

## Excel Exercise 1:

### Goals:

1. Become familiar with Guidelines for spans and proportions of common spanning members (Chapter 1).
2. Become familiar with basic commands in Excel for performing simple tasks and for organizing and arranging data.

### Requirements:

1. Information in Chapter 1 of the book.
2. A computer with Microsoft Excel.

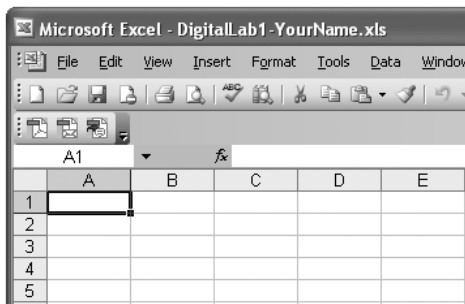
### Comments:

Understanding and calculating spans and proportions for common structural members is more important than anything else you will do in structural design.

### Instructions:

- Create a new Blank Workbook in Excel.
- Save the workbook as DigitalLab1-YourName.

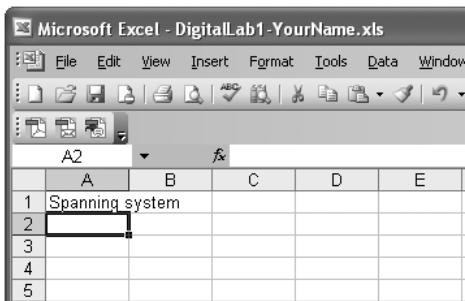
Within the spreadsheet, columns are labeled with letters and rows are labeled with numbers.



Cells can contain a variety of inputs, including, but not limited to:

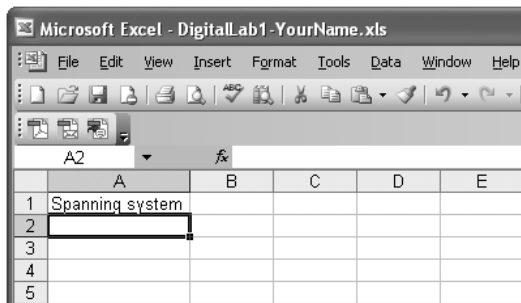
- Text
- Numbers
- Formulas for performing computations

- In cell A1, type: Spanning system
- Press Enter



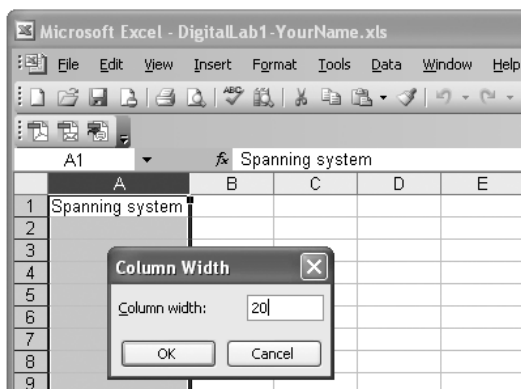
The words extend beyond cell A1. If data is typed into cell B1, the overlapping text from cell A1 will be hidden by the new text. Column A should be widened to adjust to the width of the text.

- Double click the line in the header which separates columns A and B. The cell automatically adjusts to the correct width.



To more precisely set the column width:

- Click on the A at the top of column A.
- Go to Format>Column>Width.
- In the Column Width popup, in the Column Width field, type in any number and click OK.



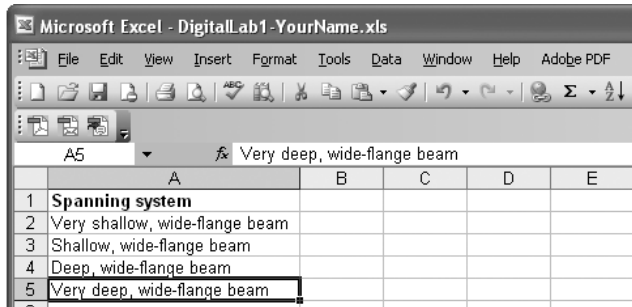
To precisely set row height:

- Click the number of any row.
- With the row highlighted, go to Format>Row>Height.

