USER GUIDE

TxDOT Concrete Box Culvert Analysis Program (CULV5)

Version 2.2

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USAGE

CULV5 is an analysis tool for concrete box culverts. The program determines the forces acting on each of the different members of the culvert using the direct stiffness method. The user provides input data for loading conditions, structure geometry, and member sizes. The program outputs the member forces for use in either a working stress design or a load factor design in accordance with the AASHTO Standard Specifications for Highway Bridges, 17th Ed. for highway loadings, and AREMA 2006 in the case of E72 and E80 loadings.

INPUT

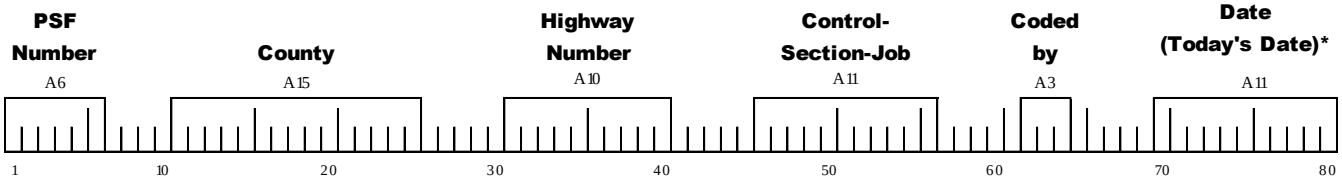
Program data is input using a text file which simulates punch card style input, where each line in the text file represents a card with fixed field format. The code above each input field indicates the required input type, a la FORTRAN conventions. Codes that begin with an "A" indicate alphanumeric input, "I" integer, and "F" floating point decimal (real numbers). The numbers following these letters disclose the number of characters in the field (e.g. an A10 field can contain up to 10 alphanumeric characters). If a code is not followed by a number it indicates that the input field has a one character length.

For the floating point decimal fields there are two numbers, the first is the total number of digits in the field, and the second is the number of digits to follow the implied decimal in the input field. If the second number is zero, the implied decimal is at the end of the field and therefore the input must be right justified if no decimal is input (i.e., if a number without an explicit decimal is entered in the field leaving a blank space or blanks spaces of the field to the right of the entered number, that space or spaces will be interpreted as a zero or zeros to the left of the decimal and the intended input value will be 10, 100, or 1000 times larger than intended for 1, 2, and 3 such spaces, respectively). All implied decimal locations may be overridden by placing an actual decimal point in the input field (e.g. an F5.4 field, entering 12345 would be read by the program as 1.2345, but entering 12.45 would be read as 12.45). The use of an actual decimal point has the effect of reducing the number of significant figures for a field by 1 but has the added assurance that the number entered is not off by a magnitude, or magnitudes, of 10. Also, if this reduction in precision is acceptable, the user may override all implied decimals and thus make the resulting input file more humanly "readable".

Header Cards

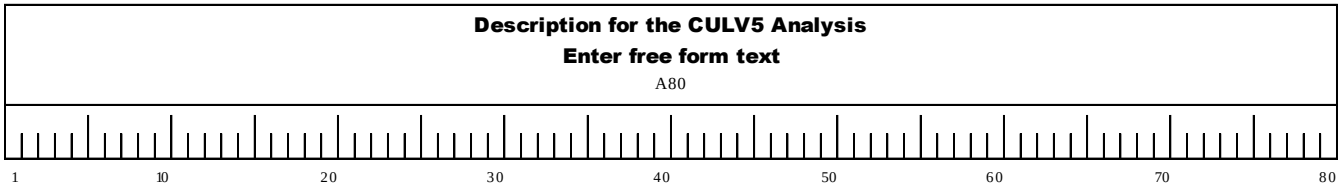
These cards are similar to the cards used by many TxDOT structural programs, such as PSTRS14 or CAP18, and these cards will be repeated as the header for each page of output. The first card may be free-format alphanumeric fields, but the following format is recommended, though the PSF Number is no longer relevant.

Card 1 – Job Header



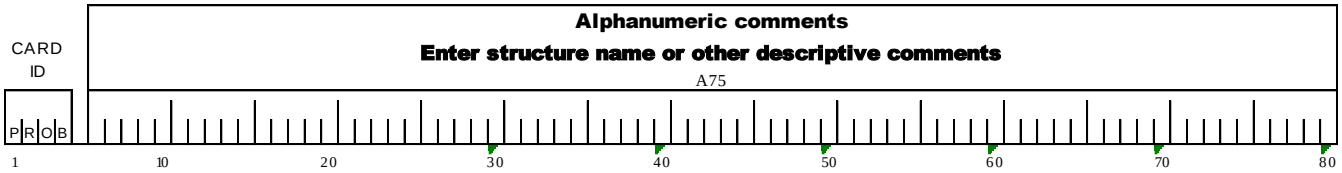
* Default is the current date, which is retrieved from the operating system.

