Heat Transfer

- Heat moves 3 ways
  - Convection
    - Moving heat with air
      - Warm air rises
      - Mostly done with fans
  - Conduction
  - Radiation
    - Energy transmitted by waves (infrared)
Exchanging heat in Buildings

- Convection based systems
  - Baseboard and valance “copper fin tube”
  - Gravity furnace
  - Forced air furnace
  - Air conditioning

- Radiant based systems
  - Hydronic or steam radiators
  - Hydronic radiant floors
  - Hydronic or electric ceilings
What is cooling “comfort” in buildings?

- Comfort Equation:
  - Evaporation 20%
  - Convection 30%
  - Radiation 50%

Radiation = Temperature, °F 🟣 74° Fahrenheit
Evaporation = Moisture, 50% Relative Humidity
Convection = Air Speed @ Feet/Second
Hydronic Radiant Energy

- Specific heat of water higher than air
- **Low temperature heating** ~110°F
  - Heater is more efficient
- **High temperature cooling** ~55°F
  - Chiller is more efficient
- Zero duct losses
- Small radiant panel back losses
- Less circulation energy
  - Fan 1/4HP, 600 Watts
  - Circulator 1/25HP, 100 Watts
Energy

- Recent T24 run for 3 small houses
  - QVM9, 90% condensing heater / DHW
  - York Affinity Chiller 15 SEER
  - Radiant Ceiling heating / cooling

- Energy is T24 pass – 30%

- A typically homeowner will operate the house for comfort not efficiency, and will realize a portion of possible savings.
Operating energy comparison

- LBL estimate 1994, Helmut Feustel
- 42.3% Less Energy!
Historical Perspectives

- Cave dwelling
- Skytherm House
- Whitecap systems
- Culvert Wall
- KaRo System
- Runtal Radiators
- Wirsbo two trac
- Wirsbo two trac on rc-channel
- Talbott Radiant Panel
Historical Perspectives

- Cave dwelling in Cappadocia, Turkey
  - Earth coupled space conditioning
Harold Hay Roof Pond

- Skytherm House Atascadero CA 1973
  - Roof Pond
  - Movable Insulation

(C) Talbott Solar & Radiant Homes Inc.
Whitecap systems

- Bourne residence 1986
- Roof pond
  - Floating foam insulation
  - Nighttime sprinkler evaporative cooling.
  - Passive heating

(C) Talbott Solar & Radiant Homes Inc.
Culvert Thermal Mass Wall

- Office building
- Winters CA 1975
- High Mass Passive
  - Nighttime ventilation cooling
  - Passive solar heating
- Very low energy
- Used in few buildings

(C) Talbott Solar & Radiant Homes Inc.
How about Radiant Floor Cooling?

- Widely used in innovative buildings
  - Bangkok Airport
  - Hunter Museum of Art, Chattanooga TN
  - Akron Art Museum, Akron OH
- Not so useful in conventional residential buildings
  - Less solar heat gain
  - More floor coverings

(C) Talbott Solar & Radiant Homes Inc.
Residential radiant floor cooling?

- Difficulty getting the loads

(C) Talbott Solar & Radiant Homes Inc.
How about ceiling cooling?

- No ceiling coverings
- Sheetrock is OK for heat transfer
- Load 10BTUH
- Capacity 15BTUH
Karo Systems

- Capillary Tube Polypropylene Mat
- Interesting Concept
  - Doesn’t fit well into American construction practices.
Runtal Radiator

- Ceiling radiator
- Conventional hydronic unit
- Requires a lot of units to cool.

(C) Talbott Solar & Radiant Homes Inc.
Wirsbo two trac panels 2005

- Radiant ceiling heating and cooling
  - Plates not in good contact with drywall
  - Too much space between Plates
Talbott Building Integrated Panel

- Integrated panel combines 6 functions:
  1. Resilient Channel sound absorbing lath
  2. Provides space for tubing
  3. Active radiant heating and cooling panel
  4. Excellent contact with drywall
  5. High emissivity coating optimizes heat transfer
  6. Layout on any joist pattern
Talbott Radiant “xLath” Module

- Modular 16” x 24”: fits frame layout
- Self furring, leaves space for tubing in panel void
- Integral emitter plate and resilient (RC) channel
- Hydronic radiant heating / cooling module
- Thermal coating for high performance
- Patent pending

(C) Talbott Solar & Radiant Homes Inc.
xLath prototype modules 2006

- Installing tubing in ceiling panels
  - Panels cross joists
  - Spacing optimal
  - No lacing tubing through joists
  - Easy skip for lights
  - Drywall attaches to panel for good heat transfer
Condition the air

