automate the creation of raceways. For more information please see [Section 4](#); under Auto-Do-Its.

4) **Manually:** *This is done by entering all the data necessary for each raceway record separately, via the Raceway Data Table. While this is possible, under general circumstances it is not suggested. It is likely to miss certain information, or enter information not expected by the program. If your situation requires the manual entering of data, please be aware the following fields are necessary to route cable*
   - Raceway Tag
   - Service Level
   - Raceway Type
   - Raceway Catalog Number
   - Size Lock
   - Length
   - From and To Point
   - From Offset
   - Note 1: *This field does not have to be populated. However, if “FIELD RUN” is entered and the raceway type is drop-out,
then CableMatic will give you the option of replacing the drop-out tag with “FIELD RUN COND” when printing the Cable Report.

**Note – From/To Point and From/To Location are not the same fields.

Another important point to mention is that the Raceway Data Table doesn’t actually hold the physical location of each raceway. Instead, it uses the raceway’s From Point, To Point, and length to make what’s known as your raceway routing network. This network is used to automatically route your cables. It will also be used to check the connectivity of the existing cable routes. This is done by connecting each of the raceways together by their From/To Points.

When designing the raceway network, conduits may connect one of two ways; either directly to a tray or to a piece of equipment. When connecting to a tray, GSN utilizes the field named “From Offset”. This field stores the distance from the beginning of the tray to the point the conduit connects to it. I’m sure by now you might be curious as to how GSN decides which side of the tray is the beginning? Here’s how…

Before CableMatic can decide where the beginning is, it needs to see which direction the tray is running. If the tray is totally in the ‘Z’ direction the beginning is the side with the least value of ‘Z’. If it is not a vertical tray, the beginning would be the least value of ‘X’. Of course, in the event the tray runs totally in the ‘Y’ direction the beginning would be the side with the least value of ‘Y’. This is calculated by CableMatic when CableMatic and TrayMatic are synchronized. You have the option to allow CableMatic to calculate the offset for Hybrid Conduits or ‘Auto-Do-Its’ automatically when they are created.

4.0 **Hybrid Conduits (HC) and Auto-Do-Its (AD):**

What are they? How do they work? Auto-Do-Its and Hybrid Conduits are two forms of automatically generated tail-end conduits. Auto-Do-Its are better suited as a tool to estimate cable lengths for your project and are not recommended to be a part of your final design. Hybrid Conduits, on the other hand, give you more control of their automation. In turn they are more widely used and relied upon for design. Below, we have listed the important design features of each:

**Auto-Do-Its:**

- Defined on either the From or To side of the cable.
Created when cables are routed, either using the Single Method or the Batch Route Method.

If a cable fails to route during the process, the AD conduit/dropout will not be saved.

Their connection to the raceway network can be either a tray, or a pull point, such as a Manhole or Stub-up.

If a conduit with the same service level is already connected to the equipment, no AD will be created.

Another important thing to remember about Auto-Do-Its is that only one service level per equipment will be created. This is to say that you are able to design multiple AD’s to the same equipment with the same service level without confusing CableMatic. The program is smart enough to only create one AD per service level and use it over and over, regardless of requests for another one.

Now, the program needs a certain amount of information from you in order to complete the Auto-Do-It process. This information can be filled out directly into the Cable Data Table; however it is much easier to utilize the supplied ‘Wizard’. If the ‘Wizard’ is not used, data must be entered into the table in a comma delimited list using the following format into the “Assoc From/To Tag”, respectively. For the sake of not being redundant, we will only discuss the fields that require something specific for manual population.

<Type>, <To Type>, <Tag>, <area code>, <search direction>, <max xy>, <max z>

1) **Type:**
   Enter ‘AD’ for a Drop-Out and ‘AK’ for a conduit. Alternately, you can use ‘FD’ and ‘FK’. This tells the program to input the text “Field Run” into the Note 1 field on the conduit created.

