# Architecture of Contingency

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Architecture privileges the two-dimensional surface. Regardless of whether the surface representation originated from the classical method of orthographic drawing or from the contemporary method of three-dimensional modeling, the result is the same: buildings that can only be processed through the qualities of the surfaces in view. The privilege afforded to the surface emanates from an *a priori* belief that perception is rooted in and determined by geometry. Geometry relentlessly tethers the built environment to static artifacts.

Geometry is, however, a subordinate player in perception. Perception is driven by local, discrete, and transient energy exchanges between the human body and its immediate surroundings. Building surfaces might provide an armature or a context for these exchanges, but they do not generate them. The architecture of a perceptual environment is instead an architecture of contingency: Not geometry and surface, but heat and light. Not form and materials, but sensuality and tactility. A contingent architecture emerges through interactions with the body, and responds to each body with behaviors that are specific to that moment in time and that individual. When the contingencies are designed, the objective totality of a geometrically-derived architecture gives way to subjective discretion.

## surface and boundary

An oft-repeated cliché is that architects do not design buildings, they design 'space.' Architects may draw surfaces and objects, but their ability to knowingly imbue those surfaces with concepts of 'territory' and 'effect' supposedly differentiates architecture from quotidian construction. The more gifted the architect, the more cerebral the effects of the designed space. The historian and theoretician Robin Evans described this quality of extension as a "projective cast" that operates in the "intervals between things." [1] Evans describes a set of ten transitive spaces that form the reading of object by observer; seven are constructed geometrically from the surfaces of the objects, while three fall into the realm of the imagination: "Projection—or rather quasi projection—breaches the boundary between world and self, the objective and the subjective." [2] The imagined space escapes precise and specific characterization of the geometrically constructed surfaces of the object, and yet the implication is that its very existence is determined by those surfaces. Even insofar as one cannot trace a line of causality from

1 Robin Evans, The Projective Cast (Cambridge, MA, 1995), p. 366. Published posthumously.

2 Evans 1995, pp. 368–369.

objective surface to subjective perception, we unconditionally accept that the surface is the progenitor of the effects that determine perception.

The hegemony of the surface reinforces a lexicon for architectural materials that categorizes materials as aesthetic artifacts. Typical materials such as wood, stone, aluminum, concrete, and glass are visually identifiable and functionally predictable. Most basic design requirements are satisfied by selection of a particular material. For example, the choice of a particular type of wood defines possible functions, properties, and appearance. If a material is not in the field of view, as in the case of materials intended for structural systems, selection is predicated on its *instrumentality*—how economical, efficient, and effective the material is for achieving the desired architectural form. A material in view, however, is no longer *instrumental* in creating an image—it *is* the image. The architect only has to name the material to define the resultant appearance. Wood connotes warmth and domesticity; aluminum, a lightweight universality.

If surfaces are the carriers of effects, then they are also the delimiters of the architectural object; as such, they define the extents of its property. Evans' "projective cast" may pose space as projecting from the object, operating between objects, even penetrating the object, but it is the object which is the relevant datum. The delimiting surface unambiguously defines the datum thus differentiating *inside*—within the extents of property; from *outside*—beyond the extents. The surface-as-datum thereby takes on an additional, and perhaps more problematic role as 'boundary.' The architectural boundary inherently marks difference and ownership through a prescribed discontinuity. The physicality of the surface manifests this boundary as a barrier, container, or edge, producing a very real discontinuity that is perceptually impenetrable if the surface is opaque, and that remains physically impenetrable even if the surface is transparent.

The building envelope represents the ultimate manifestation of the omnifunctional surface boundary. Not only does it demarcate ownership and limits, and determine form and image; it also protects the occupant from the myriad trespasses of a hostile world—intrusion by the public, assault from the environment. While traditional architecture was capable of providing shelter from the environment, the advent of HVAC (Heating, Ventilating and Air Conditioning) systems at the beginning of the twentieth century

established the building envelope as a cocoon in which an alternative universe was maintained.

