Systems:

1) Hard Systems
2) Open Systems
3) Evolutionary Systems

↳ ex: pollution control system

Systems Thinking, System Engineering:

1) ⟹ Workflow based systems (school etc)
   - Linear, Input → Output
   - Simple systems.

2) ⟹ Complex, multilevel systems
   - Many Inputs/outputs.
   - Outputs vary a lot (Dynamic) depending on surroundings etc.
   - Interconnections b/w subsystems are not clear.

Scenario based analysis: (Analysing a system)

- Try independent scenarios on a system & if they ~~work~~ work, try check if system performs well on multiple scenarios together.

System Analysis → Bottom Up Approach is preferred

- Management
- Abstraction
- Interaction
- Scope
- Expectation

System

Attributes:
- Functional or physical features of the system.

Performance:
- Objective (Quantitative)
- Subjective (Qualitative)

Properties:
- Mass properties of the system.
  → well defined, specific to a certain system.

Conditions:
- Prerequisites
- Initial operating conditions
- Stabilization
- Static vs Dynamic
- Balance of powers.

Characteristics:
→ Can also depend on environment
- Behavioural characteristics of the system.
  → Broader than properties/attributes

System vs Product vs Tool:

- Tool → Improve efficiency of achieving a task
  Product → Achieve a task with a product.
  System → Working/Components of the system.

Characteristics: (Of a System)

or a couple of systems
↳ operating environment

- General Characteristics
- Operating/Behavioural
- Physical → Similar to properties
- System aesthetics (Psychological, cultural etc)

Note: Stakeholders, end users, system users etc.

———x———

Note: System roles → Mission system or Support system.
↓
supports other systems

———x———

*Note: System → Subjective performance
→ Objective performance

↓

Measures

- Effectiveness (MOE)
- Performance (MOP)
- Suitability (MOS)
- Operational effectiveness (OT&E)

———x———

[redacted] *

Note: Logical architectures. → Logical associations

———x———

*

* Note: SOI (System of Interest) Architecture

———x———

Note: System Interfaces:

- Interoperability.

———x———

1) Smart Water Monitoring System (Case Study) (Slides)

- Power supply to sensors
- Sensor layout & number of sensors
- E-Coli detection in realtime.

———x———

Note: Line of Business

Note: Problem, Solution, Opportunity spaces

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2) Earthquake Management:

* Focus — Point where earthquake occurs
  - Generates → primary waves → can travel in liquid
  - secondary waves → cannot travel in liquid

⇒ Secondary waves → Shear waves → Reach us second

⇒ Primary waves → reach us first

⇒ Surface waves → reach us last.

* Epicenter — Point upwards from focus which reaches surface of earth.

* Scales
  - Intensity Scale
    - Qualitative → Damage etc
    - Quantitative → Amount of Energy released
  - Magnitude Scale (Richter scale)

* Types:

* ⇒ Subduction, Transverse & Expanding of plates create earthquakes

Tsunami :

- Use a grid of sensors in the ocean and if they detect the same velocity of the wave as it approaches the shore, then its a tsunami.

———x———

Note: Two types of earthquake faults

** 1) Dip Slip
2) Strike Slip

- Generally when faults rupture to create earthquakes, both of these occur together.

———x———

*Note: Reinforcement of building to make them earthquake safe.

———x———

3) Climate & Spatial Informatics

*. Hydrologic System
- Dams, Flow control structures (Spillways)
  - Canal (Spacial distribution of water)
  - Upstream
  - Downstream
- Aqueducts

* ⇒ Failures of hydraulic systems.

———x———

Note: Operational Model → Good for dedicated use applica (well defined systems)

Note: For general use / multipurpose systems, operational model may be insufficient. We only have benchmarks → not very well defined.

Energy & Power:

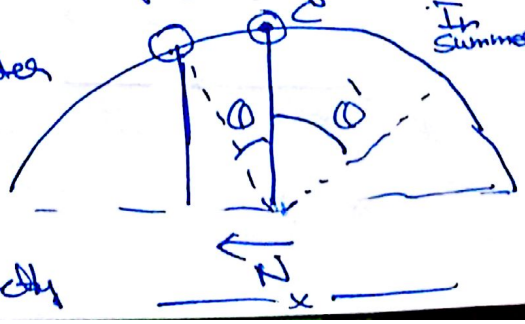
- Rate of consumption > Rate of production then its a non renewable source of energy
- Efficacy = lumens / Watts } Units dont match so its not efficiency.

Note: PIR sensors → Infrared detection → How do they work
↳ Uses doppler effect & beats to detect moving people.

- Daylight sensor
  - → Closed Loop → Sensor observes an object and calculates light intensity
  - → Open Loop
    - ↳ Sensor is outside & observes sunlight directly
  - → Dual Loop (Both open & close loop)

Note: Equinox → Sun is aligned right with the equator.

- Sun makes $\theta' = 40.5°$ max from the point C above exactly } In Winters
- Sun makes an inclination of $\theta = 6.5°$ max from the point C } In Summers
  In Hyderabad



⇒ Overhang on the north & south windows → season (summer or winter)

⇒ Overhang on the east & west windows → time of the day.

