4.1 Introduction:
This section is a step-by-step tutorial showing how to use the DCBRIDGE program. As explained in the tutorial, “Designing Steel Bridges Using DCALC” on the DCALC website, DCBRIDGE is used to collect geometrical information that is used by the other DCALC programs.

There are two possible methods of entry: “Method 1 – Manual Entry”, and “Method 2 – Using DesignCAD”.

4.2 Steel Bridge Design Example
DCALC is installed with an example calculation located in “C:\DCALC\DEMO”, “Example DCBRIDGE calculation – Steel Bridge”. This bridge is described in tutorial, “Designing Steel Bridges Using DCALC”, on the DCALC website.

4.3 DCBRIDGE Method 1 – Manual Entry

Upon starting DCBRIDGE you will see the following screen:

The following program is used to collect geometrical information for bridges used by several DCALC bridge design programs.

There are two ways to enter data:
(1) Manual entry of data points
and
(2) Using CAD to enter data points

For option 2, this program uses a CAD program, “DesignCAD” by IMSI. The user should have DesignCAD installed on their computer in order use this option.

It is recommended that you start DesignCAD before entering DCALC and bring up a drawing of the bridge. DesignCAD is capable of importing CAD drawings from other CAD programs such as AutoCAD and MicroStation using the DXF format.
You will want to position your bridge near X=0, Y=0 and roughly parallel to the X-axis, for better accuracy. There is a “base line” that is assumed to be concurrent with the x-axis. In many cases for straight bridges, the base line and the station can be the same. Stationing must run from the left to the right.

Select “Manual Entry”.
The next screen describes the nomenclature used for describing lines:

You will then be asked if this is a new file or an existing file. Enter “new”.

You will be asked the units of measurement, English or Metric. Enter “English”.

The main screen menu appears:

You will be defining all the longitudinal lines in this bridge, namely:

- Station Line
- Left Edge of Deck
- Right Edge of Deck
- Each of the 10 Beam Lines
- Profile Grade Line.
We begin by defining the station line. Click on “Enter a Longitudinal Element”. The following screen will appear:

Fill-in the above numbers indicating the coordinates (again, refer to the drawing of this bridge described in the tutorial “Designing Steel Bridges Using DCALC” to understand the basis of these dimensions.). After you’ve completed this form, click “Show Element”, and you will see a line drawn for this element.

For this simple bridge, all of the other longitudinal lines are parallel to the station line. We can simplify line entry by defining the offset of each line with respect to the station line, making use of a feature called “Alternative Entry”.

\[ \text{At Pt 1, STA} = 939.02 \]
The next longitudinal line that we will enter is the left edge of deck. Click again on “Enter Longitudinal Element” on the main menu. You then see the following screen:

Select “New Element” and click on “Proceed.” You will then see the following screen:

Enter “Left Edge of Deck” in the text box for “Long. Line Description”. You could enter the “X” and “Y” coordinates at the end points of a line describing the Left Edge of Deck. Instead, we will use the “Alternative Entry” feature which can be used for lines parallel to the station line.
Click on “Alternative Entry”. You will see the following screen:

Enter the offset, “-37.5” (noting that negative numbers are “to the left” of the station line). Then click “Compute Coordinates”. You will then see the following screen:

Note that the “X” and “Y” coordinates of a line parallel to the station line have been entered. It does not matter that this line is actually longer than the left edge of deck. You do not need to define the exact beginning and end any of the longitudinal lines. After clicking on “Show Element”, the left edge of deck will be drawn in plan.
Next, we will define the first exterior beam, “B3” (in this example, the bridge has ramps on the outside that have beams labeled “B1” and “B2”, so we skip those beams). After clicking on “Enter Longitudinal Element” and “New Element”, you will see the following screen:

Enter “B3” in the Long. Line text box. For “Type” select “Beam Line”. Again, this beam is parallel to the station line, so you can use the “Alternative Entry” feature:

