# Lesson 9: Determining Spacing

SPECIFIC OBJECTIVES

By the end of this lesson, you should understand that

- Spacing of things can be adjusted mathematically to create even spacing
- This is used in many different situations

By the end of this lesson, you should be able to

- Calculate and layout things with even spacing
- Use Construction Master to do this, using memory button

PROBLEM SITUATION 1: Stairs
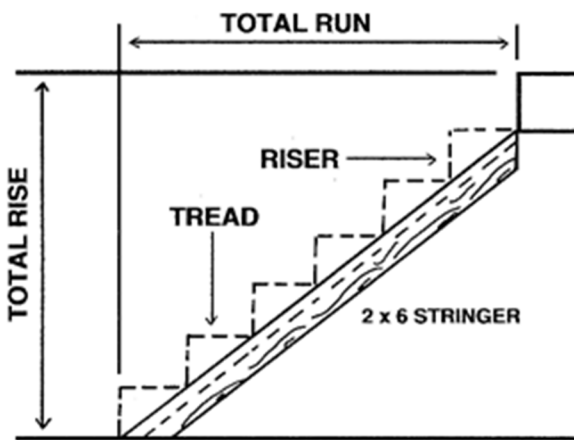
Total rise: With respect to stairs, this is the vertical distance from the lower finished floor to the upper finished floor.

Riser: The vertical part of each step in a flight of stairs.

1. Do the following problem (this is from your Lesson 3 Practice Set):
   The landing of a stairway is 59" inches high, and each rise is 7 3/8" high. How many risers does it take to reach the landing?

2. You are designing a stairway for a private home. Wisconsin Code requires a riser NO GREATER THAN 8" for each riser in a stair in a private home. If the home has a total rise for the stairway of 93"…

    a. How many risers will you need? Write down your answer and the math you did to find it.

    b. Discuss with your group a strategy you can use to make sure each riser is the same height. Write down the strategy below.

    c. What is the height of each riser?

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PROBLEM SITUATION 2: Siding

Bevel Siding

Stud

Siding: The exterior covering of a house. It is often made of horizontal pieces of wood (clapboards) that are partially overlapped.

Nail clears tip of siding, penetrates wood 1½"

Reveal: How much of a piece of siding is left visible. This is also called exposure.

Course: A horizontal row of a building material that has been applied to the house.

Sheathing

Vapor Barrier

Furring strip
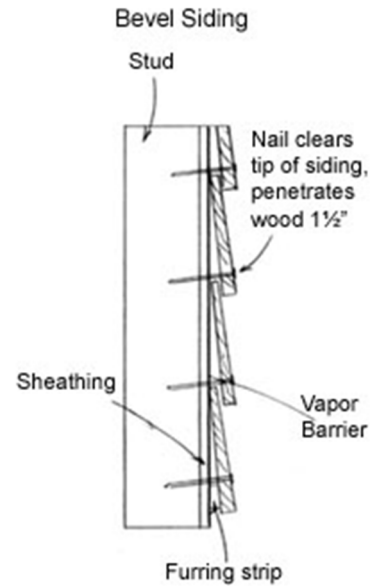
In this problem situation you will be working to determine the spacing you need to install siding on a house. When doing a job like this, it is important to keep in mind:

- The siding must overlap a minimum of 1"
- A professional siding installation needs to have all of the courses (exposure) of siding be the same width.

You have siding that is 5 ¾" wide. It is necessary to side a section of a house that is 40 ½" high. You need to determine what the 'reveal' (exposed amount) of the siding will be for each course to ensure that they are all the same width.

3. Discuss with your group a strategy you would use for this problem situation. Keep in mind that it is similar to the stairs problem. Write down the strategy below.

4. Now calculate (be sure to show your calculations along with your answers):
    a. The number of siding courses you need

    b. The 'reveal' for each course

    c. The 'overlap' for each course

5. Now verify you are correct by using a marker on the 40 ½" board to draw out your siding courses. Show your completed board to the instructor before moving on to Question 6.

