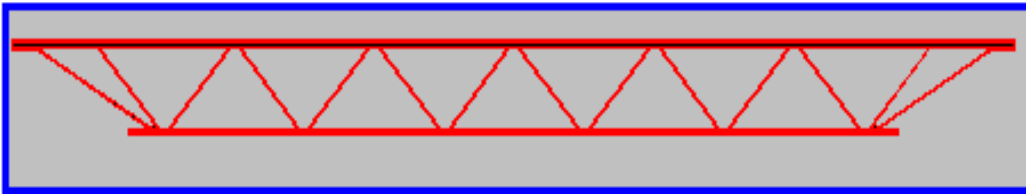


# **BARJOIST**



## **USER'S GUIDE**

**April 2001**

*Spencer Engineering, Inc.  
P.O. Box 321 Carmel, IN 46082*

*Ph: 317-848-2394 Fax: 317-848-2397  
[www.spencer-engineering.com](http://www.spencer-engineering.com)*

# **TABLE OF CONTENTS**

I. Introduction .....	3
II. Joist Tables .....	5
III. Joist Selection .....	7
IV. Vibration Analysis .....	9
V. User Agreement .....	11
VI. References & Resources .....	12

## **INTRODUCTION**

### **Program Overview**

**BARJOIST** is intended to assist design professionals in evaluating and selecting standard open web steel joists for structural applications. Joist data utilized by the program is from joist load tables and bridging tables published by the Steel Joist Institute (SJI) in their FORTIETH EDITION STANDARD SPECIFICATIONS LOAD TABLES AND WEIGHT TABLES FOR STEEL JOISTS AND JOIST GIRDERS.

The program consists of three interconnected primary sections:

- Joist Tables
- Joist Selection
- Vibration Analysis

The features of each of these are described further under other Guide topics.

Vibration analysis performed by the program is based on procedures contained in SJI's Technical Bulletin No. 5, VIBRATION of steel joist-concrete slab floors.

Users who do not already possess copies of these two SJI documents are encouraged to obtain copies directly from SJI. See the References and Resources section of the User's Guide for contact information.

The program includes load capacities, weights, and bridging information for K, LH, and DLH series joists and can handle spans from 8 ft. To 144 ft. "Span" as used in the program for the various series is as used in the SJI specifications and load tables. For the LH and DLH joists, the load tables are based on "clear span" whereas the K series tables include portions of the supports in the definition of span.

Where several joists, listed by the program as meeting the User's selection criteria, are being considered for final selection and they include a mixture of K series with LH series, the User can re-run the analysis including only one series at a time with input span value adjusted for each series' span definition, if so desired.

### **Program Navigation**

The program window consists of a series of tabbed dialog pages containing text area for entering user input and displaying program output. Individual pages can be accessed by "clicking" on the appropriate tab. In addition each page contains various command buttons, check boxes, etc. for the User's direction of the program operations. Some of these will automatically switch to a new screen when "clicked".

The Welcome page permits turning on or turning off pages associated with each of the three primary sections of the program. Pages that are not in use at some point can be turned off to "unclutter" the program window. At startup the default is to have all pages turned on

Turning off a page containing input or output data does not cause the data to be lost. It will reappear when the page is turned on again.

### **Menu Bar**

At the top of the program window is a menu bar containing three main menu items:

- File
- Options
- Help

Clicking on “File” will cause a file submenu list to display. The actions generated by clicking on each of these are as follows:

- New - Causes all input and output fields on each of the dialog pages to be cleared and where appropriate reset to their default values.
- Open - Displays a standard Windows file dialog box to permit locating and opening a saved file.
- Save - Saves the currently opened file. If the file has not yet been named, a file dialog box will open to permit naming of the file and selection of the directory it is to be saved in.
- Save As - Displays the file dialog box..
- Exit - Terminates the program and returns control to the Windows desktop.

Clicking on “Options” will cause the Welcome page to reappear at which time program pages can be turned on or off by using the check boxes at the bottom of the page.

Clicking on ”Help” causes a help submenu to display. Clicking “Help Topics “ displays the help system. Clicking on “About” displays the program’s version number, release date and serial number.

### **Using Templates**

At program startup certain data field are set to their default values. Examples are values for acceptable minimum and maximum joist spacing, acceptable minimum and maximum joist depth, types of joists to be considered (K, LH, DLH), etc.

These can be changed and the file saved under a new name if desired. This file can then be opened from the menu bar each time the program is run and the modified settings will then be in effect without having to change them manually.

On an individual project, the project and structure titles could also be saved in this manner to prevent having to re-input them each time the program is run.

### **Printing**

Several of the program pages contain “Print” buttons. Clicking on these will send output to the default printer identified in your Windows Control Panel settings.