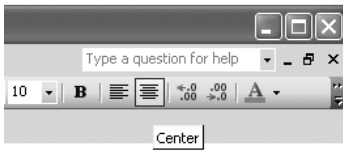
Any column or row can also be resized by placing the cursor on the line separating the row or column and dragging to resize.

Global changes can be made to the spreadsheet by clicking the corner box in the header (above row 1 and to the left of column A). This highlights the entire spreadsheet, after which many things can be changed, including the global column width, global row height, font type, and text size, etc.

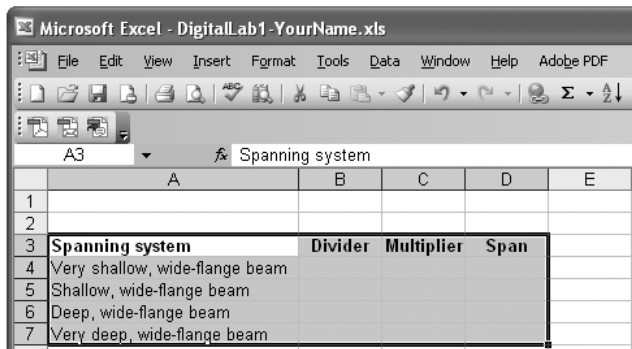
- Click on cell A1.
- Hold down Ctrl and the B key at the same time (Ctrl+B) to bold the text. (Or click the Bold Icon – **B** – in the toolbar, but keyboard shortcuts are faster when you know them.)
- In cell A2, type: Very shallow, wide-flange beam
- Press Enter. Now in cell A3, type: Shallow, wide-flange beam
- In cell A4, type: Deep, wide-flange beam
- In cell A5, type: Very deep, wide-flange beam
- Make Column A wider to fit the new width of text.



- In cell B1, type: Divider. Notice that the word is left justified.
- Highlight column B.
- Hold down Shift and click on K. (If you need to, use the scroll bar at the bottom of the sheet to scroll over to column K.)
- With columns B through K highlighted, click on the center alignment icon at the upper right of the toolbar.



- Click and drag from cell B1 to K1 to highlight the first cell in each of those columns. Make the cells bold.
- In cell C1, type: Multiplier.
- Press Tab. Now in cell D1, type: Span.
- Click and drag from cell A1 to cell D5 to highlight those cells.
- Click and drag on the bottom line of the black rectangle surrounding the highlighted cells. Drag down two rows to move the contents of the cells.



- Click on cell D3. Move cell D3 up two rows.
- In cell D2 type: L
- Make cell D2 bold.
- In cell D3 type: (ft)
- In cell B4 type: 28
- In cell B5 type: 24
- In cell B6 type: 20
- In cell B7 type: 18

|   | A                              | B              | C                 | D    |
|---|--------------------------------|----------------|-------------------|------|
| 1 |                                |                |                   | Span |
| 2 |                                |                |                   | L    |
| 3 | <b>Spanning system</b>         | <b>Divider</b> | <b>Multiplier</b> | (ft) |
| 4 | Very shallow, wide-flange beam | 28             |                   |      |
| 5 | Shallow, wide-flange beam      | 24             |                   |      |
| 6 | Deep, wide-flange beam         | 20             |                   |      |
| 7 | Very deep, wide-flange beam    | 18             |                   |      |

The upper and lower extreme values of these “dividers” are from page 29 of Chapter 1, for the proportions of wide-flange beams. They represent the extreme range of proportions for wide-flange beams. The two intermediate dividers are included to give more typical proportions than the extremes. These dividers are used to calculate the depth of the beam. Beam depth is found by dividing the Span L by the divider. These dividers are left from the days when we only had slide rules or our brains to perform simple computations. These dividers give good, economic proportions, and are also memorable and easy to manipulate.

For example:

20 is easy to remember and to divide by 2 and 10 in our heads.

24, as a factor of 12, is very easy to manipulate within the imperial system of units (feet and inches). We divide the length of the beam’s span, in feet, by 2. The resulting number is the depth of the beam in inches.

