CONTENT AREA: PRINCIPLES

Site Planning

Vocabulary:

- **Zoning:** uniform standards of construction originating in NYC in 1916 to protect the health, welfare and safety of people. Regulates the use of land, light, air, and open space while protecting property values and protecting against nuisances (factories in residential areas), undesirable businesses (porn shops by schools) and dangers (hazardous chemicals in public areas).
- **Incentive Zoning:** encourages private developers to provide amenities for public use in exchange for opportunity to build larger or taller structures on a site.
- **Nonconforming Use:** building is no longer permitted by the zoning ordinance. Typically allowed to stay unless it's unsafe.
- **Conditional Use:** a building that is permitted in an area that it is not zoned for, to benefit the public (e.g.: an elementary school in a residential neighborhood)
- **Variance:** applied for by an owner on a private site to ask to deviate from an ordinance in order to avoid hardship.
- **Spot Zoning:** a change in the zoning ordinance for a particular area
- **Ordinance:** a municipal law
- **Setbacks:** required open space measured between property line and face of building. Used to preserve light, air, and spaciousness
- **Building Line:** utilized by communities principally to achieve planned street patterns. They help insure that buildings will not be erected in the bed of projected streets or of potential street widening.
- **Easements:** legal right of government or another land owner to use one's property for a specific purpose
- **Scenic Easement:** Prevents development that upsets something scenic to the public
- **Assessment:** valuation of property for the purpose of taxes
- **Business Improvement Districts:** used to fund public space improvements (new streetscapes/graffiti removal) with the intention that it will enhance an area's appeal. All business owners in district who would benefit pay increased taxes.
- **Eminent Domain:** power of the state to take private property without owner's consent, but with fair market value of the land compensation. Must be used government or public development (highways, railroads, civic center), economic development, or to mandate an easement for access (public utilities, right of way).
- **Deed Restrictions:** place limitations on the use of the property, typically by original developers, who determined what land would be used for (live, work, or play) and can't be changed by future owners.
- **Restrictive Covenant:** limitations and stipulations used in residential settings. Can be aesthetic (allowable color pallets, vegetation types/pruning, fencing materials) pet control (how many and/or living conditions), or storage related (visibility of parked cars/boats/campers).
- **Affirmative Covenant:** commits a buyer to performing duties in the future (e.g. will make payments for common charges in a condo)
- **Conditional Covenant:** If restriction is violated or disregarded, the land will revet back to original owners/heirs.
- **Right-of-Way:** right for people to cross land of another (pathways/cattle drives)

Facts/Rules:

- One acre = 43,560 square feet
- US Survey Divided land that was not already surveyed in 1780s into a square grid system:
  Check: area 24 mi. on a side defined by parallels/meridians & divided into 16 townships
  Township: area 6 miles on a side; divided into 36, 1-mile sections
  Section: 1 mile square parcel of land containing 640 acres
  Quarter Section: area 1/2 miles on each side

Concepts/Goals:

- **Space/Site Planning Hierarchy**
  - **Total Building Group:** all of the buildings in a complex, group or masterplan
  - **Component Building:** an individual building in the group
  - **Activity Center:** spaces related to each other by function
  - **Space Unit:** each individual space within a center
  - Example: Medical Campus > Acute Care Hospital > Surgery Dept. > Pre-Op Suite
- **Space/Site Planning Considerations**
  - Relationship between site/structure
  - Response to site conditions (sun/vegetation/wind/sound)
  - Be visible but maintain human scale
  - Express and serve its purpose economically and thoughtfully
  - Utilize technologies and materials appropriately (honest tectonic expression)
  - Use local materials and building techniques
  - Create a hierarchy of parts that is interesting to look at
  - Create a relationship between the interior and exterior
  - Express human spirit and encourage human interaction

Processes:

- **Estimate Needs**
  - Determine total area by calculating the amount of space required for each use
- **Create Planning Diagrams**
  - **Matrix Chart:** numerical values of required relationships (1 = adjacent, 2 = no relationship, 3 = separate) are assigned to each program space with regard to the others
  - **Bubble Diagram:** before space planning create a loose drawing of circles that indicates required adjacencies, priorities or relationships, and relative sizes.
  - **Block Diagram:** more accurate (but still preliminary) layout of spatial organization based on bubble diagram, but with accurate sizes used.
- **Create Blocking & Stacking Diagrams**
  - **Blocking:** assigning departments to a defined area on a floor based on its desired adjacency and support requirements
  - **Stacking:** assigning floors/areas of floors to departments based on its desired adjacency and support requirements

Site Design and Design Principles

Vocabulary:

- **Cardo and Decumanus:** the two major streets in a Roman town, perpendicular
- **Loop Road:** a collector/distributor road into a shopping center
- **Point:** a position, no dimension
- **Line:** has direction and length but no thickness
- **Plane:** has position, direction and length, but no thickness
- **Volume:** a 3D plane
- **Shape:** outline of a form
- **Size:** physical dimension
- **Color:** quality of a reflected light that articulates form and space
- **Light:** radiant energy that is perceived by the human eye
- **Texture:** applied to a surface
- **Proportion:** relationship between parts that provides harmonious order
- **Golden Section:** renaissance concept where a whole is divided so that the smaller part has the same relationship to the larger part, as the larger part has to the whole.
- **Rhythm:** regular occurrence of elements in time or space
- **Balance:** equilibrium
- **Symmetry:** balanced arrangements, typically in reference to formal design
- **Static form:** parts are equal in size and located around a reference axis
- **Dynamic form:** parts are unequal in size and arrange around a reference axis
- **Local Road:** low capacity roads with direct access to a site
- **Collector Road:** connection roads between local and arterial streets
- **Arterial Road:** wide high capacity streets usually connecting to expressways
- **Expressways:** limited access roads with high speed, high volume circulation

Facts/Rules:

- **Site Slope Percentage = Vertical/Horizontal x 100**

flat area - good for all activities	=	< 4%
moderate	=	4 - 10%
steep - unusable	=	10 - 50%
very steep, subject to erosion	=	+ 50%

- **Construction Slope Percentage = Vertical/Horizontal x 100**

storm drains	=	0.3% minimum
sanitary sewers	=	0.4 - 1.4%
street surface drainage	=	0.5% minimum
planted or large pavers	=	1% minimum
lawns	=	25% max
planted banks	=	50% max
parking area/lot	=	5% max
automobile ramps	=	8% max
sidewalks	=	10% max
streets/paved driveways	=	10% max

- **Angle of repose: the greatest angle at which soil will lay without sliding.**

Loose wet clay or silt	=	30%
Compact dry clay	=	100%
Wet sand	=	80%
Dry sand	=	65%

- Gross Area = Net Area (commonly used areas) + circulation (structure/MEP/service)
- Floor Area Ratio (FAR) = Gross Area/Site Area
- Penthouses, fan rooms, and skylights are sometimes allowed to exceed height restrictions.
- **Road/Street Design**
  - Roads consist of straight sections (tangents) and simple curves
    - Avoid intersections that are slightly offset
    - Avoid intersection where the angle of roads is less than 80°
    - Cartridge Roads are loop distributor-collector drive with access to the local road
    - At intersections with more than 750 cars per hour, a traffic light is required
    - At intersection with more than 3,000 cars per hour, grade separation is required
      - Cloverleaf: two level interchange
      - Direct left turn: where two expressways intersect
      - Diamond: expressways intersect secondary roads

• Maximum length of a block	=	1,600' (that's 8 Portland Blocks!)
• Cul-de-Sacs	=	400' max w/ 80' turn around
• 2 lane highway w/ 9'-0" shoulders	=	40'-0" - 42'-0"

- Typical Surface Streets

  Made of concrete, asphalt, grave, or decomposed granite

Width	=	11'-0" - 12'-0" wide
Heavy Traffic Streets	=	6" concrete curb and gutter
Minor Streets	=	4" roll curb or gravel
Minimum curb radii @ minor streets	=	12"
Minimum curb radii @ major streets	=	50"
Landscape strips	=	7' w/trees or 4' wide w/grass/dirt

- Vehicle Turing Radii

Small cars	=	16-19 ft
Standard cars	=	19-23 ft
Large cars	=	23-25 ft
Ambulance	=	25-30 ft
Busses/trucks	=	43-50 ft

Parking Design

- Spaces are typically 9'-0" wide and 18'-0" - 20'-0" long
- Accessible spaces are minimum 8'-0" wide with access alley 5'-0" wide for cars or 8'-0" wide for vans adjacent to the space
- When parking is provided, the number of accessible parking spaces is determined by the total number of spaces.
  - However, hospital outpatient facilities must have 10% and outpatient physical therapy facilities must have 20%
- Allow 400 sf / car for parking and circulation
- Plan for 3,000 - 4,000 sf of parking for every 1,000 sf of shopping space

Clearance between cars	=	20"
Circulation Aisle	=	12'-0" wide
In lots with attendants	=	8' x 18' stalls and 20' aisles

- Angle of parking affects projection and bay width of double loaded aisle:

30° parking	=	15'-7" projection	=	43'-2" bay width
35° parking	=	16'-7" projection	=	45'-2" bay width
40° parking	=	17'-6" projection	=	47'-0" bay width
45° parking	=	18'-2" projection	=	48'-4" bay width

- 90° parking is most efficient = 11 cars/100 lineal feet of curb
  - makes for easy two-way traffic and can accommodate most cars. The only disadvantage is that it can be difficult to maneuver
- 60° parking is pretty efficient = 9 cars/100 lineal feet of curb
  - Relatively economical and allows easy access to and from parking spaces
- 45° parking is pretty efficient = 8 cars/100 lineal feet of curb
  - Relatively economical and allows easy access to and from parking spaces
- 30° parking is least efficient = 5 cars/100 lineal feet of curb
  - Uneconomical.
- Slopes in parking lots should be 5% max
- In multiple story lots, ramps should be 15% max, with 8' transitions

Concepts/Goals:

- Choose a south facing site (use overhangs or deciduous trees to block summer sun)
- Midway on a hill is best (top is too windy, fog/cold air settles in valley)
- Summer breezes are good (courtyards/porches) block winter winds
- Location Factors for Construction:
  - **Suburban areas:** lowest costs for development and connected to urban areas
  - **Urban areas:** highest costs for development (due to labor rates)
  - **Rural areas:** variable cost based on access and existing transportation
- Parking**:**
  - Most efficient layout are 90° perpendicular spaces, which allow for the maximum amount of spaces and two way traffic
  - The cheapest parking to build is an outdoor lot, then a parking structure, then underground parking

Processes:

- Address all of the primary concerns for site design:
  - Pedestrian and vehicular circulation/transportation network
  - The disposal of runoff and the effects of surface drainage
  - Landscaping
  - Access to services and public facilities
  - Natural and artificial lighting
  - Site access for emergency vehicles
  - Security
  - Subsurface conditions and topography (including fluctuating water tables, heaving, and soil stability)

Implications of Design Decisions

Note: This information typically fits under the "Concept/Goals" subheading for each topic in this Knowledge/Skills Set and has been included there.

Adaptive Reuse of Buildings and/or Materials

Vocabulary:

- **Mothballing:** term used in historic preservation when you designate certain areas to be repaired or restored at a later date, under a later contract.

