



Connecting Industry to Mathematics Instruction
NSF ATE Award # 1954291

Building Codes and Exit Separation Student Activity Sheet

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. In this activity, you will explore how a means of egress can impact building design.



In partnership with



WAKE COUNTY
PUBLIC SCHOOL SYSTEM



Your Task!

A developer plans to rent space on the ground floor of a new building downtown, which must be built in accordance with the International Building Code (IBC) guidelines. To complete the building, the developer needs to know how many exits are required for the unused space. The developer has hired you as a consultant to make this determination. You ask a few additional questions and learn that each exit door is 36 inches wide. You also learn that the building will be equipped throughout with an automatic sprinkler system.

The number of exits required by code will depend on the occupancy classification.

Mercantile occupancy: 60 square feet floor allowance per occupant

Assembly occupancy: 15 square feet floor allowance per occupant

$$\text{Occupant Load} = \frac{\text{Overall Square Footage}}{\text{Floor Allowance Per Occupant}}$$

Checkpoint

1. What is the unit of measurement for Occupant Load?
 2. Consider a space with an overall floor area of 10,000 square feet. How many people would be allowed in this space if it is used as a retail store? How many people would be allowed in this space if it is used as a movie theater?
 3. Which use of the space results in a larger occupant load? Why do you think there is a different occupant load based on how the space is used?
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For your reference, the relevant portions of the IBC code are provided below.

IBC Chapter 10: Means of Egress References:**1006.2.1 Egress Based on Occupant Load and Common Path of Egress Travel Distance**

Two exits or exit access doorways from any space shall be provided where the design occupant load or the common path of egress travel distance¹ exceeds the values listed in Table 1006.2.1.

Table 1006.2.1:

OCCUPANCY	MAX OCCUPANT LOAD
Mercantile	49
Assembly	49

1006.2.1.1 Three or More Exits or Exit Access Doorways

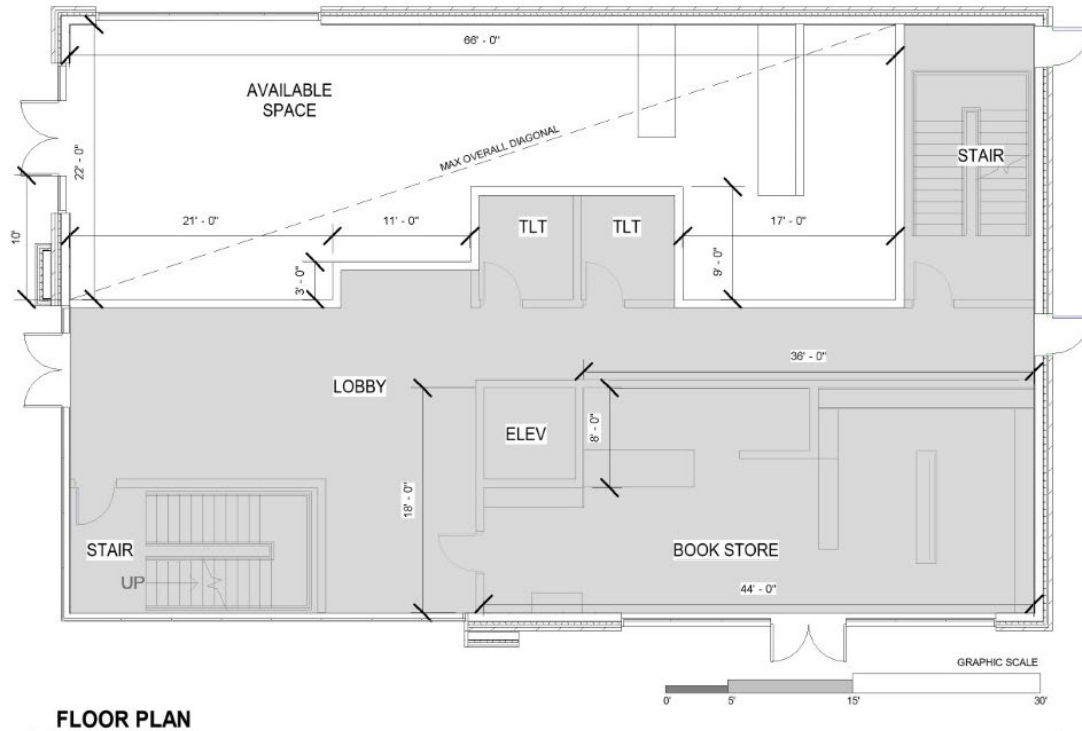
Three exits or exit access doorways shall be provided from any space with an occupant load of 501 to 1,000. Four exits or exit access doorways shall be provided from any space with an occupant load greater than 1,000.

