CT-Fill User Guide

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CHAPTER 1 SPREADSHEET OPERATION

1.1 GENERAL

1.1.1 **CT-Fill References**

The CT-Fill References folder, included in the CT-Fill package, shall always be in the same folder as the CT-Fill workbook. Without this folder the program will not be able to properly function.

1.2 INPUT PARAMETERS

Enter the appropriate input parameters as defined below in the orange boxes on the Crown Pressure Tab.

1.2.1 **Live Load Distribution, LLDF**

1.2.1.1 Description of Input

Enter the Live Load Distribution factor in cell H3 on the Crown Pressure Tab. The live load distribution factor can be determined from BDS article 3.6.1.2.6a and MBE 6A.5.12.10.3a and its commentary.

1.2.1.2 Application of Input

This input is used in determining the length and width of a wheel patch distributed through fill.

1.2.1.2.1 BDS Articles

- 3.6.1.2.6b

1.2.1.2.2 BDS Equations:

- 3.6.1.2.6b-1
- 3.6.1.2.6b-2
- 3.6.1.2.6b-3
- 3.6.1.2.6b-4
- 3.6.1.2.6b-4
- 3.6.1.2.6b-5
- 3.6.1.2.6b-6

1.2.2 **Culvert Span, D_i**

1.2.2.1 Description of Input

Enter the inside diameter or clear span of the culvert in feet in cell H4 on the Crown Pressure Tab.

1.2.2.2 Application of Input

This input is used in BDS equations under BDS article 3.6.1.2.6b to compute the live load distribution through fill, and also when compute live load factors when 'other' is selected in for Live Load Factors.

1.2.2.2.1 BDS Equations:

- 3.6.1.2.6b-1
- 3.6.1.2.6b-2
- 3.6.1.2.6b-3

1.2.2.2.2 MBE Table:

- 6A.4.5.4.5.2a-1

1.2.3 **Depth of Fill, H**

1.2.3.1 Description of Input

Enter the depth of fill over the culvert in feet in cell H5 on the Crown Pressure Tab.

1.2.3.2 Application of Input

This input is used in BDS equations under BDS 3.6.1.2.6b to compute the load distribution through fill, and also used to compute the Dynamic Load Allowance

1.2.3.3 BDS Equations:

- 3.6.1.2.6b-1
- 3.6.1.2.6b-2
- 3.6.1.2.6b-3
- 3.6.2.2-1

1.2.4 **Width of Culvert, W_c**

1.2.4.1 Description of Input

Enter the width of the culvert, perpendicular to the direction of the span, in cell H6 on the Crown Pressure Tab.

1.2.4.2 Application of Input

This input is used to limit the application of the transverse patch of live load to the width of the culvert as specified in MBE commentary article C6A.5.12.10.3a. This limitation is applied regardless of Live Load Factor method selected.

1.2.4.2.1 MBE Article

- C6A.5.12.10.3a

1.2.5 **Average Daily Truck Traffic, ADTT**

1.2.5.1 Description of Input

Enter the Average Daily Truck Traffic in trucks per day in cell H7 on the Crown Pressure Tab.

1.2.5.2 Application of Input

This input is used to compute Live Load Factors dependent on ADTT when *Other* is selected for Live Load Factor Type.

1.2.5.2.1 MBE Tables:

- 6A.4.4.2.3a-1

- 6A.4.4.2.3b-1
- 6A.4.5.4.2a-1

1.2.6 **Live Load Factor Option**

1.2.6.1 Description of Input

Select the Live Load Factor Options, *Other* or *Culvert*, to compute live load factors.

1.2.6.2 Application of Input

The program will compute Live Load Factors based on the option selected for general bridges (*Other*) or reinforced concrete box culvert (*Culvert*).

1.2.6.2.1 MBE Articles

- 6A.4.2
- 6A.5.12

1.2.7 **Apply Rigid Concrete Pavement Reduction**

1.2.7.1 Description of Input

Select TRUE to apply the Rigid Concrete Reduction Factor, K_R, as specified in BLRM article 10.1.4.1. Select FALSE to not apply the Rigid Concrete Reduction Factor.

1.2.7.2 Application of Input

If cell H9 on the Crown Pressure Tab is FALSE the program will set K_R equal to 1.0, if TRUE is selected the program will compute K_R and apply directly to the live load vertical crown pressure, P_L.

1.2.7.2.1 BLRM Articles:

- 10.1.4.1

1.2.7.2.2 BLRM Equations:

- 10.4.1-1

1.3 GENERAL INFORMATION

Enter the orange fields with the appropriate information used for documentation purposes only.

1.4 VEHICLES

The vehicles tab contains CTDOT vehicle library for rating. To add vehicles copy and paste rows 6 and 7 to the end of the table modify the data to the definitions below.