- **Adaptive Reuse:** process of adapting old structures for purposes other than those initially intended while retaining their historic features.
- **Preservation:** the act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property.

Facts/Rules: None

Concepts/Goals:

- Historic Preservation:
  - 4 treatments applied to historic structures (most historically accurate to least):
    - **Preservation**: least amount of work done to the building and any interventions are as inconspicuous as possible
    - **Rehabilitation:** retain and repair historic materials, but some replacement of damaged material is ok, as are additions that convey historic values
    - **Restoration:** remove inconsistent features and replace missing features in accordance with the restoration period
    - **Reconstruction:** new construction to look like how something existed at an earlier time
  - Protection, maintenance, and repair are emphasized while replacement is minimized.
  - Preservation/Restoration occurs to buildings that are specifically significant (designed by a famous architect, housed an important historic event, etc). These buildings are typically on the National Register of Historic Places
  - Rehabilitation occurs to buildings in a significant historic district, but aren't individually significant (and are more likely to be able to take on a new use).
  - Adaptive Reuse/Land Conservation:
    - Reduces the amount of sprawl in the outlying city
    - Is sometime associated with gentrification (eg: the pearl district)

Processes:

- Define factors affecting the scope of historic preservation including the nature of the effort (will it be preservation, rehab, restoration, or reconstruction?), the applicable regulations, significance of the property, and condition of the structure
- Team with structural/MEP engineers who have specialized historic preservation experience
- **Complete Preliminary Analysis/Predesign and Research:**
  - Documenting existing conditions, programing the intended function/use of the building and site, doing research to investigate historic nature of project/area, determining which parts of the buildings are original and sequence of construction
  - Complete preliminary cost estimate of work to be done, and prepare applications for federal grants.
- **Complete Design Phase:**
  - Coordinate with standard steps of the building design process
  - Coordinate preservation with architecture/engineering development
  - Coordinate with specification/front end
- **Complete Document Phase:**
  - Coordinate with drawings, specs, final cost estimate
  - Coordinate with bidding/negotiation phase
  - Coordinate with construction administration, observation, and documentation

- Reports for maintenance, determination of historic eligibility for review boards may be required
- **Address energy efficiency, accessibility, health and life safety issues:**
  - Take care not to obscure, damage, or destroy character defining materials or features when upgrading a building to meet code and energy requirements.
  - Asbestos/Lead abatement should be carefully done so that important historic finishes are not adversely affected.

Architectural History and Theory

Vocabulary: None

Facts/Rules:

- **Secretary of Interior's Standards for Rehabilitation:**
  - Allow for new additions/alterations to be different from the older structure, but must be complementary in massing, size, scale, and architectural features
  - Criteria must be met if Federal Tax Credits will be used
  - Takes precedence over state/local regulations
  - Clients may discover historical significance during site analysis. Archaeological activity and proper handling of structures/artifacts must take place.
- **National Park Service Standards for Preservation:**
  - Use a property as it was historically intended to, or maximize the rendition of distinctive materials, features, spaces, and spatial relationships if there is a change
  - History character of a property will be retained and preserved. Do not replace historical materials that are intact or can be repaired
  - A property will be recognized as a physical record of its time, place, and use.
  - Changes to property that are now also considered historical will be preserved (e.g. the minoan columns at Knossos that were painted red as an act of restoration)
  - Distinctive materials/features/finishes/construction or examples of craftsmanship will be persevered
  - Existing condition of historic features will be evaluated to determine the appropriate level of intervention.
  - Chemical/physical treatments will be gentle if absolutely required.
  - Archeological resources will be protected/preserved in place

Concepts/Goals:

Kevin Lynch's ***The Image of the City*** is about how users perceive and organize space as they navigate through cities. Also known as **legibility**, the ease with which people understand the layout of a place based on the following:

Paths: streets, sidewalks, trails that people travel on
Edges: perceived boundaries like walls, buildings, shorelines
Districts: city sections distinguished by some identity/ character
Nodes: focal points, intersections
Landmarks: readily identifiable objects become reference points

Camillo Sitte wrote ***City Planning According to Artistic Principles*** which suggested that the quality of urban space is more important than architectural form (the whole is much more than sum of its parts)

- Planning cannot be done in two dimensions, but three.

- Believed Greek spaces like the **agora** (gathering place) or **forum** (marketplace) were good urban spaces
- Public square should be seen as a room and should form an enclosed space
- Churches and monuments shouldn't be isolated, but integrated into the squares

Clarence Perry wrote ***The Neighborhood Theory*** which served as a framework to design functional, self-contained neighborhoods in industrial cities.

- No major traffic through residential areas, arterial streets should form the perimeter to define the "place" of the neighborhood
- Interior streets to use cul-de-sacs and curves for low volume traffic
- Population would be determined by the number of people needed to support one school, and would be about 160 acres with 10 families per acre.
- The school would be at the center of the neighborhood so that a child would have to walk 1/4 mile - 1/2 mile, and without crossing any major streets
- Shopping, churches, services would be placed on the edge of the neighborhood so that nonlocal traffic wouldn't intrude on the neighborhood
- 10% of the land area would be dedicated to parks and open space for community

Tony Garner wrote Wrote ***Une Cité Industrial*** which suggested that functions of a city could be separated by zoning into four categories: leisure, industry, work, and transportation

- Was developed in response to the industrial revolution
- Schools and vocational schools are placed near the industries they're related to, and there are no churches or government/police buildings so man can rule himself.
- Pioneered the use of reinforced concrete
- Designed innovative building block with free standing houses
- Enormous open spaces. There are few squares or parks
- Trees are incorporated into important streets

Sir Ebenezer Howard wrote ***Garden Cities of To-morrow*** which describe a utopian city where people live harmoniously with nature, the basis for the **Garden City Movement.**

- "Three Magnets" pull a people are: town, country, town-country
- Suburban towns of limited size, but financially independent could be planned ahead and surrounded by a belt of agricultural land, balancing the desire for the city and the country. These cities would be connected by a ring of rail transportation and surround a large central city.

- Land was first owned communally. In England, land was owned by the King and was given to people in return for their loyalty, support, or military service
- **Primogeniture:** land was passed from father to eldest son
- **Fee Simple:** land could be transferred and used however the owner pleased
- **Homestead Act:** 160 acres was free and transferred to private ownership provided a person built a house and lived on the land for five years.

CONTENT AREA: ENVIRONMENTAL ISSUES

Interpreting Existing Site/Environmental Conditions and Data

Vocabulary:

- **Catchment Areas aka market, trade, or tributary area:** geographic area from which the participants in an activity are drawn. It grows and shrinks with the activity.
- **Residential Catchment Areas:** determined by local transit systems.
- **Proctor Compaction Test:** Geotechnical tests to determine the maximum, practically achievable, density of soils and aggregates.
- **Percolation test:** test method to determine the rate at which soil absorbs effluent. Used to test suitably of soil for a leachfield.
- Survey:
  Baseline: parallel (line that follows latitudes of earth) used as the basis for the east-west layout of the US Survey system
  Standard Parallels: parallels between the baselines in the US Survey
  Principal Meridian: meridian (north-south line that follows longitude of earth) that serves as the basis for the north-south grid layout of the US Survey
  Guide meridian: meridians between the principal meridians
  Benchmark: standard or point of reference against which things may be compared
  Metes and bounds: verbal description of land that begins at a known point and describes the bearing and length of each side of the property until the point of the beginning is reached
- Topography:
  Contour interval: change in elevation between two contours. Smaller scaled maps typically have a larger interval for clarity.
  Crown/Ridge: contours point “down” toward the lower elevation
  Swale/Valley: contours point “up” towards the higher elevation
  Hills: concentric circles with elevations getting higher towards the center
  Depression: concentric circles with the elevations getting lower towards the center
  Frost line: max depth at which soil will freeze. Below, the soil stays warmer than freezing.
- Water:
  Swamp: wetland that features permanent inundation of large areas of land by shallow bodies of water, generally with a substantial number of hummocks, or dry-land protrusions
  Swale: an elongated depression in the land surface that is at least seasonally wet, is usually vegetated and is normally without flowing water.
  Detention Pond: low lying area that is designed to temporarily hold a set amount of water while slowly draining to another location. They are more or less around for flood control when large amounts of rain could cause flash flooding if not dealt with properly
  Retention Pond: designed to hold a specific amount of water indefinitely. Usually the pond is designed to have drainage leading to another location when the water level gets above the pond capacity, but still maintains a certain capacity
  Riparian Rights: system of rights and duties that determine the reasonable use, duties, and allocations of water to owners of waterfront property (includes bottomland,

beach, and upland, but not the water itself). Owners can use water adjacent to their property, but can't infringe upon the rights of others to use the water.
Sheet Flow: water that flows across paved surfaces.
Aquifer: permeable stratum of soil material that allows the passage of water under ground and is the water source for wells
Hydrology: the study of the occurrence, movement, and quality of water on a site.
Flume: elevated artificial channel that carries fast moving water and is used to transport things like logs and fish
Weir: embankment, levee or dam formed to hold a river or stream or divert water flow.

- Energy:
  Albedo: how much radiant energy that is reflected by a surface where 0 is a flat black surface which absorbs all heat and 1 is a mirror (rate is listed as a fraction).
  Conductivity: the speed with which heat passes through a material. Metals are high, and soils/sand are low.
- Weather/Climate:
  Macroclimate: based on latitude, elevation, and proximity to water. Water reduces temperature extremes.

Islands/Costal Region	=	constant & moderate temperature
Arid/Desert Region	=	low humidity & greater temperature variation
Mountainous Region	=	winds are forced to rise

  Microclimate: based on solar radiation, the angle between the ground and altitude

Greatest sun rays	=	perpendicular to ground
Winter Solstice	=	least hours of sun and low sun angle
Summer Solstice	=	most hours of sun and high sun angle
Vernal/Autumnal Equinox	=	equal hours of sun and dark

- **Vortex**: when moving air encounters a building perpendicular to a broad face it flows both over roof and down the facade. Air collects at the base of the building which results in a high velocity swirl of wind.
- **Air Pollution Temperature Inversion Phenomenon:** the air temperature at ground level is lower than higher elevations causing the heavy, cold trapped air below to release pollutants
- **Climate:** the composite of weather conditions (described in data or quantifiable units) including temperature, humidity, atmospheric pressure, wind, and rainfall, as well as site conditions including microclimate, topography, ground cover, water, and elevation.
- **Ecology:** the science of the pattern of relationships between a group of organisms and their environment.
- **Ecosystem:** an environment of living organisms and non-living components.

Facts/Rules:

Public Transit

- Collective Transit System: needs at least a population density of 30 persons per acre.
- Max distance to walk to a stop is 1/4 - 1/2 mile

Local Bus (short trips in city/long trips in 'burbs)	=	15 - 30 mph
Express Bus (between medium density areas)	=	40 - 60 mph
Rail (between areas with high density)	=	40 - 70 mph

- Site constraints that affect a grading plan:
  - Existing trees and shrubs to be saved, transplanted or removed.
  - The finished floor height of existing structures.

- The finish grade of existing roads.
- Existing land forms
- The properly line, grade must be met and excess runoff can't be diverted to adjacent properties.

