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Introduction to E & M tracks of the BEST 1 conference

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Building for Energy Efficiency and Durability at the Crossroads

Where Are We now -

- ***…consumption continues to rise. It is clear that environmental performance benchmarks based energy codes and efficiency standards will not significantly alter the energy future of our industry –****Wagner & Mellblom - session E4*

and Where Should We Be Going?

is this a rhetorical question, much like one already posed in Hamlet

A thought for this conference

"Our Age of Anxiety is,
in great part,
the result of trying to do
today's jobs
with
yesterday's tools"

Marshal McLuhan

Past and current trends

PAST

Proven

And

Stepwise

Tradition

CURRENT TRENDS for EE

Consumer is	&	**T**imely and
Up to	w	**R**apid
Reuse and	a	**E**valuation (of)
Repair;	n	**N**ot (yet)
Environment	t	**D**eveloped
Not the	s	**S**ystems for
Tradition,		**E**nergy & **E**nvironment

Outline -1-

- *A few contradictions to start with*
- *Issues in energy efficiency (EE)*
  - *Using yesterday tools for today's problems*
  - *Green buildings must ensure: (1) durability, (2) energy efficiency and (3) good indoor environment*
  - *Yet Green requires serious public education*
- *Conclusions: Rules for Energy Efficiency:*

(1) progress through small improvements, (2) build airtight and (3) always use exterior insulation

A few contradictions to start with

- Architectural design is a holistic process
- Building codes are not holistic – all functions are separated, requirements are ascribed to one material at the time
- The outcome is modified by interactions between different trades
- Design and construction involve highly specialized people – how do they collaborate during this process?

Definition of Building Science

"Knowledge about building, called, for convenience, building science, is valuable largely because it is useful in predicting the outcome of the result of some building situations. ..... Rational design is possible only when there is a capability to establish, each time a choice is made, the probability of a particular result."

Hutcheon N.B. "The Utility of Building Science", J. Thermal Envelope & Building Science, July 1998

We start with contradictions -2-

- ***To check environmental performance of a new building one needs service data (demo with a field monitoring system)***
- ***The designer will only know how older buildings function.***
- ***Building science could use this info for real time models of energy / durability***
- ***<u>But our HAM models are not suitable for field performance evaluation</u>, they are only good for parametric studies!***

We address today's problems with yesterday's tools (McLuhan)

Paper of Lindberg & Korpi, U of Tampere in session E5, highlights that for exterior walls a difference between measurements and calculations based on U-values (including method of calculating their areas) is typically about 50%.

Obviously this tool is not precise enough.

What's wrong?

- *Energy calculations are now performed with more powerful software and use hourly data from hundreds of weather stations. Many universities proudly announce their new computer models.*

- *YET, for a realistic description of the building performance we need adequate input to these models*

What input data represents thermal performance of the assembly?

- The R-value provides a comparative rating of building assemblies and does not measure its thermal performance under field conditions.
- The laboratory thermal resistance does not include effect of air flow or moisture transmission, at best it includes part of the effect created by multidimensional heat transport.

How large errors do we introduce to the advanced computer models

- Famous statement of computer age = GIGO. For details see session E4.
- These errors are shown to vary from negligible (for some construction assemblies) to a typical of 25 - 30 %.
- The extreme cases, as measured in a laboratory, gave field performance reductions greater than 50 %

Why are those issues not in the front and center of the research ?

- ***One needs (1) advanced laboratory facility (2) knowledge of simultaneous heat, air and moisture transfer. Note that the US supports transformative research through NSF and applies science in the practical research through DoE 's remnants of past funding***
- ***There is no sustained, collaborative federal funding (50/50 science& practical) for building science at US Universities***

The difference between public support for "applied science" or "applying science to practice" is like

The difference between
the almost-right word and the right word is really a large matter --
it's the difference between the lightning bug and lightning

Mark Twain [Samuel Longhorne Clemens]

Key considerations for construction of green buildings

- Extended service life, reduced maintenance /replacement costs
- Energy conservation
- Re-use of materials, use of renewable resources, efficient use of materials
- Improved occupant health and productivity
- Greater design flexibility, i.e., lower costs associated with changing space configurations

Green value is a product of many components

- **Example:** A standard EPS foam = uses oil, transport , etc. embodied energy = 50 Btu
- I lb, 2 inch thick layer covers 6 ft^2
- Energy saved is (30 years x 5 months x 30 days x 24 hours x 32 °F difference x 6 square feet / 3.5 x 2 in = 3 million Btu).
- So the embodied energy is not a real factor in selecting thermal insulation.