Card 2 – Description Header



Card 3 – Problem (PROB) Header

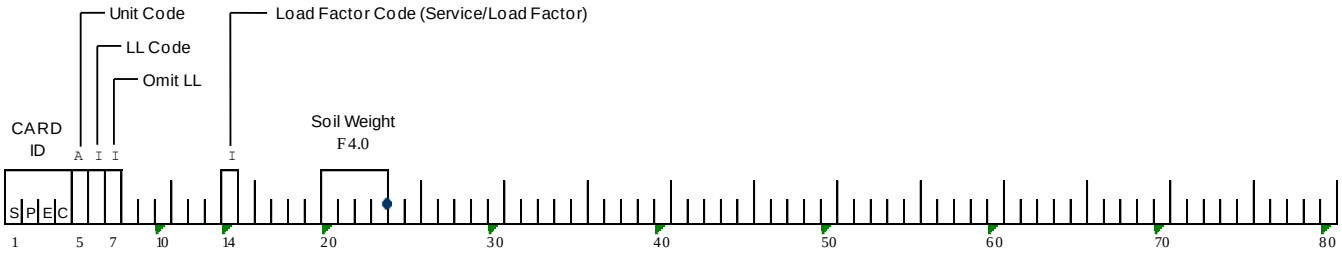
Use one PROB card per problem.



The CULV cards that follow are identified with this card until a new PROB card is encountered.

Specification (SPEC) Card

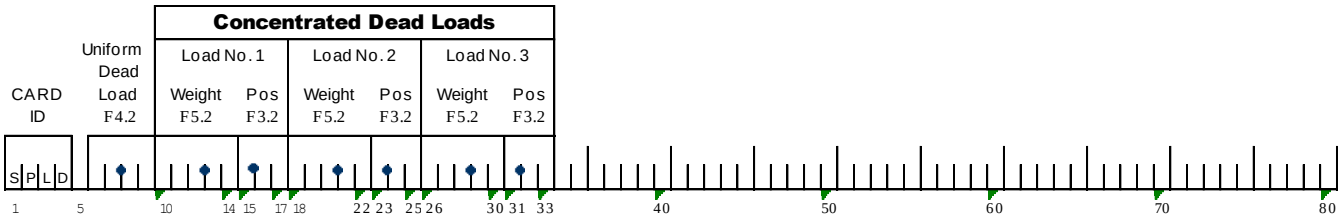
Systems of units and AASHTO Specification related toggles as well as soil weight are set by the input on the SPEC card. Defaults are shown in parentheses. This card is required to deviate from the default values.



Columns	Description
<5>	Unit code, E = English, M = Metric, (E = English)
<6>	Live load code, 1 for HS20, 2 for H20, 3 for HS15, 4 for H15, 5 for E80, 6 for E72, 7 for HS25, 9 for no live load, (1 = HS20)
<7>	Omit live load code, 1 for live load to be neglected if fill height is great enough as per AASHTO specs, 2 for live load to be included regardless of fill height (1).
<14>	Load Factor Code, 1 for Service Loads, 2 for Load Factors, (2 = Load Factors).
<20-23>	Weight of soil in lbs/ft3 or kg/m3 (120/1922).

Special Loading (SPLD) Card

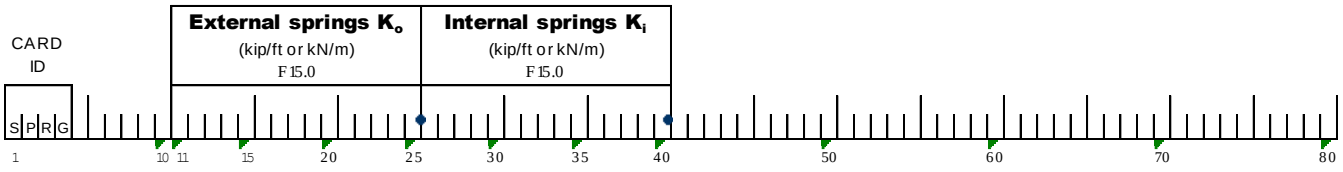
This card is optional and it is not normally included. It is used only for additional dead loads.



