The House is a System:

Building Science: A New Way of Thinking About Homes

ACI at the 2006

RESNET Conference

February 27 – March 1

San Antonio, TX.

The House Is A System

- **Doug Garrett, CEM**
  - **Assoc. of Energy Engineers, Certified Energy Manager**
  - **ACCA Certif. Instructor, Manuals J, D & S**
  - **Administered IECC Energy Code for eight years**
  - **Five Years at the COA Green Building program**
  - **Several Indoor Air Quality Certifications**
  - **Former contractor/builder**
  - **Managed Utility Energy Conservation programs that did 5,000 home and 1,500 commercial audits a year for 12 years.**

The House Is A System

- High Performance Homes For The Future!
- “The future ain't what it used to be.”

In the Beginning, There Was Darkness,…

We foolish mortals thought that homes were just components that stood alone and did not interact

“I don't want to make the wrong mistake.”

Science Has Come Home! OR…

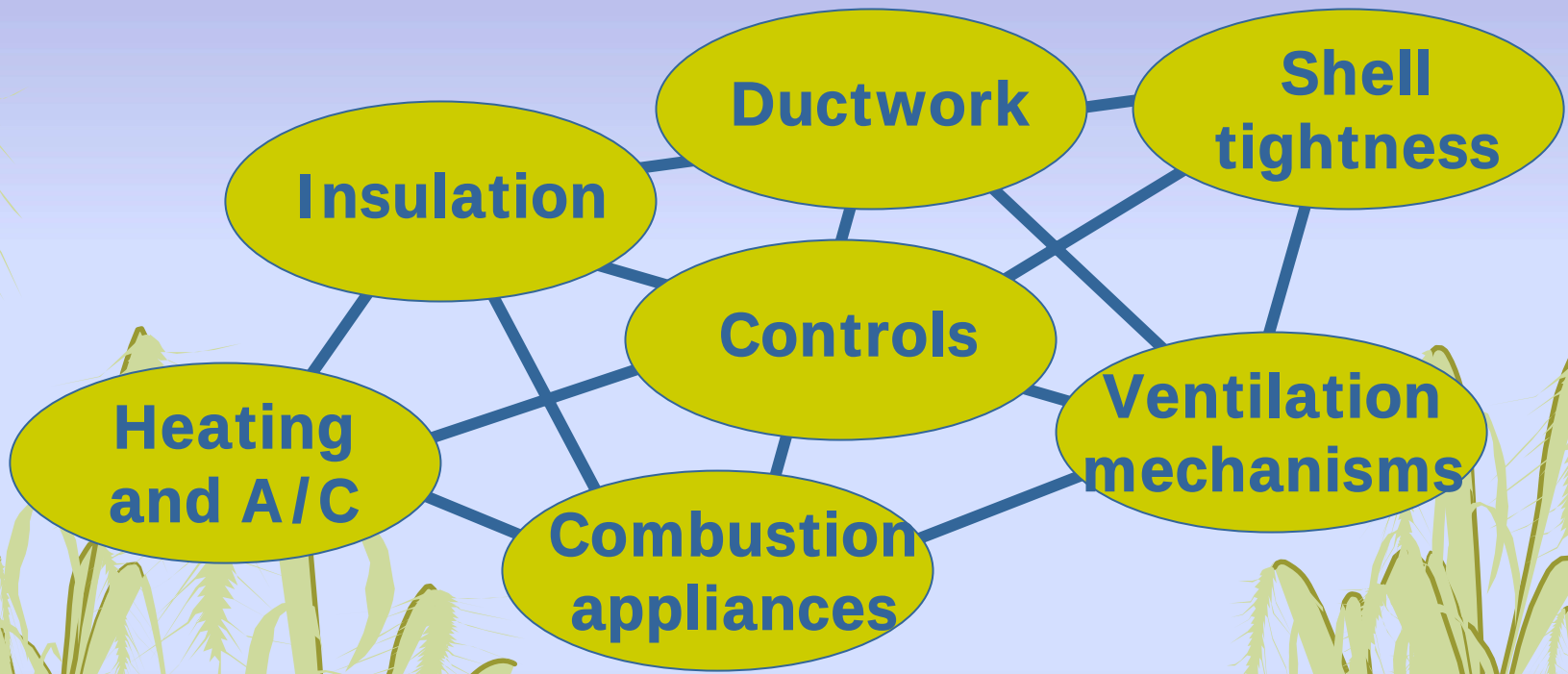
"The future ain't what it used to be."

