



PA STUDY ASSIGNMENTS

WEEK 1

Slope Math

Floods

Dirt

Brownfields

Topography

Environment Part I - Sun

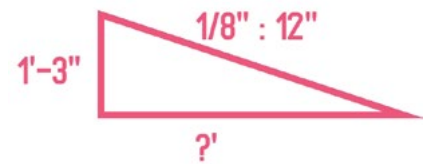
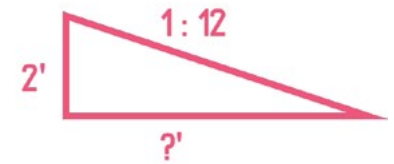
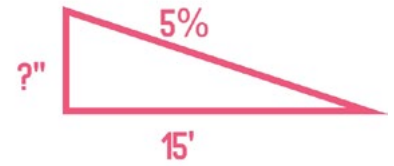
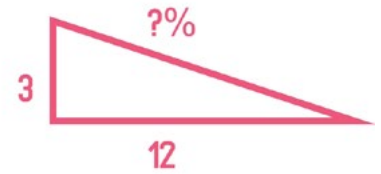
Environment Part II - Climate

SLOPE MATH

ASSIGNMENT 1

You will encounter slope calculations across multiple exams and content areas.

- » In your own words, define slope.
- » What are some site/building design components that deal with slope?
- » What three pieces of information do you need to fully calculate/understand a slope?
- » List the preferred/required slope for the following site components:
 - Sewers
 - Site Drainage
 - Parking surfaces
 - ADA Ramps
 - IBC Ramps
- » Solve for the question mark in the diagrams to the right. Pay attention to the units!



REFERENCES

FREE

2010 ADA Standards for Accessible Design [Chapter 4](#)

2015 International Building Code: [Section 1012.2](#)

YouTube / apprenticemath: [Grade Calculations: Calculate drop given grade % and run \(metric & ft-in\)](#)

YouTube / Hyperfine: [ARE 5.0 - Slope Math and Rounding](#) (omg this is so meta)

PAID

Ching: Building Construction Illustrated 4th Ed.: Chapter 1

Pluralsight / Kevin Griendling: [Prepare for the ARE Vol. 3: Programming & Analysis](#)

YOUR NOTES

CLIMATE AND FORM

ASSIGNMENT 7

Various climate related stuffs

- » Explain is surface area-to-volume ratio
- » Do you want this value to be low or high in a cold climate? Why?
- » Why are courtyards good for hot climates?
- » Is it good to orient a building north-south in any of the four climate zones?
- » For each of the four climate zones list
 - general passive heating strategies
 - general passive cooling strategies
 - ideal location for placement on a hill

((see next page))

On the map of the contiguous United States...

- » Circle the:
 - Cool Region
 - Temperate Region
 - Hot-Arid Regions
 - Hot Humid Regions
- » Match the building forms with the region
- » Identify
 - Miami
 - Buffalo
 - Indianapolis
 - Tucson
 - Seattle

REFERENCES

High-PerformanceBuildings.org: [Solar Passive Design Features for Warm & Humid Climates \(PDF\)](#)

Department of Energy: [Climate Zones](#)