Concepts/Goals:

- Ecosystems (e.g.: forest, pond, city, desert) are constantly changing, and if one component (species or non-living thing) is removed, the system will evolve to make new relationships.
- Uniform ecosystems (all rural, natural ecologies or all urban, man made ecologies) tend to be unstable. Need harmony between natural and human activities.
- Climate issues can be dealt with by addressing planning, orientation, building materials, plantings, and vegetative or constructed shading/exposure to sun.
  - **Heat Transmission**:
    - In northern latitudes, heat transmission through walls is critical
    - In southern latitudes, heat transmission through roof is critical
  - **Wind**:
    - Design plazas at ground level, or open first floors, cautiously as they can be windy due to windbreaks (where part of the wind goes up and over and part goes down)

Processes:

- **Get a Site and/or Building Survey**
  - Site Surveys: There are 3 types you can get:
    Preliminary: basic for preparation of architectural drawings
    Construction: precise condition of site and adjacent structures, bench marks
    Possession: records completed development
    And they come in 2 forms:
    Geodetic: precise, follows spherical shape of the earth
    Plane: more common, assumes a flat plane of the earth
    Aerial Photography (Google earth type images)
    City
    Construction (includes markers)
    Hydrographic (oceans, rivers, lakes, etc)
    Land (a description of the site)
    Topographic (elevations, slopes)
    Route (roads and utility lines)
  - Building Surveys: For existing buildings, there are 3 types you can get:
    Field Measurements: taken by hand
    Laser Scanning: remotely measure existing spaces (quick)
    Photogrammetry: establish control points and hand survey to get base coordinate system (takes much longer than laser scanning)
- **Determine the Land Use**
  It depends on its role in a catchment area, location, topography, and cost.
  Eight basic categories of use:

Agricultural	Institutional
Commercial	Natural Resources
Government	Open/Conservation
Industrial	Residential

- **Determine the Land Value**

  It's calculated by the relation to the use that yields the highest return for the site

  Comparison Method: compared to other similar parcels (can be applied to all categories of use) and is the most accurate if current data is available.

  Development Method: when comparisons aren't available, use estimates to determine the selling price of lot, cost to develop, time to develop, and net sale price.

  Residual/Income Approach Method: used in highly developed areas by estimating potential income from improvements that yield the highest return (highest & best use)

  Allocation Method: used to determine value of improved properties by deducting the value of site improvements to get the value of the land.

- **Determine Soil Type**

  Gravel: well drained and able to bear loads (+2 mm)

  Sand: well drained and can serve as foundation when graded (0.5 - 2 mm)

  Silt: stable when dry, swells when frozen, do not use when wet (.002 - .05 mm)

  Clay: must be removed, too stiff when dry and too plastic when wet (< .002 mm)

  Levels of Soil:

A Level	=	Topsoil (organic/mineral material)
B Level	=	Minerals
C Level	=	Partially weathered/fractured rock
D Level	=	Bedrock

  Alluvium: soil, sand or mud deposited by flowing water

  Humus: soft dark soil containing decomposed organic matter, poor bearing capacity

  Loam: rich soil containing equal parts of sand, silt, and clay

- **Determine Potential Land Problems**
  - Water within 6'-0" of land surface: pump out excavation, waterproof basement, resist hydrostatic pressure (continuous drain pipe installed at foundation)
  - Rock at/near surface of site: use explosives to reduce manual labor
  - Soil is soft clay, waterbearing sand or silt: construct deeper foundations or drive piles, remove poor soil
  - Underground streams: avoid and be cautious of siting of structure
  - Cut and Fill: balance it. There shouldn't be more taken away than added or vice versa
- **Complete Soil Testing**

  Bearing Capacity: max pressure a foundation soil can take with harmful settlement

Bedrock	=	10,000 psf
Well graded gravel/sand	=	3,000 - 12,000 psf
Compacted sand/fill	=	2,000 - 3,000 psf
Silt/Clay	=	1,000 - 4,000 psf

  Borings: locations depend on nature of the building and should be 20'-0" past firm strata

  Open warehouses: one in each corner and one in the middle
  Large structures: 50'-0" spacing
  Uniform conditions: 100 - 500' spacing

  Wash boring: the drilling of a test hold to locate bedrock beneath very compact soil. A pipe is driven into the soil while water forces the material to the surface. It can penetrate all materials other than rock.

  Auger boring: soil testing that uses an auger drill big fastened to a rod to bring the soil to the surface. Most efficient in sand and clay because the bit is easily obstructed. It has limited depth

Core boring: an intact cylindrical sample is extracted by drilling through all types of soil including bedrock. Very reliable and expensive
Test pit: an excavation of an open pit that allows for a visual examination of the existing conditions as well as the ability to take intact samples for further testing. Can determine the depth of the water table.

- **Choose Foundation Type**
  - **Spread Footing:** Most economical…$ method.
    Delivers load directly to soil.
    Area of the footing = load/safe bearing capacity.
  - **Mat Foundations:** Very expensive…$$$ method.
    Typically it's only used when the strata is weak,
    It acts as one continuous foundation.
  - **Belled Caissons:** holes are drilled to firm strata and concrete poured.
    They're basically really, really deep spread footings
  - **Socketed Caissons:** like Belled Caissons, but the hole is drilled deep into the strata.
    Bearing capacity comes from end baring and frictional forces.
  - **End Bearing Piles:** 2-3x cost of spread footings.
    Driven until tip meets firm resistance from strata
  - **Friction Pile:** Driven into softer soil.
    Friction transmits the load between pile and soil.
    Bearing capacity is limited by whichever is weaker: the strength of the pile or the soil
- **Prevent Future Problems**
  - Connect new on-site drainage to natural drainage
  - Design surface water runoff based on worst case storm scenario
  - Prevent erosion by using channels, gutters, swales, and xerioscaping

Design Impact on Human Behavior

Vocabulary:

- **Behavior setting:** a space with definable boundaries and objects where typical pattern of behavior occurs at a particular time (e.g. Tossing scarf during the national anthem at Jeld-Wen Field during a Timbers match)
- **Census:** systematic record taking about members of a population. Began in 1790 and occurs every 10 years.
- **Demography:** Statistical study of human populations
- **Density**: number of people per unit area
- **Population size:** actual number of people in a given location.
- **Proxemics:** the study of spatial requirements of humans and the effects of population density on behavior, communication and social interaction
- **Territoriality:** behavioral system where person/group lays claim/defends an area
- **Sociofugal:** grouping of people arranged so that each can have privacy from others

Facts/Rules:

- **Typical Human Comfort Zone**

Winter	=	63°F - 71°F
Summer	=	66°F - 75°F
Tolerable humidity	=	30% - 60%
Uncomfortable humidity	=	+ 75%

- **Winds**

Basic Speed	=	70 - 80 miles/hour
Unnoticeable	=	< 50 feet/minute
Pleasant	=	50 - 100 feet/minute
Pleasant *and* noticeable	=	100 - 200 feet/minute
Drafty	=	200 - 300 feet/minute
Uncomfortable	=	+ 300 feet/minute

  Pressure varies as the square of the velocity (if velocity doubles, pressure quadruples)

- **Pedestrian Circulation**

Area of a person	=	3 sf
Easy movement	=	13 sf
Crowd movement	=	7 sf
No movement	=	3 sf
Sidewalks	=	5'-0" wide min
Collector walks	=	6-0" - 10'-0" wide min

- **Noise**

  Smallest difference in 2 sounds the human ear can detect is 1 decibel

Sleeping, studying, whispering	=	30 decibels
Conversation, comfort	=	50 - 60 decibels
Safety Threshold	=	85 decibels
Rock Band!	=	90 - 100 decibels

- Trees thin out high frequency noises
- Each increase of 10 decibels the human ear perceives as 10x loud.
- Typically doubling the distance between source and ear reduces level by 6 decibels
- On freeways, doubling the distance between source and ear reduce level by 3 decibels
- Winds add "white noise" that blurs any one sound frequency.
- Walls close to a noise source reduce high frequency, but midway between the source and the ear does nothing.

Concepts/Goals:

- **Ahwahnee principles:** a collective vision of how urban and suburban planning should follow certain fundamental principles regarding community size, integration, transportation, open space, pedestrian paths, native vegetation, water and energy use.

Processes:

- Address Human Elements
  - **Senses**: sight, sound, smell and touch give an impression of size, shape, and material. Taste probably isn't an issue...unless you've got willy wonka walls :)
  - **Style:** follow conventional and acceptable solutions to maintain consistency and harmony within space and surrounding context
  - **Culture:** different cultures use buildings differently (separation of women/men, sanitary standards, layout of spaces for rituals, feng shui, vastu shastra, etc.)
- Address building organizational values
  - **Behavioral Interests:** desired spaces to perform tasks
  - **Circulation:** ease of movement around site and building
  - **Health:** reduce stressors (noise, crowding, sun glare, sick building syndrome)
  - **Adaptability:** allow for future changes, modifications, and flexibility
  - **Cost:** use regular forms, plans, and compact arrangements

- Design principles that increase personal safety in public areas
  - Design for the needs of the local residents to encourage a well used space.
  - Concentrate activities in a limited number of areas
  - Promote foot traffic by providing a shortcut or inviting features the encourage alternative routes
  - Visible into public space and evening lighting
  - Protected play area for small kids with comfortable seating for parents

Hazardous Conditions and Materials

Vocabulary:

- **Asbestos:** Naturally occurring mineral found throughout the world
- **Asbestos Containing Materials (ACM):** regulated by EPA/OSHA/State/Local Agencies
- **Permissible Exposure Limit (PEL):** standard that sets the number of asbestos fibers a worker can be exposed to.
- **National Emission Standards for Hazardous Air Pollutants (NESHAP):** an EPA regulation that dictates requirement of ACM removal before remodel/demo in order to prevent significant asbestos release into the air.
- **Asbestos Hazards Emergency Response Act (AHERA):** an EPA regulation that handles asbestos found in K-12 schools, and requires that all facilities be inspected to determine the presence and amount of asbestos
- **OSHA:** designed to protect workers who handle ACM and other hazardous materials
- **Lead:** toxic material once used in paint and other household products, found in air from industrial sources, and in drinking water from plumbing materials.