Building researchers have learned a lot about how to make homes *perform* better

…more comfortable, healthful, durable, and cost less to run

The Whole House Principle:

Everything Interacts!



The House Is A System

1. The house isn't cooling well, so we install a bigger A/C.
2. The crawlspace is damp, so we install a fan for ventilation to dry it out.
3. The attic is too hot, so we install a power attic vent to cool it down.

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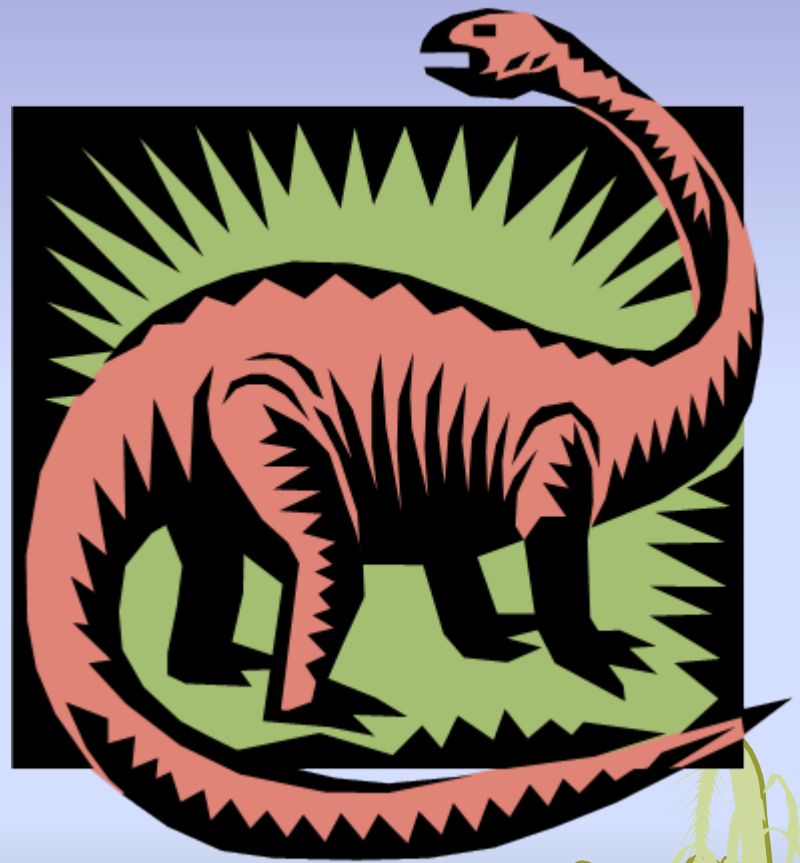
1. The house isn't cooling well, so we install a bigger A/C.
- This is a matter of faith for Southern home owners and most contractors.
- Bigger is Better When it comes to A/C!

HVAC System:

- **Sizing A/C's:**
- **Bigger Isn't Better!**
- **ACCA = A/C's Sized at 1.5 to 2.0 Times What is Needed**



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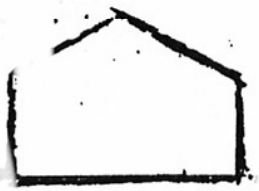
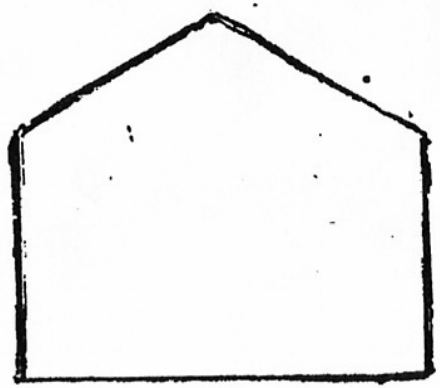
Air Conditioner or Heat Pump
SIZING CHART

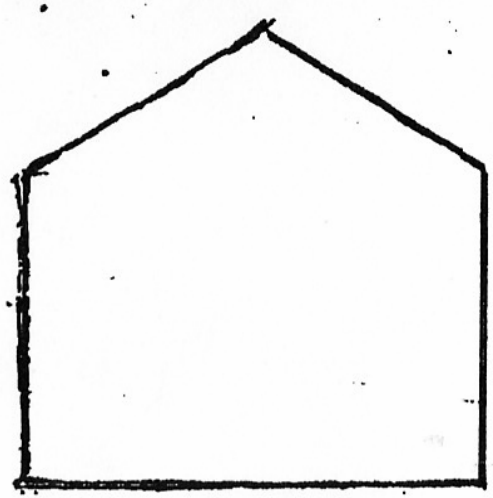
TRIM OUT VERY CAREFULLY ON BLACK LINES, THEN FOLLOW INSTRUCTIONS.