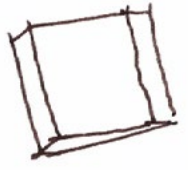
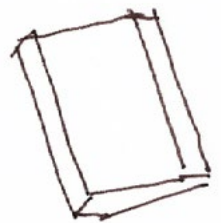
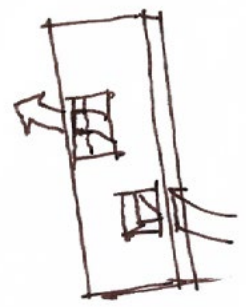
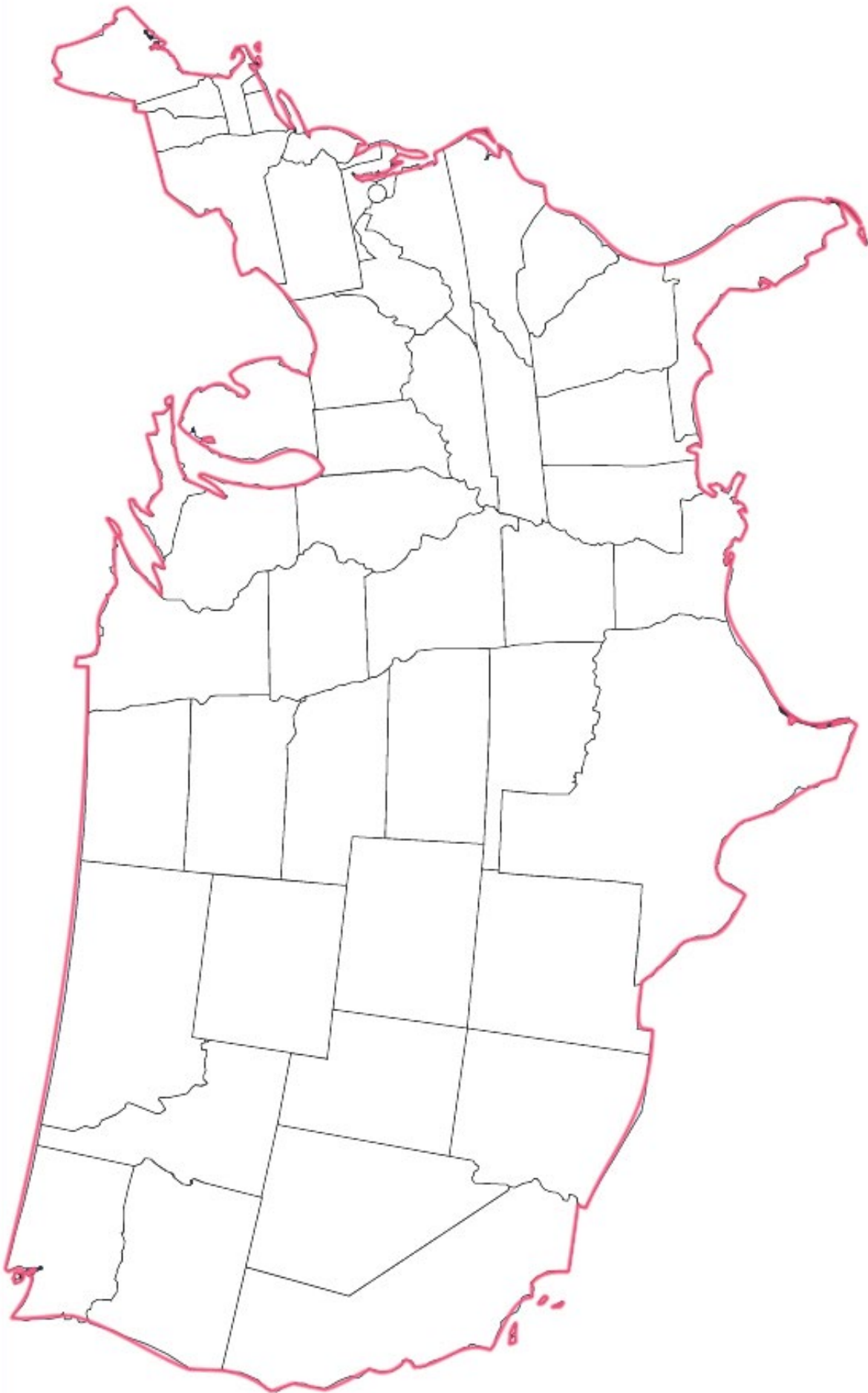
Comfortable Low Energy Architecture: [Building Shape - Surface Area to Volume Ratio](#)

Building Construction Illustrated 4th Ed.: Chapter 1

Sun, Wind, and Light: Architectural Design Strategies: Section on Orientation and Location

Erik Walker: [PPD-PA QuickStudy Guide](#)

YOUR NOTES



ZONING

ASSIGNMENT 8

You need to know zoning basics AND how they differ from code

- » What is the general point of zoning? How is this different from building code?
- » For the following, state whether it is a zoning or code requirement:
 - building height
 - fire separation
 - property setbacks
 - parking spaces required
 - building footprint
 - allowable use
 - use and occupancy classification
- » What is FAR? What two numbers do you need to determine the max allowable floor area?
- » What's an easement? What is a variance?

REFERENCES

YouTube / South LA Plan Planning Department: [FAR video](#)

YouTube / Peter Podlas Architect: [The Home Architect - Ep. 5 - How do I plot my setbacks to my survey?](#)

FindLaw.com: [Land Use and Zoning Basics](#)

Investopedia: [Floor Area Ratio \(FAR\) Definition](#)

Site Planning and Design Handbook 2nd Ed.: Chapter 4 Design for Communities and other random pages

Pluralsight / Kevin Griendling: [Prepare for the ARE Vol. 3: Programming & Analysis](#)

See the site diagram on and zoning excerpt on the next pages. The owners wants to build an office building on Lot A1, which fronts on K St. They want to create outdoor space on each side for a dog park and outdoor meditation area. They also want to maximize the building height but do not want to include a penthouse.