Facts/Rules:

- Asbestos
  - The three most common types of asbestos found in buildings are:
    - **Chrysotile:** white asbestos, accounts for about 95% of asbestos found
    - **Amosite:** brown asbestos
    - **Crocidolite:** blue asbestos
  - Asbestos was originally used for spray fireproofing, sound proofing, pipe insulation, floor/ceiling tiles, mastic, etc.
  - EPA banned spray application of asbestos containing fireproofing materials in 1973
  - Laboratory analysis is the only way to positively identify asbestos
  - Owner is responsible for cost to identify and remove asbestos.
  - Removal is less of a concern if no children will be living in the building
  - Health Hazards known to exist from exposure:
    - **Asbestosis:** non cancerous chronic respiratory disease caused by accumulation of asbestos fibers in the lungs
    - **Cancer of Lung, Stomach, and/or Colon**
    - **Mesothelioma:** rare cancer in the thin membrane lining the chest and abdomen
  - Lead
    - Typically lead based paint that is in good condition is not a hazard
    - Children under 6 are at the greatest risk for lead poisoning
    - Most common sources for lead poisoning are by breathing or swallowing the following:
      - Deteriorating lead based paint
      - Lead contaminated dust
      - Lead contaminated residential soil

- Health Hazards known to exist from exposure:
  - Children: Brain/nerve damage, behavioral/learning problems, slowed growth, etc
  - Adults: reproductive problems, high blood pressure, nerve/memory problems, etc

Concepts/Goals: None

Processes:

- Methods to minimize/contain asbestos fibers during removal:
  - Wet methods
  - HEPA vacuuming
  - Area isolation
  - Use of Personal Protective Equipment
  - Avoid sawing, sanding and drilling
- Methods to minimize/contain lead during removal:
  - If disturbing more than 6 sf of lead paint in homes, child care facilities, or a school built before 1978, the work must be done by contractors certified by the EPA to follow procedures for safe removal
  - Contain work area
  - Minimize dust
  - Clean up thoroughly

Sustainable Design

Vocabulary:

- **Biophilia:** the connections that humans subconsciously seek with the rest of life.
- **Organic feedstock:** something organic (wood fiber, paper, cotton, etc.) that mold can use as an energy source. Mold cannot eat inorganic materials like concrete, brick, or gypsum (but it loves the paper on drywall!)
- **Design Temperature:** the average temperature that a mechanical system is designed for, either for heating (how cold it gets) or cooling (how warm it gets)

Facts/Rules:

- In the US, about 300 billion sf of building area will be constructed/remodeled by 2035.
- The architecture and building community is responsible for almost 1/2 of all US greenhouse gas emissions annually (per the US Energy Information Administration)

Concepts/Goals:

- Sustainable design is the careful meshing of human purpose with the larger patterns and flows of the natural world.
- Consider stewardship, restorative acts, and regeneration of natural capital.

Processes:

- **Design in context:**
  - Use infill/brownfield sites: reduce development on pristine habitat or farmland
  - Retain/restore waterways on or near the site
  - Use native or adapted plants that don't require maintenance and restore biodiversity
  - Plant trees to reduce heat island effect/offset carbon dioxide from building emissions

- Use vegetated roofs to reduce amount of stormwater runoff, impervious surface area, and heat island effect. Also has a longer lifespan than a conventional membrane roofing system and lower overall maintenance cost
- Use swales/storage basins to reduce storm water runoff
- Avoid petroleum based fertilizers
- Respect natural habitat/local species (be wary of noise, light pollution)

- **Design in correct Climate Zone:**
  - **Hot & Dry:** minimize sun exposure and effects of wind. Use small windows. Optimize thermal mass for large temperature swing during the day, and closely cluster buildings for the shade the offer each other.
  - **Hot & Humid:** minimize sun exposure, maximize natural ventilation. Use lightweight construction to minimize radiation of heat and space buildings far apart for breezes
  - **Temperate:** maximize solar gain in the winter, minimize in the summer. Maximize breezes in the summer, minimize in the winter. Take advantage of daylighting opportunities
  - **Cold:** orient buildings/openings for maximum protection from cold winds and use small windows/compact shapes to minimize heat loss. Use south facing windows to maximize solar gains.
  - **Plan for the long term**
    - Maximize ecological, social, and economic value over time.
    - Build buildings to last (duh!)
    - Design for adaptability to accommodate future changes in program and use
    - Design for versatility to accommodate future changes in technology
    - Design for durability by using materials, construction methods and structural systems that will withstand weather, long term use, and catastrophic events.

Alternative Energy Systems and New Material Technologies

Vocabulary:

- **Building Commissioning:** process of ensuring that system are designed, installed, and functionally tested for effective operation/maintenance for an owner's operational needs.
- **Retrocomissioning:** systematic investigation process applied to existing buildings to improve an optimize operating/maintenance.
- **Life Cycle Costing:** provides a tool for determining long-term costs for the total building.
- **U-Factor:** measure of heat transmission where a Low U-value has a slow heat loss or gain (brick wall) and a High U-value has a rapid heat loss or gain (window)
- **R-Value:** measure of thermal resistance in a component. (U-Value = 1/R-Value) and typically the opposite of an U-Value. Used to define level of insulation.
- **Thermal Inertia:** ability of a material to store heat (concrete/masonry walls store heat in an arid climate and release it slowly at night)

Facts/Rules:

- North Americans spend 90% of their time indoors.
- Daylight increase productivity in the workplace and test scores in schools
- Heat loss in glass is about 20x greater than an insulated wall
- Solar heating can be cost effective, but cooling is not

Concepts/Goals:

- Green building combines the best of traditional design with updated construction technology while addressing environmental and energy crises
- Before the Industrial Revolution, environmental problems were caused mostly by concentrated amounts of compounds that occurred naturally and over time. Today the environment isn't alway able to adapt to manmade materials and waste products.
- Green technology follows green design (reduce need for building systems with passive design, then address the rest with systems like photovoltaics, wind power, low wattage)

Processes:

- Participate in the 2030 Challenge: a campaign to reduce fossil fuel energy consumption by designing efficient buildings or retrofitting existing ones through proper site design, building form, location, materials, and passive heating/cooling/ventilation/daylighting.
- Minimize use of nonrenewable energy sources and maximize use of renewable energy
- **Create Healthy Indoor Environments:**
  - Ample daylight and proper ventilation lead to greater satisfaction, more comfort, and increased productivity.
  - Supply fresh outdoor air, use passive ventilation or "Mixed-mode" systems in larger buildings that supply a mix of fresh/mechanical air.
  - Offer natural light and views to the outdoors with windows, skylights, light shelves, and the use of light colors
  - Control temperature and humidity with passive and mechanical technologies that are individually controlled by occupants.
  - Prevent moisture build up.
- **Conserve Water**
  - Reduce potable water use in irrigation and fixtures by using drip-irrigation or low-flow/graywater appliances
  - Use local vegetation that requires minimal or no irrigation
  - Catch rainwater for flushing fixtures, irrigation
  - Treat blackwater through an on site living machine so it can be reused
  - Use few impervious surfaces
- **Use environmentally preferable building materials**
  - Build to the size that is needed and no larger
  - Use materials/systems engineered for maximum efficiency
  - Use durable materials that last longer and with fewer maintenance resources
  - Avoid irreplaceable/engaged resources
  - Use renewable/well managed resources
  - Use recycled/recyclable resources and avoid anything that's toxic
  - Avoid materials that generate pollution during manufacturing, building, use, disposal
  - Use materials with low embodied energy (how much fossil fuel did it take to make?)
  - Use materials the help conserve energy (thermal mass for energy, light reflective surfaces, radiant barriers, insulation)
- **Make changes based on wisdom and user feedback**
  - Post occupancy surveys
  - Install equipment to monitor building performance
  - Design smaller/simpler buildings with accessible systems and short feedback loops
  - Develop a common language of building metrics understood by designers and users (e.g. This building gets xx miles per gallon)
  - Develop and share case studies. Don't hog work, ideas, and findings!!

CONTENT AREA: CODES + REGULATIONS

Government and Regulatory Requirements and Permit Process

Vocabulary:

- **Prescriptive Code:** Building code that specifies techniques, materials and methods to be used. Cut and dry and simple to administer by the official
- **Performance Code:** Building code that describes functional requirements, but leave method to achieve decisions up to the designer.
- **Fire resistance** values for how long a separation can resist the passage of fire. Stated in terms of hours and can be increased with the use of sprinklers. (eg: walls, doors, windows, floors, etc.)
- **Flame Spread Rating/Smoke Developed Ratings** measures the amount of flame and smoke a material generates. (e.g. Carpet, fabrics, etc)
- **Area of Refuge:** a location designed to hold occupants when evacuation is not safe or possible. Has a steady supply of outside air, passive fire protection, electrical integrity/ emergency lighting, two way communication/call box to 24 hr manned, or outside line

Facts/Rules:

Egress Requirements

- Typical common path of travel = 75'-0" max per path
- Typical distance to an exit = 250'-0" max
- Exits cannot pass through:
  - Kitchens
  - Storerooms
  - Closets
  - Through rooms that can be locked to prevent egress
- One **Fire Tower** is required in buildings over 75'-0" (one exit, minimum)
  - Non combustible construction that is connected with mechanically vented vestibules on backup power or balconies
- Doors must swing in the direction of travel
- The number of exits is based on the number of occupants
  - Typically spaces with more than 50 occupants must have 2 exits
- Required width of exits is determined by occupants on the floor plus an allowance for occupants from floors above
- Elevators are not a means of egress
- Escalators provide a conduit for smoke and are not an approved exit
- Ramps may constitute a portion of the require legal exits
- Revolving doors must collapse to be part of required legal exit

Concepts/Goals:

- **Zoning Codes** vary between every city, and influence building design through the regulation of land, function, size, and exterior elements.
- If zoning ordinances and building codes give different maximum heights or areas, the lower of the two takes precedence.
- **Fire Resistance** is intended to permit safe egress, maintain structural integrity, limit the spread of fire help extinguish blaze, limit damage, and avoid collapse.
- Each community has its own review process.
- Building permits include zoning, building/structural, life safety, and locally specific reviews

Processes:

- **Identify the Type of Construction**
  - Determining the limits on building height and area is tied to several factors, including the occupancy and if the building is fully sprinklered.
  - Classified according to degree of Fire resistance and determined by fire zone it is located and intended use
  - Buildings are allowed to have a one story and 20'-0" height increase if the building is protected throughout by a sprinkler system (does not apply to H occupancies)
- **Determine the Means of Egress**
  - Includes the path from any occupied space in a building to the public way, broken down into three elements:
    - **Exit access:** distance a building occupant must travel from the most remote point in the occupied portion of the exit access to the entrance of the nearest exit
      - Travel distance within a space is typically limited to 75'-0" before two distinct paths are required.
    - When a building requires two exits, the travel distance is only measure to one of the exits, not both
    - The overall travel distance from any space within a suite of offices to an exit is 250'-0", which includes the 75' of travel distance to an exit
  - **Exit:** a door that opens directly to the outside or a protected stair/ramp
    - Enclosed stairs are required to proved a fire-rated enclosure for 1 hour (2 hours if stair connect 4+ stories)
    - No limit on distance traveled within an enclosed exit
    - 50% of exits can discharge through a lobby space on the level of exit discharge if protects and has a sprinkler system
  - **Exit discharge:** the path between the exit door and the public way.
    - No dimensional limits on the travel distance once outside the building (except if exits discharge onto a balcony).