Note there is no axle limit to the analysis program. However for axles exceeding 19 ensure that **Number of Axles** is correctly inputted.

1.4.1 **Vehicle**

1.4.1.1 Description of Input

Enter the name of the vehicle in this column as appears in chapter 4 of the BLRM.

1.4.1.2 Application of Input

The program will use the name of the vehicle to select the Live Load Factor for permit vehicles when the *Other* option is selected for **Live Load Factor Type**

1.4.1.2.1 BLRM Articles

- Chapter 4

1.4.2 **Vehicle Type**

1.4.2.1 Description of Input

Enter the rating level in this column. Available inputs are:

- Inventory
- Operating
- Legal
- Permit

1.4.2.2 Application of Input

The program will use this input to determine the Live Load Factors.

1.4.3 **MPF**

1.4.3.1 Description of Input

Enter the MPF for each vehicle.

1.4.3.2 Application of Input

The program will use this input to apply a factor the vertical crown pressure.

1.4.4 **Tire Width**

1.4.4.1 Description of Input

Enter the width of the tire in inches.

1.4.4.2 Application of Input

The program will use this tire width to compute the path width at depth H for all axles for that vehicle.

1.4.4.2.1 BDS Equations:

- 3.6.1.2.6b-1
- 3.6.1.2.6b-2
- 3.6.1.2.6b-3

1.4.5 **Tire Length**

1.4.5.1 Description of Input

Enter the length of the tire in inches.

1.4.5.2 Application of Input

The program will use this tire length to compute the path width at depth H for all axles for that vehicle.

1.4.5.2.1 BDS Equations:

- 3.6.1.2.6b-4
- 3.6.1.2.6b-5
- 3.6.1.2.6b-6

1.4.6 **Number of Axles**

1.4.6.1 Description of Input

Enter the number of Axles of each vehicle in this column.

1.4.6.2 Application of Input

The program uses this to dimension arrays and loops.

1.4.7 **Wheel Spacing**

1.4.7.1 Description of Input

Enter the wheel spacing, or axle gauge in this column in feet.

1.4.7.2 Application of Input

The program will use this value as s_w in BDS Article 3.6.1.2.6b to compute the transverse patch width a depth H, and if transverse wheel lines interact.

1.4.7.2.1 BDS Articles:

- 3.6.1.2.6b

1.4.7.2.2 BDS Equations:

- 3.6.1.2.6b-1
- 3.6.1.2.6b-3

1.4.8 **Impact Override**

1.4.8.1 Description of Input

Enter a Dynamic Load Allowance, IM, to override the Buried Component Dynamic Load Allowance 3.6.2.2, or leave blank to use BDS equation 3.6.2.2-1.

IM should in terms of percentage.
For Example: 33% enter 33.

1.4.8.2 Application of Input

The program will apply the inputted IM value in BDS equation 3.6.1.2.6b-7. Therefore the program will divide the inputted IM by 100 and 1 to the inputted value. If the cell is left blank, the program will compute IM based on Depth of Fill input on the Crow Pressure Tab.

1.4.8.2.1 BDS Articles:

- 3.6.1.2.6b

- 3.6.2.2

1.4.8.2.2 BDS Equations:

- 3.6.1.2.6b-7
- 3.6.2.2-1

1.4.9 **Axle Spacing**

1.4.9.1 Spacing

1.4.9.1.1 Description of Input

Enter the spacing to axle before each axle in feet. The first axle shall be entered as a zero. Variable axle spacing is not supported.

1.4.9.1.2 Application of Input

The program uses this axles to determine the patch length at depth of fill and if adjacent axles interact with each other.

1.4.9.1.2.1 BDS Articles

- 3.6.1.2.6b

1.4.9.2 Axle Load

1.4.9.2.1 Description of Input

Enter the weight of each axle in kips.

1.4.9.2.2 Application of Input

The program uses this to compute the force to be divided by the patch area in computing the vertical crown pressure

1.4.9.2.2.1 BDS Articles

- 3.6.1.2.6b

CHAPTER 2 SPEC CHECK

2.1 GENERAL

The user can review the intermediate calculations, and incremental positioning of the vehicles through the spec check outputted by the program. The program will create a text file within the references folder which will display the input parameters, equations used, and results tables.

2.2 SPEC CHECK IDENTIFIES

Since the program will generate an individual spec check file for each combination of LLDF, Di, and, H, the user must select the desired input parameters to from the drop down in each cell. This will be used to populate information for cell B10.

2.3 OUTPUT TABLES

Use the drop in the Table cell, B8, to choose which table to load from the text file into the spreadsheet.

2.4 REVIEW TABLES

Click *Generate Table* and the program will load the select table from the selected spec check file into the spreadsheet. Additionally, a popup window will display the input parameters the program used to generate the analysis, and also the table headers which describe the heading of each table, and relevant equations used to by the program.