## **JOIST TABLES**

### **Joist Table Overview**

The Joist Table section of the program is used to generate a list of joists with their live load capacity, and total load capacity for a given span. The list is generated in ascending order of joist weight; therefore, serves as an “economy table” from which the least weight joist with load capacities meeting the required minimum can be picked.

If a joist spacing is input, the joist weight and load capacities are shown both in units of “plf” and “psf”.

The Joist Table section can also be used to access the joist bridging tables and pass data to the Vibration Analysis section of the program for its use. To enable the bridging and vibration analysis features, a joist spacing must be input.

### **Joist Table Input**

The minimum input required by the Joist Table section of the program is the joist span. The span can be any length between 8 feet and 144 feet. The program performs a straight line interpolation of the SJI capacities for spans that include decimal portions of feet.

The results of the table search can be further controlled by adjusting the minimum and maximum joist depths to be considered. Likewise, each of the joist types (K, LH, DLH series) can be included or excluded by means of the check boxes.

If joist weight in psf units as well as plf units is desired or if bridging or vibration analysis are to be performed, it is necessary that a joist spacing be input.

### **Joist Table Output**

Clicking on the “Joist List” button at the bottom of the page will cause the output list to appear on screen. The joist meeting the input criteria (span, acceptable depth range, acceptable series) will be listed in ascending order of joist weight.

If a joist spacing was input, the joist weight, live load capacity, and total load capacity will be shown both in “plf” and “psf” units.

If after generating the output listing any of the input is modified, the output list is cleared until all changes have been made and the “Joist List” button is clicked again.

### **Printing Joist Table Output**

If hard copy of the Joist Table input and output is desired, click the “Print” button at the bottom of the Joist Table page. Output will be sent to the default Windows system printer configured in your Windows current settings.

### **Bridging Requirements**

To access and view joist bridging requirements for a given joist in the Joist Table output list, it is necessary that a joist spacing be included in the input.

Also the particular joist for which the bridging requirements are desired must be “highlighted” in the output listing by clicking on the line on which the joist is listed.

Then click on the “Bridging” button at the bottom of the Joist Table page.

### **Vibration Analysis**

To access and perform vibration analysis for a particular joist in the Joist Table output list, be sure a joist spacing has been included in the input, “highlight” the joist for which the analysis is desired by clicking on the line on which the joist is listed, and then click on the “Vibration Analysis” button at the bottom of the Joist Table page.

Control will then be switched to the input page of the Vibration Analysis section of the program. See the topics in the Vibration Analysis portion of the User’s Guide for further details.

## **JOIST SELECTION**

### **Joist Selection Overview**

The Joist Selection section of the program is used to generate a list of joists meeting requirements of the input criteria with regard to span, spacing, acceptable joist depth range, acceptable joist type(s), applied dead and live uniform loads, and maximum allowable live load and total load deflections.

Joist spacing can be specified in two different ways. A single spacing must be input if the “Evaluate Single Spacing” checkbox at the top of the Joist Selection input page is checked. A bay width and allowable range of spacings must be input if the “Evaluate Range of Spacings” checkbox is checked.

The difference in results generated for each of the two spacing methods is described in the “Joist Selection Output” section of the User’s Guide. Basically the “Range of spacings” evaluation determines the joist spacing within a given bay width that will result in the least joist weight per square foot of bay area.

Once the “economical” spacing is determined for a range of spacings analysis, the single spacing checkbox on the Joist Selection input page can be checked, the new spacing value entered in the appropriate input box, and a list of other joists meeting all the input criteria can be generated for comparison of joist weights, depths, etc.

The Joist Selection section can also be used to access the joist bridging tables and pass data to the Vibration Analysis section of the program. To enable the bridging and vibration analysis features, the joist for which the bridging requirements or vibration analysis is desired must first be “highlighted” by clicking on the line of output on which the joist is listed.

### **Joist Selection Input**

The minimum input required by the Joist Selection section of the program is the spacing criteria (single or multiple, bay width or given spacing ), the joist span, the applied dead load and applied live load. The span can be any length between 8 feet and 144 feet. The program performs a straight line interpolation of the SJI capacities for spans that include decimal portions of feet.

The results of the joist search can be further controlled by adjusting the minimum and maximum joist depths to be considered and the maximum live and total load deflection ratios that will be permitted. Likewise, each of the joist types (K, LH, DLH series) can be included or excluded by means of the appropriate check boxes.

### **Joist Selection Output**

Clicking on the “OK” button at the bottom of the Joist Selection input page will cause the program to switch to the Joist Selection Results page and the output list to appear on screen. The joists meeting the input criteria will be listed.

