Environmental Boxes for the IR Laboratory Wish-List

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Objectives:

- Accommodate larger samples – up to 8'x8'.
- Boxes provide IR maps as well as air velocity maps for CFD simulations of "room" with only one exterior wall, and U-factor measurements
- Develop series of modular boxes:
    - Environmental side with parallel flow only
    - Test Specimen "Buck"
    - Interior Side IR "tunnel"
    - Calorimetric "Metering Box" insert into Interior Side. This approach would require separate flow/temperature control systems for IR and calorimetric. With UHB design, you would have one "metering box" usable for both IR and U-factor and separate IR tunnel, which would only have "transfer ducting". This approach would also effectively eliminate need for sturdy floor, because of access from both sides into "IR tunnel"
- Mount specimen once, run IR test and if needed, second test is calorimetric

Environmental Side

- Provide equal or better cold side controls (temperature and wind speed). Howdy can you provide mode details here. I would recommend considering design that would provide better mixing and uniformity of the flow than it is right now. For parallel flow, Ray Williams system seems to be entirely appropriate.
- Variable speed fan providing parallel wind speeds up to 4-5 m/s. We need more than 4-5 m/s. Minimum is 6.7 m/s as required by standard, but because of some of the issues with projecting products, I think that we need something closer to 10-15 m/s (I will elaborate little bit later) (feedback loop provides fan speed correction to maintain proper air flow despite heat exchanger icing)

- Temperatures at least as low as –20C should be controlled with +/- 0.05C accuracy and uniformity across the field should be within 0.5C. I think that we should think about going down to –40, because of specific issues with condensation resistance and integrity of the window assembly at very low temperatures.
- Provide option for cold side to become a warm side with temperature up to 100F??
- Allow for the option of solar simulator lights on the environmental side.
- Parallel wind only on cold side is fine
- Air flow direction is from bottom to top. Normal width of the parallel flow slot (channel) is 6 in.

Test Specimen Buck

- Allow for projecting products 2' deep to be tested. This could be handled elegantly by providing "test buck insert", which would accommodate deeper specimens. Having same test buck for "flat" or projecting may not be a good idea. Also, need to think about movable baffle on the cold side, which would accomplish this same goal. Here, my comment on the cold side wind speed going to 10-15 m/s is relevant, because for deeper projecting products, the opening becomes so wide, that 4-5 m/s for normal slot (6 in.) becomes close to natural convection for 2-3 feet wide slot. Having capability to crank up volume of flow, would solve this problem. Increased volume at wide slots may translate to equivalent speeds for normal slots of more than 10 m/s.
- Allow for tilted samples???20 degree tilt. This is worth thinking about, but I am afraid that this feature alone may significantly (prohibitively?) increase the cost of a chamber. Also, there is absolutely no agreement or standard how to actually do this. I am not saying that this is not a good idea, just to watch it!

Interior Side IR tunnel

- Maintain very uniform warm side air and wall surface temperatures with warm side "tunnel". Control surfaces with +/-0.05C accuracy. Bulk air gradients should be maintained below 1C. Light, variable fan

speed air mixing to simulate natural convection with controlled temperature. Air supplied at top of specimen and collected at bottom.

- Maintain low relative humidity (10-15%). Not necessary to have it controllable to anything between 5-95%, but that would be a nice extra.
- Allow IR camera to be remotely controlled within the tunnel to do close ups and lateral movement for images of different parts of the 8x8 specimen. Note, we estimate that with the current FOV, a 10' deep space should allow us to mage 1/6 or 1/8 of the specimen. These images will be patched together.
- Allow for traversing system for velocity and temperature probes on the warm side to measure temp and velocity (where? – within 1" of sample, all over box??) * * * Distances off of the specimen probably wouldn't exceed a few inches; however, projecting surfaces will require an overall travel of 18 to 24 inches, perpendicular to the specimen plane. Travel should also extend past the typical 8x8 specimen opening, by at least 6 inches on all sides.
- Control heat and other impacts from camera
- Have this serve as a guard for the metering box. As I said, I don't think that this is good idea, because of the need for completely separate system to maintain flow and temperature control in IR mode. I know that this is Howdy's idea, but please have him elaborate how exactly this would be accomplished, because last time when we talked about this I didn't have an impression that he understood all implications.
- Provision for human entry to chamber while running, with minimal impact, such that stability can be reestablished quickly.
- Raised floor (air flow likely underneath) should be mechanically strong enough for heavy loads (person/furniture). This is tough and expensive. As I indicated earlier, having an IR tunnel as an insert would eliminate the need for walking on the floor.

Metering Box

- Works as insert. See above.
- Maintains same interior film coefficient as IR tunnel. How? See above.
- Maintain very uniform warm side air and wall surface temperatures with warm side "tunnel". Control surfaces with +/-0.05C accuracy. Bulk air gradients should be maintained below 1C. Light, variable fan

speed air mixing to simulate natural convection with controlled temperature. Air supplied at top of specimen and collected at bottom.

- Extraneous losses between guard room and metering room need to be minimized
- The whole exterior side of the guard box needs to be well insulated to maintain uniformity.
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