2) **To Type:**
   Enter ‘Tray’ to find the closest Tray and ‘Box’ for the closest JBox or MHole. As opposed to entering the data manually, you have the option to utilize the ‘Wizard’ that was previously mentioned. To access this wizard, place your cursor in the “Assoc From/To Tag”, respectively, and hit the F5 key. This will open the ‘Wizard’ seen below.
3) **Type:**
   Choose “Conduit” or “Drop-Out”

4) **Connection Point (From):**
   Select whether you will be connecting from a “Tray” or a “Pull Point”.

5) **Tag:**
   A tag must be specified to create your AD. Alternately, you can enter AUTOTAG in this field, as shown above in the “Wizard” picture, to allow the program to assign an intelligent name for you.

6) **Search Direction:**
   This will tell the program which direction to search (X,Y,Z), from your equipment, to your connection point; i.e. Tray or Pull Point.

7) **Search Distance:**
   Specify the distance, in feet or meters, which CableMatic will search for your connection in the X and Y Plane, as well as in the Z Direction.

8) **Area Code:**
   The value entered here will help to decide which Retrieval Code to use while creating your AD. It is also during this process that the raceway being created is assigned an intelligent name.
1) CableMatic must look into TrayMatic’s Retrieval Code Table and ignore anything that isn’t a conduit or a Drop-out.

2) Once that’s complete, with whatever is left, CM filters out all the possibilities with Area Codes that do not match what you entered.

3) CM then compares the Segregation Code of all the possibilities left to the Segregation Code of your cable.

After moving through the whole process, CableMatic will only be left with retrieval codes that match the parameters that you specified. If there is more than one that is suitable, CableMatic will select the first one it comes to. Only where Area Codes match will CableMatic be able to use that Retrieval Code. If no value is entered here, only retrieval codes that do not have a value in the Area Code column can be used.

Of course, it’s possible to make a mistake and choose an Area Code not defined by TrayMatic’s Retrieval Code Table. If that happens, CableMatic will not know which retrieval code to use, or what to tag your newly designed conduit with. In the event that happens, CableMatic will notify you of it after the routing process has been completed. For more help or clarification on the Retrieval Code Table, please see Section 5 of the “Making a New Project” documentation.

**Hybrid Conduits:**

As stated earlier, these automatically generated tail-end conduits give the user more power in the automation process. It is this reason they are used more widely than Auto-Do-Its. The Hybrid Conduit feature is a fast way to design and connect tail-end conduits from specific boxes to the Raceway Network. Hybrid Conduits may also be used to create a connection between two local equipments.

To create a Hybrid Conduit, enter/select the following information into the Raceway Data Table in the specified format: (it’s important to note that when the word “select” is used, it’s intended for you to use the Smart Drop Down.

1) **Raceway Tag:**

   Use this field to enter the name of the raceway you’re creating. If your project is only using CableMatic, there is no format that must be followed in choosing your naming convention.
If your project is using TrayMatic, this might not be the case. In this event, how you name your raceway will depend on whether or not you would like to be able to use TrayMatic to display your Hybrid Conduits. If you do not intend to utilize TrayMatic to display your hybrid conduits, whichever logical naming convention is suitable for you will work. To take advantage of TrayMatic’s features however, your raceway will have to contain the retrieval code in TrayMatic that the raceway should belong to.

Let’s take a step back and look at the whole picture. Because Hybrid Conduits are created using CableMatic, before we can view them using TrayMatic, it has to know they exist. To tell TrayMatic about your new raceway, use the Import Function built into TrayMatic. Keep in mind, before the Import Function (explained below) can be used, the Hybrid Conduit must be Designed And Calculated, otherwise there will be no data to import. In continuing through this section the entire process will be explained.

