Index Table

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BSI NEWSLETTER

Bridge Software Institute

In this issue's Technical Corner, we discuss the latest feature made available in the newly released FB-MultiPier 4.19.3, i.e., elastic thermo-mechanical analysis feature.

The articles Technical Corner and Discussions are open for input from all readers. If you have a topic that you think should be discussed, let us know. Did you create a great model with features that you want to share? Everyone is welcome to submit articles for possible inclusion in subsequent issues.

Please contact BSI at **BSI@ce.ufl.edu** with your ideas.

SPRING
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Index Table

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What's New at BSI

We are pleased to announce the release of FB-MultiPier v4.19.3. This program and other structural analysis software are available for download from the **BSI** website. The new version of FB-MultiPier contains fixes to the latest reported bugs and also includes a number of new features.

Technical Corner - New Features

Elastic Thermo-Mechanical Analysis Model

A new analysis model has been implemented in FB-MultiPier (FBMP) Version 4.19.3, which can be used to predict thermally-induced displacements of bridge spans, and takes into account for user-defined span-end boundary conditions. This new feature allows users to apply uniform temperatures (TU) and/or temperature gradients (TG) profiles through both the depth and width directions of the individual span that consists of a deck and various types of girders: steel, concrete, and box. Span section properties can be either user-defined (same as the previous versions of FBMP bridge modeling) or computed if section geometries are input in detail. Given user-defined temperature profiles through the height (and/or along the length) of spans, thermally-induced deformations in the spans are computed, and subsequently, internal resultant forces are calculated. With the span-end boundary conditions, external loads are computed for the quasi-static equilibrium at the bearing locations. These loads can, then, be automatically superimposed onto any other loads applied at the bearings to simulate combined load effects on the piers.

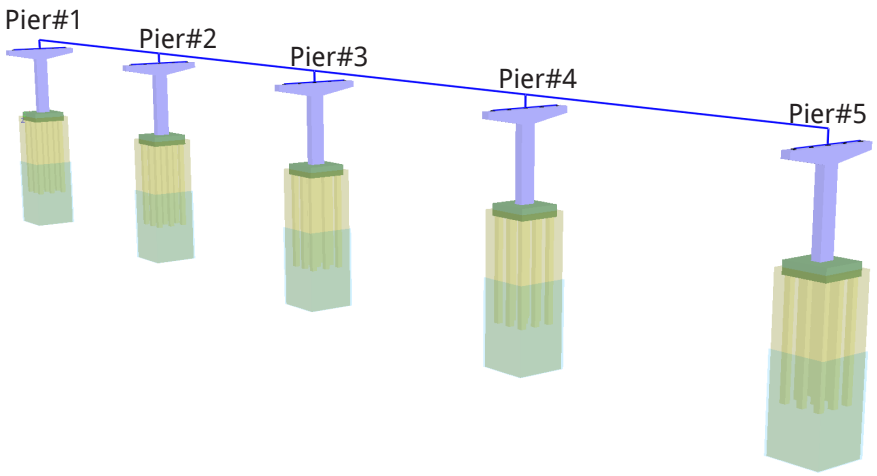

Fig. 1 A schematic sketch of the four-span bridge model.

SPRING
2015

Index Table

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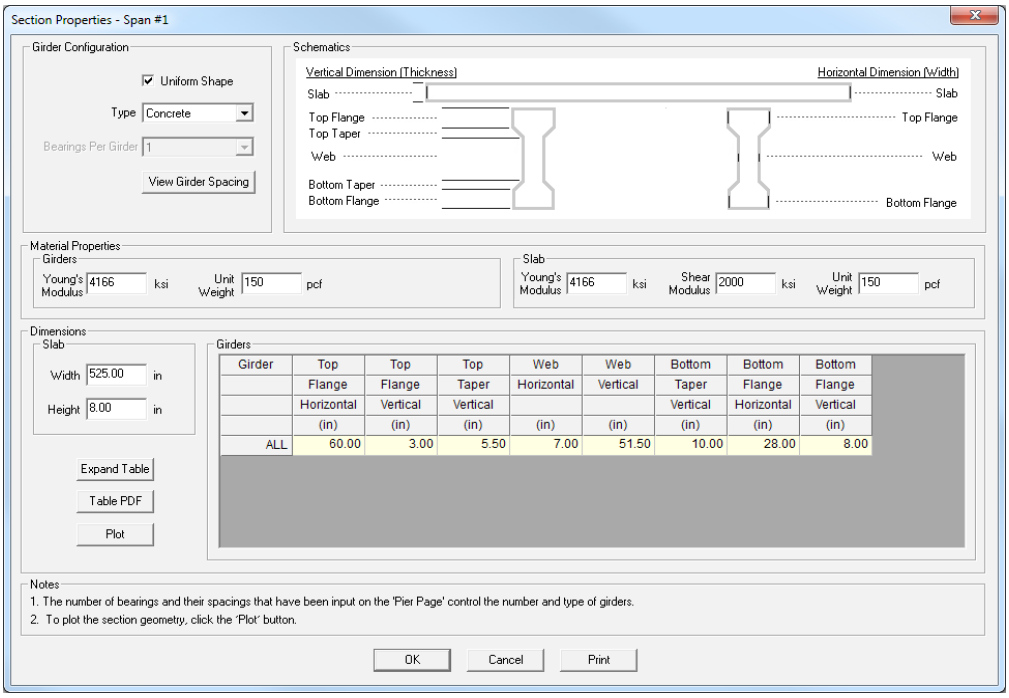

