Index Table

What's New at BSI Page 2 FB-MultiPier v4.19

Technical Corner

Page 2

Discussions Page 6

<u>Program Status</u>

Page 9 FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697



In this issue's Technical Corner, we discuss the latest feature made available in the newly released FB-MultiPier 4.19, i.e., design load tables.

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.

Index Table

What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

> Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

What's New at BSI

We are pleased to announce the release of FB-MultiPier v4.19. 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 Design Tables (Envelopes of Force)

The highlight of FB-MultiPier 4.19 is found in the new Design Tables feature. Design Tables are a series of tables that summarize analysis data for various parts of the model for a particular force or demand capacity ratio, across all load cases or load combinations. These tables are intended to streamline the process of transforming analysis results into technical report documentation for submission to clients. To access the Design Tables feature, run a static analysis for a General Pier or Pile Bent model. Then click the Design Tables "D" button on the toolbar, as shown in **Figure 1**.

👬 FB-MultiPier File	e: C:\Documents and Set	ttings\All Users\Documents\BS	I\FB-MultiPier\
<u>File View</u> Control W	/izard <u>H</u> elp		
	M 🔎 🕅 🖬 🕅 🙀	🗐 🔃 🖑 🛛 Pier #1 💌 🗍	🕂 Load Case
Model Data Global	Problem Problem Type General Pier Pile and Cap Only	Project Data	

Fig. 1 Accessing the Design Tables

Index Table

What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

From here, a wide range of output data can be retrieved with ease, where the data are pre-packaged into succinct, summary formats. Data available among the Design Tables include:

- 1. Maximum Axial Forces at All Pile Heads this table displays the maximum compression and maximum tension forces at the pile head nodes, across all load cases. These data are useful in making comparisons to pile driving capacities.
- 2. Maximum Demand/Capacity Ratio For All Pile Cross Sections this table displays the maximum demand capacity ratio for each pile cross section across all load cases, as well as the corresponding internal forces.
- 3. Maximum Demand/Capacity Ratio For All Column Cross Sections this table displays the maximum demand capacity ratio for each column cross section across all load cases, as well as the corresponding internal forces.
- 4. Pier Cap Shear F22 Design there are two sub tables of this type. The first table displays the maximum (+) shear forces at the immediate left and right of the bearings; and, at the left face, right face, and centerline of supports. The second table contains the corresponding minimum (-) shear forces at the aforementioned locations.
- 5. Pier Cap M33 Moment Design there are two sub tables of this type. The first table displays the maximum (+) moment forces at the bearings and at the left face, right face and centerline of supports. The second table contains the corresponding minimum (-) moment forces at the aforementioned locations.
- 6. Maximum Forces for All Pile Cross Sections this table displays the maximum and minimum axial force for each pile cross section across all load cases, and the corresponding internal forces. This table also repeats this process for the maximum and minimum Shear 2, maximum and minimum Shear 3, maximum and minimum Moment 2, maximum and minimum Moment 3, and maximum and minimum Torque.
- Maximum Forces for All Column Cross Sections this table displays the maximum and minimum axial force for each column cross section across all load cases, and the corresponding internal forces. This table also provides analogous summary data for the maximum and minimum Shear 2, maximum and minimum Shear 3, maximum and minimum Moment 2, maximum and minimum Moment 3, and maximum and minimum Torque.

Bridge Software Institute - Newsletter

Page 4



Index Table

What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

8. Maximum Forces for All Extra Member Cross Sections - this table displays the maximum and minimum axial force for each extra member cross section across all load cases, and the corresponding internal forces. This table also repeats this process for the maximum and minimum Shear 2, maximum and minimum Shear 3, maximum and minimum Moment 2, maximum and minimum Moment 3, maximum and minimum Torque, and maximum D/C ratio.

In addition to the table-formatted data, plotting utilities are now available to view moment shear envelopes for the pier cap, as shown for an example case in **Fig. 2**, below.



Fig. 2 Example F22 Shear envelope for a pier cap.

