APES Home Design: active and passive systems

- passive vs. active: define
- why is passive better?
- How can you tell active from passive? Which systems fail with no power
- cost? benefits? intangibles?
- Extreme examples: elab vs. typical office building
- Points for including each of these into your design
- Research and include newer solutions (e.g. PV windows)

Passive design:

- air-ventilation
- water
- lighting
- heating-cooling
- energy
- waste

Elab examples:

Passive air flow:

- using airfoil design, pulls air out of building
- horizontal louvers drop dust and mist while channelling air upwards along surface (laminar flow)
- Stack effect: hot air rises, pulls air up and out
- air exchange per hour to reduce CO2 (ACH)
- try: place your house in a natural air flow (valley, peak)

Passive water capture:

- Rain water capture on three roofs, one vertical, two horizontal
- gravity feed to tank
- solar powered pump
- solar powered UV purification
- pressure driven filtration
- green roof to capture and slow water (transit time)
- drip irrigation to preserve green areas, reduce temperature and evaporation
- evaporative cooling (EtO)
- low flow faucets and toilets
- bottled water to meet county regs (arsenic)
- grey water where possible (plants, irrigation)
- try: orient your house to capture rain or mist

Passive lighting:

- orientation: south to capture light, depends on latitude
- north facing skylights to capture light, not heat
- diffusers to soften light, reduce heat and shadows
- south facing windows with shades as needed to modulate
- light colored floors and paints to reflect light inside
- try: orient your home to maximize passive lighting

Passive heating-cooling:

- South facing windows with shades
- large thermal mass foundation, 180° phase change for heat
- west facing walls to capture heat for night
- wind driven air exchange
- sensible heat: air flow reduces perceived temp
- 12” soy foam insulation on roof
- insulation inside all walls
- Low E double glazed glass
- sound insulation panels for comfort, lighting, acoustics
- insulated floor tiles for sound
- heat exchangers where needed (e.g. AK, UAE)
- fiber siding reduces heat flow

- metal roof: reflects heat
- Overhang: reduces direct solar
- sealed doors in HVAC rooms
- periodic heating audit to locate heating-cooling leaks
- try: adjustable ventilation, heat exchangers

Passive energy:

- Thermal panels with thermosiphon flow for hot water
- Passive solar PV panels for energy
- Lithium battery storage for night
- Wind turbines for cloudy augmentation
- EMC system to detect, reduce passive loads
- EV charging system below
- try: passive solar thermal first

Passive waste:

- Gravity flow to bioreactor
- Low flow faucets and toilets to preserve water capture
- try: local biodegradation

Elab active systems: all solar powered

Air:

- Thermal radiative cooling system, with solar pump
- Fans for air flow, augments stack effect
- HVAC filtration where needed

Water:

- Water pressure system: solar powered
- Forced water purification system, solar powered

Lighting:

- LED bulbs with occupancy sensors and timers
- Daylight sensors for exterior lights
- manual control for events, astronomy

Heating-cooling:

- High SEER heat pumps for heating, cooling (HVAC)

Energy:

- pump driven solar thermal system (demo downstairs)

Waste:

- motor driven digester (if needed)

Typical building systems:

- Air: very little air flow, sick building syndrome, toxic materials
- Water: no local capture, dependent on city water

- Lighting: incandescent, sodium (yellow), or CFL, harsh spectrum
- Heating-cooling: HVAC systems (pumps, radiators, AC)
- Energy: no local capture, dependent on city systems (HELLCO)
- Waste: dependent on city systems

NYC is an example, but offsets all of these active systems, with concentrated, efficient stacking of humans

Next: materials

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