IPRO 317
High Performance Green Homes

Design based in Green Philosophy for a better future.

Sponsored by Jimmy Eng
Goals and Team Breakdown

Task:
- Designing a small scale sustainable and affordable condo building

Goals:
- Research and move beyond existing technologies
- Collaborate and Communicate effectively

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<th>Phase 1: Research</th>
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**Private Home**
Wagner Zaun
Architecture
Duluth, MN

Bedrooms: 3  
Baths: 2  
Square footage: 2,660 sq. ft.  
Annual Energy Use: 19.4MMBtu  

**Important Design Aspects**
Super insulated  
Walls = R53  
Roof = R88  
Foundation = R40  
+ R60 (foundation wall)

Cellulose insulation  
26-in.-deep parallel chord trusses in the roof construction. 24 in. of cellulose insulation

**Private Home**
Farr Associates
Chicago, IL

Square footage: 2,675 sq. ft.

**Important Design Aspects**
Concrete floor is a thermal mass to absorb the heat from the sun

Roof overhang is designed at such an angle to prevent direct sunlight from entering the home, thus requiring less cooling

PV system = 2-10 year payback  
Evacuated tube solar heating = 6-12 year payback
As-built Case Studies

**Zeta Communities**
California
1,540 sf
2-bedroom/2-bath
LEED Platinum

**Energy**
Consumption : 7852 kW/h
Production : 7882 kW/h

- R-30 Roof, R-22 Walls, R5 exterior rigid foam, R-22 Floor, Serious Materials Windows:
  - R-5 & R-7 Energy Star Rated

- 50 percent less time compared with the typical design-and-build process.

- Install cost $165/square foot (comparable to $250/square foot)

**Habitat for Humanity/ NREL**
2005 Colorado
1,200 sf
3-bedroom/2-bath
LEED Platinum

**Energy**
1st year: produced 24% more energy than consumed, and 12% the second year

- Passive solar elements

- Super insulated:
  - R-40 Walls, R-30 Floor, ceiling R-60

- Construction cost $90/square foot
Structures Integration

**Below Ground Unit**
- Benefit from stable ground temperature
- Consider soil properties and ground water table
- Mat foundation or Spread footing

**Sustainable Space Design**

**Structure**
- Reduction of volume/mass for higher units
  - Natural convection
  - Structural stability
  - Reduction in vibrations from EI
- Reinforced concrete for slabs and foundation
- Insulated concrete forms (ICF) elsewhere

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**Square**
- Area = $b^2$
- Perimeter = $4b$

**Rectangular**
- Area = $b^2$
- Perimeter = $5b$

**Circular**
- Area = $b^2$
- Perimeter = $3.54b$
ICFs from Logix

High impact green product
- No thermal bridging
- Constant R value for life
- Wind rated up to 200 mph
- Fire rated up to 4 hours

Energy Sources
- Solar
- Wind
- Hybrid

Choosing Appropriate one
Mechanical Systems

- Radiant Heat
  - Pex Tubing
- Geothermal Heat Pump/Turbine
- Indirect Heating
  - Condensing Boiler
- Led Lighting
  - Motion Sensors
- Plumbing
  - Grey water
  - Rain Capture
Site Analysis

1114 WEST ROSCOE
CHICAGO, ILLINOIS

SUN STUDY
GENERATED FORMS

FINAL SUN STUDIES
TERRACE FORM

BOX FORM
ATRIUM FORM
TERRACE FORM

SUMMER
WINTER
Obstacles and Future Plans

Problems to Date
- Site Issues
- Group Size
- Sub Group Communication

Anticipated Challenges
- Cost
- Integrating Systems

Concluding Research Phase
- Collaborate and implement Solutions
- Begin final Design phase