- » Draw in the setbacks
- » Hatch the allowable building area
- » What is the allowable gross floor area per FAR?
- » What is the maximum height?
 - What does this tell you about the required building materials?
- » What is the allowable building area?
- » Can the owner build their entire allowable FAR given the above conditions?
 - Consider how many stories the building would have to be
 - What if they decided to not include the outdoor areas?

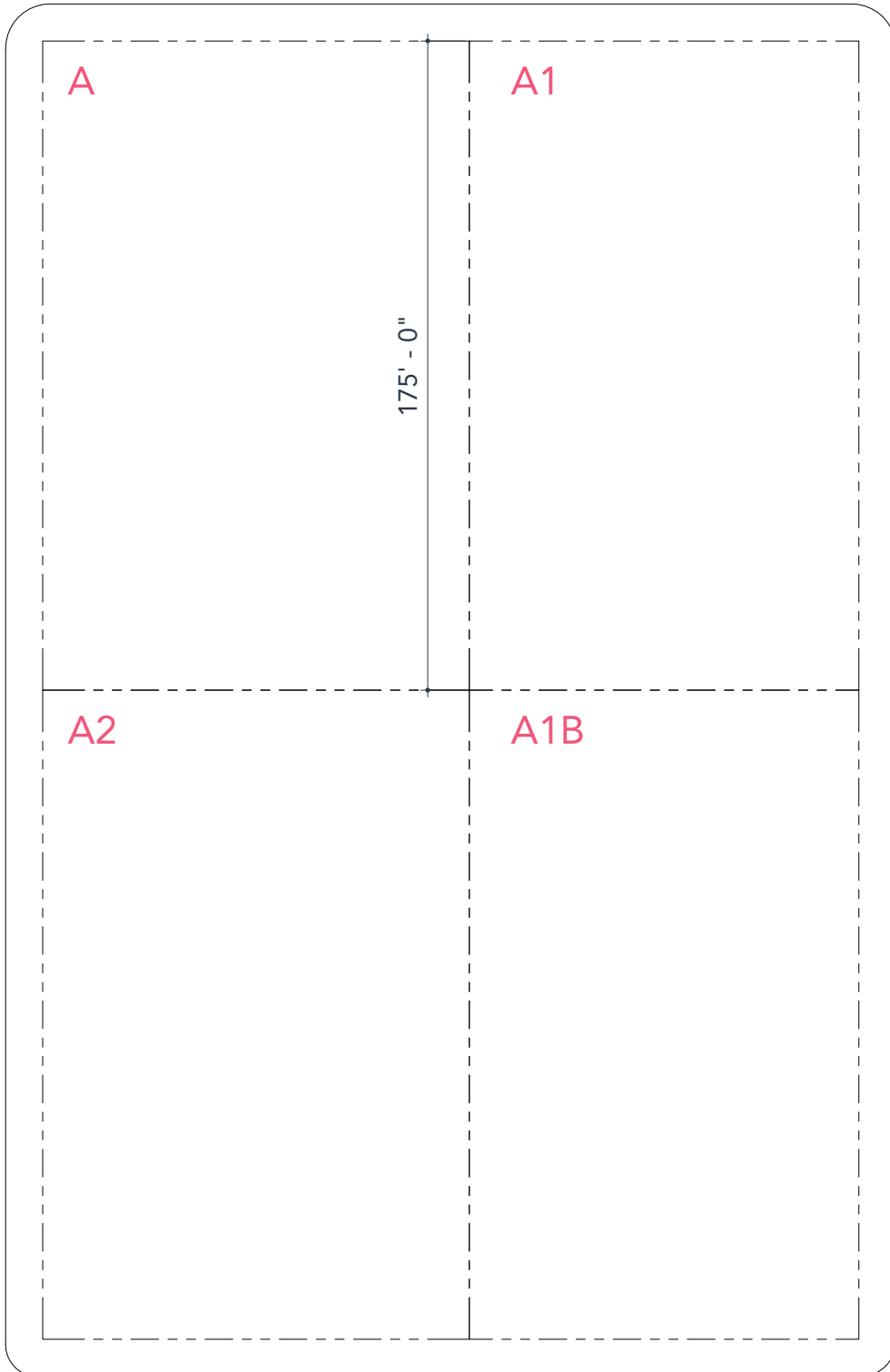
YOUR NOTES

ZONING

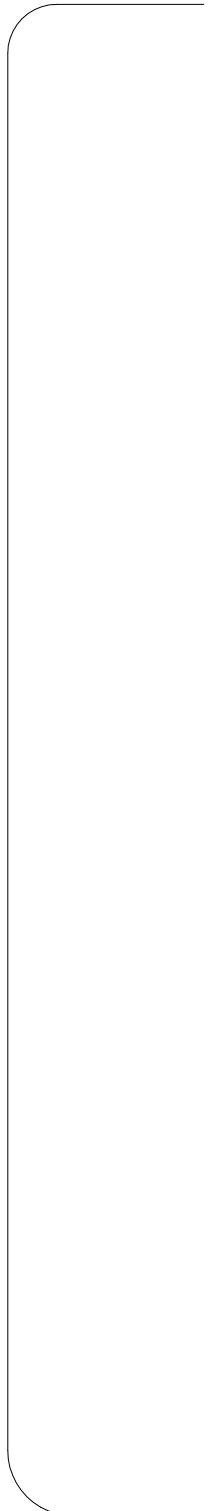


K ST

105' - 0"



14TH ST



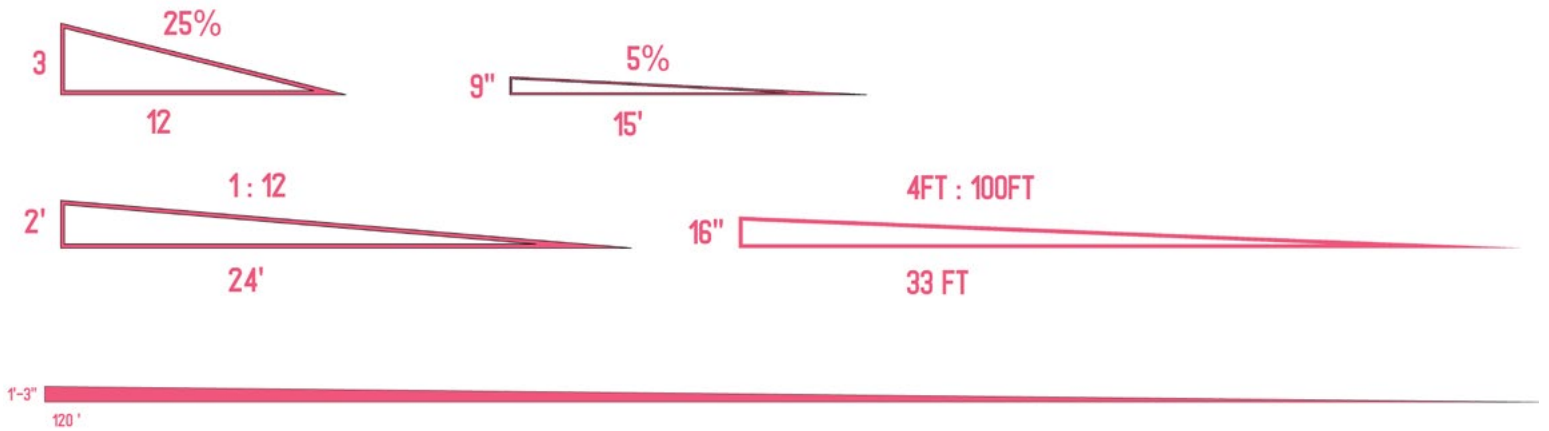
HYPERFINE

Development Standards								
	Floor Area Ratio (max.) ¹	Height (ft.)	Penthouse Height (ft.)/Stories	Lot Occupancy (percentage) ²	Rear Yard (ft.)	Side Yard (ft.)	Green Area Ratio	Zoning Regulation Reference
D-6	None	130 (fronts on right-of-way of at least 110 ft.)	20	100	2.5 in. per 1 ft. of vertical distance from the mean finished grade at the middle of the rear of the structure to the highest point of the main roof or parapet, but not less than 12 ft.	If provided, at least 2 in. wide for each 1 ft. of height of building but no less than 5 ft.	0.20	Subtitle I, Chapter 5
	10.0 (non-residential, fronts on right-of-way of at least 110 ft.)	120 (fronts on right-of-way of at least 100 ft. but less than 110 ft.)	1 plus mezzanine; Second story permitted for penthouse mechanical space					
	8.5 (non-residential, fronts on right-of-way of 110 ft. or less)	110 (fronts on right-of-way of at least 90 ft. but less than 100 ft.) No taller than the width of the right of way plus 20 feet (on streets less than 90 ft)						

ANSWERS

SLOPE MATH

ANSWER 1



Slope is a measurement of how much an elevation is changing. Just remember rise over run. How far are you going up (or down) divided by how far you're going to the side.

