Lesson #2: Building a Ramp Project (10 Days)

Objectives

Students will be able to...

- Determine the distance between two points on a coordinate plane using the Pythagorean theorem.
- Analyze given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.
- Apply mathematics to problems arising in everyday life, society, and the workplace.
- Work cooperatively with others

Common Core Standards

LS 11-12.6
RSIT 11-12.2
RLST 11-12.2
Writing 9-10.5
Problem Solving/Critical Thinking 5.4
Health and Safety 6.2, 6.3, 6.6, 6.12
Responsibility and Leadership 7.4, 9.3
CCSS.MATH.PRACTICE.MP6
CCSS.MATH.PRACTICE.MP2
CCSS.MATH.PRACTICE.MP1
Residential and Commercial Construction Pathway D2.1, D2.2, D3.1, D3.7

Materials

Ramp to ADA Guidelines Handout
Bill of Materials
Granny on The Ramp Guidelines Handout
Self-Evaluation
Project Rubric

Lesson Sequence

- Pass out the ***Ramp to ADA guidelines Handout*** and the ***Granny on the Ramp Guidelines Handout***. Review as a class. Answer any questions as needed.
- Support students with filling out their ***Bill of Materials.***
- Support students as needed while they work in groups to create and build their ADA ramp.
- When project is finished have students place their finished products out and walk around the room to look at each other's projects.
- Have students complete the ***Self-Evaluation*** and use ***Project Rubric*** to grade student's ADA ramps.

Assessment

Perform informal observations through questioning and observing student's teamwork while building their ramps.

Use rubric to grade student's final ramp project.

Accommodations/Modifications

Strategic Partners
One on One Support
Extra Time If Needed
Calculators
Visuals When Needed

Ramp to ADA Guidelines Handout

Building a Stand-Alone Ramp to ADA Guidelines

Objective:

Putting the concepts of slope and the Pythagorean Theorem to use in the real-world context of building a ramp for handicap access to a building.

You will demonstrate your understanding of how the concept of slope is applied to the real-world construction of a wheelchair access ramp. You will use the Pythagorean Theorem to calculate the length of the ramp surface based on the acceptable slope of the ramp as defined by the Americans with Disabilities Act guidelines.

Safety:

The steeper the slope, the easier it is to slip or trip. It most likely won't be you (as you built it and know its pitfalls) but someone else will.

The steepest slope for a public ramp is one in twelve (1:12), which is governed by ease of use for wheelchair users. For use by the general public many building codes recommend a maximum slope of 1:8 (that is one-inch rise for every eight inches horizontally.) With a 1:8 slope, if the floor is nine inches above the ground, the ramp will be 72 inches long (1.83m long).

Complete a Bill of Materials:

Use the DIY Ramps plans to create your materials list.

Granny on the Ramp Guidelines Handout

Objectives:

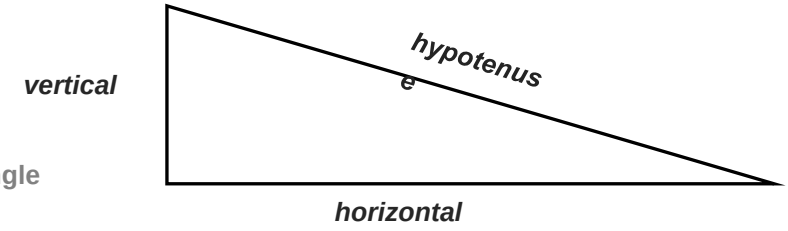
- Identify ***rise***, ***run***, and ***ramp length***.
- Describe the relationships among ***rise***, ***run***, ***and slope***.
- Determine height, slope, and velocity.
- Describe the ***Americans with Disabilities Act (ADA)*** guidelines for ramps.
- Identify ramps that are compliant with ADA guidelines.
- Design a ramp according to ADA guidelines.

Activity Description:

Students identify the different parts of a ramp. They will learn about the accessibility issues that come into play when someone must use a wheelchair. **"Build a Better Ramp"** is the design challenge. Students will analyze various ramps around the school to determine if they meet ADA guidelines. For each ramp that does ***NOT*** meet ***ADA*** guidelines, explain what must be done to make the ramp compliant with the requirements for safe ramps.

