**Bad vs. Standard**

Filip: When considering the concept of “bad”—in relation to architecture, engineering, and specifically environmental engineering—I’d like to start with the criteria that dictates “Thermal Comfort,” since this term represents attitudes shaped by quantitative and qualitative criteria.

Erik: At Transsolar, we often understand comfort as culturally determined. No universal standard defines comfort for everyone. It can be defined physiologically, but it’s also a cultural construct, a result of prior experience and personal expectations. We’re intentionally creating experiences that achieve a level of comfort and delight not conventionally recognized by our culture.

A simple example that we have used in many projects—such as the Angelos Law Center—is an exposed concrete ceiling slab, often heated or cooled by embedded radiant tubing. If one focuses on air temperature as a number, they might conclude they should be uncomfortable; in reality, if they listen to their bodies they discover they *are* comfortable. And this construction type usually offers the advantage of higher ceilings and improved daylight.

A richer example is semi-conditioned buffer zones, such as the south-facing winter gardens at Manitoba Hydro Place. These spaces aren’t designed to be fully heated in the winter—their temperature varies significantly depending on available solar radiation; in summer, they essentially have the same conditions as the outdoors. Because these aren’t fully programmed office environments, they provide a welcome connection to the outside and an opportunity to experience a different environment during the workday.

 Filip Your work negotiates the unexpected and preexisting standards with norms or tastes. In this sense, the unexpected you just described provides a subjective criteria, yet there is always some objective truth. Does the latter vary according to the comfort model being used?

Erik: ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) is the dominant institution for indoor, thermal comfort standards in the U.S; they establish the reference for acceptable thermal comfort in quantitative terms. It is very much an institutional definition of comfort.

Filip: Since ASHRAE represents the HVAC engineering “establishment,” is diverging from those standards “bad”?

Erik: The ASHRAE standards are very dominant in North America; there is a preconception they are too limiting and that we shouldn't be bound to these institutionalized standards. Is ASHRAE bad because of these constraints? The reality is more nuanced. ASHRAE 55 is much more flexible than most people realize. Over the past 10 years, it has accepted a wider range of definitions of comfort.

 Our industry and its standards are always changing; ASHRAE gradually incorporates these shifts and is usually ahead of most clients. Often, our challenge is to have a client willing to use the full range of comfort accepted by ASHRAE. 80°F air and radiant temperature, along with 70% relative humidity, and a ceiling fan on very low speed is considered perfectly comfortable for someone wearing pants and a short-sleeve shirt. That’s hard for a lot of clients expecting an air temperature of 75°F to accept.

Filip: The ASHRAE standards function as instruments of practice/service—tools that project and even enforce certain institutional biases and subjectivities. The last 50 years of ASHRAE comfort models recognize changing expectations and desires of building atmospheres, both on a cultural and an individual level; a meta-history of taste, measured through a range of comfort definitions.

Erik: Yes, definitely. Any comfort standard is a tool, one of many, that we utilize in our work. You could say we are “bad” because our ideals are not governed by standards—we are willing to be transgressive and work outside of these standards. For us, a project’s success comes from using a number of approaches, defining and analyzing the problem in various ways, with different models, simulations, mock-ups, tests, and among others.

Advanced modeling can allow a more nuanced discussion and understanding of the definition of performance. Thermal comfort has traditionally been evaluated with air temperature, an incomplete representation that ignores a host of physiological metrics. We use dynamic thermal simulation software such as TRNSYS (Transient System Simulation Tool) to calculate the key inputs, such as radiant temperature, to the latest thermal comfort models. The results of this modeling require discussion with the client to agree if the expected range of comfort is acceptable for them; thermal comfort standards are only one reference point in this discussion.