Additional Practice - work on determining the spacing for two different siding scenarios

6. You measured the distance from the soffit to the bottom of the house to be 12' 8 ½". Your siding is 5 ¾" wide.
    a. How many courses will you need of the siding? Be sure to show your calculations along with your answer.

    b. What is the exposure amount for each course?

    c. What is the overlap for each course?

7. You measured the distance from the soffit to the bottom of the house to be 11' 1". Your siding is 7 1/2" wide. How many courses will you need of the siding?

    a. How many courses will you need of the siding? Be sure to show your calculations along with your answer.

    b. What is the exposure amount for each course?

    c. What is the overlap for each course?

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PRACTICE for Lesson 9, Problem Situations 1 and 2

Note: When building stairs, the Wisconsin building code requires that all risers be $\leq$ 8" and that all risers be the same.

1. For a flight of stairs with a total rise of 96"

    a. What is the height of each riser? Show your work.

    b. How many risers will the stairs have? Show your work.

2. For a flight of stairs with a total rise of 101"

    a. What is the height of each riser? Show your work.

    b. How many risers will the stairs have? Show your work.

Note: When installing wood siding on a house, it is important that each piece overlap the piece below it by at least 1" but no more than 2" as shown in the drawing below. Best practice is to install the siding so that each course of siding has the same reveal.

3. The height from the bottom to the top of a wall is 120". You will be installing wood siding that is 8" wide. If each piece of siding must overlap the previous piece by no less 1" and no more than 2"

    a. What is the reveal of each course of siding? Show your work.

    b. How many courses of siding will there be on the finished wall? Show your work.

4. The height from the bottom to the top of a wall is 120". You will be installing wood siding that is 6 ¾"" wide. If each piece of siding must overlap the previous piece by no less 1" and no more than 1 ¾"

    a. What is the reveal of each course of siding? Show your work.

   b. How many courses of siding will there be on the finished wall? Show your work.

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Lesson 9: Determining Spacing, Part 2

PROBLEM SITUATION 3 : Balusters

Baluster: The vertical pieces of wood or metal that are installed on a railing to prevent falling though it. They are also called spindles.

On-Center (OC) Spacing: This is the spacing between each baluster *plus* the width of one baluster.

Wisconsin Code states that there cannot be more than four inches of space between balusters.

space between ballusters

space between posts
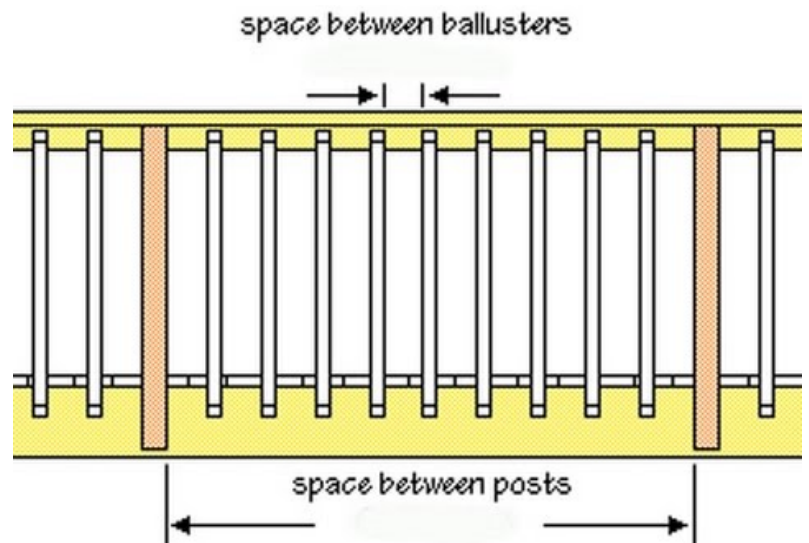
Part 1 – In the shop

7. Space the 4x4's on top of the post-it paper so that the distance between them is 15" (Note: The post-it paper grid is 1" squares)
    a. Now, place 2 balusters between them so they are evenly spaced
    b. Draw a quick sketch with the measurements showing what you made (include in your measurements the space *between* each baluster)

    c. What is the 'On-Center spacing' for your setup?