☐ Some air handling is needed
☐ In most climates use a Dedicated Outdoor Air System (DOAS)
☐ Bring in fresh air
☐ Dehumidify as needed
☐ Use energy recovery ventilator when possible
For Multifamily occupancies

- Talbott *xLath* is a component of a Dedicated Outdoor Air Systems (DOAS)
- The Talbott *xLath*:
  - Replaces the main air conditioner in each residence
  - Unit thermostat control
  - Uses typical hydronic manifolds
  - Is a compact installation
  - Has simple service and maintenance methods
  - Integrates into the sound isolation method commonly used
Health and Safety Issues

- Talbott *xLath*:  
  - Operates above the dew point  
  - Prevents condensation issues  
  - Minimizes places for fungi growth  
  - Limits the pathways for fire and smoke distribution throughout the building  
  - *xLath* is nonflammable  
  - Tubing is HDPE or PEX and is commonly used in new buildings.
Building Structural Issues

- Talbott *xLath*:
  - Takes up less building volume than ducts
  - Installs using standard building construction practices
    - Lath installed by drywall contractors
    - Tubing installed by piping contractors
    - Connection to building hydronic system uses the same methods as a fan coil
  - Adds negligible mass to the structure
Risk Management Issues

- Minimizes moldy ducts
- Less pollen in the air
- Fewer pathogens distributed
- Reduces smoke & aerosol diffusion
- Reduces building operating energy
- Reduces operating costs
Environmental Benefits

- Much less energy usage
- Smaller building volume uses less material
- When used, HDPE Pipe is recyclable
- Coated steel Recyclable
Building Industry Knowledge

- Talbott *xLath* radiant ceiling modules:
  - Have been deployed in 13 residences in the region
  - Title 24 methods model the system
  - Dedicated Outdoor Air Systems (DOAS) have a strong academic background
  - Radiant panel cooling systems are supported by ASHRAE and RPA
  - The Western Cooling Efficiency Center (WCEC) at UC Davis is helping deploy these systems into new construction
Client or Tenant benefits

- Talbott \textit{xLath} ceiling modules:
  - Invisible
  - Absolutely quiet
  - Better health than forced air
  - Better comfort than forced air
  - Reacts faster than radiant slabs
  - Cools as well as heats
  - Rapid installation
Moving Along

- Tubing and Manifolds
- Manifold box
- Circulator box
- Finished Room
- Mechanical Equipment
Distributing heating and cooling

- Tubing Wall and Manifolds
  - Manifolds inside wall
  - Tubing collects in otherwise unused void
Manifold Box

- Manifolds enclosed in closet wall
- Covered with return air grill
Circulator center  14”w x 18”h

☐ Mounted in closet wall
☐ Covered with return air grill
Hydronic Radiant Ceiling

- Main room finished
- Note: thermostat above chair
Mechanical Equipment

☐ Combined Georadiant
  ■ Heating, cooling, hot water

☐ Reversing Chiller
  ■ Really simple system

☐ Combined Water Heating
  ■ Dual purpose water heater and chiller
Georadiant Combined Hydronic

- Climatemaster Geoexchange Heat Pump
- Hydronic Fan Coil
- Radiant ceiling H/C
- Geo DHW
- QVM9
- Solar PV 2.5kW
Tetco GeoRadiant

- Dual function geoexchange HP
- Radiant floor/ceiling heating and cooling
- Hot water
- D’Mand Circulator
York Reversing Chiller

- Reversing Chiller
- 15 SEER
- R-431A
- Efficient
- Quiet
- Reliable
Combined Hot Water Appliance

- Quietside QVM9-90
- 90% Condensing
- PVC Flues
- Hydronic Heating
- Tankless Hot Water
- Modulating to 30%
- Microprocessor control

(C) Talbott Solar & Radiant Homes Inc.
Radiant Panel Lessons

☐ Wirsbo panel
☐ Wirsbo on Z-bar
☐ Z-bar plane finishing
☐ Avoid drywall zip drive
☐ Avoid joists
Wirsbo two trac panels 2005

- Panels cover ~40% of ceiling
  Just enough coverage for load
- Panel not in close contact with dry wall
- Tubing routs through joists
- Work just fine!
Wirsbo Panels on RC-channel 2006

- Coverage ~80% of Ceiling
- Tubing routes on surface
- Panel in good thermal contact with drywall
Ondol module on z-bar

- Ceiling plane finished with z-bar
- Tubing in screw line
Applications for Agriculture
Cheese cave – Twig Farm Vt
Z Specialty Foods – Woodland CA

Proposed to prepare honey for processing and packaging
Questions?
Thank You

- Dean T. Newberry
  Talbott Solar & Radiant Homes Inc.

- http://www.talbottradiant.com/