Filip: What we define as comfortable or appropriate often requires satisfying radically divergent contextual and subjective criteria. For example, David Gissen explores various systems that produce atmospheres—clean, polluted, mediated, social, political—and presents a history of building atmospheres. His essay, “The Architectural Production of Nature,” examines the design competition for the Temple of Dendur’s exhibition space. The Metropolitan Museum of Art proposed building an enclosed space that supported an atmosphere and intended to preserve the temple in perpetuity. The HVAC system had to accommodate both the comfort of the museum visitors, and the preservation of the temple. The design emphasis was to create the “appropriate environment”—the atmosphere of the museum as an environment for the preservation of art work. If the goal was preservation, then the art, the temple, and their entire collection should be sealed-off away from light, air, varying moisture and temperature. The physiological premise for comfort is then undermined by the cultural and political demands of optimized performance and energy savings. Is there an inescapable compromise between performance and comfort? Can you have both?

Erik: The reinforcement of that perceived contradiction is one criticism of LEED. Blind pursuit of LEED—or any certification—often results in a focus on specifying equipment, fixtures and assemblies. Each “performs”, but in the end you're just selecting a high-performing, slightly more efficient version of standard practice.

 Rather than applying standard solutions, we focus on how that environment changes by asking critical questions. We embrace the idea of climate-responsive design and accept the variable nature of the environment. We use tools to probe the interaction between indoor and outdoor environment to understand how different design concepts will influence the built environment. The glass canopy at Zaryadye Park in Moscow, for example, doesn’t create a fully conditioned space, but establishes a semi-outdoor environment much warmer than the outdoors in winter. The ventilation rates and resulting thermal conditions have been studied to confirm that the design produces the desired experience.

 Traditional, mechanical system design accounts for extreme conditions rather than an understanding of the variability in between. Frankly, what we do is difficult. Because the environment is so extremely variable, there are many possible conditions. Ultimately, we’re systems thinkers interested in system dynamics that are constantly changing in response to many different inputs, both quantitative and qualitative. Our experience allows for exceptional comfort and energy performance.

Filip: External variables, such as weather or taste, heavily influence the negotiation between quantitative and qualitative criteria, like building performance and occupant comfort. Failure is not absolute, even if the performance lies outside of the expected norm. Do you think architects have incorporated this type of systems thinking or an eco-consciousness that strategizes building operations and occupants experiences beyond short term needs?

Erik: It's not typical for architects to think this way yet. The tools are different—drawings are static. Sometimes, we discover that our collaborators and clients can’t imagine buildings being designed for variation rather than as a static condition.

Filip: Is that because architects do not associate programmatic variability with fluctuations in the indoor climate? Meaning that there is an unchanging correlation between building program and indoor climate.

Erik: Yes. The unique challenge of environmental engineering is designing for a multitude of unknowns. That variability is at odds with expectations of a static indoor environment. For instance, a classroom might need to remain comfortable, whether occupied by one or fifty people. How is this accomplished if we partially rely on architecture—such as its exposed thermal mass—to deal with this variation? It becomes necessary for the space to begin slightly cooler and end slightly warmer.

Filip: Does this absence of a critical, architectural attitude to variable environmental conditions—both indoor and outdoor—represent a type of failure?

Erik: As part of the design process, once a certain range of environmental conditions are predicted, then there is an expectation of what to achieve. Whereas, if there are no predictions, it probably was not discussed and there is no expectation. Failing to have this conversation is probably a failure of the design process.

At the same time, if a particular outcome is predicted, there is already a possibility for design failure specifically because it creates expectation. If we expected a limit to a predicted range, and it's significantly warmer, then that could be a design failure. Maybe it's a failure of the process that the design team—architects and consultants—or the owner didn't identify a possible use scenario.

Filip: With more advanced predictive abilities, is there a greater likelihood of identifying possible failures, even those that might occur under rare circumstances?

Erik: Exactly. Our increasingly sophisticated palette of tools might also predict that a space isn't going to be comfortable all the time. It’s possible to recognize that and the client can then say, "You know, we accept that." What might have been considered a failure before would now be considered acceptable. For the Karl Miller Center at Portland State University, the client accepted a small percentage of hours above the comfort threshold in order to achieve a building with no mechanical cooling.