Enter “-34.5” for the beam offset for this beam.
After clicking “Compute Coordinates”, and you will see the following screen:

```
<table>
<thead>
<tr>
<th>Long Line Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beam Line</td>
</tr>
</tbody>
</table>

Number of line segments = 1 (1 min/4 max)

<table>
<thead>
<tr>
<th>Point</th>
<th>X</th>
<th>Y</th>
<th>Line Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>34.5</td>
<td>Straight</td>
</tr>
<tr>
<td>2</td>
<td>275</td>
<td>34.5</td>
<td></td>
</tr>
</tbody>
</table>

Proceed in similar manner defining the following other longitudinal lines:

- Beam B4, Type “Beam Line”, offset –26.83
- Beam B5, Type “Beam Line”, offset –19.17
- Beam B6, Type “Beam Line”, offset –11.5
- Beam B7, Type “Beam Line”, offset –3.83
- Beam B8, Type “Beam Line”, offset 3.83
- Beam B9, Type “Beam Line”, offset 11.5
- Beam B10, Type “Beam Line”, offset 19.17
- Beam B11, Type “Beam Line”, offset 26.83
- Beam B12, Type “Beam Line”, offset 34.5
- PGL, Type “Profile Grade Line”, offset 0
- Right Edge of Deck, Type “Right Edge of Deck”, offset 37.5
The next step is to define all the transverse lines. On the main menu, click on “Enter Transverse Element”. You will see the following screen:

You begin by defining the Back of West Abutment. Enter “BK. OF W. ABUT.” In the Transverse Line Description text box and select “Back of Abutment” for the “Type”.

You can enter the coordinates for “X” and “Y” at the end points of this line. Rather than using that approach, we will use the “Alternative Entry” feature. After clicking on “Alternative Entry”, you will see the following screen:

Enter the station “936.103” (don’t show a “+” sign!) and the angle “90” (don’t show minutes and seconds!). After clicking on “Compute Coordinates”, you will see the following screen:
The coordinates of a transverse line that is arbitrarily 50 feet long are indicated. The length of the line does not matter. DCALC uses these coordinates to compute a straight line equation for computing intersection points of lines.

After clicking on “Show Element”, this line will be drawn.

Next, enter the centerline of bearing at West Abutment. Similar to the previous line, the following screen will appear after selecting “Enter Transverse Element”:

For this line, enter the description “CL BRG. E. ABUT.”, select the Type as “CL Bearing”, select Bearing type as “Exp”.

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After clicking on “Alternative Entry” and you will see the following screen:

Enter “90” for the angle and “939.02” for the station. After clicking on “Compute Coordinates”, you will see the following screen:

Again, the coordinates of a line arbitrarily 50 feet long have been entered.

You will need to complete entry for the following remaining transverse lines:

- CL Pier 1, Type “CL Pier and CL Bearing”, Bearing type: Exp, Station 1014.02, Angle 90
- CL Pier 2, Type “CL Pier and CL Bearing”, Bearing type: Exp, Station 1086.36, Angle 90
- CL Pier 3, Type “CL Pier and CL Bearing”, Bearing type: Fixed., Station 1151.23, Angle 90
- West Brg. Pier 4 (this bridge has an expansion joint at pier 4, so there are two sets of bearings, Type “CL Bearing Upstation”, Bearing type: Exp, Station 1213.452, Angle 101.5
The remaining task is to describe information pertaining to deck thickness and parapet geometry. (This data will be used for computing loads by the other DCALC programs.)

From the main menu, click on “Deck/Parapets/Sidewalks”. You will then be directed to a series of graphics asking various dimensions. The screen should show the following dimensions after you have entered this data:

You’ve finished input. Make sure to save this calculation.

After saving this calculation, you can view the output. DCBRIDGE computes a great deal of geometrical information that is used by all the other DCALC bridge programs. You are essentially creating a database - information regarding geometry, bearings locations, bearing fixities, profile grade line location, station line location – all relevant to the design of all bridge elements. It is especially important to accurately input this data, check it, and revise this database accordingly.

It is up to you, the designer, to see that the accuracy of data is maintained and is followed through in the dependency of programs. For example: If you design a beam using roadway geometry that latter changes, it is your responsibility to update all of the files from the beginning of the flowchart process (geometry, beam designs, bearings, etc.).
4.4 DCBRIDGE Method 2 – Using DesignCAD

If you own a copy of DesignCAD, you will be able quickly enter bridge geometry from a drawing. In fact, even if you are unfamiliar with DesignCAD and are proficient with another popular CAD package, such as AutoCAD or MicroStation, those formats can be exported easily to DesignCAD. The number of DesignCAD commands that we will need is minimal for our purposes here.

Step 1: Before using DCALC, start DesignCAD.
Step 2: Draw the bridge, or import a drawing from another CAD package.

DCALC is installed with an example drawing, “Example1”, which is stored in the “C:\DCALC\DEMO” directory. On the DesignCAD menu, click on “File”, then open.

After opening this drawing, you will see the following:

Step 3: Minimize DesignCAD before starting DCALC.
Step 4: With DesignCAD now minimized, start DCALC.
- Select “Make a Calculation”.
- Select “DCBRIDGE” from the bridge design flowchart.
- For entry method, select “Method 2 – Use DesignCAD”

You will see the following screen, showing DCBRIDGE’s main menu riding on top of DesignCAD:

You are now actually operating two programs at once. (As a programming note, this is a feature uses something called Microsoft “Automation”). DCALC is now controlling DesignCAD. Most of DesignCAD’s features are disabled to you, except a few such as the zoom and scroll bar.
Step 5: Enter lines using Pick Point Feature

Select “Enter Longitudinal Element” and you will see the same familiar entry form that was explained in the previous section for Manual Entry:

You can now make use of the “pick points” feature. You will want to click on a point at the left end of beam B3, after which you will click on a point on the right end of beam B3. First, for Point 1, click on “pick pt”. You will then see the DesignCAD drawing:
Note there is a prompt at the lower left hand corner of the screen, saying that DesignCAD is waiting for you to set a point. Use the “gravity point” feature to set a point exactly at the ends of the line. After setting the point, you will see that the “X” and “Y” coordinates of the line have been entered for point 1. Do the same for point 2.

As previously described for Manual Entry, you can proceed to enter all of the line using this “pick point” method. This process can work very quickly.

A word of caution: Because you are running two programs simultaneously, DCALC and DesignCAD, you must try to strictly adhere to entering the commands that you are prompted (i.e., picking points, not other things). Although we have attempted to make this integration flawless, sometimes automation errors occur in ways that are difficult to predict. If you stick to pick points, errors should not occur; however, if you zoom out, it is possible automation may get fouled-up.