You may be asked about slope as it relates to sewer pipes, site drainage for pervious and impervious surfaces, drainage on parking lots, parking ramps, ADA and IBC ramp maximum slopes, roof slopes and more.

To fully understand the slope you need to know the rise (vertical change) and the run (horizontal change). If you have these you can write the slope in a number of different ways, usually it's a percentage or a ratio.

Slope as a percentage = $\text{rise/run} * 100$

Slope as a ratio is shown as rise: run, though the run is usually shown in a fixed unit, like 12 or 100. If you're given 4:12 it means that for every 12 units you go horizontally, you move 4 units up. This could be feet or inches or yards, just make sure to pay attention to units. Often on the exam you will be given a question with one unit of measurement and asked for an answer with a different unit. A slope question might give you a slope ratio, a horizontal distance in feet and you will have to provide an answer in inches.

Some of the more common slopes are:

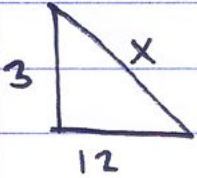
- » Sewers
 - 1/4" : 12" (2%) for 2" pipes
 - 1/8" : 12" (1% for 3-6" pipes)
- » Site Drainage
 - 5% min away from buildings
 - 2% min for impervious surfaces
 - 1.5% - 10% for grass areas
- » Paved Parking Lots
 - 2% - 3%
- » ADA Ramps
 - Not greater than 1:12 (8.33%)
 - See 2010 ADA Section 405
- » IBC Ramps
 - Not greater than 1:12 (8.33%) when it's a component in a means of egress
 - Not greater than 1:8 (12.5%) elsewhere

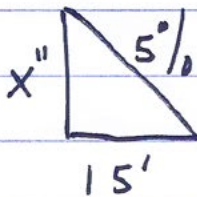
Slope answers above. Math is on the next page.



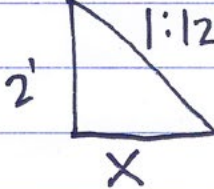
SLOPE MATH

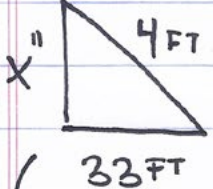
ANSWER 1

①  $3:12 \rightarrow \frac{3}{12} = .25 = 25\%$

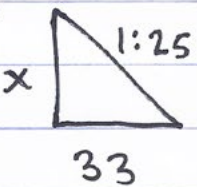
②  $\frac{X''}{15'} = .05 \rightarrow X'' = .05 \cdot 15' \rightarrow X = .75'$
 $X = 9''$

$\frac{X''}{15' \left(\frac{12''}{1\text{FT}} \right)} = .05 \rightarrow X = .05 \cdot 180 = X = 9''$

③  $\frac{2}{X} = \frac{1}{12} \rightarrow (X)(1) = (2)(12) \rightarrow X = 24'$

④  $\frac{33\text{ FT}}{100\text{ FT}} \cdot 4\text{ FT} = 1.32\text{ FT} (12) = 15.84''$



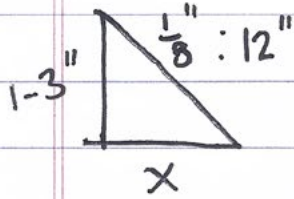
 $\frac{X''}{33} = \frac{1}{25} \rightarrow 25X = 33 \rightarrow X = \frac{33}{25}$
 $X = 1.32'$
 $X = 15.84''$



SLOPE MATH

ANSWER 1

5



$$\frac{1-3''}{x} = \frac{1/8''}{12''} \quad \frac{1.25'}{x} = \frac{.125}{12}$$

$$.125x = 1.25' \cdot 12$$

$$x = \frac{15'}{.125} = 120 \text{ FT}$$

$$\frac{1''}{8} = \pm 1\%$$

Watch out for rounding. You will always be told how much to round, but I usually make sure to not round until the final answer. 1/8:12 is about a 1% slope, but if you round to 1% too early it can throw your answer off.

