Basic Stair Building


Courtesy Dean Peterson

Basic Stair Building

LESSON 1: BASIC LAY-OUT

Stair Building

- A staircase is a permanent piece of furniture that is often a focal point in the consideration of the buying and selling of homes.

- A safe, aesthetic, and functional staircase depends heavily upon the attention given during the early design and layout stages of the stair body.

Lesson 1. Stair Terms

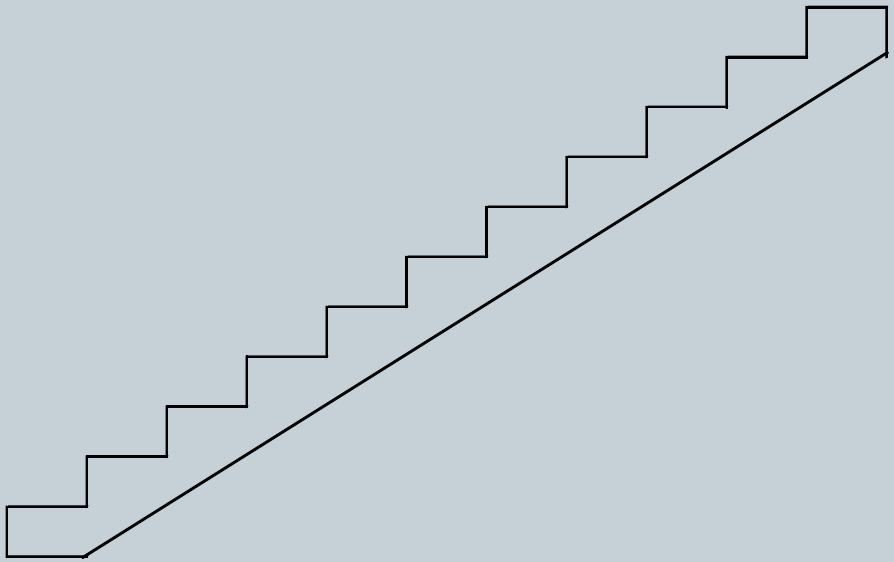
- Stringer (carriage)
- Tread
- Riser
- Total Rise
- Total Run
- Unit Rise
- Unit Run
- Minimum Unit Rise
- Maximum Unit Rise
- Minimum Unit Run
- Maximum Unit Run
- Headroom
- Upper Floor Opening
  - (well opening)

Basic Stair Parts

- **Stringer** (carriage). A stringer is a supporting member running the length of the stairway on which treads, risers, and balustrade are mounted.

Stringer (carriage)

- 2 x 12 or 2 x 10



Stringer (carriage)

Stringer (carriage)