Fig. 2 Span section properties.

The following example demonstrates the application of this new feature to the TG load case of AASHTO LRFD (2011) using a bridge configuration with four spans (as shown below). Each span is 155 ft long, includes continuous deck units, and five 78 in. deep bulb-T beams. The span-end boundary conditions consist of rollers at Piers 1, 2, 4, and 5, and a hinged condition at Pier 3.

To compute thermally-induced loads, detailed span cross section properties are required (shown in **Fig. 2**). Based on user's input of the dimensions and material properties of the slab and girders, the transformed section properties are computed (**Fig. 3**).

SPRING
2015

Index Table

Contact BSI
Page 8

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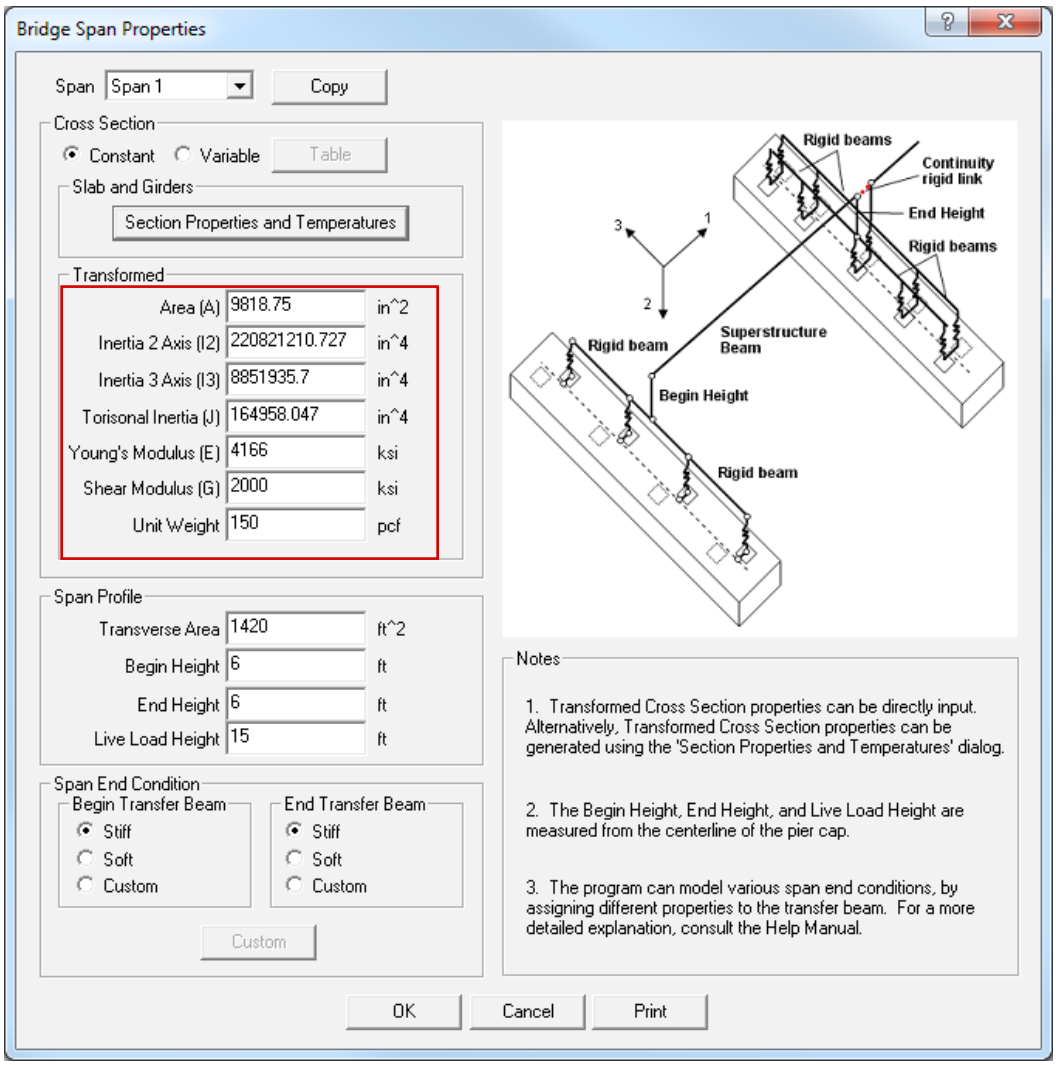