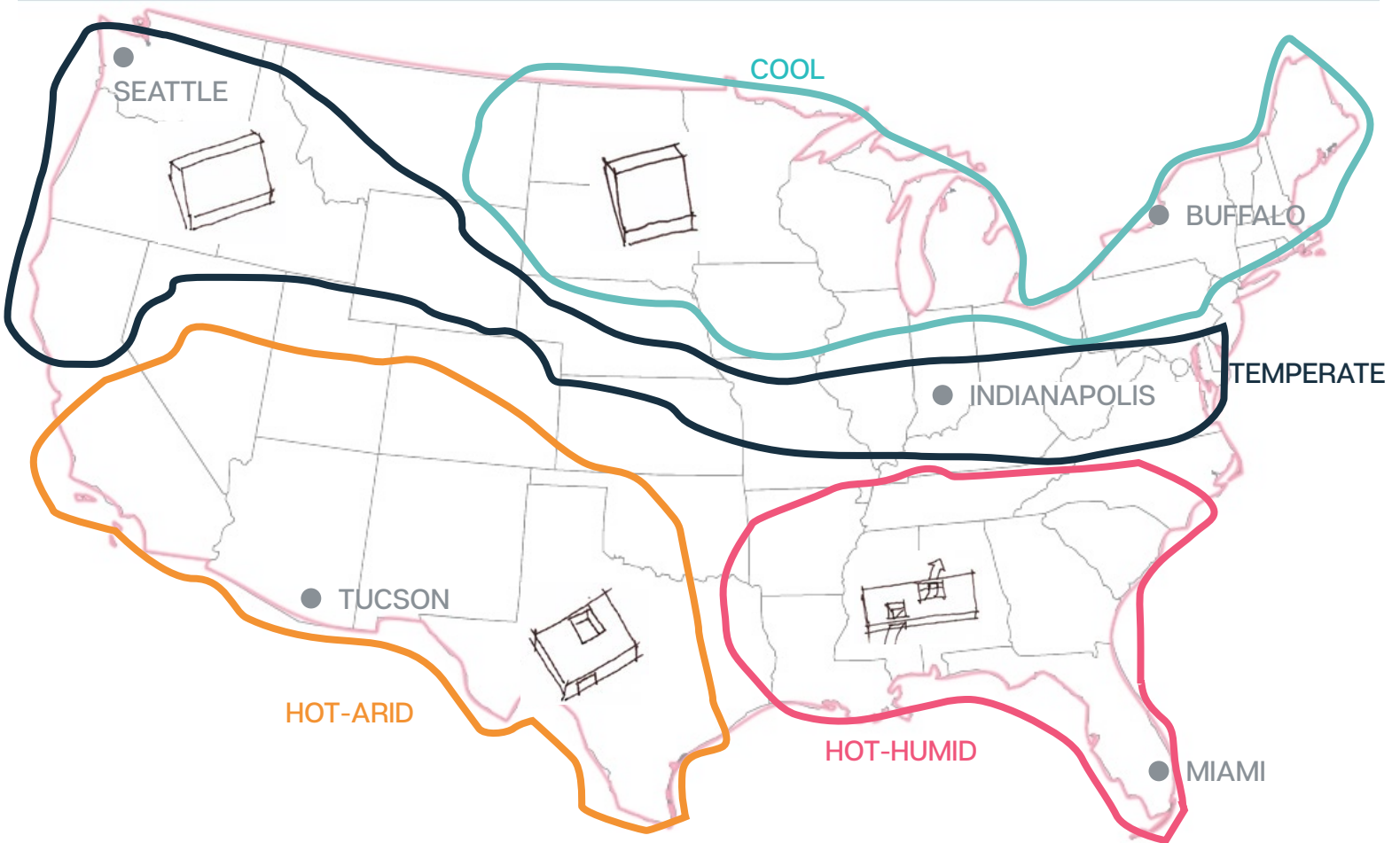
$$\frac{1.25'}{x} = .01 \rightarrow x = 125'$$

$$\frac{1.25'}{x} = .0104 \rightarrow x = 120.19$$

$$\frac{1.25'}{x} = .01041667 \rightarrow x = 119.999962$$



CLIMATE ANSWER 7



Surface-to-volume ratio compares the amount of surface area of a building's facade to the volume of the building's interior space.