1007.1.1 Two Exits or Exit Access Doorways

Where two exits, exit access doorways, exit access stairways or ramps, or any combination thereof, are required from any portion of the exit access, they shall be placed a distance apart equal to not less than one-half of the length of the maximum overall diagonal dimension of the building or area to be served measured in a straight line between them.

Exception: Where a building is equipped throughout with an automatic sprinkler system, the separation distance shall be not less than one-third of the length of the maximum overall diagonal dimension of the area served.

¹ Table 1006.2.1 has been shortened for this activity. We will not consider the common path of egress travel distance.



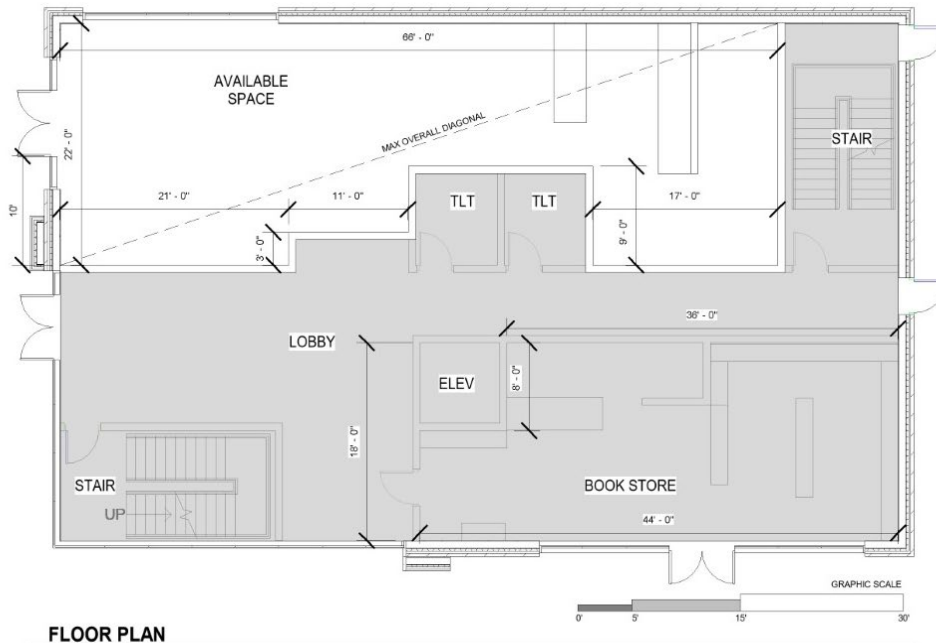
FLOOR PLAN

MOSELEYARCHITECTS

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MOSELEYARCHITECTS.COM

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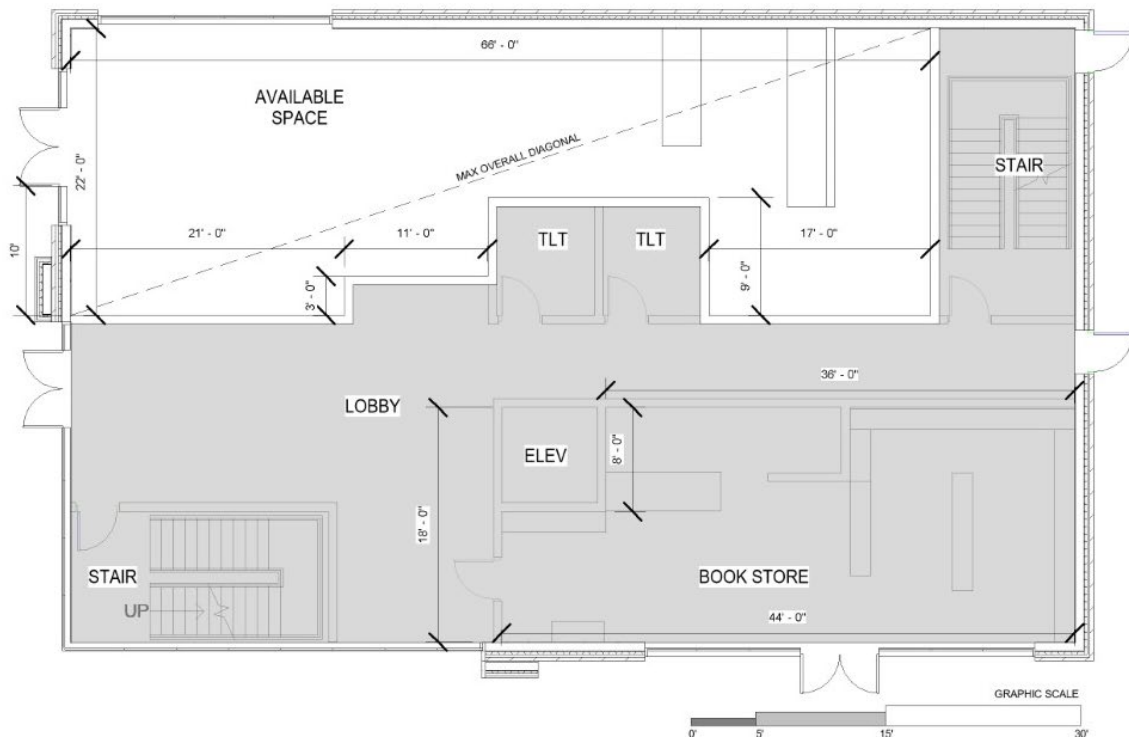