Fig. 3 Bridge span properties.

The "Bridge Span Properties" dialog lists the transformed section properties if and only if user input a detailed input set for the span cross section. These transformed properties may be manually edited if so desired. When the vertical dimension (depth) of the span cross section varies along the length of the span, user can input the variation per a total of ten segments along each span.

The remainder of this article uses a series of annotated figures to highlight certain aspects of the new elastic thermo-mechanical analysis feature in FBMP.

SPRING
2015

Index Table

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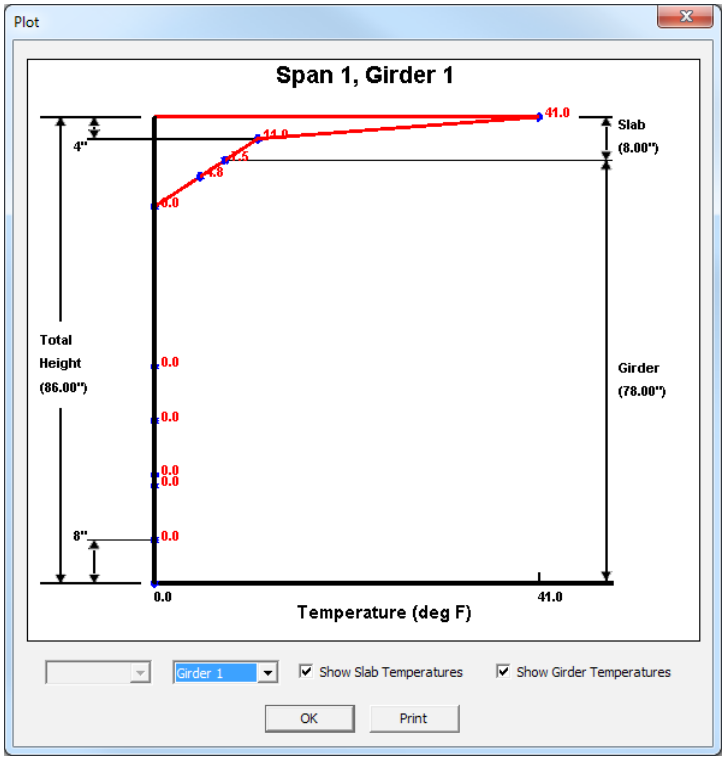

Fig. 4 By navigating to the "Bridge Span Properties" dialog, accessing the "Temperatures" dialog, and clicking the "Plot" button, the span temperature profile can be viewed for any span element or girder.

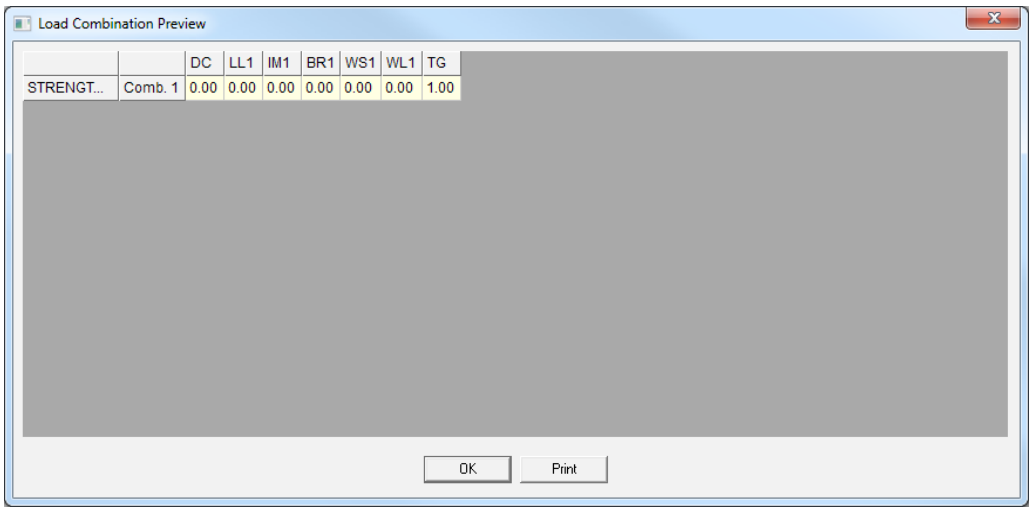

Fig. 5 The "Load Combination Preview" dialog is shown to signify the single AASHTO load combination to be analyzed for this demonstration case. Note that all non-TG load factors have been edited to zero.