Columns	Description
<6-9>	Additional uniform dead load in kip/feet or kN/m (0.0)
<10-14>	First additional concentrated dead load in kips or kN (0.0)
<15-17>	Position of first load (distance from centerline of leftmost wall of the culvert to the load in feet or meter (0.0)
<18-22>	Second additional concentrated dead load in kips or kN (0.0)
<23-25>	Position of second load (distance from centerline of leftmost wall of the culvert to the load in feet or meter (0.0)
<26-30>	Third additional concentrated dead load in kips or kN (0.0)
<31-33>	Position of third load (distance from centerline of leftmost wall of the culvert to the load in feet or meter (0.0)

Spring (SPRG) Card

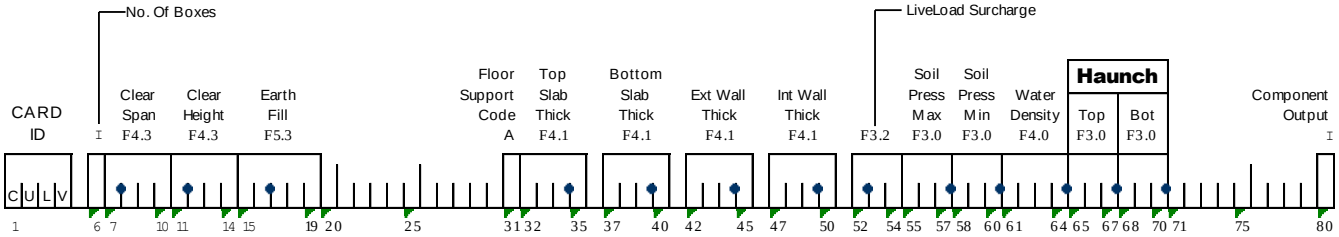
This card is used to input spring stiffness values for the floor supports. This card is only used when the spring support option is chosen for the floor support code ("Z" in column 31 on the CULV card).



Columns	Description
<11-25>	Spring stiffness of vertical supports at exterior walls in kip/feet or kN/m (0.0)
<26-40>	Spring stiffness of vertical support(s) at interior wall(s) in kip/feet or kN/m (0.0)

Culvert Data (CULV) Card

This card is used to input culvert data and is required for each culvert.



Columns	Description
<6>	Number of boxes (barrels), from 1 to 4, (required)
<7-10>	Clear span in feet or meter (required)
<11-14>	Clear height in feet or meter (required)
<15-19>	Earth fill to top of top slab in feet or meter (0.0)
<31>	Floor support code, See Figure 1 - Floor Support Systems for diagrams of the different systems. (Blank) Blank – full floor support with interior supports X – No floor with fixed end support H – No floor with hinged supports Y – Full floor support without interior supports Z – Full floor support with spring supports (requires SPRG command card).
<32-35>	Thickness of top slab in inches or millimeters (required)
<37-40>	Thickness of bottom slab in inches or millimeters (top slab thickness)
<42-45>	Thickness of external wall in inches or millimeters (required)
<47-50>	Thickness of interior wall in inches or millimeters (exterior wall thickness)
<52-54>	Live Load surcharge in feet or meter (2.0/0.610)
<55-57>	Maximum soil equivalent fluid pressure in lbs/ft3 or kg/m3 (40.0/640.72)
<58-60>	Minimum soil equivalent fluid pressure in lbs/ft3 or kg/m3 (20.0/320.36)
<61-64>	Water density in lbs/ft3 or kg/m3 (0.0/0.0)
<65-67>	Top haunches in inch or millimeter (0.0/0.0)
<68-70>	Bottom haunches in inch or millimeter (0.0/0.0)
<80>	Output component moments, shears, and axial loads (VDL, VLL, LDL, etc). 1 to output, 0 for no output (0)