This is still the most common first step in estimating the depth of a wide-flange beam. Today, we have calculators and spread sheet programs. Such creative mental manipulation of numbers is no longer as crucial as it used to be.

The best way to start the calculations is with the span, which we know, and move on to the depth, which we are trying to estimate<sup>1</sup>.

- In cell C4 type: =1/B4
- Press Enter.

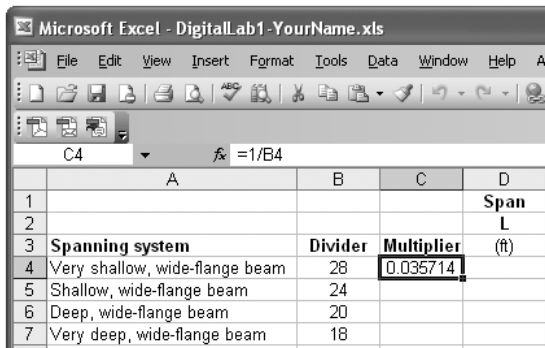
The equal sign is the method of telling Excel that you want it to perform a computation. The end product of that computation is displayed in the cell.

|   | A                              | B              | C                 | D    |
|---|--------------------------------|----------------|-------------------|------|
| 1 |                                |                |                   | Span |
| 2 |                                |                |                   | L    |
| 3 | <b>Spanning system</b>         | <b>Divider</b> | <b>Multiplier</b> | (ft) |
| 4 | Very shallow, wide-flange beam | 28             | 0.035714          |      |
| 5 | Shallow, wide-flange beam      | 24             |                   |      |
| 6 | Deep, wide-flange beam         | 20             |                   |      |
| 7 | Very deep, wide-flange beam    | 18             |                   |      |

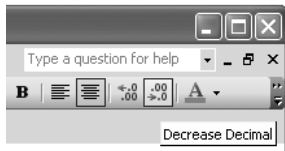
<sup>1</sup> It might seem more appropriate to express the process in terms of a multiplier. For some situations, we will do that, since there is often confusion in the fact that the larger divider leads to a shallower beam. Multipliers have the advantage that the larger multiplier corresponds to the deeper beam. Dividers, however, express an aspect of proportions that our minds grasp fairly easily. They represent how much longer the beam is than it is deep. We are better able to visualize a beam that is 20 times longer than it is deep than we can a beam that is 0.05 times as deep as it is long.

To display text starting with an equal sign without Excel performing the calculation, put a single quote in front of the expression.

- In cell E3 type: '=1/B4
- Press Enter. Excel simply displays the expression after the single quote as a text string, rather than doing any computation.
- Highlight cell E3. Press Backspace to clear the cell.
- Click on cell C4. The formula is displayed in the formula bar above the column headers, the generated number is displayed in the cell. If you wanted to edit the formula, you would do so in the formula bar.



- Click the Decrease Decimal icon in the toolbar until there are only three digits shown after the decimal.



The Increase Decimal icon is to the left of the Decrease Decimal icon. Using these icons does not change the accuracy to which the computations are being performed. It simply changes how many figures are being displayed. Since we have a hard time remembering or even evaluating too many figures, we are reducing the number to three digits after the decimal, which in this case is only two significant figures. The fraction 0.036 is the multiplier, that is, the number by which we would multiply the length to get the depth.

- Highlight cells C4 through C7.
- Hold down Ctrl and press the D key (Ctrl+D). This is called Fill Down<sup>2</sup>.

This creates formulas in all the cells below C4. These formulas are automatically adjusted to correspond with the correct cells. For example:

- Click cell C7. The formula =1/B7 appears in the formula bar.