If the single spacing evaluation was checked on the Joist Selection input page, the program will generate a list of up to 10 joists that meet the input criteria.

If the range of spacings evaluation was checked, the program will utilize the input minimum and maximum spacing criteria. It will first calculate the minimum number of equal spaces and the maximum number of equal spaces the bay width can be subdivided into without violating the max./min. spacing input criteria. For these two spacings (and each of those in between) the least weight joist meeting all the other input selection criteria is determined.

If after generating the output listing, the Joist Selection input page is returned to and any of the input is modified, the output list is cleared until all changes have been made and the “OK” button is clicked again.

### **Printing Joist Selection Output**

If hard copy of the Joist Selection input and results is desired, click the “Print” button at the bottom of the Joist Selection Results page. Output will be sent to the default Windows system printer configured in your Windows current settings.

If one of the joists is “highlighted” by clicking on its screen output line prior to clicking on the Print button, an arrow indicating which joist was highlighted will be included in the printout.

### **Bridging Requirements**

To access and view joist bridging requirements for a given joist in the Joist Selection output list, the particular joist for which the bridging requirements are desired must be “highlighted” in the output listing by clicking on the line on which the joist is listed.

Then click on the “Bridging” button at the bottom of the Joist Selection Results page.

### **Vibration Analysis**

To access and perform vibration analysis for a particular joist in the Joist Selection output list, “highlight” the joist for which the analysis is desired by clicking on the line on which the joist is listed, and then click on the “Vibration Analysis” button at the bottom of the Joist Selection output page.

Control will then be switched to the input page of the Vibration Analysis section of the program. See the topics in the Vibration Analysis portion of the User’s Guide for further details.

## **VIBRATION ANALYSIS**

### **Vibration Analysis Overview**

The Vibration Analysis section of the program generally follows the procedures of the Steel Joist Institute Technical Digest No. 5, VIBRATION of steel joist-concrete slab floors, written by Dr. Theodore V. Galambos. If the User does not already possess a copy of this publication, it is recommended that he or she do so by contacting the Steel Joist Institute. See the “References and Resources” section of the User’s Guide for contact information.

For this program the procedures for calculating the floor system’s effective moment of inertia were modified from those presented in the above reference in order to take into account the effect of floor deck run perpendicular to the joists. Because of the deck rib height the moment of inertia of the floor slab calculated at a “peak” in the deck is different than that in a “valley”.

The procedures of the program use a “weighted” average for moment of inertia, giving 2/3 weight to the value calculated in the deck valley and 1/3 to the value calculated at the top of the deck rib. Results have been found to compare favorably with those generated by other software based on the SJI Technical Digest No. 5 method.

### **Vibration Analysis Input**

Much of the input required by the Vibration Analysis section of the program is automatically copied from the program section from which the Vibration Analysis button was clicked. From the Joist Table section, this includes the joist designation, joist span, joist depth, joist weight, and the joist total uniform load capacity.

Remaining input to be entered by the User includes the design live load, concrete unit weight, concrete strength, floor deck rib height, thickness of concrete above the deck rib, uniform dead load other than the weight of joist, deck and slab, and the percentage of the design live load assumed to be acting during the loading condition for which the analysis is to be performed.

The only difference in input procedures in the case of the Vibration Analysis button of the Joist Selection section being clicked is that the design live load is also automatically copied from the Joist Selection Input page.

Input values that were copied from other program sections cannot be changed on the Vibration Analysis Input page. The values can only be changed by returning to the input page of the appropriate section, making the changes, and then clicking the “Vibration Analysis” button again.

### **Vibration Analysis Output**

Output of the program’s Vibration Analysis section include the floor’s calculated natural frequency, the calculated maximum amplitude due to two types of impact, the results from a human response equation developed by Wiss and Parmalee, and the results of a floor acceptance criterion equation developed by Murray.

The background theory and nomenclature associated with floor vibration analysis and interpretation of results are discussed in detail in the Steel Joist Institute Technical Digest No. 5, VIBRATION of steel joist-concrete slab floors, written by Dr. Theodore V. Galambos. If the User does not already possess a copy of this publication, it is recommended that he or she do so by contacting the Steel Joist Institute. See the “References and Resources” section of the User’s Guide for contact information.

### **Vibration Analysis Graph**

In addition to numerical results, a plot of calculated frequency and amplitudes superimposed on a graph of Modified Human Response Domains for Transient Vibration of Steel Joist-Concrete Slab Floors According to Lenzen can be generated by clicking on the “Graphic” button at the bottom of the Vibration Analysis Results page.