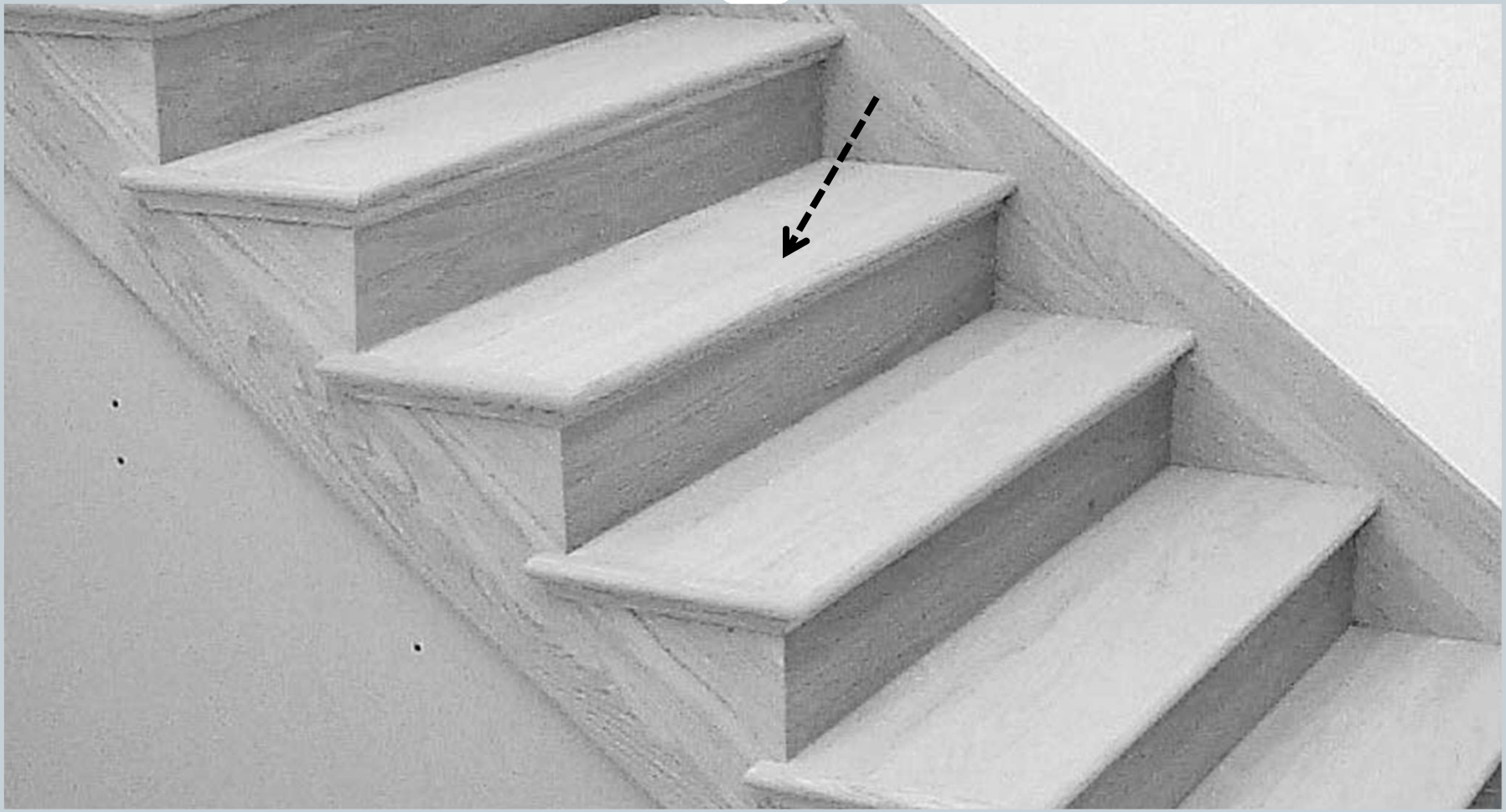
Basic Stair Parts

- **Tread**. A tread is a the horizontal component of a stair on which one steps.

Tread

- Solid 2 x 12, 2 x 10, or $^{5}/_{4}$" x 11"