Once your Hybrid has been designed, navigate to the File Menu of TrayMatic. Under this menu is the option to “Import Data from CM+”; select it. Once this function has been run, TrayMatic will know about your Hybrid Conduits. Though, there are guidelines that must be followed when using this operation. The whole retrieval code must match with the beginning of the raceway tag that you chose for your Hybrid Conduit. Not to mention, if a different retrieval code matches your raceways tag more appropriately, it will be used in lieu.

Let’s assume that your TrayMatic project has a retrieval code name RP01 and the Hybrid Conduit Tag that you have chosen is RP01A1. When using the import function, your conduit will be assigned to retrieval code RP01. If, however, in addition to retrieval code RP01, your project also uses RP01A, then your raceway will be assigned to that retrieval code instead because it is a closer match. The table below illustrates how the match is made.

<table>
<thead>
<tr>
<th>Hybrid Tag</th>
<th>Retrieval Code</th>
<th>Characters Matched</th>
<th>Best Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP01A1</td>
<td>RC01</td>
<td>1</td>
<td>No</td>
</tr>
<tr>
<td>RP01A1</td>
<td>RP01</td>
<td>4</td>
<td>No</td>
</tr>
</tbody>
</table>
If no match can be made, TrayMatic will notify you after using the import function.

2) **Service Level:**
Select your raceways service level using the Smart Drop Down.

3) **Raceway Type:**
For this field, select either ‘Drop Out’, or the conduit type that you will be using, i.e. COND RGS.

4) **Raceway Catalog:**
Leave this field blank for Drop-outs, otherwise use the F3 key to select your desired value. If blank, the conduit will be automatically sized; assuming size lock is not “Y”.

5) **Length:**
Enter the word ‘CALC’ or the length desired.

6) **From Offset:**
Enter the word ‘CALC’ or the From Offset desired.

7) **From:**
There are three options when entering information into this field. One, enter the tray tag that your raceway will be connected to. Two, enter the word ‘CALC’. If ‘CALC’ is entered, CableMatic will search for the closest tray, within 200ft (66m), that has the same service level you have chosen. Three, if you’re creating a conduit to run between local equipments, enter the Equipment tag it will be coming from.

8) **Size Lock:**
This field controls whether or not your raceway can be sized automatically by CableMatic. If the value of this field is blank, it will assume the default value of “N”. If a “Y” is entered/selected, this raceway will be locked; CableMatic cannot auto-size this raceway. If a “B” is entered/selected, this raceway is Blocked. This means not only can CableMatic not Auto-size the raceway for you, but it will also be “Blocked” from routing.
Once your information has been saved to the database, you must tell CableMatic to replace the word ‘Calc’ with value needed for the field. To do this, navigate to the Main Menu and select the option ‘Advanced Tools’. Under this option you will find another button labeled “Calculate Length/Offset for Hybrid Conduits/Drop-outs”. Once this button is pressed, CableMatic will attempt to calculate the values; you will be notified if an error occurs. Once your values are calculated correctly, your Hybrid Raceways are now ready to be imported into TrayMatic as discussed earlier in this section.

5.0 Logistical Checks:
CableMatic is loaded with features that help you make sure you haven’t made any mistakes during your design process. Some of these features will issue a Warning. A warning will stop a cable from routing entirely and must be fixed before continuing. Other times, an alert will be produced. An alert is designed to notify you of a potential problem, though it will not stop the route as a result. Regardless of whether you are looking for Warnings or Alerts, the programs “Logistical Checks” are the way to search. The Logistical Checks can be found on the Main Menu under the “Cable Route Logistical Checks” button. GSN suggests running these checks before you begin to route your cables. The different safeguards are as follows:

Missing Critical Type Data:
When ran, your Cable Type Table is checked for missing data. This will make sure that all of the information used to calculate raceway fill is correctly in place. If in fact you are missing some of this data, the “Check” will list it for you.

Missing or Invalid Cable Type:
This feature will list cable and an error concerning whether or not the cable type is missing in the Cable Type Table. It will also list cables with errors; for instance when the segregation code is not compatible with the cable.

