Morning:
Problems/awareness in academia in different disciplines:
- Architecture
- Construction
- Architectural Engineering
- Mechanical Engineering
I’d like you to speak to the academic needs you see in both programs that you are involved in. Need for recognition in industry and accreditation bodies, need for educators, need of different disciplines/programs.
More or less most of what you brought up during our discussion – maybe you can weave in the one or other positive aspect of your programs (spread some hope?)

Afternoon:
Ok, this can be about solutions – I’d internally call it “solutions light” – planting the seeds – you can emphasize again, what resources are applicable for educators and students to get their feet wet without missing the boat ... here I’d really like you to focus on recipes of “tools” (e.g. your spreadsheets that you have them develop) on how you get students of different disciplines engaged.
All this should be discussed on the university program level.

This workshop should be seen as horizontal discussion across disciplines – even though we can or better should address the need on the vertical axis (K-12/vocational schools/community colleges) as well, but this can wait for another day.
Building Science Education

Jan 11, 2016

Professor John Straube, Ph.D., P.Eng.
Associate Professor, University of Waterloo
Principal, RDH Building Science
Criteria for Excellence in Building Science Curricula

Task Group: Following the 2012 Annual Meeting of the University Consortium, a task group was formed to develop the criteria for excellence in building science education curricula. Current leaders of the task group include:

- Pat Huelman (Chairman) – University of Minnesota
- John Straube (Co-chairman) – University of Waterloo

Development of Criteria Metric: Criteria for excellence in building science education curricula and associated content are being developed to define, and set the expectations for, building science education. The criteria will provide a metric against which universities can assess building science curricula, key courses, teaching methodologies, and learning outcomes. The criteria will help guide the development of such teaching materials. The metric would also support the work of accrediting organizations and licensing and certification programs. Further, it will support the annual award for “excellence in building science education” and the student competition programs for quality, high performance buildings.
What is Building Science

• the **cross-disciplinary** collection of **knowledge** and **experience** required to **understand** and **predict** many aspects of the **behaviour** (performance) of **buildings** and their systems, specifically including durability, comfort, energy, environmental separation, indoor air quality, acoustics, lighting, economics, and constructability.
Why add Building Science?

• Modern buildings *routinely*:
  – Leak rainwater (mostly a design problem)
  – Leak air (for energy, and IAQ)
  – Experience damaging or unhealthy condensation
  – Experience durability problems (short design life)

• Modern buildings demand **higher, predictable** levels of
  – Durability
  – Energy consumption
  – Comfort (beyond air temperature)
Building Science Toolkit

• Building science is a toolkit of knowledge and skills
• Different players need different sets of tools
• Eg. University programs
  – Engineering (e.g., Mechanical, Civil, Architectural),
  – Architecture,
  – Construction Management; and
  – Building Science (does not exist, we need it)
Building Science Knowledge

• **Not** how you build,
• **Not** the best way to build
• **Not** computer simulations or project management skills or blower door testing

• How to decide how to build, what is best, what to test, when to simulate, etc
Example Building Physics

- A stainless steel cladding with a solar absorptance of 0.4 and an emittance of 0.2 is proposed for an Arizona office tower. How much would a 4’6” long panel expand when exposed to the summer sun? Assume the panel was installed at 60°F.

- A north-facing 2x6 wood stud wall with R22 batt, latex painted gypsum, and OSB sheathing with housewrap and vinyl siding separates an indoor climate of 70°F and 45%RH and an outdoor climate of 10°F and 80%RH. How much moisture will accumulate in the OSB due to diffusion over a 72-hour period? What permeance did you choose for the vinyl siding? Did you assume the permeance of the OSB was constant with moisture content?

- A duct discharges 200 cfm of air, at 58F and 70%RH into a room that maintains 72F. If no moisture is stored or produced in the room, what is the room air RH.

- If a phase change material had a heat capacity of 300 kJ/kg°C at a transition range of 22°C to 28°C, how long would it take 20°C air ducted from a room at 50 cfm to cool 3 kilograms of the material lining the walls?

- A low-slope roof is covered with a membrane trapping 1 gallon of water per square yard in the insulation (wetted by heavy rainfall during construction). How much energy would be required to evaporate this water? If the sun delivers 2 kWh of heat energy per sunny day to that square yard of roof membrane, how many such days are needed to evaporate the water?

- An office worker sits 4 feet from a floor-to-ceiling window during a winter evening. If the outdoor temperature is 10°F, indoors is 72°F and the glazing is simple double-glazing, what is the effective temperature the worker feels?
Real World Experience

- Does caulking fail?
  - Two-stage joint as strategy
- Can we specify airtightness and get it?
  - How do we get airtightness?
- Integration of teaching and research with actual on-site problems, forensics
- In my opinion: a key differentiator of North American Building Science
Building Scientist vs Building Science

• Most building industry professions, technicians and technologists, trades
  – Need some building science knowledge
  – Basic understanding, decision-making in practise
  – Be able to know when help is needed

• A “Building Scientist”
  – a lot of building science knowledge
  – Be able to quantify, predict, explain
  – Some knowledge of many other allied disciplines
Building Science “Quanta”

• Need to decide on what knowledge is needed in each discipline
• Task Force has been underway ..
• Pat Huelman *et al*

• Much room for variations, specialization, school/program flavours
What Building Science-by component

• Structural Systems
  – Durability, thermal bridge

• Building Enclosures
  – Heat, Air, Moisture physics, energy
  – Psychrometrics

• Building Service Systems
  – Psychrometrics, interior conditions, HVAC interaction with enclosure
by Topic e.g., Psychrometrics

- HVAC Engineers- standard topic
  - Enthalpy content, mix, humidfy, heat, cool, etc

- Architects
  - Why condensation, under what conditions
  - Why dehumification needed
  - Ventilation can dry in winter, but adds humidity in summer
Topic e.g., Material Science

• Civil and Mechanical engineers
  – Typical Strength, weight, fatigue, etc
  – Need: learn damage functions, thermal conductivity vs strength

• Architects
  – Typical: what materials are available
  – Need: Durability
Getting Building Science in Curriculum

• First major hurdle: gaining acceptance that building science is needed in curricula
  – E.g., what should be dropped?
• Second major hurdle: finding competent faculty to teach
Faculty Challenges

• Very few academics have formal training or experience in building science

• Most need to “learn it themselves”
  – This approach would never be accepted in other established disciplines (5-7 times)

• Few opportunities for faculty to learn from experts

• Almost no chance to gain real experience
Solutions

• Develop peer-to-peer training programs for faculty of
  – University
  – College
  – Trade school
• Support from Schools required
• Encourage/require faculty to get formal training in building science (if they teach it)
Summary

• Building Science is poorly understood by building industry- academy mostly unaware
• Building Science key to higher performance
• Many disciplines need building science knowledge injection
• Few faculty with requisite building science knowledge
• Few available options for faculty to learn
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Download the presentation in .pdf format from:

buildingsciencelabs.com/presentations

RDH Building Engineering Ltd. and Building Science Consulting and Labs Inc. are merging. Effective November 1, 2015, we will operate as one integrated firm. The merger brings two of the leading building science firms in North America together to provide a combination of cutting-edge research with leading design and implementation capabilities. The result is a unique offering for our clients—an ability to explore new and innovative ideas based on science and our practical knowledge of what can be built. We are excited about the possibilities as we launch the new firm.