Tread

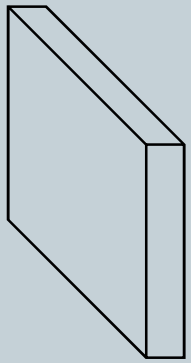


Basic Stair Parts

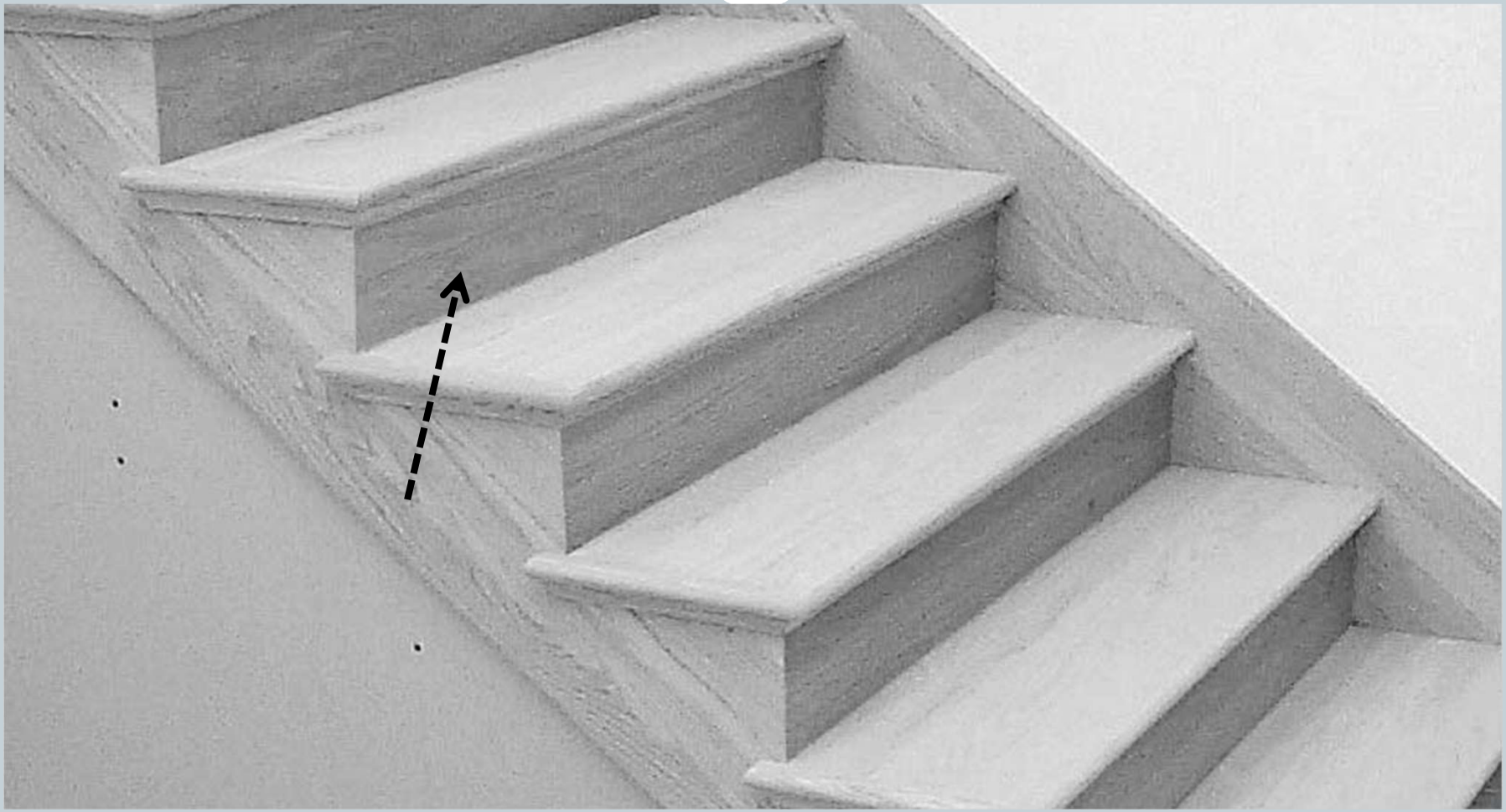
- **Riser**. A riser is the vertical finished component of a stair filling the space between the treads.