EXIT SEPARATION



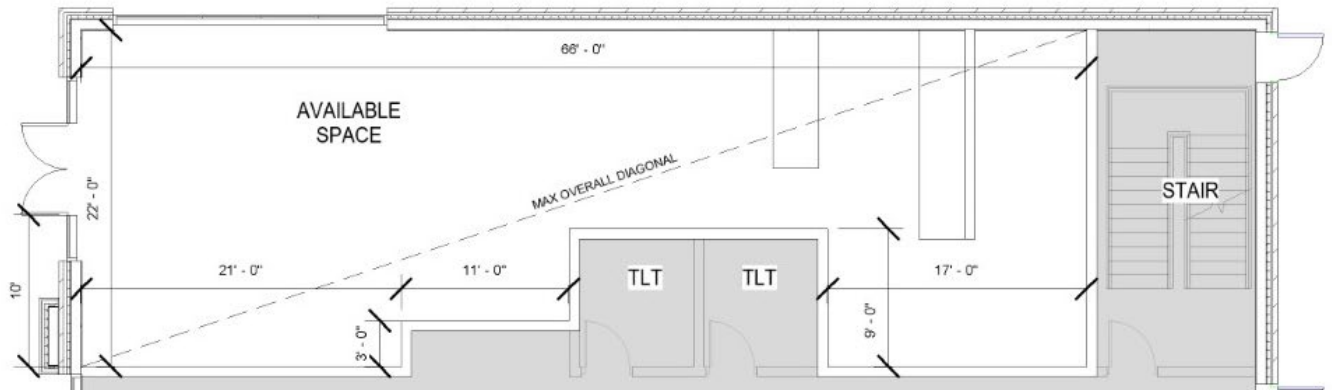
The space to be rented is the AVAILABLE SPACE pictured in the floor plan above. (TLT = toilet room)

1. Notice the Exception written in the International Building Code. What impact does a sprinkler system have on the required distance between exit doors? Why do you suppose that is?
2. Do you think the number of exits for the AVAILABLE SPACE is reasonable? Why or why not?
3. Suppose the available space is to be used as a coffee shop and will be classified as mercantile occupancy. What is the occupant load for the coffee shop and how many exits are needed? (Show work to justify your answer.)
4. Suppose the available space is to be used as an art gallery and will be classified as assembly occupancy to accommodate special events. What is the occupant load for the art gallery and how many exits are needed? (Show work to justify your answer.)