Missing or Invalid Routing Data:
This is the most comprehensive report. It will check for a missing cable type, an invalid segregation code, or missing tail end design data. In the event of missing tail-end design data, an error will be listed when the following conditions are met:

1) No Auto-Do-It is input.
2) No tail end raceway connects to the corresponding Equipment that shares it’s Segregation Code.
3) No tail end raceway connects to the corresponding Associated Equipment that shares it’s Segregation Code.

**Trays Connecting With Different Service Levels:**

This report will tell you if you have more than one service level where multiple trays connect, for instance at a ‘T’. Be aware, this report will also warn you of service level differences in separators.

**Parallel Raceways Not Size Locked:**

Imagine you have three feeder conduits being used to hold three separate phases going to an MCC; and they must remain separate. If these conduits are not size locked, CableMatic is smart enough to realize that you have three cables going to and from the same spots; using three different routes. When it’s realized, it will make one of the conduits large enough to route all three cables through it, and leave the other two empty. Obviously, this is not what was intended. By size locking the conduits, you’re telling CableMatic that you do not want it to resize that conduit for you, regardless of the cables around it. This report, in turn, checks whether or not you have conduits that share the same to and from. If you do, it will then verify to make sure those conduits are Size Locked. If they are not locked, you will be notified.

**6.0 Synchronizing with TrayMatic:**

Please note, if your project is not using the TrayMatic program, you should skip this section and proceed to ‘The Ins and Outs of Cable Routing’. Oppositely, if your project is using TrayMatic, the synchronization process between CableMatic and TrayMatic are critical before routing cable. Let’s explain…

Earlier in this document we discussed the process of letting TrayMatic know about what CableMatic had created. The same idea applies in letting CableMatic know what’s been created with TrayMatic.

As you design your plant with TrayMatic, the program saves that design for you into a combination of three different tables:

1) Electrical Box Data
2) Raceway Data (Trays)
3) Tail End Raceway (Conduits/Drop-outs/Airways)
As the data is saved to its table, a digital checkmark is placed next to it by TrayMatic, but only if its geometry has changed. This “checkmark” will be used by CableMatic during the synchronization process.

The synchronization process is started by navigating to the Main Menu of CableMatic and selecting the “Advanced Tools” button; your “Advanced Tools” form will appear. Once looking at the form, look to the bottom of the column of buttons to find “Import Raceways and Boxes From TrayMatic”; once pressed the synchronization will begin. Below is a picture of your Synchronization Window. Keep in mind, when the Synchronization Form first appears, it will suggest a method for you to use by selecting the correct method for you when it’s loaded; if it’s needed. If a synch isn’t needed, the text, “There is no indication that a synch is required” will be displayed; as seen below. This keeps the guess work out of which method to utilize. This text area is also used to show you information about your synch while it’s happening.

There are three methods used by CableMatic in order to synchronize. They are as follows:

1) **Fast Synch:**
   This method synchronizes items in the Tail-End (Conduit) Table that have been marked by TrayMatic as having their geometry changed.

2) **Synch Changes:**
   This synchronizes all trays, airways, and tail-end items with an exception… If a conduit is not affected by the change of a tray, it will not synchronize.

3) **Complete Synch:**
   This method will synchronize all trays, airways, and tail-end items. GSN recommends utilizing this method regularly because it is all
inclusive. This method will, however, take more or less time respectively; depending on the overall size of the project.

Before you press the ‘Execute’ button, it’s important to notice some of the additional checkboxes also on the form.

4) **Compute Area and Ref Dwg for Equip:**
   This check box tells CableMatic whether or not you would like to calculate your Area and Drawing boxes. In the program these are referred to as “A-Boxes” and “D-Boxes”. **Note – This is not a part of cable routing; for more help regarding this functionality please refer to Section 3.0 of the TrayMatic Operating Guide.**

5) **Resize/Regen Raceways:**
   This check box tells CableMatic whether or not you would like to resize any conduits that are under/over filled. If selected, CableMatic will resize any conduits that require resizing and are not size locked. Following that process, the raceway’s fill is re-calculated.