Filip: Contemporary architectural discourse includes ideas and concepts such as scenario and systems planning, emergence theory, and indeterminacy, but the outcomes are counter-intuitive and they usually manifest in stable forms or static compositions. How could the architectural discipline adopt these modes of thinking as previously mentioned?

Erik: Post-occupancy evaluation is the most important tool and allows us to examine how architecture is changing from the perspective of the occupants and perhaps altering the relationship between the architect and the project, which generally focuses on the delivery of a finished product and does not usually include some form of long-term monitoring or feedback-loop. By looking back at our work helps us understand how the indoor environment actually varies over time, how the expectations of the occupant change, and how these changes occur in relationship to one another.

Whether intentionally designed or not, this interplay happens in every building. Without this feedback, the idea that environmental conditions are good or bad remains hypothetical and, again, definitions of failure are based only on standards and not a real, lived experience. Evaluating your own work allows for better design in future variability. If you document that occupants value space with variability, clients are more willing to accept it. In the last few years, we pushed much harder to perform post-occupancies studies in our completed projects and the findings have been immediately informative both for ourselves and for our clients.

Filip: That architects could reconceive and appropriate the post-occupancy evaluation in order to develop a design-specific feedback loop is an intriguing proposition. It would be another way to nudge architectural thinking towards strategies that are not bound to static outcomes. What do you think are some of the obstacles to this strategy in practice?

Erik: Not every client is ready to take the time and engage in a meaningful way. They may also be hesitant to allow the design team to directly interact with their full community, which is critical in getting feedback that represents all perspectives. Of course, design teams would prefer to be compensated for this work, which means we must offer value to the client and not just for our own future work. This is easiest with clients interested in long-term, collaborative relationships.

Filip: When I’ve worked on projects with developers, they often don’t have an occupant. As an architect, you are designing for…

Erik: For unknown people. I've seen that problem on commercial building projects; brokers or tenant representatives demand that you design for a high occupant density or super high plug loads, which result in massively oversized equipment. It’s a waste of money because you install for an unnecessary capacity and it's inefficient to operate.

Filip: In recent years, real-estate developers, marketers, and architects, have been particularly aggressive in touting building performance and sustainability. On one hand, this could be interpreted as a shift towards greater environmental responsibility. Then again, as you mentioned earlier with regard to LEED, simply replacing one system, material, or part for a “greener” version is likely an ineffective and excessive approach. This is certainly a flawed design strategy.

Erik: The piecemeal approach only layers on technologies without questioning underlying assumptions, such as the unnecessarily high plug loads previously mentioned. Does it impact the people that are there? Not really. It could still be a fantastic building, except the developer spent five-million dollars or more for a capacity that will never be used because somebody thought they might need it and also because someone applied a ‘standard’—often unwritten—without any critical thinking. Rather than using cost savings, by questioning traditional assumptions to fund other aspects of the project, the technologies required to be ‘green’ are inevitably seen as an additional cost.

Filip: It’s a perverse form of conspicuous consumption that simultaneously revels a form of excess while projecting an essentialized, rational aesthetic. How much of that is intrinsic to contemporary architecture because it persists in upholding certain modernist orthodoxies—the legacy of transparency, for example.

Erik: Anytime a project begins with an end in mind—whether that includes an idealized form or an specific material vocabulary—then it is a bad start. It means that too many contextual variables are being ignored while the solution space is already unnecessarily constrained, which can limit the potential to reveal the ‘best’ design option. Form and material need to respond to site specific conditions and that doesn’t mean the response is deterministic. If the contemporary canon is biased towards an indiscriminate use of a material, like glass without clear intent, then that is a design failure.