SPRING
2015

Index Table

Contact BSI
Page 8

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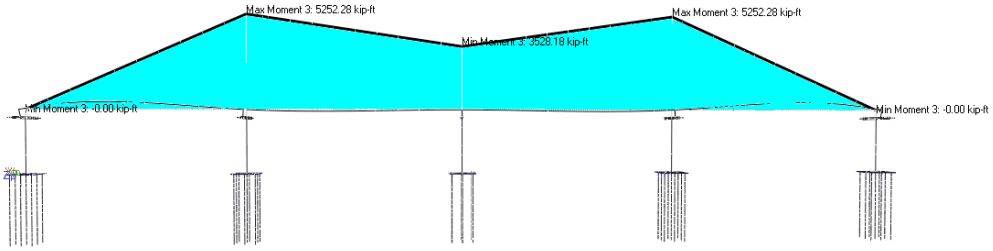
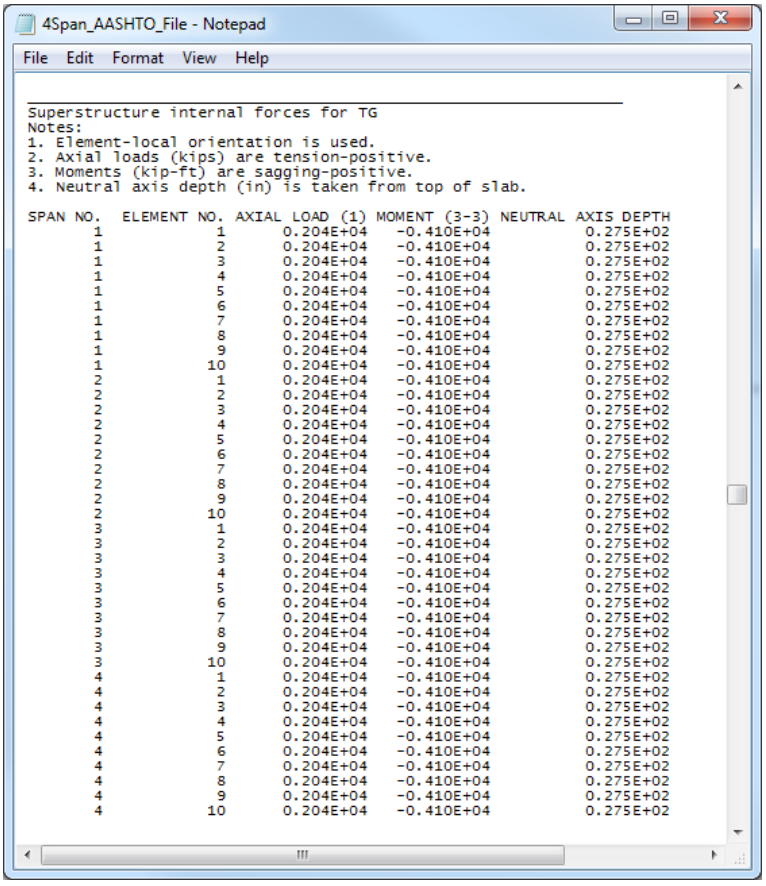


Fig. 6 Plots of internal forces can be generated in the "3D Results" output window, as is demonstrated here for M3. Note that positive moment represents tension at the bottom of the span members.



4Span_AASHTO_File - Notepad

File Edit Format View Help

Superstructure internal forces for TG
Notes:
1. Element-local orientation is used.
2. Axial loads (kips) are tension-positive.
3. Moments (kip-ft) are sagging-positive.
4. Neutral axis depth (in) is taken from top of slab.