Riser

- Solid 1 x 8 or ¾” plywood

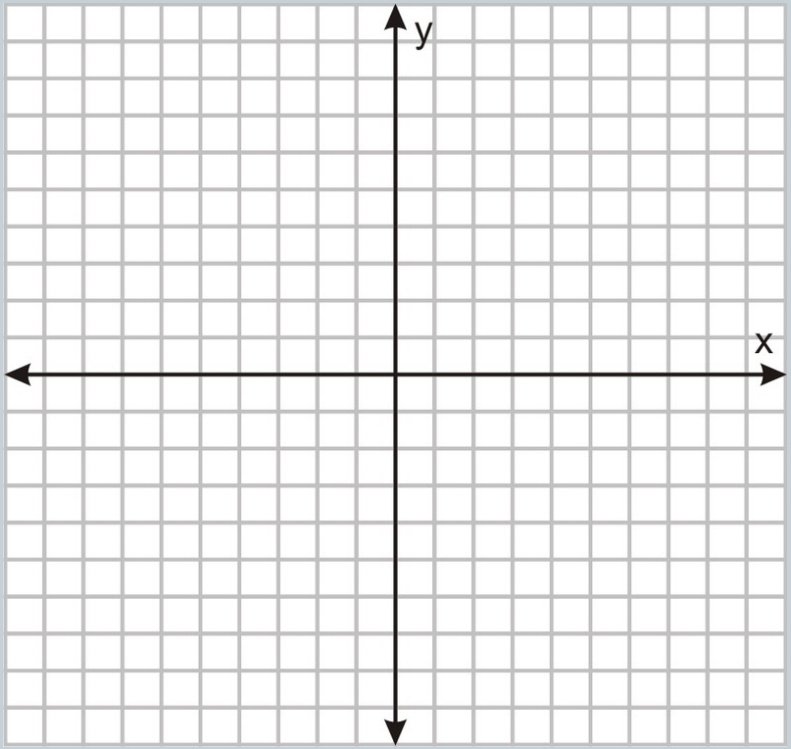


Riser



Coordinate Plane

- To calculate stairs we use the same x y coordinate plane as you use in Algebra and Geometry.



Basic Stair Terms

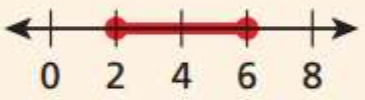
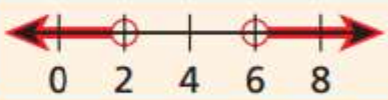
- **Total Rise**. Total rise is the total vertical distance from *finished*-floor to *finished*-floor.
- **Total Run**. Total run is the total horizontal distance covered by the entire stairway.
- **Unit Rise**. The unit rise (or rise) is the vertical distance from the top of one tread to the top of the next tread.
- **Unit Run**. The unit run (or run) is the horizontal distance from the face of one riser to the face of the next riser.

Stair Building

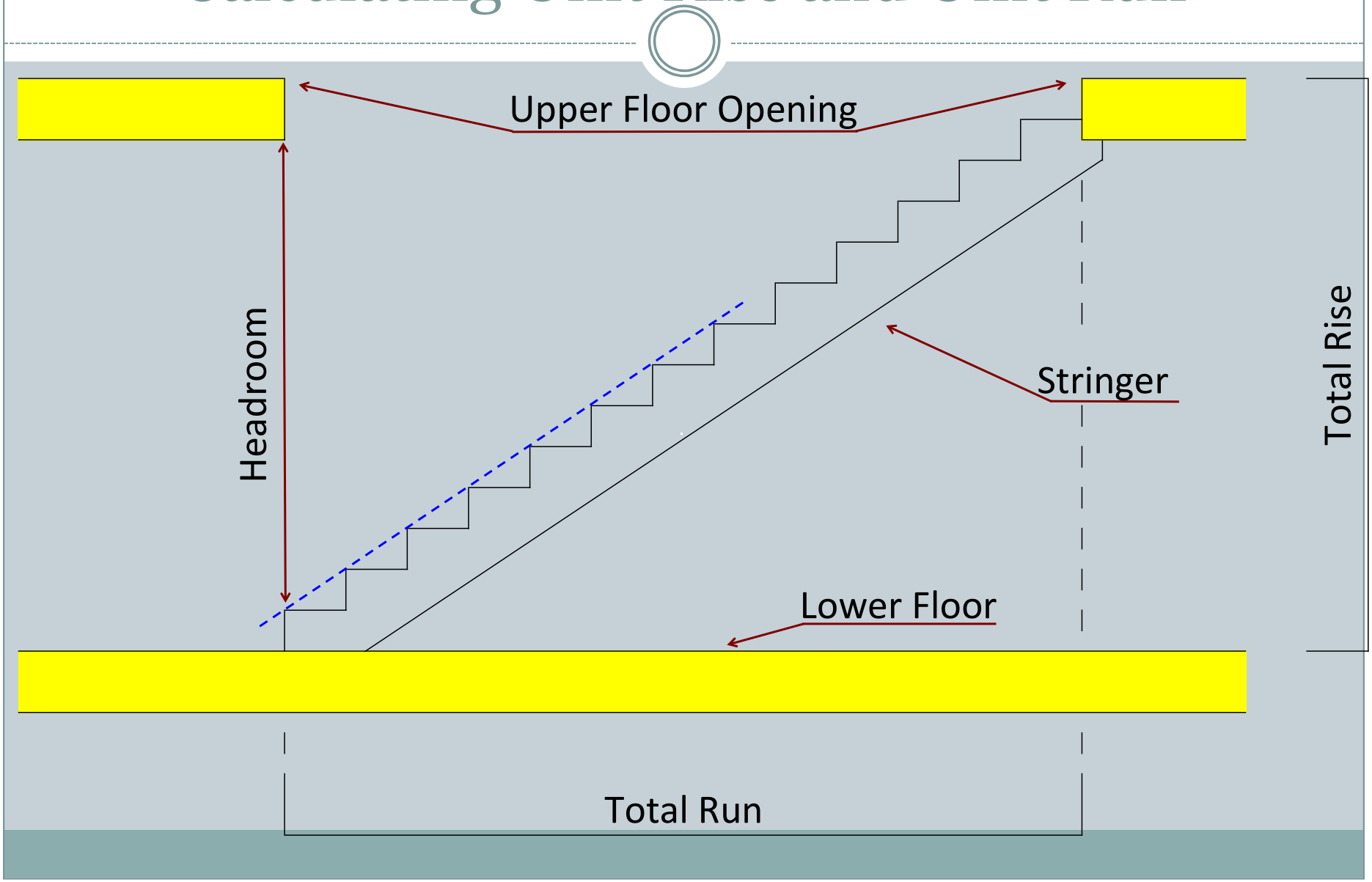
- Considerations such as local building codes, options in stair design, and options in stair layout need to be carefully addressed before beginning any construction.
- Knowledge of basic Algebra is needed to make the calculations of Unit Rise and Unit Run.