A low ratio means there is less surface area per volume. See the CLEAR link. The diagram is confusing because the shaded area is bigger on the diagram that has minimal surface area, but otherwise its correct. Surface areas conduct heat, so you want a low ratio in cold climates.

Courtyards are good for hot climates because they introduce airflow, can provide shading and...I guess those are the two big ones. Maybe the increased surface area to volume ratio helps.

It is never good to orient a building north-south if it is avoidable. Unless the question is about an urban lot and you are restricted by zoning, a building orientation question will almost always have an option to orient east-west and this should be considered.

Cold:

- maximize solar heat gain
- minimize exposure to wind
- provide compact building form
- place low on a hill

Temperate

- maximize solar gain in winter
- reduce solar gain in summer
- reduce exposure to wind in winter
- allow exposure to wind in summer (see tree types)
- place higher on a hill

Hot Arid

- maximize shade and minimize wind (probably because hot wind is uncomfortable)
- courtyard building types
- at bottom of hill on flat topography

Hot Humid

- maximize shade
- maximize wind
- place at top of hill
- courtyard building types, lots of interior access to wind



ZONING

ANSWER 8

Both zoning and code can dictate the size of a building. Zoning is concerned with density and land use. Code is concerned only with safety.

Building height can be restricted by both zoning and code.

Fire separation is code. Fire is a safety issue, so it's a code thing.

Property setbacks is zoning. Anything dealing with the actual use of the land or the legal description of the property is zoning.

Parking is zoning

Building Footprint is a zoning term. This is often used in conjunction with Lot Coverage.

Allowable Use is zoning, it tells you what kind of program you can have, i.e. schools, hospitals, adult entertainment, gas stations, single family residential etc.

Use and Occupancy is code, this is used to determine how the program will limit the size, egress distances, fire separation, all that stuff.

It's important to know what type of requirements are code and which are zoning because you will have to look this stuff up...like how many parking spaces a project needs. You don't want to waste time looking in the wrong document. So if you need to find the # of parking spaces you look in the zoning document.

FAR is Floor Area Ratio. It is a code limit on the gross

floor area of a building. It will be given to you in writing or in a chart as a number, 3, 5.5, 10, etc. To find the max allowable area you multiply the provided FAR by the total area of the lot. There seems to be a lot of confusion about this, but FAR calc is easy. Setbacks and lot occupancy can change the size and shape of the actual footprint you can build, but finding the gross floor area per FAR is simple. $FAR * Lot Area$.

Per the AHPP, an easement is "a legally created restriction on the unlimited use of all or part of ones land." These exist if another property owner or the public needs to access something on your land. Either a utility, a public attraction, maybe a driveway to a property behind yours. The big takeaway is these areas can not be built on, even if they aren't in the setbacks.