6) **Audit Cond Plan Dwg:**
   This check box tells CableMatic whether or not you would like to verify that the reference drawing you have entered in the Equipment Table matches the plan drawing entered in the Raceway Table. If this checkbox is marked, and your drawing numbers do not match, the program will show you the differences.

7.0 The “Ins and Outs” of Cable Routing:

**Above Ground:**

There are plenty of different things that go into planning your strategy. One thing that must be looked at is the overall level of required engineering detail. On some projects it will be necessary to use TrayMatic; as a result of it being able to detail your route.

On the other hand, you will also be working with projects where only conduits larger than a pre-determined size will require any engineering. When this is the case, GSN suggests using CableMatics [Hybrid Conduit](#) and [Auto-Do-It](#) features. These methods are considered to be “Diagrammatically designed” and are less labor intensive then the latter. For more assistance on these features please refer back to their respective sections in the documentation.
GSN is aware that cases will arise where you won’t need conduit to connect from a tray to a piece of equipment; for example, the use of a drop-out plate in cable tray. While, in the real world you wouldn’t need anything to connect the two, here you’ll use a drop-out. Refer to Section 3.4 to review the definition of a Drop-out, or to Section 3.7 to review the different criteria to be entered into the Raceway Data Table (Field Run).

**Underground:**

Unfortunately, it is often the case where the underground duct bank is designed before we know of the cables routing through it. As a result, the number of conduits we’ll need for each service level is ‘up in the air’. However, there are tools that will assist us in making this an easier process. TrayMatic’s, “Automatically Generated Cross Sections” and “Conduit Editing Form” can be used together to fix this problem. By generating a cross section and then selecting that cross section with our editing tool, you can make any changes necessary.

Another option is to allow CableMatic to find the cross sectional requirements for each service level in a duct bank for you. To do this route all of your cables through the Guide Cond (For more help with Guide Conduits refer to Section 3.4 of this document.) Once your cables have been routed through the Guide Cond, navigate to the Main Menu and select the button labeled, “Duct Bank Conduit Requirements”. When this button is pressed CableMatic will create a report based on cables that are routed through any ‘Guide Cond’. The report can now be used to assign service levels and edit the conduit tags listed.

No matter what strategy you choose to route your cables, take the time required to evaluate your situation specifically. GSN suggests each designer receives an area that he or she is responsible for in total: this helps to eliminate confusion between designers and responsibilities. Because all projects are different, it’s necessary to consult with your design team or supervisor to decide the strategy best for your project.

**8.0 Routing Cables:**

Once everything needed to route cables is understood and in place, it’s time to begin routing. CableMatic gives you four methods to route your cables; they are as follows:

1) Batch Routing:
2) Single Route – Automatic
3) Single Route – Semi Automatic
4) Single Route – Manual
Once a cable has been routed, its route will be stored in the table called, “ACRS_COMMITTED_VIAS”; the length will also be updated in the Cable Data Table. Regardless of the method you choose, each has its own advantages and disadvantages. Each should be used depending on what your needs are at the time. We’ll go further into explaining each of these methods in a bit, but first let’s take a look at some of the options that you’ll have, regardless of the method you choose. The majority of the ‘Checking’ functions are self-explanatory and do not require much in terms of description.

- **Check Tray Fill:**
  CableMatic will search all possible routes and reject those that are over filled. (Tray)

- **Check Conduit Fill:**
  CableMatic will search all possible routes and reject those that are over filled. (Conduit)

- **Check Max Conductors per Conduit:**
  When selected, the conduits being used to route through are checked to verify the number of conductors in the conduit does not exceed the maximum number allowed for the Service Level of the conduit

- **Check Util Code:**
  This verifies that conduits with Utilization Codes only have cables sharing that same code routing through them. If you would like more assistance with Utilization Codes, please see Section 3.6

- **Check Work Package:**
  While selected, if the conduit being routed through was assigned a Work Package, the cable being routed would have to share that Work Package.