SPAN NO.	ELEMENT NO.	AXIAL LOAD (1)	MOMENT (3-3)	NEUTRAL AXIS DEPTH
1	1	0.204E+04	-0.410E+04	0.275E+02
1	2	0.204E+04	-0.410E+04	0.275E+02
1	3	0.204E+04	-0.410E+04	0.275E+02
1	4	0.204E+04	-0.410E+04	0.275E+02
1	5	0.204E+04	-0.410E+04	0.275E+02
1	6	0.204E+04	-0.410E+04	0.275E+02
1	7	0.204E+04	-0.410E+04	0.275E+02
1	8	0.204E+04	-0.410E+04	0.275E+02
1	9	0.204E+04	-0.410E+04	0.275E+02
1	10	0.204E+04	-0.410E+04	0.275E+02
2	1	0.204E+04	-0.410E+04	0.275E+02
2	2	0.204E+04	-0.410E+04	0.275E+02
2	3	0.204E+04	-0.410E+04	0.275E+02
2	4	0.204E+04	-0.410E+04	0.275E+02
2	5	0.204E+04	-0.410E+04	0.275E+02
2	6	0.204E+04	-0.410E+04	0.275E+02
2	7	0.204E+04	-0.410E+04	0.275E+02
2	8	0.204E+04	-0.410E+04	0.275E+02
2	9	0.204E+04	-0.410E+04	0.275E+02
2	10	0.204E+04	-0.410E+04	0.275E+02
3	1	0.204E+04	-0.410E+04	0.275E+02
3	2	0.204E+04	-0.410E+04	0.275E+02
3	3	0.204E+04	-0.410E+04	0.275E+02
3	4	0.204E+04	-0.410E+04	0.275E+02
3	5	0.204E+04	-0.410E+04	0.275E+02
3	6	0.204E+04	-0.410E+04	0.275E+02
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3	8	0.204E+04	-0.410E+04	0.275E+02
3	9	0.204E+04	-0.410E+04	0.275E+02
3	10	0.204E+04	-0.410E+04	0.275E+02
4	1	0.204E+04	-0.410E+04	0.275E+02
4	2	0.204E+04	-0.410E+04	0.275E+02
4	3	0.204E+04	-0.410E+04	0.275E+02
4	4	0.204E+04	-0.410E+04	0.275E+02
4	5	0.204E+04	-0.410E+04	0.275E+02
4	6	0.204E+04	-0.410E+04	0.275E+02
4	7	0.204E+04	-0.410E+04	0.275E+02
4	8	0.204E+04	-0.410E+04	0.275E+02
4	9	0.204E+04	-0.410E+04	0.275E+02
4	10	0.204E+04	-0.410E+04	0.275E+02

Fig. 7 The internal forces applied during the AASHTO TG analysis are printed, along with the distance from the top-of-slab elevation to the transformed section neutral axis.

Index Table

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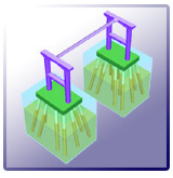
For Technical Support

Technical Support, Bridge Software Institute

Technical support questions. When requesting technical support for any BSI software, it is recommended to email the input file (.in file for FB-MultiPier and Atlas or .spc file for FB-Deep) to the BSI address bsi@ce.ufl.edu along with a brief explanation and any supporting documentation of the issue. This will allow the support staff to provide the users prompt technical support.

Identifying the program version. It is important that users have the current most up-to-date version of the BSI software. Thus we recommend that users regularly visit the home page of the **BSI** website. To identify the current version of program installed on your computer, open the program and go to Help > About to see the program version number.

BSI Program Status



FB-MultiPier V4.19.3 Download a FREE demo today!

Released: January 28, 2015 - Continuing Development - Technical Support Available

FB-MultiPier is the successor to FB-Pier. In addition to all the capabilities of FB-Pier the FB-MultiPier program allows for the modeling of a bridge that consists of multiple piers that are connected with bridge spans. In addition to the multiple load cases and the AASHTO coefficients that are available in FB-Pier, the new program is capable of performing dynamic analysis for the bridge. For more information about FB-MultiPier, click here.

Index Table

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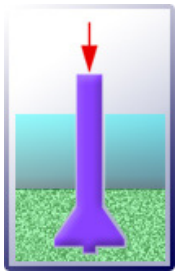

FB-Deep V2.04 Download a FREE demo today!

Released: May 28, 2012 - Continuing Development - Technical Support Available

The FB-Deep computer program is a Windows based program used to estimate the static axial capacity of drilled shafts and driven piles. The methodology is based upon Federal Highway Administration (FHWA) reports. FB-Deep guides the user through pile and shaft materials data, shape and dimensional inputs, soil properties, and boring log info. FB-Deep presents the data analysis in both clear graphical and text form. For more information about FB-Deep, click here.

Atlas V6.04

Released: December 8, 2011 - Limited Web Support Available

Atlas is a finite element analysis program that is used for the design/analysis of cable supported traffic signal systems. The Atlas program models dual cable supported systems including single-point or two-point attachments and suspended box systems. For more information about Atlas, click here.

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