Exit Strategy: Means of Egress

A Practice Understanding Task

Purpose: In this lesson students will interpret and apply building codes to determine the number of exits needed for a commercial space and the minimum distance between exits. Students will need to convert units, find the area of irregular shapes, apply a formula to determine occupant load, and use the Pythagorean theorem.

Career Field: Architecture, Interior Design

Industry Partner: Moseley Architects

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NC Math 3 Standards:
NC.M3.G-MG.1 Apply geometric concepts in modeling situations:
- *Use geometric and algebraic concepts to solve problems in modeling situations*
- *Use geometric shapes, their measures, and their properties, to model real-life objects*
- *Use geometric formulas and algebraic functions to model relationships*
- *Apply concepts of density based on area and volume*
- *Apply geometric concepts to solve design and optimization problems*

NC Math 4 Standards:
This activity may be a good review of the Pythagorean Theorem leading into the trigonometry unit
NC.M4.AF.2 Apply properties of trigonometry to solve problems

Unit Alignment:
NC Math 3 - Unit 4 Modeling with Geometry
WTCC Math 121
WTCC Math 110

Common Core State Standards for Mathematical Practice
Indicate which of the standards are highlighted in this lesson
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Prerequisite Skills

These skills could be reviewed in a warm-up and are addressed in the Desmos activity.

- Area of irregular shapes
- Pythagorean Theorem
- Unit conversions

Time Required

The time required to complete this activity is approximately 90 minutes.

Materials Needed

- Access to the desmos activity and launch video
- Student Activity Sheet
- Calculator

The Teaching Cycle:

Launch:

(20 minutes for Desmos Activity and Launch Video)

“When constructing buildings, considerations must be made regarding the safety of the designed spaces. In order to provide a standard for these safety measures, aspects of the design must meet certain codes as defined by the International Building Code (IBC). If a building is not constructed to code, it will not pass inspection and will have to be redesigned. This can be costly with respect to both time and finances.”

(Begin Desmos activity **OR** begin Prerequisite Skills Sheet)

- Desmos activity: Please make a copy of the activity before assigning it to your class
  https://teacher.desmos.com/activitybuilder/custom/60fa1eebfb40695105c631bb?collections=60fa1e8a0ed86643347ed4c9

- Prerequisite Skills Sheet:
  https://drive.google.com/file/d/1ox_7QSCAAkmJ9h7GPd-pPjbtsu5CA70e/view?usp=sharing

When appropriate, discuss answers to the Desmos/Prerequisite questions as a class.

(Play Launch Video)

Explore:

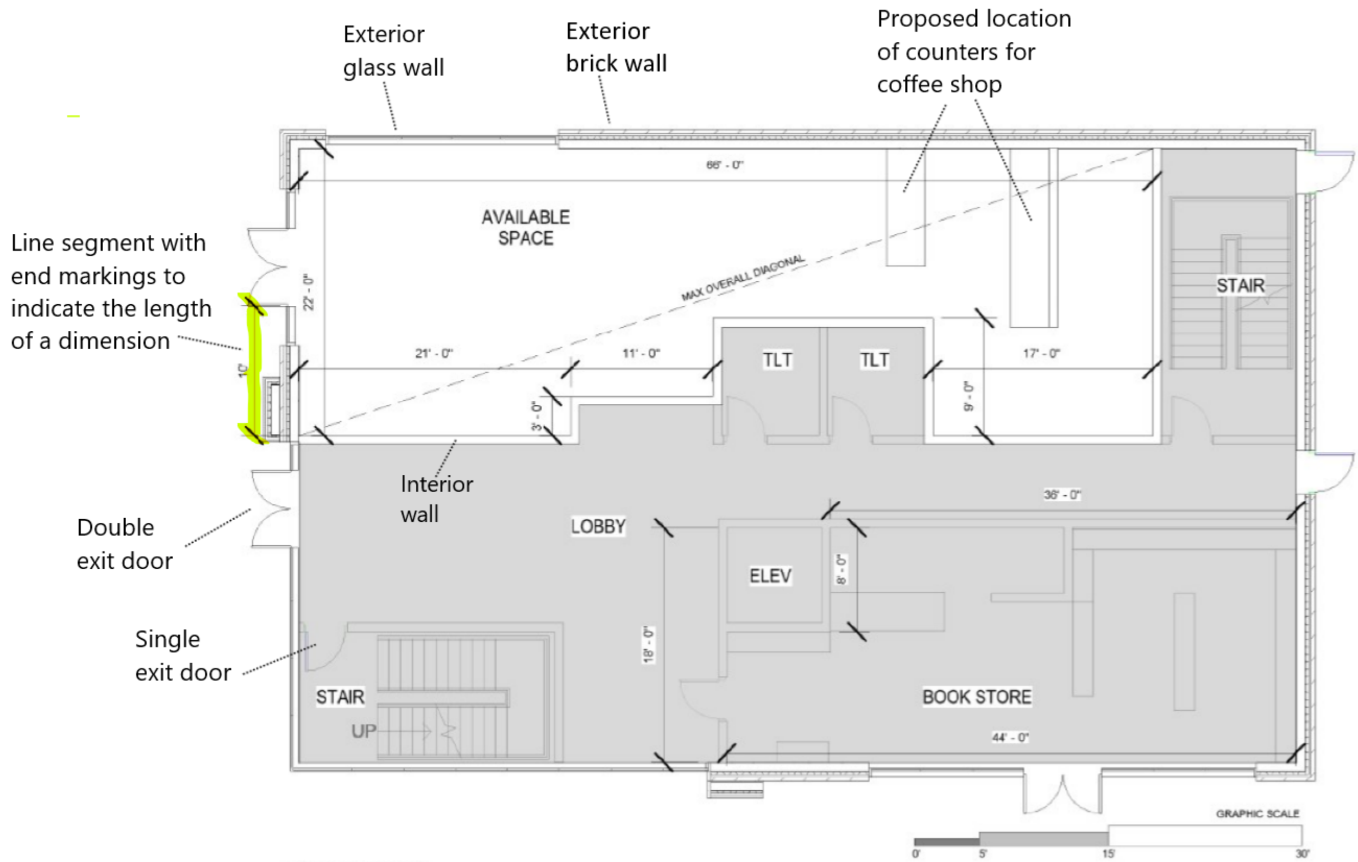
(50 minutes)