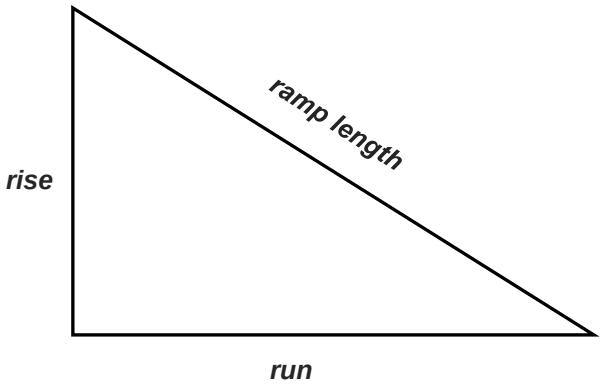
Background Knowledge:

As you already know, a ***right triangle*** consists of a ***vertical leg***, a ***horizontal leg***, and the ***hypotenuse***.

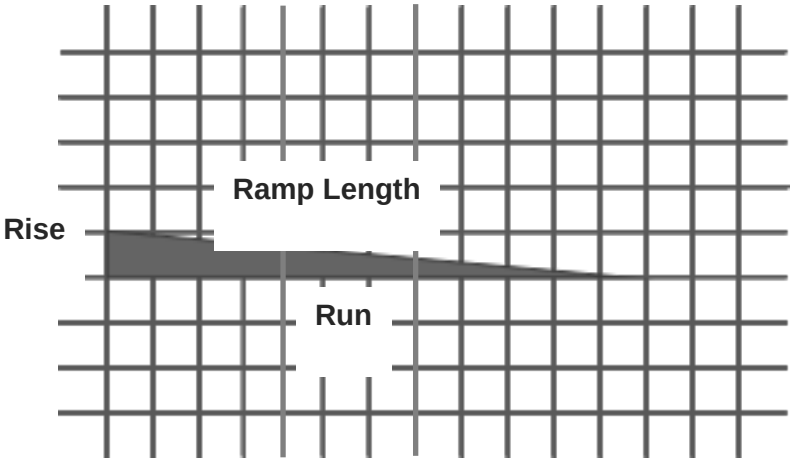


Parts of a Right Triangle

A ***ramp*** is an inclined surface that connects areas of different heights. The right triangle ***above is*** just like a ramp, although the parts of a ramp have different names. The part of a triangle that is called the vertical leg is called the ***rise*** of a ramp. The part of a triangle that is called the horizontal leg is called the ***run*** of a ramp. The ***hypotenuse*** of a triangle is like the length of the inclined surface of a ramp. In this activity, we will call this the ***ramp length***.



Parts of a Ramp



Slope of a Ramp

Assume a ramp, has a ***rise*** of 1 space and a ***run*** of 12 spaces. A ***ratio*** is a relation between two values in which one value is divided by the other. The ***ratio*** of the ***rise*** to the ***run*** of this ramp would be 1:12. There are several ways to express a ratio, and all of them are correct. The ratio can be expressed as 1:12; 1 *to* 12; or $^{1}/_{12}$.

The ratio of rise: run is called the *slope*. The slope of a ramp is an indicator of the steepness of the ramp. In the ramp above with its slope of 1:12, there is a rise of 1 box for every 12 boxes of run.

$$\textbf{Slope} = \text{Rise-Run} = \frac{\text{Rise}}{\text{Run}}$$

The *Americans with Disabilities Act (ADA)* is a civil rights law that was created in 1990 to provide protections against discrimination towards those in the community who have disabilities. The ADA states that **"an individual is considered to have a 'disability' if she/he has a physical or mental impairment that substantially limits one or more major life activities, has a record of such an impairment, or is regarded as having such an impairment."** Thus, this law applies to persons with seeing, hearing, speaking, walking, breathing impairments, and those persons whose impairments may interfere with performing manual tasks, learning, caring for oneself, and working. The law also protects those persons who **"have a known association or relationship with an individual with a disability."**

The ADA law provides for equal opportunities in a work environment and ensures access to public facilities (such as hotels, restaurants, theaters, auditoriums, stores, services, museums, recreational areas, and schools), transportation systems, and telecommunications. Some people with disabilities may need to use a wheelchair or other devices to get around in the community and in their homes. The ADA describes guidelines to reduce architectural barriers that can prevent a disabled person from having full access to the things they, like anyone else, may need in a community.

The law contains rules for new construction and modifications to existing structures so that public facilities are as barrier- free as possible. Some of the ADA guidelines talk about removing barriers (ADA Section 36. 604) with the priority being to install interior and/or exterior pedestrian ramps. Other portions of the ADA provide directions for building ramps or using existing space as ramps.

