Rand Kjell Jim

Q: I use eQuest. Is it guaranteed that what an early analysis of massing will behave more or less the same once the HVAC systems are decided? I wonder if different massing options work better with certain HVAC systems, and as a result making early massing decisions based solely on energy modeling maybe unwise.

Jim: The HVAC system and distribution types should be selected based on the massing, not the other way around. So your early massing decisions should be based on energy use estimates (and other design parameters). Then you should analyze alternative HVAC system scenarios to determine which is most appropriate for your selected massing.

Kjell: Nothing is guaranteed, although early energy modeling to test early options will general help create a better-performing building (with the caveat that you understand what you are doing with early energy modeling). If you design a good passive building (ie, with no HVAC), then when systems are added it will perform better (in general) than a building that does not work well passively.

It’s true that some massings work better with some HVAC systems, and conversely it’s also true that some HVAC systems just don’t work with some massing/glazing layouts. For instance, chilled beams do not work if there is excessive solar gain. Another example is that most energy modeling software (including eQuest) is not natively good at natural ventilation. Some experienced modelers have work-arounds for natural ventilation, but other software and experts should be consulted if you are trying to do a mixed mode building with natural ventilation.

Q: When filing for a permit from Department of building in NY they ask you to put energy calculation on your drawings. What is the best program that you recommend for a small architectural firm to calculate energy calculations?

Q: For small residential projects, is there a place to learn the basics on an internet site or book that you recommend for architects?

Kjell: The Passivehaus US group (PHIUS) offers training for single-family residential, including a spreadsheet-based software (PHPP) that does very accurate energy modeling. Their systems focuses on lots of insulation, eliminating thermal bridging (using THERM software), pressurization testing to reduce infiltration, and using a heat recovery system.

Q: What tools are best for early analysis of low-rise commercial?

Jim: We recommend two approaches, depending upon your project’s needs. If you need to analyze the entire building, we prefer to use hourly simulation models. Some programs, such as eQuest, include default building and system information. So even though many building components are not yet known, we can model the entire building using the defaults and the few components that are known. The design progresses the model can be updated with additional information replacing the default entries.

If you need to analyze specific components then either a bin data model or a comparative model is more appropriate. Many programs have been developed for specific component types, way too many to list. Bin data models are best for components that are strongly related to a single variable, most commonly dry-bulb temperature. Your energy consultant probably has many of these already or can develop one that meets your specific need relatively quickly.

Kjell: Most of the energy modelers that use early simulation have developed a toolkit of several software. As I mentioned, one needs to ask a question first. Once you have the question you can then choose the right software to answer it. We are unfortunately prohibited from answering the question in terms of software recommendations, however if you ask me via email I’d be happy to answer.

Q: What effect does climate have on envelope as compared to building type?

Jim: The difference between the envelope and the building type is that the architect can design the envelope to address the specific climate conditions whereas the building type is a given for a specific project.

Climate affects different building types to varying degrees. For example, climate greatly impacts laboratories that require large amounts of outside air whereas climate has much less impact on data centers that do not have much interaction with the outdoors. So the designer may focus more effort on the HVAC system, at least when it comes to the impact of climate, in a laboratory building. And the HVAC design solution will be very different for the laboratory in a hot-humid climate like Miami versus a cold climate like Minneapolis.

Conversely, a laboratory and a data center in a given location may have similar envelope design (assuming both have similar envelope component areas, such as glazing). But the focus on the envelope will vary by climate. For example, envelope insulation is much more important in Minneapolis than in Miami due to greater differences in sensible heat flow through the envelope.

So while climate has an effect on building energy use due to both envelope and building type only the envelope can be changed for a given project.

Kjell: Both are very important, I would say about equally so. Climate has to do with lighting, heating, cooling, fan power (to move air), and a few other loads. These often are 50% or more of a building’s energy usage and can be significantly reduced by designing with climate. The climate tends to have a larger effect on smaller buildings, and not quite as much of an effect on larger buildings.

Q: When does a Passivhaus approach become relevant, i.e. building type, climate, etc?

Kjell: Passivhaus has been primarily used in Europe for houses, although larger buildings have been done. They are predominantly done in climates that do not require a great amount of cooling. An interactive map is here: <http://karten.passiv.de/?q=gebaeude&o=true&l=en_EN>

Q: Kjell- Most of the energy saving strategies you showed can be arrived at intuitively. Do you think that clients need to see the quantitative simulations and aren't willing to accept their architects' judgment without them? Has the availability of simulation software lessened clients' willingness to rely on the judgment of their architects?

Kjell: it’s true that most of the energy savings in the examples I showed can be intuitive, partly because this is an introductory course. However, even experienced energy modelers learn things on every project… so I believe everyone can learn more.

But to answer your question most directly, many people don’t want to challenge their intuition with simulation, as they might find out they have been wrong for years. Finely tuned intuition is the best, but building up an intuition requires a great deal of experience generally. As simple as it sounds, clicking the buttons through many sequential iterations of a simulation helps develop an intuition. Many architects believe things about daylighting, energy use, etc.. that are not true. When they play with software correctly, they can learn what sustainable strategies really do for a project.

One great example is that green roofs generally do not save as much site energy as many people think. Some believe that more glass equals better daylighting, that lightshelves solve glare problems, that vertical fins reduce solar gain the on west, and others that huge amounts of insulation is better on all buildings in all climates. One can learn WHEN these responses are true using simulation.

It’s also difficult to have intuition about complicated spaces. In my book, for instance, one well-respected architecture firm designed in 5 different skylights to daylight an atrium. When they tested each one, they found that only one of them had a significant effect in lighting the space.

Regarding your last question, clients have reason to be skeptical of architects’ intuition in many cases because we, as a whole, are still at a basic level regarding sustainability. There are many architects with a very refined sense of intuition, but the average architect has not spent the time to develop it, and in some cases post-rationalize their decisions based on ‘intuition’, which reduces the trust in those who have a good intuitive sense. While clients still don’t expect it in most RFPs, I’ve seen more and more simulations in proposals. Clients will become more sophisticated as we become more sophisticated in explaining energy use to them, and more consistent in being correct.