 Our work with Behnisch Architekten on Artists for Humanity, a net-zero building project in Boston, is an example of a problem driven by assumptions. The aesthetic expectations associated with high-performance design in prevailing design culture assumes the curtain wall. The client is amazing and ambitious; they want a net-zero building on a very tight site and budget. We've redesigned the façade multiple times to get the project within budget. It started with a super radical-looking façade that evokes a beehive while integrating fixed shading, translucent glazing, and photovoltaics. It eventually became obvious that the curtain wall suppliers could not make the required U-value work as a curtain wall system within the project budget. Not because of the glass, but because of the frame. If the expectation was energy-performance, maybe that wasn't the right starting point for the project. Sometimes, we have to go back and rethink the question and our expectations.

Filip: What if you were hired first, before the architect?

Erik: We would still need to maintain our usual roles in the end. I struggle with architects who expect our input to drive the project—this idea that climate-responsive design is deterministic—*that* makes me uncomfortable. It's the difficulty of a blank-page and the challenge of architecture: you start with nothing.

 We need to see architectural proposals to form the right questions. You have to start with the bad to get to the good. It's part of the process. Architects are more comfortable with the unknowns of the design process; they understand that the first idea is not going to be good. Engineers are not typically comfortable with this and it’s something we focus on in our practice as inherent to the process of collaboration, going outside our personal comfort. The architects who expect us to act as a traditional consultant ask us for a concept and we deliver the fully baked, complete and correct concept on a platter—the first time. But we expect to see their ideas, start noodling on our own—including good and bad ideas—and begin a discussion. Authorship of the concept is truly collaborative and the idea develops over time, with the result being something neither of us would arrive at individually. This process is how you get from bad to good, and it’s different every time.

Filip: When something is good, are we really saying that it is just good-enough? Perhaps in order to be “bad”—as a form of productive transgression—we have to be extremely precise about the terms, such as the criteria we use to evaluate performance. In this regard, yourCloudscapes project at the Venice Biennale succeeds as the embodiment of meteorology at the scale of architecture. It produces a spatial experience that challenges expectations. It is both a theatrical performance and high-performance.

Erik: That's the point: a special experience emerges from a mixture of art and science that thinks carefully about the application of physics and has nothing to do with any standard definition of the indoor environment. Most engineers, and even many architects, just want to be handed the rules, the roadmap of standards.

Filip: There is a play between the hard data accrual in something like TRNSYS (transient systems simulation tool) or CFD (computational fluid dynamics) and the quick-and-dirty mock-up, like those you did for Cloudscapes.

Erik: Our use of simulation loosely relates to the idea of starting with the bad to get to the good. Very few design firms take a critical approach to simulation; it’s rare for someone to ask whether the simulation results validated your design, or better yet, helped shape it. What needs to adjust in response to its predictions? Architects should learn how to have a dialog with the results in order to draw conclusions and further ask questions. Without a clear impact on the design process, simulation for the sake of simulation is definitely bad.

Filip: As we discussed, Cloudscapes performs in multiple ways—as theater, as a climate, an experience—and I could imagine a future in which the definition of building performance includes entertainment through some type of thermodynamic theatricality.

Erik: There’s certainly space for designing experiences that can challenge end-user expectations; they are meaningful and powerful by being not-so-polite or not-so comfortable. The cloud we designed for the Munich Kammerspiele, a repertory theater, hovers over the stage and requires highly controlled environmental conditions to remain stable.

 Why can't we expand that notion to also include the audience and the space that the audience occupies as well? One goal of the cloud was not to simply have the cloud float out over the audience; there’s already iterations like the fake snow falling at Radio City or Random International’s Rain Room at MoMA. Why can't that be considered part of the performance?

 What if the action in the play was heating up, it's getting more and more intense, and the whole auditorium gradually gets hotter at the same time, so everyone's sweating and they're super nervous, asking "Why am I so sweaty?” Their endorphins are going and the moment there is catharsis on stage, the air conditioning turns on, and everyone feels a sudden drop in temperature, "Oh, thank God."

 Though this example is extreme, the same idea can extend to non-performance spaces. The sound of rainfall on an ETFE membrane roof—which essentially acts as a drum—is generally seen as a liability, but it also be part the space’s theatricality, an attraction in itself.