Index Table

What's New at BSI Page 2 FB-MultiPier v4.19

Technical Corner Page 2

> Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697



Fig. 3 Example M33 Moment envelope for a pier cap.

With these powerful, new post-processing features, the BSI Team hopes that the process of generating technical reports from analysis results will become much more direct, saving you valuable design time!

Index Table

What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

> Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

Discussions

In modeling bridge and pier structures using FB-MultiPier, the node-to-node spacing between elements (or mesh density) can have a significant effect on predictions of structural response. Therefore, it is extremely important to make sure that the element meshes for constituent model members have been sufficiently refined. A practical means of ensuring proper mesh density is to incrementally refine (or increase) a given member mesh density until consistent responses are observed from one mesh refinement to the next.

To illustrate the process of mesh refinement, consider the following pile and cap model, with the incrementally refined meshes shown in **Fig. 4 - Fig. 7**. The mesh density of the pile cap in **Fig. 4** is such that there are three elements across the cap short dimension, and five elements across the cap long dimension. The aspect ratios of the pile cap shell elements vary from 1:2 to 1:4. Additionally, the underlying piles shown in **Fig. 4** contain five nodes from pile head to pile tip. In contrast, through incremental refinement, the pile cap mesh shown in **Fig. 7** contains seven elements along the pile cap short dimension and 14 elements along the pile cap long dimension. Also, the piles shown in **Fig. 7** contain 25 nodes from pile head to pile tip.



Fig. 4 Coarsely meshed pile and cap model



What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697



Issue #14



Index Table

What's New at BSI

Page 2 FB-MultiPier v4.19

Technical Corner Page 2

Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697



Fig. 7 Incrementally refined mesh pile and cap model

For each model illustrated above in **Fig. 4 - Fig. 7**, self-weight loading, and three concentrated vertical loads are applied. Additionally, a lateral load is applied in each model such that the pile and cap system is applied at the leading edge of the pile cap. Salient results taken from the analysis outputs are listed in **Table 1**. It is clear from the analysis results that significant differences exist between the structural response predicted in association with the mesh shown in **Fig. 4**, relative to that associated with the mesh shown in **Fig. 5**. However, the response differences diminish for an analogous comparison between the results obtained using the mesh in **Fig. 4** as opposed to the mesh used in **Fig. 5**. Finally, the differences in predicted structural response for the mesh shown in **Fig. 6**, relative to the mesh shown in **Fig. 7**, vary by less than 1%, indicating that the mesh is sufficiently refined for any of **Fig. 6** or **Fig. 7**.

Model	Max lateral displacement (in)	Max vertical displacement (in)	Max pile shear (kip)	Max pile moment (kip-ft)
Fig. 4	2.99	0.78	35	802
Fig. 5	3.25	0.78	34	788
Fig. 6	3.29	0.79	34	767
Fig. 7	3.28	0.79	34	770

Issue #14

Page 9

spring **2014**

Index Table

What's New at BSI Page 2

FB-MultiPier v4.19

Technical Corner Page 2

> Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

BSI Program Status



FB-MultiPier V4.19 Download a FREE demo today!

Released: November 27, 2013 - 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 <u>here</u>.

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 <u>here</u>.

<u>Atlas V6.04</u>

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 twopoint attachments and suspended box systems. For more information about Atlas, click <u>here</u>.



Page 10

spring **2014**

Index Table

What's New at BSI Page 2 FB-MultiPier v4.19

Technical Corner Page 2

Discussions Page 6

Program Status Page 9

FB-MultiPier v4.19 FB-Deep v2.04 Atlas v6.04

> For Technical Support Page 10

Contact BSI Page 10

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611

> Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

For Technical Support

Cary Peterson 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 <u>bsi@ce.ufl.edu</u> 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 upto-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.

Contact BSI

If you need to contact BSI for any reason you can use any of the methods below: Online: <u>bsi.ce.ufl.edu</u> Email: bsi@ce.ufl.edu Fax: (352) 392-3697

Mailing Address:

Bridge Software Institute University of Florida PO Box 116580 Gainesville, FL 32611