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<sup>2</sup> An alternate method is Edit>Fill>Down. You may also Fill Right with Ctrl+R.

|   | A                              | B              | C                 | D    |
|---|--------------------------------|----------------|-------------------|------|
| 1 |                                |                |                   | Span |
| 2 |                                |                |                   | L    |
| 3 | <b>Spanning system</b>         | <b>Divider</b> | <b>Multiplier</b> | (ft) |
| 4 | Very shallow, wide-flange beam | 28             | 0.036             |      |
| 5 | Shallow, wide-flange beam      | 24             | 0.042             |      |
| 6 | Deep, wide-flange beam         | 20             | 0.050             |      |
| 7 | Very deep, wide-flange beam    | 18             | 0.056             |      |

- In cell D4 type: 32
- Highlight cells D4 through D7.
- Fill Down (Ctrl+D)
- In cell E1 type: Depth
- In cell E2 type: d
- In cell E3 type: (ft)
- In cell F1 type: Depth
- In cell F2 type: d
- In cell F3 type: (in)
- Make cells E2 and F2 bold, if they are not already.

|   | A                              | B              | C                 | D    | E     | F     |
|---|--------------------------------|----------------|-------------------|------|-------|-------|
| 1 |                                |                |                   | Span | Depth | Depth |
| 2 |                                |                |                   | L    | d     | d     |
| 3 | <b>Spanning system</b>         | <b>Divider</b> | <b>Multiplier</b> | (ft) | (ft)  | (in)  |
| 4 | Very shallow, wide-flange beam | 28             | 0.036             | 32   |       |       |
| 5 | Shallow, wide-flange beam      | 24             | 0.042             | 32   |       |       |
| 6 | Deep, wide-flange beam         | 20             | 0.050             | 32   |       |       |
| 7 | Very deep, wide-flange beam    | 18             | 0.056             | 32   |       |       |

- In cell E4, type: =D4/B4
- Press Enter
- In cell F4, type: =E4\*12
- Press Enter

An asterisk is used to instruct Excel to do a multiplication.

- Reduce the number of digits shown after the decimal to three for both cells E4 and F4.
- Highlight cells E4 through F7.
- Fill Down

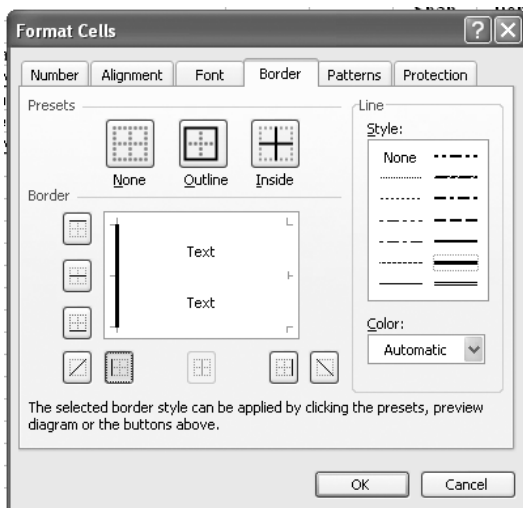
Microsoft Excel - DigitalLab1-YourName.xls

File Edit View Insert Format Tools Data Window Help Adobe PDF

E4      =D4/B4

|   | A                              | B       | C          | D    | E     | F      |
|---|--------------------------------|---------|------------|------|-------|--------|
| 1 |                                |         |            | Span | Depth | Depth  |
| 2 |                                |         |            | L    | d     | d      |
| 3 | Spanning system                | Divider | Multiplier | (ft) | (ft)  | (in)   |
| 4 | Very shallow, wide-flange beam | 28      | 0.036      | 32   | 1.143 | 13.714 |
| 5 | Shallow, wide-flange beam      | 24      | 0.042      | 32   | 1.333 | 16.000 |
| 6 | Deep, wide-flange beam         | 20      | 0.050      | 32   | 1.600 | 19.200 |
| 7 | Very deep, wide-flange beam    | 18      | 0.056      | 32   | 1.778 | 21.333 |

- In cell G1, type: Maximum
- In cell G2, type: Span
- In cell G3, type: Commonly
- In cell G4, type: Used
- In cell G5, type: (ft)
- In cell G6, type: Get from
- In cell G7, type: Tables
- Highlight cells G1 through G7.
- Ctrl+1. This brings up the Format Cells popup<sup>3</sup>.
- In the Format Cells popup, click the Border tab.
- In the Format Cells popup, in the Line Box, under the Style heading, click the icon of the thickest line.
- In the Format Cells popup, under the Border heading, click the icon with a solid vertical line on the left of the dashed grid within it. This will make a thick, vertical line appear on the left within the preview box.