1½ TO 2 TON



2½ TO 3½ TON



4 TO 5 TON

INSTRUCTIONS:
Stand on the curb and look through hole,
if the house fits in a hole thats the size unit to use.

HVAC System:

- **Most A/C's are oversized for the house - Resulting in Short Cycling**
  - **Short Cycling – *Results in Poor Dehumidification***
  - **Short Cycling – Reduces Equipment Life**
  - **Short Cycling – Reduces Efficiency (SEER)**
  - **Short Cycling – Reduces Filter Effectiveness**

HVAC System:

- **A/C Sizing:**
- Rules of Thumb – Set in the Late ’60’s (1Ton/400 to 500 SF)
- Exaggerating design temperatures
- Duct Leakage not accounted for
- Selecting equipment far over calculated load (Load + 15% Maximum)

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2. The crawlspace is damp, so we install a fan for ventilation to dry it out.
   - Many P.E.’s will recommend this solution to this very day!
   - Let’s talk about moisture sources.

Crawlspaces and Basements

- Dr. Bill Rose, University of Illinois
- Exposed soil is a Major source of Moisture in the home.
- 100 Lbs. (12.2 gals.) per 1,000 SF of dry exposed soil per day!
- Whole Family = 8 gals./day

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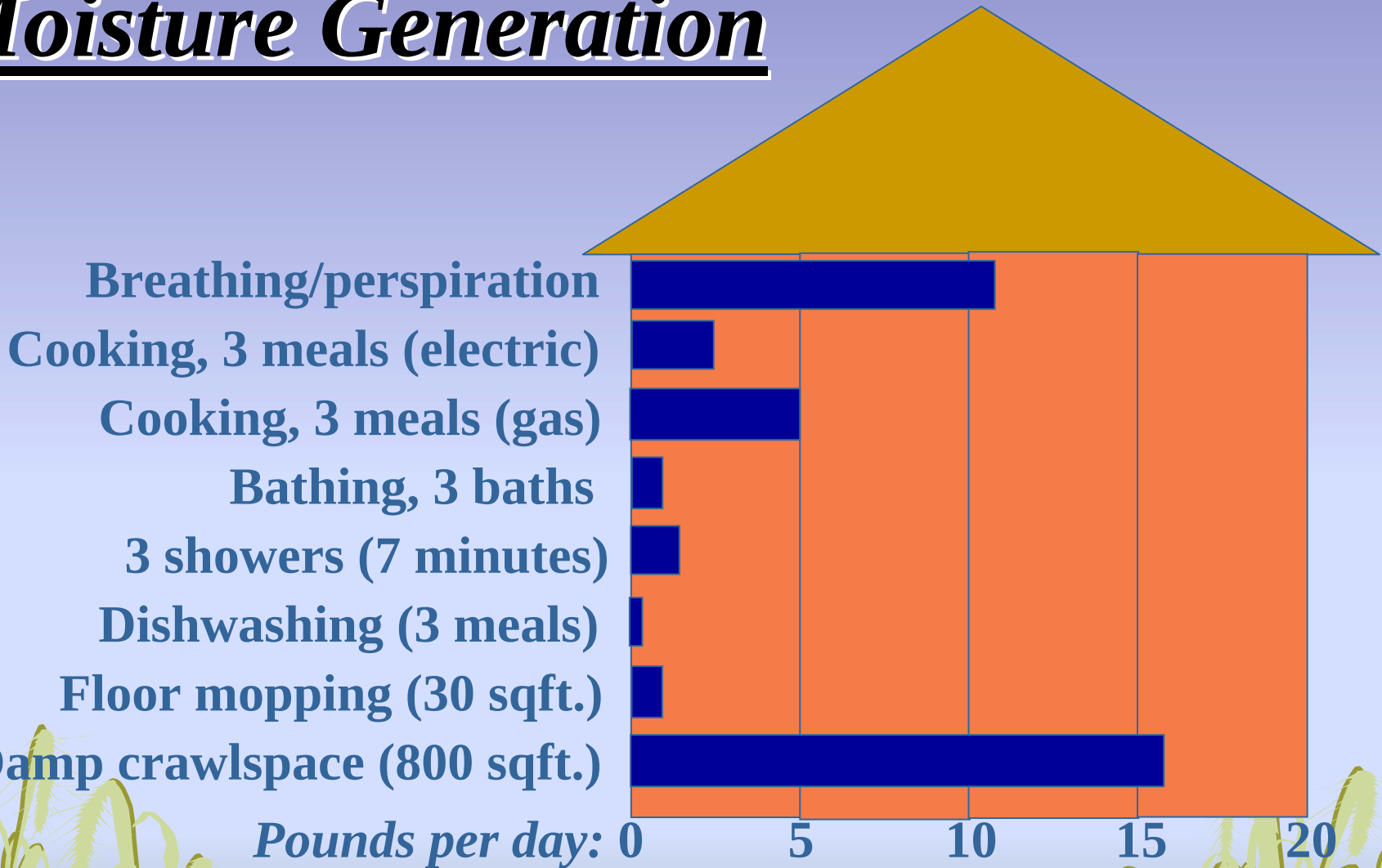
- Crawl Spaces