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8. Now, space the 4x4's so that the distance between them is 20 ½"

    a. Place 3 balusters between them so they are evenly spaced

    b. Draw a quick sketch with the measurements showing what you made

    c. What is the 'On-Center spacing' for your setup?

9. PREDICT – what space would you need for 4 balusters (of the same width) that are evenly spaced with On-Center spacing of 5 ½" ?
   a. WHY?

Part 2 - Return to the classroom

10. Think about your prediction in #9. Was your prediction correct? What if you don't know how many balusters there are? What math can you use to make sure that you correctly determine the on-center spacing for the 4 balusters? Show your work or explain here.

Lesson 9: Determining Spacing, Part 2

Part 3 – How it is typically done in the industry

<u>Formula to determine the On-Center Spacing:</u> $$C = A \div (Rounded\ A \div B)$$
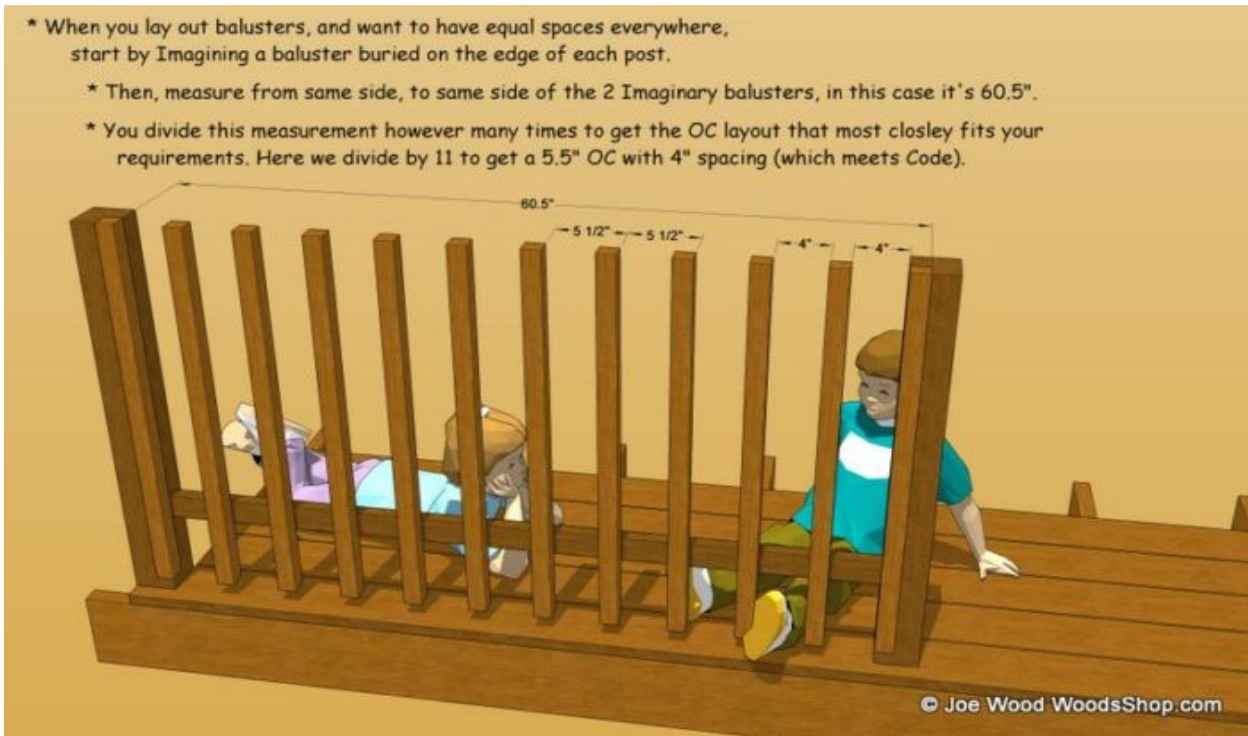
<u>Variable Definitions:</u>
- **C** = On-Center (OC) Spacing. This is the spacing between each spindle plus the width of one spindle.
- **A** = Gap between the two posts + the width of the 'imaginary baluster buried on the edge of the post'
- **B** = Width of a single baluster/spindle + maximum allowable space between