Some of these guidelines follow:

4. 8. 2 Slope and Rise

The *least possible slope* shall be used for every ramp. The *maximum slope* of a ramp in new construction shall be 1:12. The maximum rise for any run shall be 30 in (760 mm)

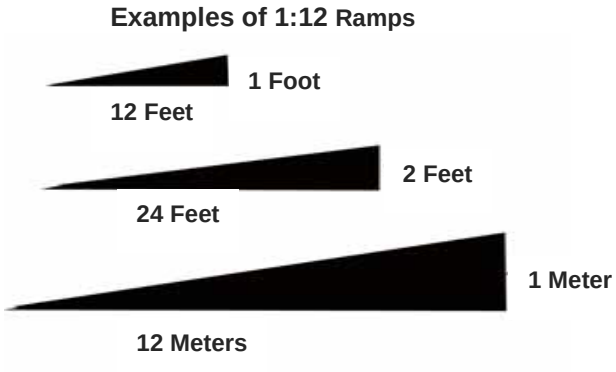
4. 8. 3 Clear Width

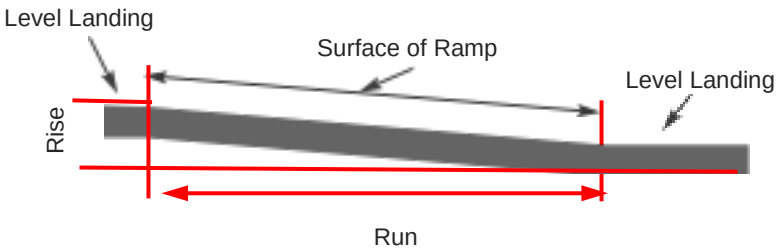
The minimum clear width of a ramp shall be *36 in (915 mm)*.

4. 8. 4 Landings

Ramps shall have level landings at bottom and top of each ramp and each ramp run. Landings shall have the following features:

1. The landing shall be at least as wide as the ramp run leading to it.
2. The landing length shall be a minimum of 60 in (1525 mm) clear.
3. If ramps change direction at landings, the minimum landing size shall be 60 in by 60 in (1525 mm by 1525 mm).





Components of a Single Ramp Run

You may work with a partner, but each person needs to hand in their own paper.

Using a ruler and graph paper, ACCURATELY DRAW (this means that one box on the graph paper = one unit) the following triangles.

1. DRAW a triangle that shows a slope of 1:20 (this is the same as 1/20). Label the rise of this slope triangle as side **a**. Label the run of this slope triangle as side **b**.

2. DRAW a triangle that shows a slope of 1:16 (this is the same as 1/16). Label the rise of this slope triangle as side **a**. Label the run of this slope triangle as side **b**.

3. DRAW a triangle that shows a slope of 1:12 (this is the same as 1/12). Label the rise of this slope triangle as side **a**. Label the run of this slope triangle as side **b**.

4. Which triangle appears to be the "steepest"? Explain why this triangle is the steepest on your drawing.

5. What ratio of side lengths (using the letters a and b) determines the slope of the ramp?

6. What does a slope of 1:12 mean in terms of the relationship between the ramp height and the ramp run?

7. Using the Pythagorean Theorem, find the deck length or ramp surface for each of the slope triangles you have drawn. Give the ramp surface dimension in inches.

The Pythagorean Theorem - Rubric for Ramps

Team Members:

_____

_____

Requirements to be Assessed	Pts.	Anticipated Mark	Actual Mark
Accuracy and Neatness -of product -of measurements -of calculations Teamwork -ability to work with others -everyone contributed			
Teamwork -divided task evenly -not just one person **Independent of teacher** **Tone and Volume** -talked in regular voices **Completion of Task** **Accuracy** -product is mostly accurate -measurements and calculations are within a 5 % -needed my help a couple of times	**4**		
Teamwork- -could have split up task better -one person doing a little more **Independent of teacher** -needed teachers help...? **Tone and Volume** -voices were a bit too loud **Completion of task-** -needed about 10 minutes to finish **Accuracy-** -product wasn't very accurate -calculations and measurements about 10% off	**3**		
Teamwork - task not divided up evenly -one person doing a majority **Independent of teacher** -needed teacher's help more than 5 times **Tone and Volume** -voices too loud for classroom **Completion of task-** -incomplete even after extra time was given **Accuracy-** -product wasn't very accurate	**2**		
None of the above, but some portion of the project was done.	**1**		

Building a Ramp Project Self-Evaluation

1. What I had learned from this project ...

2. Parts of the project I am most proud of ...

3. Safety practices I have been observing...

4. What I have learned that I should be doing, from this point on, to ensure any other projects have an excellent outcome.

Bill of Materials

Part #	Description	Material Type	Dimensions (calculate footage)		Footage (bd/ft, lin/ft, sq./ft)	Quantity Of Parts	Unit Cost	Total Cost
				=				$-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-
				=				-

To calculate board feet with all measurements in inches: T x W x L / 144

Total Cost: $-