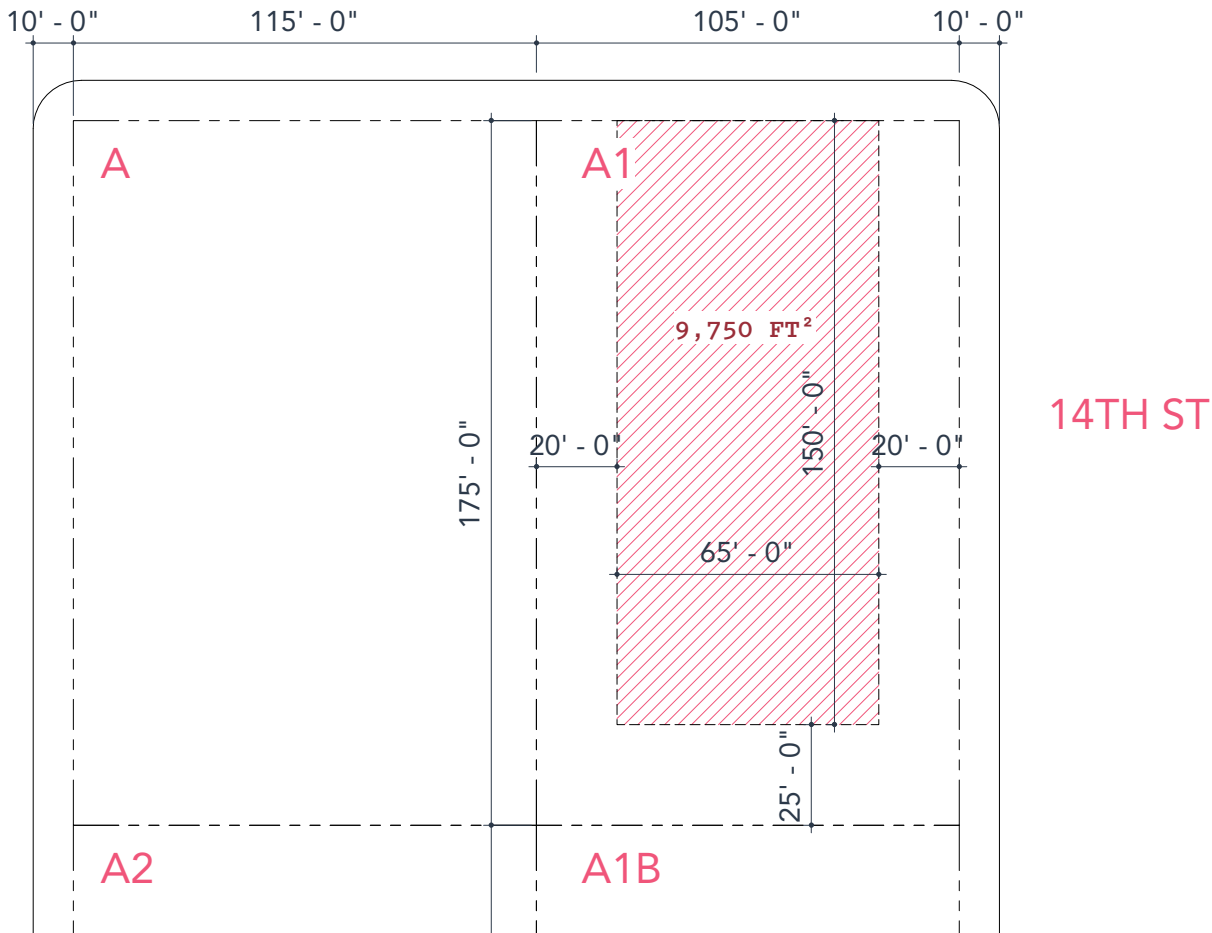
A Variance is required if the zoning ordinance restricts what you want to build on the property. This isn't something you just get to do...you can't apply for a variance to build a gas station if that's not allowed in a residential zone, or to build an extra 30 feet higher so you can have more floor space. For a variance you typically need to show some type of hardship that prevents you from building what everyone else is allowed to build as a matter of right...so your lot is odd shaped or has an unusual topography that prevents you from building within the confines of what the zoning laws allow.



ZONING

ANSWER 8

K ST



Setbacks are shown above. The side setbacks are 2" per foot of building height. This is a moveable target...if the building height changes the setbacks change and if the setbacks change the max footprint changes, which can change how many stories you need, which can change the building height. You should be given at least one fixed number on any exam question. In this case you are told the building height is 120 ft so $120 * 2" = 240" / 12 = 20\text{ft}$. The rear setback is $2.5" * 120 = 25\text{ft}$

Gross floor area per FAR is Lot Area * 10 So $(105 * 175) * 10 = 183,750\text{ft}^2$

The maximum height is 120 ft. This tells you that you will have to use Type IA construction, which means steel and concrete. This is code, not zoning, but it's a coordination point for using both documents. See 2015 IBC Table 504.3

The allowable building area is the actual space you can build on. It's $9,750\text{ft}^2$ in this question. In this case we are just concerned with the area inside the setbacks. Other things could effect this as well...required green area, lot coverage, easements...see the old PPP vignette for an ARE kind of example.

The owner probably can NOT build their entire FAR with these conditions. They are allowed $183,750\text{ft}^2$ and are restricted to a $9,750\text{ft}^2$ footprint. That means the building would have to be $183,750/9,750 = 18.8$ stories. With a max height of 120ft you would need a floor-to-floor height of $120/19 = 6'-3"$. There is no **required** side setback, just a requirement on it's size IF you decide to include one. Without including an open area they can build to the lot lines and the allowable building area becomes $15,750\text{ft}^2$. In this case they only need $183750/15.750 = 11.67$ stories so the floor-to-floor height would be $120/12 = 10\text{ft}$...so maybe they could do it, though that's probably still a bit low. The answer isn't important because I just made up all these numbers. It's the process that counts.