<u>Steps for using the formulas:</u>
- To find the number of Balusters:
  Step 1: Calculate the values for A and B
  Step 2: Calculate A ÷ B
  Step 3: If you need to, round the answer from step 2 UP to ensure that the gap is less than code
       NOTE: the answer from Step 3 is the number of *spaces* in the installation.
  To determine the number of balusters, take the answer from Step 3 and subtract one.
- To find the On-Center Spacing:
  Step 4: Continue with the answer from Step 3 and Divide A by the Step 3 value.
  The answer to Step 4 is the On-Center spacing for the installation

Write down the example done by your instructor here:

*EXAMPLE: Determine how many 2x2 balusters you would need for a rail that has 4x4 posts with a 26"
space between them?*

For problems 11 through 13 below you will be using posts that are 4x4, and balusters that are nominally
2x2 (1 ½" x 1 ½") . Code for balusters is that there cannot be more than four inches of space between
balusters.

11. You have two posts on a deck with a distance between them of 42 ½"

    a. Step 1: Calculate A for the formula: A= _____

       Calculate B for the formula: B = _____

    b. Step 2: Calculate A ÷ B = _____

    c. Step 3: If you need to, round the answer from step 2 UP to ensure that the gap is less
       than code. Rounded A ÷ B = _____

    d. To determine the number of balusters, take the answer from Step 3 and subtract one.

       Number of balusters: _____

    e. Step 4: Find On-Center Spacing by Calculating A ÷ the answer from Step 3 = _____

    f. What is the space between each baluster?

    g. Draw a quick sketch showing your setup based on your answers- in your sketch, draw in
       the values for A, B and C. You can use the example shown above to help you.

12. Now, you have two posts on a deck with a distance between them of 48". Use your own method or the formula and procedure provided to determine the following information:

    a. How many 2x2 (nominal) balusters will you need? (show your work or explain)

    b. What is the on-center spacing for the project? (show your work or explain)

    c. What is the space between each baluster?

13. You are building a new deck for a client. You have two posts on your deck and again, you are using 2x2 (nominal) balusters. The distance between the posts is 78 ¾". It's your job to build the rail:

    a. Before taking out a calculator... *estimate* how many balusters do you think you'll need? Explain your estimation strategy

    b. Now, calculate the actual number of balusters you need. (show your work or explain)

    c. What is the on-center spacing for the project? (show your work or explain)

    d. What is the space between each baluster?

14. What if your balusters were 7/8" stock for the deck in the previous question instead of 2x2's?

    a. Now, calculate the number of balusters you need. (show your work or explain)

    b. What is the on-center spacing for the project? (show your work or explain)

    c. What is the space between each baluster?

15. What if you are doing a project where you already know the number of balusters? Can you think of other methods to determine the on-center spacing? Brainstorm with your group and try to use a DIFFERENT method to answer 14b or 14c.

MAKING CONNECTIONS

State the main idea of the lesson

PRACTICE

Note: When building hand rail, Wisconsin building code requires that the spaces between balusters be $\leq$ 4". Furthermore,   it is best practice to make all of the spaces between balusters equal.

1.   The distance between posts for a hand rail is 78". What is the on center spacing of 1 ½" wide balusters? Show your work.

2.   The distance between posts for a hand rail is 6'-4" and you are using 1" wide spindles.
     a.   How many balusters will you need?

     b.   What is the on center spacing of the wide balusters? Show your work.

     c.   What is the spacing between each baluster?

3.   Do problem number 2 on page 158. Note: a 'square' for roofing = 100 square feet. Review page 157 for a picture of a shingle installation.

4.   List as many application in construction as you can think of that require equal spacing