DIAGRAMS

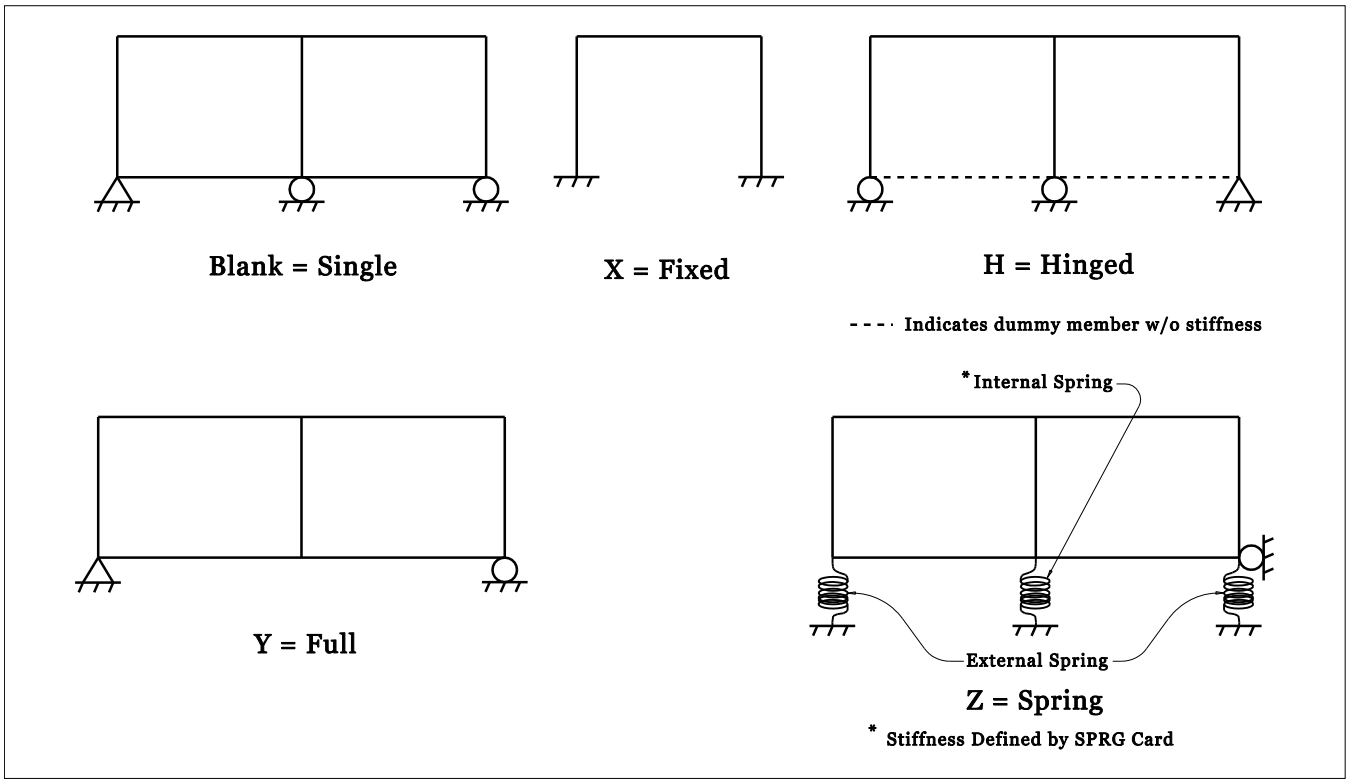


Figure 1 - Floor Support Systems

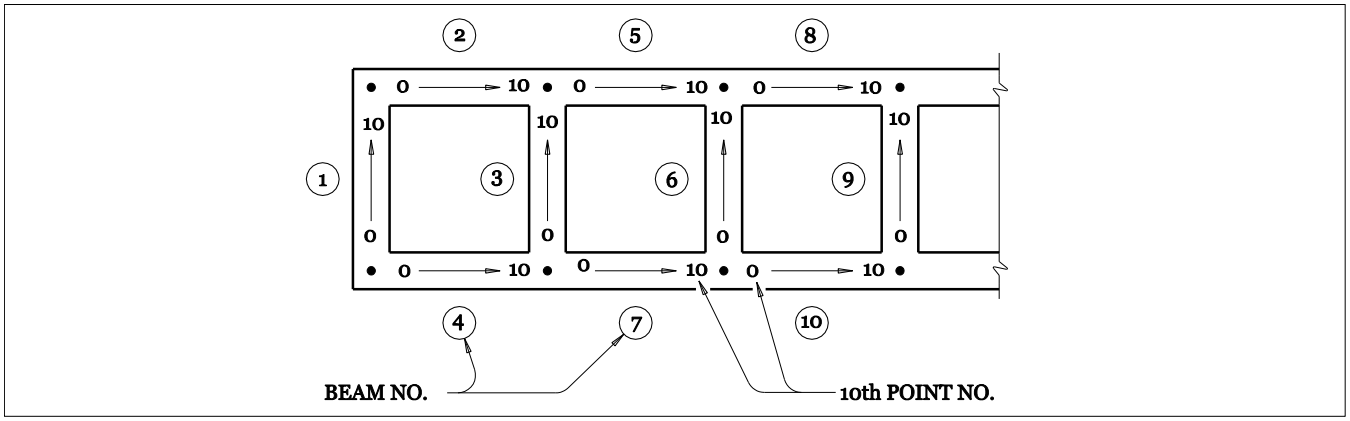


Figure 2 - Member Labeling Convention

Document History

DOCUMENT HISTORY		
Initials	**Date**	**Description**
TT	2000-APR	Input Instructions prepared by programmer for release 1.70.
TT/TEB	2003-FEB-03	Transferred from programmer to end-user OPR for maintenance.
TEB	2003-DEC-01	Revised for version 1.71 release and called it an Input Guide.
AJ	2008-DEC-08	Revised support conditions shown for floor support codes H and Z; revised size of Figure 2; renamed to User Guide; Added Title Page; Added Table of Contents; Added Document History section; Revised styles.
TEB	2010-MAY-21	Updated to version 2.1. Updated headers and footers. Revised content and formatting.
TEB	2012-JUL-12	Updated to version 2.2. Updated headers and footers. Revised content and formatting of input cards.