- In the Format Cells popup, click OK.

A bold line now separates the data.

<sup>3</sup> Also: Format>Cells

|   | A                              | B              | C                 | D           | E            | F            | G              |
|---|--------------------------------|----------------|-------------------|-------------|--------------|--------------|----------------|
| 1 |                                |                |                   | <b>Span</b> | <b>Depth</b> | <b>Depth</b> | <b>Maximum</b> |
| 2 |                                |                |                   | <b>L</b>    | <b>d</b>     | <b>d</b>     | <b>Span</b>    |
| 3 | <b>Spanning system</b>         | <b>Divider</b> | <b>Multiplier</b> | (ft)        | (ft)         | (in)         | Commonly       |
| 4 | Very shallow, wide-flange beam | 28             | 0.036             | 32          | 1.143        | 13.714       | Used           |
| 5 | Shallow, wide-flange beam      | 24             | 0.042             | 32          | 1.333        | 16.000       | (ft)           |
| 6 | Deep, wide-flange beam         | 20             | 0.050             | 32          | 1.600        | 19.200       | Get from       |
| 7 | Very deep, wide-flange beam    | 18             | 0.056             | 32          | 1.778        | 21.333       | Tables         |

Using lines to visually organize a spreadsheet is invaluable. In this case, the heavy line suggests a break in the continuity of the process: everything to the left of the heavy line has to do with computations for a particular specified span. The cells to the right of the line involve information retrieved directly from the figures on spans and proportions in Chapter 1 of the textbook.

Another important organizing tool, is the insertion or deletion of rows, columns, and cells.

- Click on C. With column C highlighted, right click and click Insert.

A new, blank column appears, while the data formerly in column C has been moved to the right.

- With column C still highlighted, right click again and click Delete.

The data moves back to its original location. The same may be done for rows and cells.

Homework:

Using data from the tables on spans and proportions (Fig. 1-37), in your book, use the methods from this exercise to:

- Format your spreadsheet to match the one listed below.
- Input data from tables and create formulae to complete the spreadsheet.

Note: The length at which a member is shown in the tables is the Maximum Span Commonly Used for that member.