Number 1 on the green scale is durability - extending service life

If a building last 20% longer than a typical construction

1) replacement is postponed

2) materials/ energy became available

3) energy is used for other applications

4) If you lowered the cost of a building by 20%, injected this money into the economy, and reduced green gas emissions by 60% (3x20%) or more

What the E -sessions will tell you -1-

E2. Commissioning is only as good as design intent is clear to all the parties ; need for change = to incorporate continuous commissioning approach

E4. We need a fundamental change in the approach to the energy efficiency *– much as happened with the concept of car quality*

E4 & E5. *Heat, air & moisture transports are not separable. So is the Building Enclosure design process. The High Performance houses require biodynamic not mechanical concept of design.*

What the E -sessions will tell you -2-

E7, E8 and E11 . These sessions review several issues in detail, such as thermal performance of PCM, thermal bridges, parapet walls and panels, air flows, incorporating solar and mass effects

E13. When the building façade is to be preserved one must upgrade the interior. It requires airtightness (sealing of BE) and either use air pressure fields or moisture control by use of capillary active materials.

The outcome of E-track presentations

Three requirements for energy efficiency:

(1) Energy efficiency is achieved through small but continuous improvements

(2) If we continue to use air permeable cavity insulations we must keep the building enclosure airtight

(3) Using exterior, continuous insulation is a sign of a good design

Moisture Track

- *The Bugs Mold and Rot Series put on by BETEC over the years has see recurring moisture problems, so the question is …*
- *?? Do we now have the capability of designing buildings with low risk of mold growth ??*
- *The answer is YES but are we prepared to build them*
- *Hence, we are at a crossroad - again*

Moisture Track

- ***What you will learn in this track is that some construction continues to be done poorly.***
- ***Some traditional construction techniques are still being done and they have been demonstrated to fail most everywhere, not just in the U.S., but everywhere.***

Moisture Track

- *At least some recognize this and are prepared to learn from past mistakes.*
- *You will learn from the experience of others in the field, the labs, and the experimenters.*
- *You will also learn that unless good design and construction practices are followed, the legacy for each poorly building will have a large cumulative environmental and physical cost.*

Moisture Track – Session M2

- ***Field Moisture Measurement – do I have a problem or not ?***
- ***Thermography***
- ***Resistance based moisture meters***
- ***Capacitance based moisture meters***
- ***When should they be used ? What accuracy can you expect ? How should that information be interpreted ?***

Moisture Track – Session M4

- *Indoor Environment & Health Effects*
- *All you wanted to know about molds*
- *A new population study about children's heath and the homes they live in*
- *Distribution of air inside dwellings and do we need as much as we (someone) said we needed ?*
- *Will molds cooperate and allow us to pretend that we can predict whether they will appear or not ?*

Moisture Track – Session M5

- ***Healthy Homes***
- ***Everything else you didn't know about molds***
- ***Can you design to avoid mold and convince your banker and insurer that they should smile on you ?***
- ***Programs that make high performance housing a reality – are they there yet, or do we have some way to go to make a big impact***

Moisture Track – Session M7

- Foundations (crawl spaces)
- What systems are not working but can be made to work
- What nasties can grow at the building-to- ground interface
- Learn how to remediate a bad crawl space in a way that works. There are lots of them
- And while you are at it, why not take care of bugs and molds upstairs.

Moisture Track – Session M11

- ***Cladding – Managing Moisture (from outside)***
- ***Flashing details that succeed in keeping water out in demonstration houses.***
- ***One of several experimental test huts in the U.S. looking into drainage behind cladding and learning how weather affects them.***
- ***Want to learn what happens when water gets behind different claddings - pour it on and watch, and measure, and think.***

Moisture Track - Overview

- ***Have we reached a crossroad here ?***
- ***Remember, it is dumb to do something that you know is dumb. Doing dumb things several times will not make them smart.***
- ***You are here to learn about the smarts in dealing with moisture, and hopefully to move well past the critical crossroad.***