↳ On east & west windows overhangs can be on the sides so that sun enters in the winters but not the summers.

Fins.

Note: Mesh (with thickness) can be used on any window and it will act as a good overhang.

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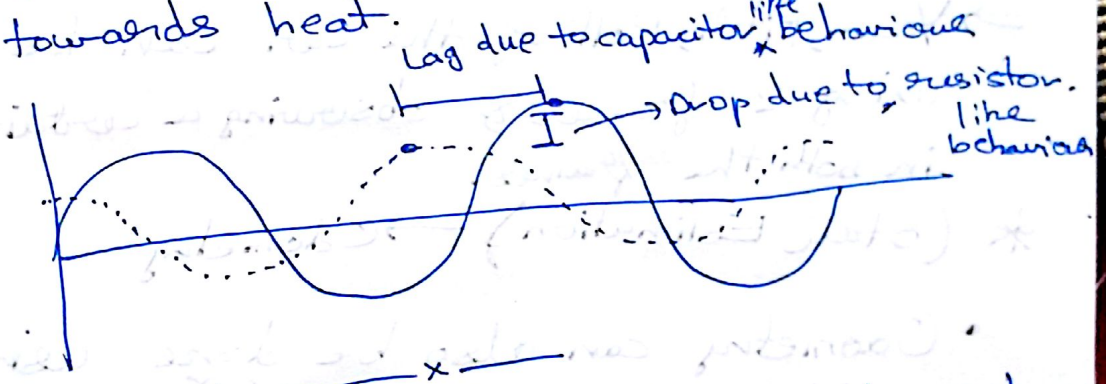
*Note: A wall acts like a resistor & a capacitor towards heat.



Note: Radiation, Solar Spectrum, Sun motion (geography).

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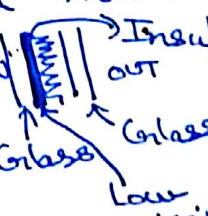
*Glass: (SHGC, VLT, U)

SHGC → Ratio of total heat coming inside/falling outside

U → Conductivity

VLT → Ratio of light coming inside/falling outside

- Use 2 layers, and put a non-conductive gas like argon etc inside it in between.



(This can be done in a thermos but not for windows etc)

- In Best glass:

$\frac{VLT}{SHGC} = 2$ (Least heat & most light)

Assuming light corresponds to 50% total heat.

radiation.

Note: Glass only allows ~~long~~ shortwave, to come in. So using curtains outside is best but it may get dirty so we put them between 2 glass panes.

———x———

* Driverless Car:

- Sensors together can detect depth of objects they see.

⇒ Fusion of various sensors
- → Laser → Only depth (Perception → Depth Map)
- → Stereo camera → Appearance

⇒ Yaw, Pitch, Roll of the car can be calculated using 2 frames & observing a certain object in both the frames.

* (State Estimation) → Odometry

- Odometry can also be done using the wheel rotation estimations, GPS, etc.

radiation.

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———x———

*Liquefaction of Soil: (During/After Earthquak

- When soil loses all its shear strength it loses its strength → This is liquefaction!

⇒ Soil behaves like liquid
(Water between soil does not leave & pressure builds up)

- Now on earthquake, the pressure increas & the water leaks out and the soil is also weak, so building can collapse.

⇒ FS_L = Capacity/Demand } Soil Liquefaction Potential.

* • Cyclic Stress Ratio & Cyclic Resistance ratio.

⇒ SHAKE2000 → Considers vibrations only in 1 direction & apply same in 3D.
→ Considers leveled uniform ground.

• Mitigation Techniques → Improve soil strength, use other types of soil etc.

———— x ————

*Seismicity of Earthquakes: (Slides)

• Magnitude class x.5 → All earthquakes having, x to x+1 magnitudes.

———— x ————

*

*Earthquake Disaster Management:

Prevention → Mitigation → Preparedness → Response → Rehabilitation → Reconstruction

• Risk = H × E × V
(E: Exposure (82%) people living; V: Vulnerability)

* H: Hazard

*Active fault → If an earthquake has occured in the last 10,000 years.

⇒ Building typology → 30 types earlier.

———— x ————

Note: Tools / Resource procurement

———— x ————

⇒ System models → Waterfall
* Evolutionary
Incremental
Spiral
V-Model
} Development models

* • Integration & Interface requirements / difficulties.

———— x ————

* Resilience → On a change to the system, the time taken for the system to come back to equilibrium.

———— x ————

* Green field project → Start from scratch
Brown field project → Extend an existing system

———— x ————

⇒ IPCC Scenarios → 4 Scenarios

———— x ————

Note: Anthropometry → Physical constraints (Height etc) → Slides
Ergonomics →
Haptics →

———— x ————

* Synchronous → Asynchronous systems.

———— x ————

*Human Factors Eng:

1) Anthropometric factors → Physical dimensions of human etc.
   → exc. Safety in rides.

2) Sensory factors → If our senses work properly
   exc: Jobs which require good eyesight etc.

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—— x ——