### **Printing Vibration Analysis Results**

If hard copy of the Vibration Analysis input and results is desired, click the “Print” button at the bottom of the Vibration Analysis Results page. Hard copy of the plotted graph can be obtained by clicking on the “Print” button on the Graph page. Output will be sent to the default Windows system printer configured in your Windows current settings.

## **USER AGREEMENT**

### **User Agreement**

License for use of this software was issued to the Purchaser based on Purchaser's agreement to the terms and conditions contained herein. Under this license the Purchaser is authorized to permit use of this software by others as long as such use is in compliance with this agreement. As User, you are required to acknowledge you have also read and accept the terms of this agreement before the program can be accessed

#### **General:**

In purchasing and using this software product, Purchaser and User understand this software is intended to assist qualified design professionals in evaluating and selecting standard steel bar joists for structural applications. It is not intended to replace or diminish the requirement for knowledge, experience, competence or responsible judgment in design of structures and in particular those involving life and safety issues. Whereas the program may be useful to a broad range of design personnel, particularly in preliminary stages of design, Purchaser and User understand final design will still require a qualified structural design professional's review and independent verification of the accuracy and suitability of any design resulting from the use of this software.

#### **License:**

Purchaser is granted permission to use and allow use of this software by Purchaser's employees , subject to the following limitations:

1. The program diskettes shall not be copied except that Purchaser is authorized to make one archival copy for the sole purpose of back-up.
2. The software shall not be available, at any time, in any form, for simultaneous use by more users than the number paid for by Purchaser and authorized in the Purchase Agreement.
3. Neither the software nor this license shall be transferred, assigned, leased , donated or made available in any other manner to anyone other than those persons authorized under this agreement, without written permission of Spencer Engineering, Inc.
4. Spencer Engineering, Inc. retains the right to terminate this license, with written notice, if any breach of the terms or conditions of the Purchase Agreement are found to have occurred.
5. Upon termination of this license, all copies of this software in Purchaser's possession, in any form, shall be destroyed.

#### **Warranty:**

With respect to the program diskettes issued to Purchaser, Spencer Engineering, Inc. (SEI) warrants the same to be free of defects in materials and workmanship for a period of six months from the date of purchase. In the event of notification within the warranty period of defects in material or workmanship that have occurred under normal use ,and return of the defective program diskettes to SEI, SEI will replace the defective diskettes. The remedy for such defects shall be limited to replacement of the program diskettes and shall not encompass any other damages.

Spencer Engineering, Inc.(SEI) and Bill Spencer, the program's author, disclaim any and all warranties, expressed or implied, as to the accuracy, fitness or suitability of this software or information contained therein with respect to any particular application, use, or purpose or freedom from infringement of any patent, trademark, or copyright. In no event shall SEI or the program's author be liable for any loss of profit or any other commercial damage including but not limited to special, incidental, consequential or other damages, resulting from the use of this software.

## **REFERENCES AND RESOURCES**

### **SJI**

The following recommended supplemental information is available from the Steel Joist Institute:

1. FORTIETH EDITION STANDARD SPECIFICATIONS LOAD TABLES AND WEIGHT TABLES FOR STEEL JOISTS AND JOIST GIRDERS, Copyright 1994 by Steel Joist Institute
2. Technical Digest No. 5 VIBRATION of steel-joist-concrete slab floors, Revised March 1988, Written by Dr. Theodore V. Galambos, Consulting Engineer, University of Minnesota, Minneapolis, Minnesota
3. DESIGNING WITH STEEL JOISTS JOIST GIRDERS STEEL DECK, Authored by Dr. James M. Fisher, Michael A. West, and Julius P. Van de Pas, Computerized Structural Designs, Inc., Milwaukee, Wisconsin, Copyright 1991 by Nucor Corporation

Contact information:

Steel Joist Institute  
3127 10<sup>th</sup> Ave. North Ext.  
Myrtle Beach, SC 29577-6760  
Ph. (843)626-1995  
Fax (843)626-5565  
Web Site: [www.steeljoist.com](http://www.steeljoist.com)

### **AISC**

The following recommended supplemental information is available from the American Institute of Steel Construction:

1. Steel Design Guide Series 11, Floor Vibrations Due to Human Activity, Authored by Dr. Thomas M. Murray, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, Dr. David E. Allen, Institute for Research in Construction National Research Council Canada, Ottawa, Ontario, Canada, and Dr. Eric E. Ungar, Acentech Incorporated, Cambridge, Massachusetts, Copyright 1997 by American Institute of Steel Construction

Contact information:

American Institute of Steel Construction  
One East Wacker Drive, Suite 3100  
Chicago, Illinois 60601-2001  
Ph. (800) 644-2400  
Ph. (312) 670-2400  
Fax (312) 670-5403  
Web Site: [www.aisc.org](http://www.aisc.org)