Accessibility Laws, Codes and Guidelines

Vocabulary:

- **Americans with Disabilities Act (ADA):** law that prohibits discrimination based on disability
- **Building Owners and Managers Association (BOMA):** professional organization that for commercial real estate professionals
- **Fair Housing Act:** law that prohibits housing discrimination on the basis of race, color, religion, sex, disability, familial status, and national origin.
- **HUD:** US Department of Housing and Urban Development

Facts/Rules:

- **ADA Accessibility Guidelines:**
  - All new design or new construction areas must meet accessibility requirements
  - Includes all employee work area and temporary construction that is open to the public
  - Some areas are not require to be accessible:
    - Temporary construction facilities (e.g. Job shacks, scaffolding, trailers)
    - Raised areas used for security/life safety (e.g. Security or life guard towers)
    - Non-occupiable service areas accessed infrequently for maintenance (e.g. Mechanical rooms, penthouses)

- Tollbooths
- Water slides
- Non-public animal containment areas
- Raised boxes and wrestling rings
- Raised structures for officiating/announcing sports events

- **Dimensional Standards:**

Wheelchair Passage Width		=	32” clr at a point/36” clr continuous
2 Wheelchair Passing Width		=	60” clr min
Headroom		=	80” min
Turning Space		=	5’-0” circle min
Clear floor space		=	2’-6” wide x 4’-0” long min
Changes in levels		=	1/4” max w/o edge treatment
	Beveled Edge Ok	=	1/4” – 1/2” w/ 1:2 max slope
	Requires Ramp	=	1/2” or more
Doors		=	32” clr min when open 90 deg
Door clearance		=	1’-6” clr on pull side of door
Accessible route cross slope		=	1:50 max
Ramps	Slope	=	1:20 min to 1:12 max
	Width	=	3’-0” wide
	Length	=	30’-0” max
	Landings	=	5’-0” at each end (width of ramp)
	2 Handrails	=	If rise is +6” or run is +72”
Handrail Height		=	34” min - 38” max
Handrail Cross Section		=	1-1/4” - 2” and 1-1/2” clr from wall
Handrail Extension		=	12” top and 12”+ 1 tread bottom
Stairways		=	48” clr between hand rails min
Walkways		=	1:20 max (5%)
Curb Cuts		=	3’-0” sides 1:10 max, front 1:12
Car Parking Space		=	9’-0” wide min with 5’-0” wide aisle
Van Parking Space		=	11’-0” wide min w/5’-0” wide aisle
Parking Space Location		=	200’-0” max from building entrance
	7 - 50 car lot	=	2 accessible spaces
	51 - 100 car lot	=	3 accessible spaces
	101 - 150 car lot	=	5 accessible spaces

- **Fair Housing Act Guidelines:**
  - Covers most housing (owner-occupied building with 4 or less units, single family houses sold/rented by owner, and housing run by clubs that limit occupancy to members are sometime exempt)
  - Requirements for New Buildings with 4 or more units and an elevator:
    - Public common area must be accessible
    - Doors and hallways mush be wide enough for a wheelchair (32”-36” min)
    - All units must have:
      - An accessible rough into and through the unit
      - Accessible light switches, electrical outlets, thermostats, etc
      - Reinforced bathroom walls to allow later installation of grab bars
      - Kitchens/bathrooms can be used by people in a wheelchair
    - These rules do not replace more stringent state/local codes

Concepts/Goals:

- Accessibility services scope can vary depending on the size of the client, their organization, and the project.
- Name recognition matters...large, public, visible companies are more vulnerable to lawsuits so need to be prepared for issues.

Processes:

- Identify client's potential accessibility problem areas and desired outcomes
- Identify strategies for correcting problems including a proposed implementation schedule and budget/cost analysis
- Develop prototype design details for implementation
- Prepare and administer surveys if required to assess population using building
- Prepare client training program manuals and facility monitoring documentation

CONTENT AERA: MATERIALS + TECHNOLOGY

Construction Details and Constructability

Vocabulary:

- **Sheepsfoot:** a tamper roller used during the soil compaction process which has large teeth used to increase soil stability and bearing capacity.
- **Wale:** horizontal brace of steel or timber used to support sheathing or other members such as concrete form work.
- **Trenching:** creating shallow excavations used for pouring small footings and foundation walls or to provide drainage of surface water.
- **Shoring:** temporary wood or steel bracing usually set at an angle and used to hold walls in place
- **Underpinning:** providing additional support to an existing foundation by rebuilding or reinforcing
- **Raker:** a temporary diagonal brace used to support vertical sheeting against earth walls created by excavation.
- **Cribbing:** horizontal boards 2-4" thick placed between soldier beams to hold soil in place during excavation

Facts/Rules:

- Soil stabilization methods:
  - **Silt fence:** filter fabric usually fixed to wood stakes filers find sediments from runoff before it gets to streams
  - **Straw bale dams/earth dikes:** placement prior to grading will minimize loss of soil.
  - **Hydroseeding or mulching:** Temporary seeding with quick sprouting annual grass or a layer of mulch
  - **Retaining walls:** a more permanent solution.

Concepts/Goals:

- OSHA (Occupational Safety and Health Administration) Requires that the contractor will provide and maintain the following regarding site layout:
  - Adequate access roads into and through the site for the safe delivery and movement of derricks, cranes, trucks, other necessary equipment, and the material to be erected and means for pedestrian and vehicular control.
    - This does not apply to roads outside of the construction site.
  - A firm, properly graded, drained area, readily accessible to the work with adequate space for the safe storage of materials and the safe operation of the erector's equipment.

Processes:

- Ways to minimize the impact of construction on topsoil and native vegetation:
  - Relocate existing tees and plants prior to construction
  - Define staging areas and routes for construction vehicles
  - Excavation and construction done in phases. Soil can then be replaced quickly and stabilized.
  - Reuse site debris: stockpile and protect topsoil for later use.

Construction Materials

Vocabulary:

- **MasterFormat**: a standard for organizing specifications and other written information for commercial and institutional building projects in the U.S. and Canada.
- **CSI: Construction Specifications Institute:** One of the master specifications available. These are prewritten texts that include the majority of requirements for a particular section.

Facts/Rules:

- The choice of materials for a project depends on the type and purpose of the geotechnical system itself.
- Some geo-materials, such as peat, muck, expansive/swelling soils, and collapsible soils cannot be used in any type of construction because the severity of post-construction damage they may cause can be disconcerting.
- Often site soils are unacceptable for the intended function and must be replaced with better quality materials or improved. One method of improvement is to mix high-quality site materials with lesser quality site materials to provide an acceptable soil material.

Concepts/Goals:

- Three main things to think about when choosing materials (in order of importance):
  - Will they meet the performance requirements?
  - Will they be easy to process?
  - Do they have the right 'aesthetic' properties?
- The choice of materials for only aesthetic reasons is not that common, but it can be important: (e.g. for art)
- Most products need to satisfy performance targets, which are determine by considering the program and the site (e.g. they must be cheap, or stiff, or strong, or light, or all of the above)

Processes:

- Select and specify material within the following MasterFormat Divisions:
  - Division 02 — Existing Conditions(natural conditions)
  - Division 03 — Concrete(footing)
  - Division 31 — Earthwork
  - Division 32 — Exterior Improvements
  - Division 33 — Utilities
  - Division 34 — Transportation
- Improve soil bearing capacity
  - **Fill:** poor soil is replace with the appropriate soil, sand, and gravel mix
  - **Compaction:** usually of existing soil with a technique similar to compaction of fill.
  - **Densification**: use of heavy pounding piles/vibration/weights to compact and fill voids.
  - **Surcharging:** adding fill to existing soil and allowing settlement to take place with time.
  - Mixing: addition of sand or gravel to the soil.

Fixtures, Furniture, Equipment, and Finishes

Vocabulary:

- **Furniture, Furnishings, and Equipment:** Refers to a wide assortment of products that are prefabricated or custom and located in the building or on the site, including:

System furniture	Signage
Loose furniture	Planters
Artwork	Window Coverings
Accessories	Custom Furniture
Millwork	Awnings
Specialty Equipment	Audiovisual Equipment
Custom Lighting	

- **Ergonomics:** applied science concerned with designing equipment/furniture to maximize productivity by reducing fatigue and discomfort.

Facts/Rules:

- Services are applicable to project of all sizes
- The budget for FF&E is about 3-4x Interior design fees.
- Specialized knowledge is required with respect to construction, fabric types, available lines, specification of furniture and fabrics, installation procedures, building codes, regulations in commercial projects.
- Understand client's budget, and evaluate needs and constraints, to determine starting point for programming.

Concepts/Goals:

- Appropriate furniture reinforces the design concept of a building.
- Enhances the overall functionality of the building and influences the way that people use and interact with the space.
- Architects/design firms can offer additional services for FF&E selection/acquisition management.
- Vendors who help owners might not make selections that follow the design concept, choosing instead for low-cost, easily attainable products, that they represent or have hire quota they're looking to move.
- **Reasons for FF&E Services**
  - To furnish a new space: using new or reconfiguring old for a space.
  - To replace or upgrade existing FF&E: accommodate new/replace outdated technologies
  - To refurbish existing furniture: restore antiques, refinish instead of buying new
  - To expedite FF&E procurement: get things in time for a fast track project
  - To simplify FF&E procurement: assembles FF&E from multiple sources in one coherent package/one single point of sale.

Processes:

- **Evaluate Client Needs (FF&E Programming Process)**
  - Identify and document needs for all functional spaces including:
- **Prepare a Cost Estimate**
  - Line Item breakout of all FF&E to establish budget.
  - Based on current prices of items comparable to those requested
  - Client should approve budget before proceeding so architect has a benchmark for considering products.

- **Select Furniture**
  - Decisions are based on:
    - **Function**: what the client needs
    - **Durability:** how long it should last
    - **Aesthetics:** what will enhance the design
    - **Budget:** how much the client can afford
    - **Style:** what scale/size/proportion is appropriate for the space
- **Prepare Specifications**
  - Include an instruction to bidders with requirements for delivery, installation, warranties, and punch list procedures, and reference/include a furniture plan.
  - 3 types of specifications to choose from:
    - **Proprietary (Closed) Spec:** does not allow for substitution, and typically used to control aesthetics, function, and quality.
      - Identify name, model number, finish type, and submittal requirement.
    - **Descriptive (Open) Spec:** used in competitive bidding, and does not give level of control in closed spec.
      - Describe characteristics, materials, finishes, workmanship, and fabrication of products and give list of comparable manufactures.
    - **Performance Spec:** used with vendors who propose products they think will meet requirements
      - Describe only the desired/required results. Give no characteristics or manufactures.
- **Assemble Bid Package/Solicitation of Bids**
  - Typically a two week process for mid size projects (approx. 20,000 sf.)
  - Allow three weeks for large projects (100+ workstations)
  - Include site factors, elevator access, building access, dumpster/recycling use.
  - Award bid to a single dealer, or divvy up to different furniture, equipment, fixture providers
- **Administer Contract**
  - Owner/Supplier enter into their own contract (much like Owner/Contractor agreement)
  - Supplier sends shop drawings/submittals to architect for review and approval
  - Purchase orders are sent directly to the owner for payment, architect is copied on all correspondence and notified of any issues (long lead time, discontinued items, etc)
  - Architect helps establish installation schedule and arranges for punch list.

Product Selection and Availability

Vocabulary:

- **Life cycle analysis:** an assessment of the environmental impacts of a product in each phase of its use, from raw material to disposal.
- **Carbon Footprint:** the total set of greenhouse gas emissions caused by a person, place, or thing.

Facts/Rules:

- Building materials are evaluated on performance, aesthetics, and cost.
- Handling and storing materials involves diverse operations such as hoisting tons of steel with a crane, driving a truck loaded with concrete blocks, manually carrying bags and material, and stacking drums, barrels, kegs, lumber, or loose bricks.