- **Check Route Through Equipment:**
  When selected, a cable will not be permitted to route through a piece of equipment.

- **Prefer Physical Conduit to Guide Conduit:**
  CableMatic will route through a Physical Conduit over a Guide Conduit when this option is selected.
- **Report Locked Cables:**

  This option is left off by most clients. When selected, however, CableMatic will list the locked cables and check the continuity of their cable routes.

- **Max Len Ratio:**

  Len Ratio is the length of the route (minus reserve length) divided by the rectilinear distance between the From and To Equipment. The reserve length of a cable is a footage added to each end of the cable as a maintenance loop. Well, all that sounds great, right, but what does it mean? First, it’s important to know that a perfect Len Ration is 1. That being said, let’s not expect to see 1. The closer our ratio is to 1, however, the better.

  Let’s look at an example. Let’s say we have a cable that’s 15 feet long, with a reserve length of 5 ft, but the distance between the equipment it’s routed to is only 2 feet. Just looking at the numbers, we can tell that doesn’t make much sense. Normally, it shouldn’t take 15 feet of cable to travel 2 feet. Let’s substitute some values into the equation and see what our fictitious cable’s Len Ratio would be.

  \[
  \text{Length} - \text{Reserve} / \text{Distance between Equipment} = \text{Max Ratio}
  \]

  \[
  15 - 5 / 2 = 5 \quad \text{Len Ratio} = 5
  \]

  As we said earlier, 1 is the perfect ratio. Obviously, 5 is far from what we are looking for. Since we decided before the calculation was made the numbers didn’t seem efficient, it makes sense that our ratio would be so far from 1. Let’s take a look at a different situation.

  In this example our cable has a total length of 70 feet, with a reserve length of 20 feet. This time though, the rectilinear distance between equipment is 40 feet. That sounds a little more reasonable, doesn’t it? As we did before, let’s substitute these values into the ratio formula and find our Len Ratio.

  \[
  \text{Length} - \text{Reserve} / \text{Distance between Equipment} = \text{Max Ratio}
  \]

  \[
  70 - 20 / 40 = 1.25 \quad \text{Max Len Ratio} = 1.25
  \]
Here we can see the ratio of 1.25 is much lower than our original figure of 5, which stands to reason. This time our fictitious cable’s length is closer to the actual length it needs to travel, which in turn means it is a more efficient route.

So, by making the Max Len Ratio a larger number before we route, CableMatic will allow less efficient cable routes to be committed. The question then, is, why would GSN allow the user control over something like that to begin with?

Well, what if the distance between our equipment is only 6 ft rectilinearly, however there is a load bearing wall separating the two pieces of machinery. That means we won’t be drilling through the wall to place a piece of conduit. Instead we’re going to have to compromise and either:

1) Route the cable to a level above the equipment, so that it can clear the wall, then back down to the equipment level

2) Route the cable to a level lower than the equipment location and then back up after clearing the wall.

3) Route around the wall.

Either way, we’ve just added a lot of footage to a cable that’s connecting two pieces of equipment a small distance from each other. That’s a big difference, but in this case, it can’t be avoided. This is why GSN allows the user to adjust the Max Len Ratio. If you’re already aware of a situation that might require something extraordinary, you’re given the option to overlook the “Check”.

- **Resize/Set Fill for Raceway:**
  The larger a project becomes, the longer this operation could take. As a result, CableMatic re-sizes raceways during various operations, for instance:

  1) When requested by the user.
  2) After Batch Routing
  3) When making a tray or conduit design report
  4) When making an issue
The user, however, always has control as to whether or not the function is started. See the Design User Guide, Section 13.4 for more help.