- Do Not Ventilate Them!!
- Outside Air Is Too Humid to Dry Anything.
- Seal them air tight, use vapor barrier on the floor, insulate the stem wall and pressurize with conditioned air. IRC allows this method of construction.

Moisture Generation




Healthy, Dry,
No Rot
Crawlspace

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3. The attic is too hot, so we install a power attic vent to cool it down.
   - Even today many engineers still believe that convection loops move the heat from the roof deck down to the attic floor.
   - “In theory there is no difference between theory and practice. In practice there is.”
   - FSEC research showed that this is not true!

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- Convection loops move only 20% of the heat from the roof deck to the attic floor!
- Radiant heat transfer is responsible for 80%+ of the heat transfer.
- So, you could create Hurricane Katrina in your attic and only affect 20% of the heat transfer.

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- What does happen when we power ventilate an attic?
  - The attic becomes a big negative pressure zone – a vacuum cleaner!
  - The air is drawn in from outside and up from inside the house.

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- Research at the Advanced Energy Corporation showed that 40% of the air exhausted by a PAV is conditioned inside air!

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- This leads to back drafting of combustion appliances – CO!
- An equal amount of hot, humid outside air is drawn into the home to replace the exhaust air.
- Indoor humidity rises.
- Comfort goes down, mold grows and wood floors warp, just to name a few side affects.

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- Lessons:

1. Go along with the typical recommendation on fixing an A/C problem and suffer with high bills, poor comfort, high humidity, and grow a bumper crop of mold!

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- Lessons:

2. Follow the crowd to fix a damp crawlspace or basement and make it a truly wet crawlspace or basement!

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- Lessons:

3. “Improve” attic ventilation and run the risk of making the house more humid, more likely to grow mold, cause the electric bills to go up and possibly cause a fire or CO poisoning!

The House Is A System

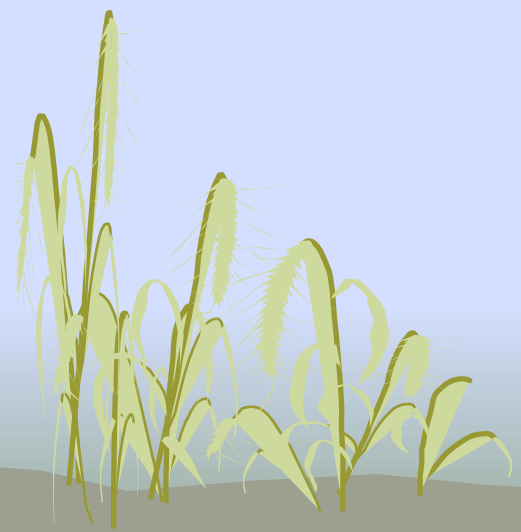
- Everything Interacts!
- See the house as a system!
- Understand that changes have multiple side effects in a system.
- Don’t draw imaginary boundaries between parts of a home or building.
- Be curious and don’t stop learning!

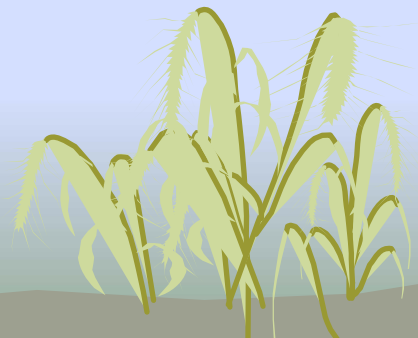
The Future's So Bright…

- Guaranteed Performance
- Improved Comfort
- Greater Efficiency
- Healthy Indoor Air Quality

The Future's So Bright…

- **"You can observe a lot just by watchin'"**
- **"I never said most of the things I said."**





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