|    | A   | B                                | C                 | D           | E            | F   | G              | H            | I    | J    | K              |
|----|---|----------------------------------|-------------------|-------------|--------------|---|----------------|--------------|------|------|----------------|
| 1  |   |                                  |                   | <b>Span</b> | <b>Depth</b> | <b>Depth</b>  | <b>Maximum</b> |              |      |      |                |
| 2  |   |                                  |                   | <b>L</b>    | <b>d</b>     | <b>d</b>  | Span           |              |      |      |                |
| 3  | <b>Spanning system</b>                              | <b>Divider</b>                   | <b>Multiplier</b> | (ft)        | (ft)         | (in)  | Commonly       |              |      |      |                |
| 4  |   |                                  |                   |             |              |   | Used           |              |      |      |                |
| 5  |   |                                  |                   |             |              |   | (ft)           |              |      |      |                |
| 6  |   |                                  |                   |             |              |   | Get from       |              |      |      |                |
| 7  | <b>Simple-span, wide-flange beam</b>                |                                  |                   |             |              |   | Tables         |              |      |      |                |
| 8  | Very shallow  | 28                               | 0.036             | 32          | 1.143        | 13.714  |                |              |      |      |                |
| 9  | Shallow   | 24                               | 0.042             | 32          | 1.333        | 16.000  |                |              |      |      |                |
| 10 | Deep  | 20                               | 0.050             | 32          | 1.600        | 19.200  |                |              |      |      |                |
| 11 | Very deep   | 18                               | 0.056             | 32          | 1.778        | 21.333  |                |              |      |      |                |
| 12 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 13 | <b>Cantilevered, wide-flange beam</b>               |                                  |                   |             |              |   |                |              |      |      |                |
| 14 | Very shallow  | 14                               |                   | 16          |              |   |                |              |      |      |                |
| 15 | Shallow   | 12                               |                   | 16          |              |   |                |              |      |      |                |
| 16 | Deep  | 10                               |                   | 16          |              |   |                |              |      |      |                |
| 17 | Very deep   | 9                                |                   | 16          |              |   |                |              |      |      |                |
| 18 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 19 | <b>Simple-span, plate-girder</b>                    |                                  |                   |             |              |   |                |              |      |      |                |
| 20 | Shallow   |                                  |                   | 100         |              |   |                |              |      |      |                |
| 21 | Deep  |                                  |                   | 100         |              |   |                |              |      |      |                |
| 22 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 23 | <b>Cantilevered, plate-girder</b>                   |                                  |                   |             |              |   |                |              |      |      |                |
| 24 | Shallow   |                                  |                   | 50          |              |   |                |              |      |      |                |
| 25 | Deep  |                                  |                   | 50          |              |   |                |              |      |      |                |
| 26 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 27 | <b>Steel Fink Truss</b>                             |                                  |                   |             |              |   |                |              |      |      |                |
| 28 | Shallow   |                                  |                   | 200         |              |   |                |              |      |      |                |
| 29 | Deep  |                                  |                   | 200         |              |   |                |              |      |      |                |
| 30 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 31 | <b>Standard, double-angle, parallel-chord truss</b> |                                  |                   |             |              |   |                |              |      |      |                |
| 32 | Very shallow  |                                  |                   | 32          |              |   |                |              |      |      |                |
| 33 | Shallow   | 20                               |                   | 32          |              |   |                |              |      |      |                |
| 34 | Deep  | 16                               |                   | 32          |              |   |                |              |      |      |                |
| 35 | Very deep   |                                  |                   | 32          |              |   |                |              |      |      |                |
| 36 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 37 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 38 | <b>Steel bow truss</b>                              |                                  |                   |             |              |   |                |              |      |      |                |
| 39 | Shallow   |                                  |                   | 300         |              |   |                |              |      |      |                |
| 40 | Deep  |                                  |                   | 300         |              |   |                |              |      |      |                |
| 41 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 42 | <b>Simple-span wood joists</b>                      |                                  |                   |             |              |   |                |              |      |      |                |
| 43 | Shallow   |                                  |                   | 16          |              |   |                |              |      |      |                |
| 44 | Deep  |                                  |                   | 16          |              |   |                |              |      |      |                |
| 45 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 46 | <b>Simple-span Glulam wood beams</b>                |                                  |                   |             |              |   |                |              |      |      |                |
| 47 | Shallow   |                                  |                   | 50          |              |   |                |              |      |      |                |
| 48 | Deep  |                                  |                   | 50          |              |   |                |              |      |      |                |
| 49 |   |                                  |                   |             |              |   |                |              |      |      |                |
| 50 |   | <b>Overall Rise of the Frame</b> |                   |             |              | <b>The Depth of the Cantilever</b>                  |                |              |      |      | <b>Maximum</b> |
| 51 |   |                                  |                   |             |              | Assume length of cantilever is half of overall span |                |              |      |      | Span           |
| 52 |   |                                  |                   | <b>Span</b> | <b>Rise</b>  |   |                |              |      |      | Commonly       |
| 53 |   | <b>Divider</b>                   | <b>Multiplier</b> | of frame    | of frame     | <b>Length</b>                                       | <b>Depth</b>   | <b>Depth</b> |      |      | Used           |
| 54 |   | for                              | for               | L           | R            | of  | at base of     | at base of   |      |      | (ft)           |
| 55 |   | frame                            | frame             | (ft)        | (ft)         | Cantilever  | cantilever     | cantilever   |      |      | Get from       |
| 56 | <b>Rigid frame made from plates</b>                 |                                  |                   |             |              | for   | for            |              |      |      | Tables         |
| 57 | Shallow   |                                  |                   | 120         |              | cantilever  | cantilever     | (ft)         | (ft) | (in) |                |
| 58 | Deep  |                                  |                   | 120         |              |   |                |              |      |      |                |
| 59 |   |                                  |                   |             |              |   |                |              |      |      |                |