When this option is selected, CableMatic will size trays and conduits for you. This function will not affect raceways that are marked as, “Size Locked”.

It is important to be aware there may be other conditions that affect raceway fill and sizing such as:

1) The Cable Type being changed for a particular cable
2) Cable diameter or area is changed for a cable type
3) A conductor size is changed for a cable type
4) Reserve fill is changed
5) A tray or conduit type is changed
6) A tray or conduit size is changed
7) Cable routes are added or deleted by some external process not controlled by CM+

**Warning:**

If this function is not being run, the amount of fill percentage for raceways is not calculated; hence, values displayed in the Raceway Data Spreadsheet might be inaccurate.

**Batch Routing:**
Above we find a picture of the Batch Routing Form. Notice the options that were discussed previously in this section are available on this form. Batch routing was designed in order to route more than one cable at a time based on a list. This list can be a .txt file selected from the Windows Explorer, a list of cables in your clipboard, or even a list of segregation codes. When the routing process is finished, CableMatic will produce a text file containing information regarding the cable(s) that you’ve just routed. The list will include Segregation Codes, From and To, Associated From and To, and an Error Code. A blank Error Code signifies a successful routing. It’s important to note “Locked” cables will not route.

Be sure to notice the Error Code Description Button located on the bottom right corner of the Batch Routing Form. This will open a link listing possible routing errors and what they mean: a crucial tool in extrapolating why your cable(s) aren’t routing as expected.

Single Route – Automatic:
This form is found under the “Cable Data Form and Routing” button on the Main Menu. By selecting the drop down arrows on the right sides of each field, you can narrow your selection down to one cable and have it routed for you automatically. This method of cable routing is suggested by GSN if you would like to review and/or change specific data for each of the cables that you’re routing. By selecting your cable and pressing the “Route” button CableMatic will open your single cable “AutoRoute” form as seen below.
Once the “AutoRoute” form is open, you can see the options listed and available to be checked/unchecked at your will. Take note of the field labeled, “Restricted Rway List”. Entering a list of comma separated values into this box will tell CableMatic not to use those raceways for routing purposes.
Single Route – Semi-Automatic

This method is more geared toward one of two things: One, analyzing a problem with a cable that won’t route, and two, forcing the route into specific raceways.

In order to use this method, find the “Design Vias” tab, shown above, and enter the final raceway on both sides of the route. You must enter the From end and the To end raceways for the Semi-Automatic method to work properly, though, all other portions of the route may be left blank for CableMatic to fill out for you. Be sure that your raceways are in the correct order; meaning sequentially starting at the “From” end.

Once your list is entered as you’d like it, select the button labeled, “Update Design Vias”; this stores your route into the “ACRS_Design_Vias” table. Now, proceed to “Route” the cable, as explained earlier in the document. Once the “Route” form opens, be sure to check the box labeled, “Route with Des Vias”. This tells CableMatic to use the list of raceways you entered and fill in whatever blanks are left over on its own. If during the process CableMatic finds there is no route, it enters as much information as it can, then notifies you of any discrepancies with the label, “No-Conn”; whether your route has errors or not, CableMatic allows you to commit it to the database. When the “Commit”
button is pressed the route will be stored to the “ACRS_Committed_Vias” table, as discussed previously.

**Single Route – Manual**

This method would be the same as the Semi-Automatic method; instead, you would enter the entire route on your own into the Design Vias area on the routing form.

## 9.0 Analyzing Problems:

As your project continues to grow, you’ll come across different types of problems and error messages. A good trick to remember when you’ve come across a difficult problem is to display your route in TrayMatic. After all, sometimes it just helps to be able to see the route itself. Below are just a few of the most often seen errors and the possible reasons for encountering them.