Students will work in groups of or 2-3. They will complete the attached Activity Sheet to practice the ideas established during the previous lecture.

(Introduce the activity with a brief discussion)

- Encourage students to read through the entire activity before starting and make note of any details. (e.g. the sprinkler system, the width of a door, etc.)

- Discuss the excerpts from the IBC. The language may seem obscure, but this is how the building codes are written.
- Inspect the floor plan as a class and make sure students understand the symbols and markings.



FLOOR PLAN

(Student groups work on the questions in the Student Activity Sheet)

The teacher will facilitate this phase by monitoring student participation, observing student interactions, and checking for mistakes in work as the teacher moves around the room. Provide guidance when necessary.

Potential questions and mistakes:

- Some students may not notice that **the building is equipped with a sprinkler system**, which will affect their answers. This is mentioned in the first paragraph to encourage students to read and pay attention to details.
- It is expected that some students miss the detail that each exit door is 36 inches wide. A double door is 72 inches wide. Some students may not realize they need to convert these units to feet.
- For this activity, separation distance between exits is defined as the shortest distance between any portion of the two exits.
- Students may inquire whether the door can be placed where windows are indicated on the floor plan. The answer is Yes. All of the materials used for the outer and inner walls can accommodate a door.
- Students may believe that exit doors must be located on the exterior walls. However, this is not always possible. Exits may be located on the interior walls to exit to a lobby or hallway and still meet code.

Round UP for Occupant Load:

- When calculating the Occupant Load, it may seem intuitive to round down. However, the Occupant Load is not the number of people *allowed* to be in the space. If it were, then rounding down would be appropriate.
- The Occupant Load is the minimum number of occupants who should be accounted for when determining egress from a space. Therefore, rounding the Occupant Load calculation up ensures that the required number of exits is met for the given space.

Discuss:
(30 minutes)

Once the activity is complete, review the occupant load for #3 and #4.

Ask groups to share their answers for #5. Life-safety considerations for exit placement are more detailed than what is presented here. Have students share some of their reasons for the door placement they chose. Student responses may include ideas about the width of the door, obstacles and path to the door, access to other structures or parts of the building, etc.

Review the length of the longest diagonal and discuss its impact on the answers to #6, #7, and #8. Pose the question, "Under what conditions is it a *good* idea to remove the sprinkler system?"

Allow students the opportunity to identify any errors in their work and provide a chance to correct them before concluding the activity.

Discuss #9 as a group and share what other, non-safety considerations may impact door placement. Ideas may include obstacles/clear path to exit, cost considerations, etc.

Student Activity Sheet

Student Activity Sheet:
https://docs.google.com/document/d/10aWK3vuFvJNQDFXUE_PKHpaMwvFQZ2WF/edit#heading=h.30j0zll

Answer Key

Student Activity Sheet Answer Key:
https://drive.google.com/file/d/1NydeEZ7fM4Y6_rBPINuu9ylHcSPp-SpD/view?usp=sharing