Compound Inequalities

Compound Inequalities

WORDS	ALGEBRA	GRAPH
All real numbers greater than 2 AND less than 6	$x > 2$ AND $x < 6$ $2 < x < 6$	
All real numbers greater than or equal to 2 AND less than or equal to 6	$x \geq 2$ AND $x \leq 6$ $2 \leq x \leq 6$	
All real numbers less than 2 OR greater than 6	$x < 2$ OR $x > 6$	
All real numbers less than or equal to 2 OR greater than or equal to 6	$x \leq 2$ OR $x \geq 6$	

Calculating Unit Rise and Unit Run



Building Code Requirements

- **From International Residential Code (IRC):**
- **"R311.7.4.1 Riser Height.** The maximum riser height shall be 7 ¾ inches. The riser height shall be measured vertically between leading edges of the adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 3/8 inch."
- **"R311.7.4.2 Tread Depth.** The minimum tread depth shall be 10 inches. The depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at a right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than 3/8 inch."

Calculating Unit Rise and Unit Run

STAIR BUILDING

Procedure

- 1. Determine the total rise, measured from *finished* floor to *finished* floor, in inches
- 2. Divide this number by 7, the typical height of a unit rise.
- 3. The quotient (answer in division) will be the *total number* of rises.

Calculating Rise and Run

- 1. Determine the total rise, measured from *finished* floor to *finished* floor, in inches.

  – 8’ – 9 ¾” = 105 ¾”

Calculating Rise and Run

- 2. Divide this number (total rise) by 7, the typical height of a unit rise.
  - 105 ¾” ÷ 7 = 15.107
- 3. This means there will be 15 (rounded down) total rises.

Calculating Rise and Run

- 4. Now divide the total rise by the *number* of rises.
  - This quotient will be the unit rise (*y*) for each step.
  - The unit rise may not be more than 7 ¾" (per building code).
- 105 ¾" ÷ 15 = 7 $^{1}/_{16}$"

- If you come up with a unit rise that is more than 7 ¾", go back and add one rise and divide the total rise again.