- The efficient handling and storing of materials is vital to industry. These operations provide a continuous flow of raw materials, parts, and assemblies through the workplace, and ensure that materials are available when needed.
- Improper handling and storing of materials can cause costly injuries.

Concepts/Goals:

- Ties in with sustainable design, many construction products contain a proportion of recycled content. However by simple product substitution, projects can increase their recycled content significantly without increasing the cost of materials or risk.
- There can be financial savings in some cases, especially when recycling construction and demolition materials locally. The environmental benefits include less demand on finite natural resources, diversion of waste from landfill, and stronger markets for the materials that contractors want to send for recycling.
- Understand where products are coming from, and weigh transportation issues. Is it really necessary to specify something that must be trucked across country?
- Given the many tools and resources available for evaluating and identifying materials, it is useful to develop an organized process for making product selections. There is no definitive process for selecting materials.

Processes: None

Thermal and Moisture Protection

Vocabulary:

- **Surface Runoff:** water flow that occurs when soil is infiltrated to full capacity
- **Water Infiltration:** process in which water on the ground surface enters the soil
- **Moisture Migration:** the passage of moisture into/through a material or construction in the form of water vapor due to a difference in vapor pressure in the two faces
- **Thermal Expansion:** materials expand (and contract) due to temperature variation.
- **Water Table:** boundary between aerated and water saturated soil that can rise and fall seasonally
- **Catch basin:** a reservoir in which debris and sediment from runoff may settle before it enters the storm drain
- **Invert:** the lowest point or lowest inside surface of a drain, sewer, pipe, etc. established due to the dependency of gravity
- **Culvert:** drain or channel that permits the passage of water below ground. Typically a large diameter concrete or metal pipe often used under a road
- **Storm drain:** underground conduit used to carry rainwater from a catch basin to a body of water.
- **Drain tile:** perforated pipe surrounded by granular fill used to release hydrostatic pressure from foundation of retaining walls.
- **Vapor Barrier:** plastic or foil sheet that resists the diffusion of moisture through wall, ceiling, and floor assemblies, located on the warm side of the insulation.
- **Heating Degree Day:** a unit that measures how often outdoor daily dry-bulb temperatures fall below an assumed base, normally 65°F
- **Bulk Moisture:** is the flow of water through holes, cracks, and other discontinuities into the basement walls.

- **Capillary Action**: occurs when water wicks into the cracks and pores of porous building materials, such as masonry blocks, concrete, or wood. These tiny cracks and pores can absorb water in any direction—even upward.

Facts/Rules:

- Vapor diffusion retarders can help control moisture in:
  - Basements
  - Ceilings
  - Crawl Spaces
  - Floors
  - Slab On Grade Foundations
  - Walls
- Three basic storm water quality control strategies:
  - Infiltrate runoff into the soil
  - Retain/detain runoff for later release
  - Convey runoff slowly through vegetation
- Managing Water Infiltration Into Buildings:
  - Occurs from floods, roof leaks, potable water leaks, sewage backup, steam leaks, and groundwater infiltration.
  - Water damaged buildings and fixtures can become significant sources of sick building syndrome.

Concepts/Goals:

- Thermal and Moisture Protection includes the materials used to seal the outside of the building against moisture, thermal, and air penetration.
- How, where, and whether a vapor diffusion retarder should be used depends on the climate. Typically, the number of Heating Degree Days in an area is used to help make these determinations.
- Most basement water leakage results from either bulk moisture leaks or capillary action.

Processes:

- Congenital drainage systems are designed to control flooding during large, infrequent storms. They must cost-effectively manage flooding, control stream bank erosion, and protect water quality.
- Site Drainage/Stormwater Management Design:
  - Slope basin at 4:1 or flatter to prevent bank erosion and minimize risk of drowning
  - Design basins so that large particles settle in depressions and so inflows don't erode. Plan for maintenance to remove trash, debris, and sedimentation that collects in the forebay.
  - Low flow channels covey dry-weather flows and the last of captured volume to the basin outlet.
  - Plant vegetation to control erosion and enhance sediment entrapment
  - Access for maintenance must be included.
  - Incorporate flood control, recreational facilities, landscape, and wildlife habitat
  - Integrate basins into swales to take advantage of aesthetic qualities of water and plants
- Moisture Control In Basements/Below Grade:
  - Keep all untreated wood materials away from soil.
  - Provide drainage/gutters to conduct rainwater away from building
  - Slope the earth away from all sides for at least 5 feet at a minimum 5% grade and establish drainage swales to direct rainwater around.
  - Add a sill gasket to provide air sealing.

- Install a protective membrane (eg: caulked metal flashing) to serve as a capillary break that reduces wicking of water up from the masonry foundation wall. This membrane can also serve as a termite shield on top of foam board insulation.
- Damp-proof all below-grade portions of the foundation wall and footing to prevent the wall from absorbing ground moisture by capillary action.
- Place a continuous drainage plane over the damp-proofing or exterior insulation to channel water to the foundation drain and relieve hydrostatic pressure. Drainage plane materials include special drainage mats, high-density fiberglass insulation products, and washed gravel. All drainage planes should be protected with a filter fabric to prevent dirt from clogging the intentional gaps in the drainage material.
- Install a foundation drain directly below the drainage plane and beside the footing, not on top of the footing. This prevents water from flowing against the seam between the footing and the foundation wall. Surround a perforated 4-inch plastic drainpipe with gravel and wrap both with filter fabric.
- Underneath the basement's slab floor, install a capillary break and vapor diffusion retarder, consisting of a layer of 6- to 10-mil polyethylene over at least 4 inches of gravel.

Natural and Artificial Lighting

Vocabulary:

- **Sun Chart:** A Sun chart is a graph of the ecliptic of the sun through the sky throughout the year at a particular latitude. It is a plot of the azimuth vs altitude throughout the day for a period of time between the winter and summer solstices.
- **Solar Altitude:** The angle of the sun 90 degrees or less above the horizon.
- **Solar Azimuth:** The angle from due north in a clockwise direction, given in degrees
- **Albedo:** ratio of the radiant flux reflected by a surface to the incident flux.
- **Daylight Factor:** ratio of the illuminate at a point on a give plane due to the light received directly or indirectly from a sky of assumed luminance, to the illuminance on a horizontal plane due to the unobstructed hemisphere of the sky.
- **Lumen:** the SI unit of luminous flux, a measure of the total amount of visible light emitted by a source.
- **Luminance:** a photometric measure of the luminous intensity per unit area of light traveling in a given direction.
- **Foot Candle:** the illuminance cast on a surface by a one-candela source one foot away
- **Light Pollution:** Brightening of the night sky that inhibits the observation of stars and planets, caused by street lights and other man-made sources.

Facts/Rules:

- Lighting usually represents 1 - 3% of project construction costs.
- Daylight increase productivity in the workplace and test scores in schools.
- Basically every type of facilities may benefit from lighting design.
- Before the invention of the incandescent bulb in the late 1800s, most architectural lighting design relied on daylighting techniques.
  - Designers added ornamental/decorative lighting from candles/gas lamps as required.
- In the 1900s daylighting became less important and designers focused on electric, artificial techniques.
- The energy crisis of the 1970s resulted in a return to daylighting, energy conservation.
- Good lighting aims to:
  - Reinforce the functionality of the spaces
  - Add to the acceptability/appreciation of space by the occupant.

- Add value to the project
- Create a feature that assists in the sale/rental of a space
- Promote worker productivity and/or merch sales
- Reduce long-term expenses
- Minimize customer/user satisfaction

- **Orientation is influenced by lighting needs:**
  - Place important spaces and windows at southeast corner of the site, it will get more sun in the winter and less in the summer
  - Place windows on the south side to get winter sun into the space
  - Use architectural overhangs/fins/louvers and to some extent deciduous vegetation to block solar rays in the summer
  - Use few windows on the east and west sides of buildings because of morning and late afternoon sun.
  - If unavoidable, use vertical fins to block solar rays.
  - Use northern windows for even daylight throughout the day.
- **Footcandle Levels and Recommendations:**

Sunlight	=	10,000 fc
Full Daylight	=	1,000 fc
Overcast Day	=	100 fc
Very Dark Day	=	10 fc
Twilight	=	1 fc
Full Moon	=	0.01 fc
Public Spaces with Dark surroundings	=	2-5 fc
Simple orientation for short visits	=	5 – 10 fc
Houses, Warehouses, Theaters	=	150 fc
Offices, Libraries, Grocery, Labs	=	500 fc
Office Landscapes	=	750 fc

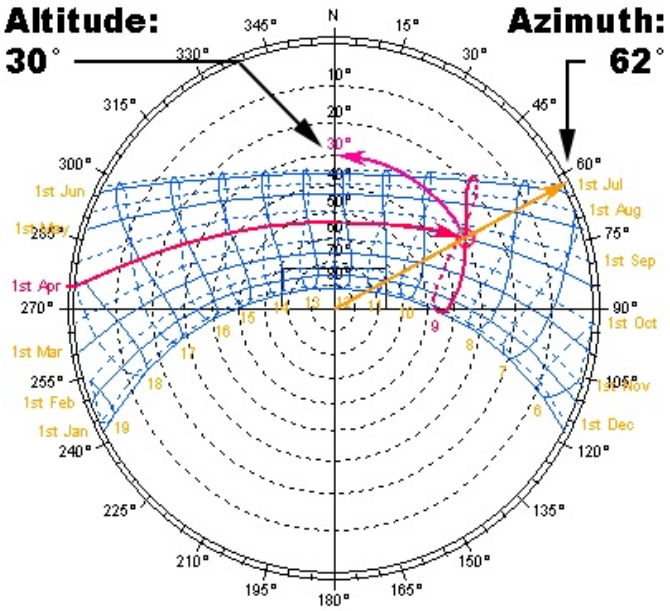
Concepts/Goals:

- Lighting should benefit a project: that is, be part of the design for people and spaces.
- It is used to reveal or reinforce the functions of the spaces being occupied.
- Lighting is <u>not</u> an add-on.
- We live in a visual culture, and lighting plays an important role in seeing and experience.
- People should recognize feelings of safety, friendliness, comfort, humanity, or other desired emotions, all of which are helped by lighting.