1) **Missing Equipment Location:**
   As it sounds, the equipment in question has no X,Y,Z

2) **Tail-End Not Found:**
   This error can be generated by a multitude of things, such as:
   a) The Tail-end conduit not being designed properly
   b) Service Levels do not match
   c) Raceway if over filled
   d) Utilization codes don’t match
   e) Start-up Systems don’t match
   f) Auto-Do-It information is not input properly: (*Section 4.1*)

3) **No Route Found:**
   This error can also be produced by different things. Below is a list of common culprits:
   a) Raceway Fill
   b) Max Conductor limit reached
   c) NEC rule violation
   d) Circuitous routes
   e) Utilization Code
   f) Work Package
   g) Routing Through Equipment
   h) Synchronizing Errors
   i) Incomplete Raceway Network

## 10.0 Checking The Design:
Your final step in the cable routing process is the verification of your design. We strongly suggest that this be done before making any releases to construction. In order to do this, navigate to the “Audits – Calcs – Tools” button on the Main Menu. When the form opens, under the ‘Audit’ section, is a list of functions that should be run in order to make sure there are no design flaws. The available audits are:

1) **Missing Raceways in Routing Vias:**
   Checks that cable routes don’t use a raceway that is not in the raceway data table.

2) **Raceway Segregation Errors:**
   Checks that a cable’s Segregation Code isn’t incompatible with a raceway’s service level in its route.

3) **Cable Route Continuity Errors:**
   Illustrates an apparent gap in a cable’s route; meaning there is no link between raceways.

4) **Start-Up System in Different Conduit:**
   This warns the user when cables belonging to multiple Start-Up Systems are routed through the same conduit.

5) **Cable Pulling Diversion:**
   This feature points out cables that share a beginning and end conduit, but for some reason use different paths in the middle of the route.

6) **Check Work Package Routing:**
   Checks for cables belonging to multiple Work Packages that have been routed in the same conduit.

7) **Check Utilization Routing:**
   Similar to the Work Package Audit, this verifies there are no cables routed through conduits with a utilization code that do not share the same property.
8) **Tray Separators:**  
This reports errors where the sum of the tray separators is larger than the tray itself.

**Helpful Hints:**
Part of becoming comfortable with anything means making a mistake here or there, and it is no different with cable routing. Below is a list of pointers, hints, or suggestions that should help you along as you encounter design errors on your own. It’s important to know that if you have designed a tray system with fatal warnings the trays retrieval code will not be synchronized. Instead, CableMatic will abort that particular retrieval code and leave the data as it was before the synch. This is only true for the retrieval code that had an error; the rest will be synchronized as expected. **Note – A tray run can be defined as a continuous run of tray segments (including bends) without an ID change.**

1) A tray run can only have two control nodes. A control node is what’s considered to be the end/beginning of a tray run.

2) All tray segments in a tray run must have the same cross sectional attributes, such as service level or separator data.

3) Tray ID’s must change at a branch; a ‘T’ for instance.

4) Airways will not have a tray name under “To” or “From” if they do not connect to a trays control node.

5) During the Synch, a conduits From and To connections are found using two separate methods, one for tray and the other for a Jbox(JB) or Man Hole(MH); these are commonly referred to as Pull Points.
   - Tray: Connections are found based on how close the tray is to the conduit in question: granted their service levels are compatible.
   - Pull Points: For a connection to be found in a pull point, the conduit must be in the envelope of the box.

Separate from the Auditing section, there is also a section of the program called, “Cable Route Logistical Checks”. Don’t forget to include the “Logistical Checks” offered by the program as well. They are described in Section 5.0 of this document.

That was a lot of reading! If you hung in there until the end, congratulations, you’re now a Cable Router. If you didn’t, that’s OK too. At GSN we’re aware that there
isn’t always time in the day to read a forty page manual; that’s why it was designed to double as a Desk Reference. Since all the information in this document is bookmarked, it’s easy to open and find the answer you’re looking for in a hurry. If you still can’t find the answers needed, help is only a phone call away. You can reach the GSN professionals at (678) 831-0725. Thank you for your time.

**Happy Routing!**