Lesson 1: Formulae

Calculating Rise and Run

- To calculate unit run (x) (step depth), there are three formulae:
    1. $16 < (1 \text{ rise} + 1 \text{ run}) < 18$
    2. $24 < (2 \text{ rises} + 1 \text{ run}) < 25$
    3. $70 < (1 \text{ rise} * 1 \text{ run}) < 75$
- Additional Rule:
    4. $30^{\circ} < \text{slope} < 35^{\circ}$

Calculating Rise and Run

- 1st formula. The sum of one rise and one run must be between 16 and 18.

- Example:

16 <	1 rise "	+ 1 run	<	18
16 <	*7.25* "	+ x	<	18
-7.25 "	- 7.25		-	7.25
8.75 <		x	<	10.75

- Therefore, according to this formula, the unit run must be between 8 ¾" & 10 ¾" .

Calculating Rise and Run

- 2nd formula. The sum of two rises and one run must be between 24 & 25.
- Example:

24	< 2 rises	"+ 1 run	<	25
24	< 2(7.25)	"+ x	<	25
24	< 14.5	"+ x	<	25
-14.5	"- 14.5		-	14.5
9.5	<	x	<	11.5

- According to this formula, the unit run must be between 9 ½" & 11 ½".

Calculating Rise and Run

- 3rd Formula. The product of one rise and one run must be between 74 & 75.
- Example:

$$70 < 1\text{ rise} * 1\text{ run} < 75$$

$$70 < 7.25 * x < 75$$

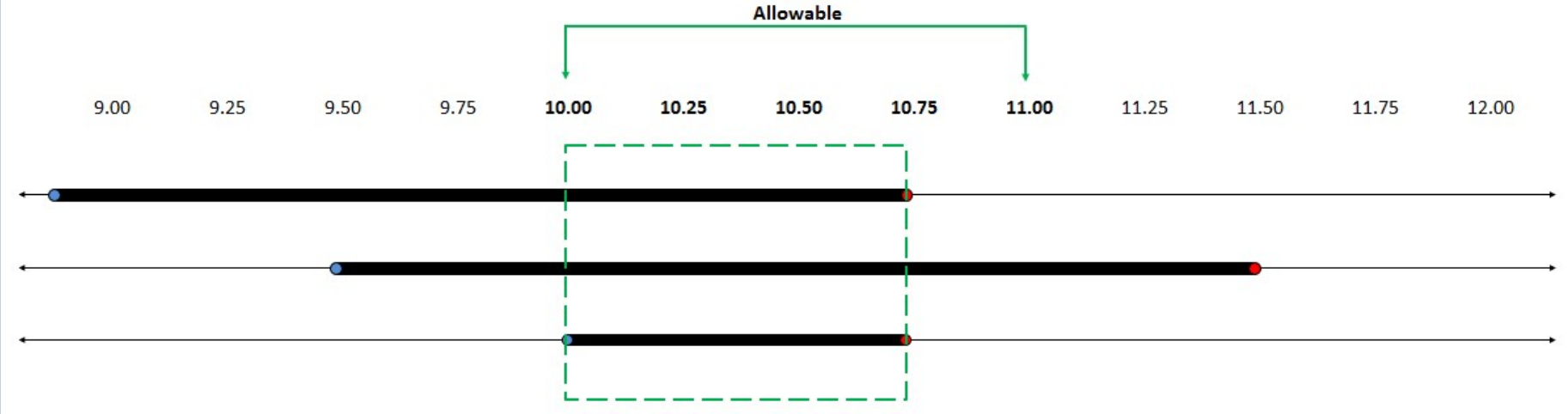
$$\frac{70 < 7.25 * x < 75}{7.25 \quad 7.25 \quad 7.25}$$

$$10 < x < 10.34$$

- According to this formula, the unit run must be between 10" & 10 ¾"