Processes:

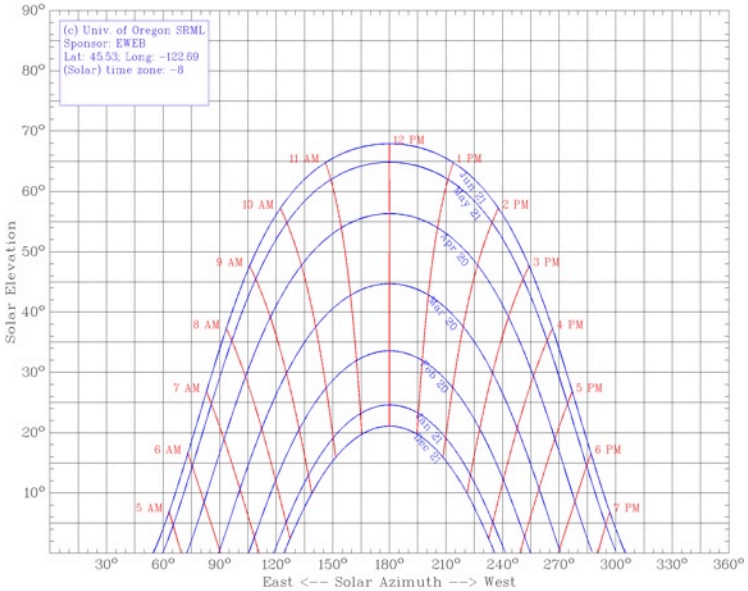
- Analyze the existing site conditions for natural lighting capabilities
- People should recognize feelings of safety, friendliness, comfort, humanity, or other desired emotions, all of which are helped by lighting.
- There are no prescribed lighting design answer, it is based on the needs of the client.
- **Conduct preliminary research:**
  - Visit client's existing abilities and analyze current lighting levels
  - Understand the degree of difficulty that the project presents. Are there any code compliance issues or variance requirements?
- **Advance plan analysis:**
  - Perform subjective analysis of client's staff/users of each location.

- Perform objective analysis of building materials and measuring illuminance of the general, local and task areas.
- Identify and describe specific stakes of sites visited that relate to the project needs
- Establish a budget.
- **Project Execution:** Oversee installation during construction and verify effectiveness in actual use.
  - **Reading a stereographic sun-chart:**
    - Locate the required hour line on the diagram.
    - Locate the required date line (solid are for Jan-Jun and dotted lines for Jul-Dec)
    - Find the intersection point of the hour and date lines. (intersect solid with solid and dotted with dotted lines)
    - Draw a line from the center of the diagram, through the intersection point, to the end of the diagram.
    - Read the azimuth as an angle taken clockwise from North.
    - Trace a concentric circle around from the intersection point to the vertical North axis, on which is displayed the altitude angles.
    - Look between the concentric circle lines to find the altitude. This gives the position of the sun as an altitude and azimuth.



and read off the solar altitude from the values shown...

  - **Reading a Cartesian sun chart:**
    - In cartesian co-ordinates, the azimuth is plotted along the horizontal axis and the altitude is plotted vertically. The date and time values are first located in exactly the same way as in the stereographic sun-chart diagram.
    - Locate the required hour line
    - Locate the required date line. In these diagrams, the highest altitude line at noon is always in midsummer. Each other line represents the 1st of each month, solid Jan-Jun, dotted Jul-Dec.
    - Find the intersection point of the hour and date lines.
    - The azimuth is given by reading off the horizontal axis.
    - The altitude is given by reading off the vertical axis.



- **Design:**
  - Schematic Design: lighting composition concept is developed and hierarchy through the project is set, with lighting to suit the space needs.

- Design Development: make final equipment selection, and prepare a complete lighting quantification. Add supplementary lighting as needed.
- **Project Execution:**
  - Oversee installation during construction and verify effectiveness in actual use.

Implications of Design Decisions

Note: This information typically fits under the “Concept/Goals” subheading for each topic in this Knowledge/Skills Set and has been included there.

CONTENT AREA: PROJECT + PRACTICE MANAGEMENT

Construction Sequencing

Vocabulary:

- **Sequence:** the order in which activities occur

Facts/Rules:

- Projects follow different types of construction schedules:
  - **Gantt/Bar Chart:** illustrates start to finish dates of a project broken out by activity.
    - They focus primarily on schedule management rather than the size of the project or the relative size of the work elements/activities.
    - Can't show the relationship between activities
  - **Critical Path Method:** all events expected to occur and operations to be performed in completed a given process are rendered in a form permitting determination of the optimum sequence and duration of each operation.
    - The diagram is called a **Network Diagram**
    - Circles are are start and finishes, arrows are tasks, numbers show the time for each task to occur.
    - **Critical Path:** the path with the longest required time from start to finish is the basis for the schedule. Activities on this path are called **critical activities.**
    - **Float:** range of time during which non critical activities can start/end without affecting the overall schedule
    - **Total Float:** individual float times added together don't influence the critical path time

Concepts/Goals:

- Determining construction sequencing is part of the larger construction planning and scheduling process.
- People/communities need to be aware of the interaction of the natural systems in the landscape, and need to make planning/design/development decision that will protect and enhance the interaction of those systems in the landscape.

Processes:

- **Stake Lot:** A Surveyor accurately drives stakes to locate boundaries and building lines
- **Install Temporary Utilities:** includes water, power, phone/data, toilets, job shack, etc.
- **Clear and Rough Grade:** Remove necessary trees and undergrowth from the site and grade site for approximate drainage patterns, yards, driveways, walkways, etc.
- **Apply surface stabilization:** including graded areas, channels, dikes, streams, and disturbed areas where work won't take place for 30+ days by temp seeding/mulching.
- **Excavate:** for foundation, slurry walls, basements
- **Pour footings/piles/caissons:** depending on site, soil, and seismic requirements
- **Pour Foundation:** slab on grade, crawl space, basement, etc.
- **Install Waterproofing and Foundation Drain:** locate below grade to minimize water accumulation
- **Install sewer and Water Taps:** connect to municipal system mains
- **Backfill:** push excavated dirt into ditches surrounding foundation and grade for drainage away from the building/foundation wall.

- **Install slab plumbing:** any plumbing that would go in the slab on grade/basement floor.
- **Pour slab:** for slab on grade or basement.
- **Install exterior framing, windows, doors:** includes flashing/waterproofing at openings
- **Install Roofing Materials:** shingles, bitumen, etc.
- **Install Siding and Trim:** remember vapor barrier goes on warm side of the insulation. Prime, seal, and paint as required as soon as possible.
- **Install Gutters/Downspouts:** get water away from building
- Continuing Outside...
  - **Build Retaining Walls:** can be structural or decorative
  - **Pour Sidewalks, Driveways, Patios, Curbs:** typically concrete
  - **Install Asphalt:** parking lots, roads, etc.
  - **Finish Grading and Landscape:** ensure proper drainage and landscape. Remove any unstable sentiment, remove any temporary structures.
- Meanwhile inside…
  - **Install Interior framing:** includes partitions, walls, soffits
  - **Install Stairs:** rough frame with finishes to follow
  - **Install rough HVAC/Plumbing/Electrical:** run major ductwork, install pipes, run wires, and install electrical boxes
  - **Install Electric/Gas meters:** set up for heating and conditioning the interior spaces
  - **Insulate:** vapor barrier goes on warm side of insulation (inside in northern climates)
  - **Hang Drywall:** then tape, mud, and texture
  - **Install Casework:** uppers and lowers
  - **Install Interior Doors and Trim:** includes moulding, window casing, built in casework, stair rails, baseboards, wainscot.
  - **Paint and/or Install Wall Finishes:** prime/sub layers as required for desired finish.
  - **Install Countertops and Lay Tile:** typically in wet or work areas.
  - **Finish Plumbing/Electrical/HVAC:** includes sinks, toilets, lavatories, faucets, light switches, outlets, fixtures, fans, registers, thermostats.
  - **Install Appliances/Specialty Equipment:** either owner or contractor supplied.
  - **Install Finish Accessories:** including mirrors, toilet accessories, etc.
  - **Install Finish Flooring:** carpet, hardwood, etc.
  - **Install Interior Doors/Relights:** includes closets, window screens, glazing partitions, and door hardware
  - **Final Cleanup and Touchup:** fix any drywall, trim, paint, accessories.

Cost Estimating, Value Engineering, and Life-Cycle Costing

Vocabulary:

- **Preliminary Costs:** SF Cost Estimates; based on occupancy, size & type of construction
- **Detailed Costs:** Itemized break down
- **Value Engineering:** process to get the best value for the project using similar, but more affordable materials and techniques
- **Pro-forma:** financial analysis of a building project which involves cost/return on investment

Facts/Rules:

- **Traditional construction fees:**

Construction Cost	=	Amount of $$ to build
Construction Budget	=	85% construction cost

Contractor's OH/Profit	=	15 - 40% construction cost
Surveys, testing, fees, FF&E	=	15%

- **Traditional project budget:**

Site Acquisition	=	not included in project budget
Utility/Off Site Construction	=	not included in project budget
On Site construction	=	10-20% of construction cost
Building construction	=	10-15% of construction cost
Contingencies	=	5-10% of construction cost
Professional Services	=	varies
Inspection and Testing	=	varies
Financing	=	varies

Concepts/Goals:

- Cost Projection Objectives:
  - Complete the project within the financial limits set by the owner
  - Provide an appropriate use of resources/value for the money within the budget
  - Optimize longer-term life cycle costs by examine alternative that offer the best balance between upfront costs and maintenance costs
  - Provide the owner with relative implications to the budget based on owner decisions throughout the project duration.
- Cost Projections for a project are based on four factors:
  - **Cost Factors:** what influences the project
  - **Project Scope:** what's included in the building
  - **Quality:** how nice the building will be (construction, technologies, finishes)
  - **Budget:** how much the owner can spend
- Typically architect estimates cannot account for inflation, market conditions, and contractor means and methods.
- Other factors that influence the construction budget include:
  - Availability of labor and materials (if there's no work, people will do jobs for cheap, if there is work, prices go up...basic supply and demand principle)
  - Labor rates fluctuate depending on cost of living, demand, project location, deadline
  - Material prices fluctuate depending on the market, where they ship from, etc
  - Convenience of transportation
  - The more remote the location the more expensive
  - Costs are less predictable in rural areas

Processes:

- The appropriate type of cost estimating for a building depends on the phase of the project it is developed to:
  - **Pre-Planning/Proposal:** based on unit costs (the cost per person, cost per bed, cost per sf, etc)
  - **Programming:** based on unit cost system (cost per sf) based on similar building types and/or functions of spaces
  - **Schematic Design:** based on the major elements of each building system (mechanical, electrical, plumbing, structure)
  - **Design Development:** based on detailed components (curtain walls, storefronts, lay-in ceilings, etc)

- **Construction Documents:** based on unit rates for construction competes, assembles and systems. This estimate is what pre-bid cost checks and cost breakdowns are based on.