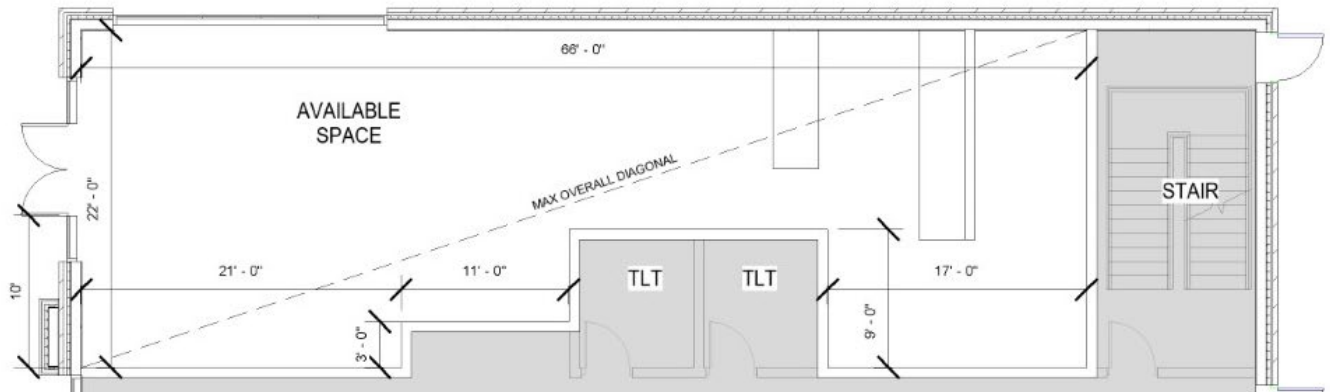
5. The developer decides they want the space to accommodate assembly occupancy. If a second exit is needed, make a logical guess for where to place the exit and sketch it on the floor plan below. Explain why you chose this location.



6. What is the distance between the existing exit and the exit that you sketched? Is your proposed exit to code? If not, propose a new door placement that does meet design code. Confirm your claim. (Show work to justify your answer.)
7. Identify the area of the building that is “off limits” for the placement of a second exit to meet the code for assembly occupancy. Show the area that is off limits on the floor plan below. (Show work to justify your answer.)



8. Suppose the developer decides to eliminate the planned sprinkler system in order to reduce costs. Identify the area of the building that is now “off limits” for the placement of a second exit to meet the code for assembly occupancy. Show the area that is off limits on the floor plan below. (Show work to justify your answer.)



9. What other considerations may be needed when determining the placement of exits?

Glossary of Terms

Assembly Occupancy – occupancy classification per the IBC for a building that is used to gather for social, civic, religious, or other functions. Further classified by the type of seating, if any, available in the space (fixed or not)

Common Path of Egress – travel distance measured from the most remote point in a building story or room to the point where occupants have separate and distinct access to two exits.

Egress – exiting out of a building. Egress is determined by Life Safety calculations determined by the International Building Code to safely exit occupants out of the building.

International Building Code (IBC) – Written building code that preserves and protects the health and safety of the public in the built environment. Adopted and usually amended by each state to ensure a building is safe when designed and constructed.

Mercantile Occupancy – occupancy classification per the IBC for a building that is open to the public and displays/sells goods.

Occupant Load – the amount of people a building can safely hold at a given time as determined by the International Building Code

References

International Building Code available through UpCodes: <https://up.codes>

City of Raleigh Municipal Code available at: <https://raleighnc.gov/services/government/city-code>