Calculating Rise and Run

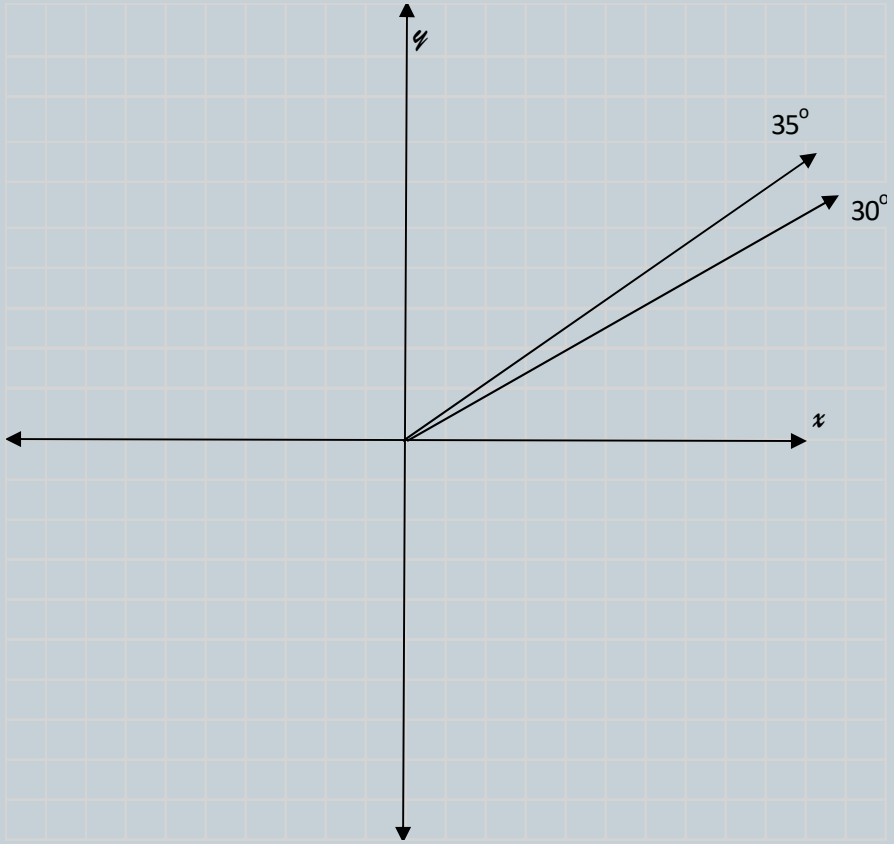
- Choose a value that satisfies all three formulae:



- In this case, the unit rise must be between 10” (code) and 10 ¾” (within all 3 parameters).
- Choose 10 ½” since that is the width of a 2 x 12 less a 1” nosing.

Calculating Rise and Run

- The angle (degrees) must be between 30° & 35°.



Optimum Stair Layouts

Unit Rise	Unit Run	1. Degrees. $30^{o} < m < 35^{o}$	2. 24 < 2(rises) + 1(run) < 25	3. 75 ≅ 1(rise) x 1(run)	4. 17 < 1(rise) + 1(run) < 18	A. Unit Rise. 7” < y < 8 ¼ “	B., Unit Run. 9” < x < 11”	C. Slope. 7/10 or .7
6.5"	11.5625"	29.343	24.5625	55.16	18.063	6.5	11.563	0.56
6.5"	11.625"	29.21	24.625	75.56	18.25	6.5	11.625	0.56
6.75"	11.125"	31.24	24.625	75.25	17.875	6.75	11.125	0.61
7"	10.75"	33.07	24.75	75.25	17.75	7	10.75	0.65
7.25"	10.375"	34.94	24.875	75.22	17.875	7.25	10.375	0.70
7.5"	10"	36.87	25	75	17.5	7.5	10	0.75
7.75"	9.6875"	38.66	25.1875	75.08	17.438	7.75	9.6875	0.80
8"	9.375"	40.47	25.375	75	17.375	8	9.375	0.85
8.25"	9.0625"	42.31	25.9625	74.77	17.313	8.25	9.0625	0.91
8.5"	8.8125"	43.97	25.8125	74.91	14.25	8.5	8.8125	0.96

Stair Calculation Practice

	Total Rise	No. of Rises	Unit Rise	Unit Run
1.	49"			
2.	58"			
3.	$20\ ^{1}/_{4}$"			
4.	108"			
5.	132"			

Use a Framing Square to Lay Out Stringers