Project Schedule Management

Vocabulary: None

Facts/Rules:

- Typical phase breakdown for architectural services (programming is an extra service):

Schematic Design	=	15%
Design Development	=	15%
Construction Documents	=	35%
Bid/Negotiation	=	5%
Construction Administration	=	30%
Sometime Project Closeout	=	about 2-5%

- Project calendar days = number of working days x 5 or 7
- Schedules are impacted and influenced by:
  - The size of the project
  - The complexity of the budget
  - The number of people working on the project
  - Client action/reaction time (and to an extent, municipal review time)
- Risks of extending the schedule:
  - Can increase costs due to inflation
  - Team members could change, causing a learning curve
- Risks of shortening the schedule:
  - Requires people to work overtime (costly/inefficient)
  - Requires the need to hire more people (learning curve to project and office standards)
  - If no employee changes are made, drawings can turn out poor, uncoordinated, etc
  - Generally causes higher costs for design and construction for a lower quality project

Concepts/Goals:

- **Fast Track Schedule:** Construction documents are issued in phases and construction begins while design is still being finishes.
  - Requires coordination between architects, contractors, and construction managers
  - Requires staged bidding, which might result in multiple contractors.
  - Can reduce time of project by 10–30%

Processes:

- Scheduling the five phases of the design process varies depending on the project size and complexity, the quality of the client's program, the design team, and the decision making ability of the client. Generally the following applies:

Schematic Design	=	1 - 2 months
Design Development	=	2 - 6 months
Construction Documents	=	3 - 7 months
Bid/Negotiation	=	3 - 6 weeks (2 weeks for contractor bid)
Construction Administration	=	Varies
Contingencies	=	25-50% of length of project

- The planning and scheduling phases of the construction process follow these steps:
  - **Establish an objective:**
    - an exact, measurable project goal. (Eg: install a plant a tree, grade a site, construct a parking lot.)
  - **Identify project activities:**
    - Break down the project into definable work activities that, when complete, reach the objective
    - Activities should be action-oriented, visible, and measurable
      - Eg: Survey and layout site, form footings, plant shrubs and trees
    - **Determine activity sequence:**
      - Decide in what order activities will occur by examining each activity independently.
        - What activity must proceed this activity?
        - What activity must succeed this activity?
      - The more activities that can occur concurrently, the faster the job will go.
    - **Determine activity durations:**
      - Decide how long it takes to do each activity in the most effective manner.
      - Determine the critical path, and then expedite only those actuates that are deemed critical to meet deadline.
    - **Perform schedule calculations:**
      - Add up the durations of the different activity sequences, the longest path is the critical path and determines the total duration of the project.
    - **Revise and Adjust:**
      - Adjust the original schedule to account for crew size, resources, and changes in completion date.
    - **Monitor and Control:**
      - Ad the work proceeds, changes in the schedule may occur. Revise durations, calculations and adjustments as necessary to meet new deadlines and solve any issues that may arise.

Risk Management

Vocabulary:

- **Mediation:** not legally binding. Use of a mediator to reach agreement between each party
- **Arbitration:** legal technique for the resolution of disputes outside the courts. It's a form of binding dispute resolution, equivalent to litigation in the courts.
- **Litigation:** conflicts/disputes that are resolved in a court of law. Typically a last option.
- **Subrogation:** legal technique where an insure takes over for a party for whom it has made a payment. (e.g. damage to a property under construction caused by a subcontractor is covered by insurance who then sues subcontractor in the owner's name)
- Architects should cary multiple types of insurance for their protection.
  - More than the required minimum insurance may be needed for a job. Anything extra is noted in the supplemental conditions
- Types of Insurance include:
  - **Professional Liability:** Held by architects/design professionals. Liability due to negligence or not meeting the standard of care expected of them. (eg: not designing ADA compliant restrooms in a public building)

  - **Workers Comp:** Held by almost everyone. Liability to employees for injury or sickness as a result of their employment.
  - **Property/Builders Risk:** Held by owner. Covers any damages, loss of work on site/off site/in transit.
  - **Loss of Use:** Held by owner. Covers any financial loss due to delay in construction because of damage, accidents, fire, other hazards needed to be dealt with.
  - **Product & Completed Operations:** held by contractor. Liability for damages caused by installed goods after the construction phase and transfer of title.
  - **Contractual/Indemnification:** Liability assumed by contract where contractors agree to hold owners/architects harmless for damages that are the result of specific events.
- The owner can require the contractor to submit a certificate of insurance with a bid to prove what insurance he carries and what his limits are.
- NO SUBROGATION. Owner/Contractor should keep this provision in the AIA 201 document, so the insurance company, after paying out, can put themselves in the shoes of their client and go after whoever might be responsible for the damage that's otherwise "No-Fault". You don't want the owner's insurance company going after the contractor if there's some sort of freak fire in the middle of the night that could somehow be tied back to him.

Facts: None

Concepts/Goals:

- **AIA Ethical Standards**
  - Code applies to all AIA members regardless of membership category
  - Common ethics violations:
    - Attribution of credit
    - Accurate representation of qualifications
    - Attainment and provision of examples of work
    - Basic honesty Penalties for Violations:
      - Admonition (private) – letter of ruling sent to the parties and kept in member's file
      - Censure (public) – letter is sent and notification of the case and ruling is published to AIA membership
      - Suspension of membership – membership is suspended for period of time; 1 or 2 years & ruling is published
      - Termination of membership – membership is terminated & ruling is published

VIGNETTE: SITE GRADING

Processes:

1. Write down all major programmatic restraints, max slopes, finish elevations, etc. (double check!)
2. Calculate minimum and maximum spacing in feet for the slopes given by NCARB:
   Given:
   min% = min' rise in 100'-0" run :: 100/min = max spacing (ft) for 1' contours max% = max' rise in 100'-0" run :: 100/max = min spacing (ft) for 1' contours

   Example:
   2% = 2'-0" rise in 100'-0" run :: 100/2 = max spacing for 1'0" contours is 50'-0"
   20% = 20'-0" rise in 100'-0" run :: 100/20 = min spacing for 1'0" contours is 5'-0"
3. Open vignette, determine site slope direction (draw a diagram on paper if helpful).
4. Place building pad away from all tree drip lines and other undisturbed requirements, and in area with the most even slope, so contours are simple to move.
5. Draw centerline sketch lines for swale locations which will direct water around the pad (remember that water is lazy and will pick the most direct route down the site, pay attention to what is affected!)
6. Adjust the nodes on the contours (or click anywhere on the contour to add new ones) to follow the swale locations.
7. Adjust the contour at the building pad so that it is directly adjacent to the building pad (1 click away at most)
8. Verify that all modified contours meet the max and min spacing by drawing sketch circles with the min/max as the diameter place between contours (zoom in to verify!)
9. Verify all centerlines of swales meet the max and min spacing by drawing sketch lines and adjusting as needed.
10. Set elevation of building pad at required height per the program.
11. Double check: Verify that all water is diverted around the building pad and that the elevation is correctly labeled.

Notes:

- Use sketch circles to verify minimum spacing, typically around the building pad.
- Use sketch lines to measure down the centerline of a swales to verify maximum spacing
- Intercept the runoff before it reaches the paved area. Do this with swales…not berms.
- Swales look like "^"
- Berms look like "V"

VIGNETTE: SITE DESIGN

Processes:

Part One (give yourself 5 minutes): Understand the Problem

1. On the vignette screen: turn on ORTHO and the full screen cursor.
2. Drop all buildings, and make basic plaza on the site to get a sense of scale
3. Draw a sketch rectangle to represent a typical parking lot for the number of cars given:
   33 cars = 105' x 150' with 3 rows -or- 120' x 120' with 4 rows
   44 cars = 105' x 170' with 3 rows -or- 120' x 150' with 4 rows
4. Note any cluster of trees, easements, existing buildings, water, features, etc.

Part Two (give yourself 10 minutes): Document the Program

5. Complete the following chart, with heights, areas, required views, shade/sun, proximity

	Building/Site Modifications	**Proximity Close/Far**	**View To/From**	**Protection Sun/Wind**	**Other Criteria**
Building 1 ____' tall					
Building 2 ____' tall					
_____sf Plaza					
__ car Parking ___ standard ___ HC					
Other Program					

6. Make a note if the plaza is allowed to be part of the circulation system?
7. Now, double check everything!

Part Three (give yourself 5 minutes): Sketch Initial Ideas

8. On scratch paper, sketch two layouts that could work. Try different parking lot designs.
9. Review the chart and select the option that works best. Think about: compactness, minimum number of trees killed, sun, shade, wind, grass, response to site features.

Part Four (give yourself 5 minutes): Draw Site Restrictions & Initial Layout

10. On vignette, draw site restrictions. Use sketch circles to locate setback from pond.
11. Draw a sketch circle at the intersection of the two roads with a radius equal to the minimum distance to the curb cut for the driveway.

12. Draw sketch circles at the corners of the buildings with a radius equal to the minimum building separation.
13. Draw two sketch lines at the same angle of the wind direction arrow. Move them to the side to be used to verify wind protection later.
14. Move the buildings and plaza/parking sketch rectangles to fit within the restrictions.
15. Draw a sketch rectangle 24' wide by however long to serve as a driveway from the street to the parking lot.
16. Draw a sketch circle from the center of the entrance with a radius equal to the max distance from the door to the handicap stalls. They all must fit in that circle completely.
17. Use check tool to make sure the max number of removed trees has not exceeded.
18. Verify everything works with the chart.

Part Five (give yourself 15 - 20 minutes): Draw the Parking Lot

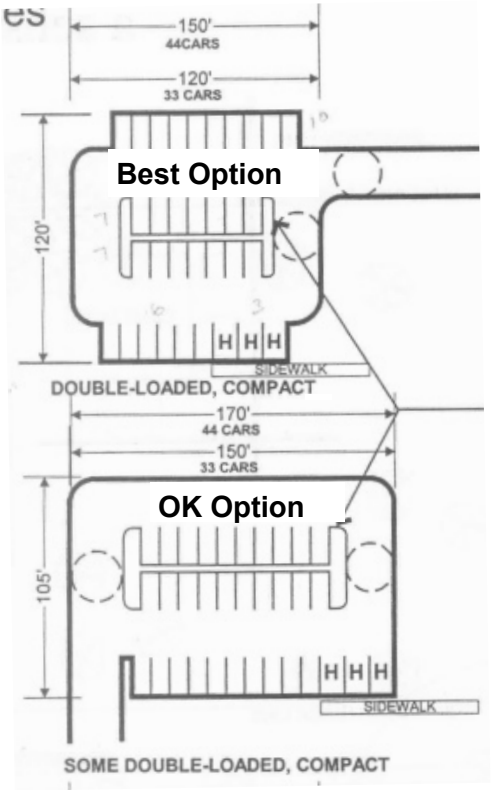
19. Draw the parking lot with a "stub" for the driveway to connect with the lot. Allow 5' buffers at the end of rows .
20. Add driveway starting from centerline of the street and into the site. Use ORTHO!!
21. Draw service drives. Make long enough for a 20' truck to not impede traffic flow

Part Six (give yourself 10 minutes): Draw Plazas, Walkways, and Trees

22. Draw Plaza in correct location, make sure area is accurate.
23. Draw a walkway from the head of the handicap stalls to the plaza or other sidewalks
24. Draw the rest of the sidewalks, connecting existing sidewalks to the program.
25. Move the wind sketch lines done in step #16 to test wind.
26. Add conifer trees as needed to block wind
27. Add deciduous trees to shade plaza or building entries as required. The height of the tree is the length of the shadow given a 45 deg solar angle.

Part Seven (as long as you need): Review

28. Review solution and check each box on the the chart to verify that the design meets all of the criteria. Focus on required clearances, proximity, shade, sun, wind protection



Suggestions From Dorf

Notes & Things to Remember:

- Only use as many trees as necessary. Don't overlap conifers.
- Trees can be located on the plaza.
- Draw a separate sidewalk if the plaza is not included in the circulation
- Do not make any improvements on a steep slope.
- "Close" means a distance equal to about 10% of the width (long dimension) of the site
- Keep driveways and service areas away from residential neighbors
- Stay within 5% of area requirements
- "Sun at Noon" = face south
- "In Shade" = face north
- Conifer trees block wind AND views Deciduous trees create shade

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