In a lecture delivered in 1929, Le Corbusier described the envelope as a "hermetic" seal that enabled the nascent HVAC system to provide ideal interior conditions: "The Russian house, the Parisian, at Suez or in Buenos Aires…will be hermetically sealed. In winter it is warm inside, in summer cool, which means at all times there is clean air at exactly 18°." [3] Half a century later, James Marston Fitch essentially equated 'architecture' with 'envelope' in describing its thermal determinism:

> The task of architecture is not merely to abolish gross thermal extremes (freezing to death, dying of heat prostration) but to provide the optimal thermal environments for the whole spectrum of modern life…. To achieve a thermal steady state and a thermal equilibrium across space.[4]

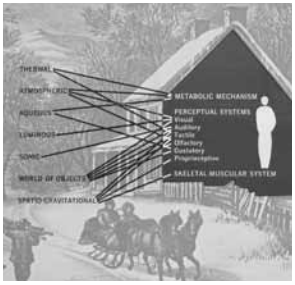
The image that illustrates this equivalence appeared on the cover of Fitch's seminal *American Building 2: The Environmental Forces That Shape It*.[5] The building is entirely represented by an envelope that isolates a static, homogeneous interior from a dynamic, heterogeneous exterior. As if the image were not didactic enough in stating the authority of the envelope as determinant of man's condition, the accompanying notes list what was then considered to be the full range of perceptual responses in the interior with the associated physical phenomena on the exterior, showing the envelope in a role as the intervening litigator. From the ill-fated Biosphere 2 project in Arizona, in which microcosms of the Earth's major biomes were housed in a completely sealed complex, to the German Passivhaus with its massive, highly-insulated walls, there continues to be a profound faith in the envelope as not only the definitive boundary for architecture, but also as the only boundary of consequence.[6]

## boundary conditions

The static surfaces of the envelope may demarcate the ownership of property or the territory of a domain, and they certainly establish the visual extents of the picture plane; but these are boundaries of discontinuity. When speaking about phenomena rather than objects, the boundaries of consequence are all continuous. In physics, a boundary is a region in which change occurs: heat is exchanged, pressure is equalized, molecules are

3 Le Corbusier, Precisions on the Present State of Architecture and City Planning, trans. E. Aujame (Cambridge, MA, 1991), p. 66. The volume is an English translation of a series of lectures that Le Corbusier delivered in Brazil in 1929. The original compilation was published in French in 1933. Degrees are in celcius.

4 James Marston Fitch, American Building 2: The Environmental Forces That Shape It (Boston, 1972), p. 46.



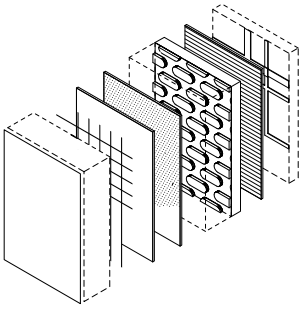

5 The classic James Marston Fitch image depicting the building envelope as the primary determinant of human well-being. External physical phenomena: thermal, atmospheric, aqueous, luminous, sonic, world of objects, spatio-gravitional. Internal perceptual responses: metabolic mechanism, perceptual systems, skeletal-muscular system. From American Building 2: The Environmental Forces That Shape It (Boston, 1972).

6 Built in the late 1980s, Biosphere 2 is a large glass enclosed complex located between Tucson and Phoenix, Arizona. Two teams of 'biospherеans' were sealed inside the artificial environment during the 1990s to test survivability, but severe problems with sustaining the interior environment resulted in the high-profile cancellation of the missions. The Passivhaus stems from a concept developed by Wolfgang Feist in the 1980s which was premised on the reduction of heating load by using super-insulated walls in a tightly sealed envelope. All fresh air enters the building through means of a mechanical heat recovery system.

combined. A boundary is a zone of action, where the laws of physics are manifest at their most fundamental and potent level. A cold front colliding with a warm front produces a line of thunderstorms at the boundary where the two storms' different thermal conditions are negotiated;[7] an airplane fights gravity through manipulation of pressures in the boundary layer that forms between its air foil and the surrounding atmosphere. Unlike the static boundary of the building envelope, the energy boundary does not exist to create discontinuities; rather, it emerges to resolve them.

7 The boundary in a collision between a cold front and a warm front is clearly demarcated by the cloud layers. Image courtesy of the National Oceanic and Atmospheric Administration.

Many architects would argue that the building envelope is an active zone of energy exchange, even pointing to Fitch's image as evidence of just how embedded the idea of exchange is in the accepted concept of the building boundary. Indeed, there continues to be a great deal of interest in the 'performative' envelope. The performative envelope is a highly engineered façade construction that, at its most basic level, is optimized for a variety of performance criteria relating to heat and light transmission. At the envelope's most advanced level, it may contain active components that allow for adjustment of its performance as exterior conditions change: automated shades may drop to prevent glare as the sun angle shifts; fans may be activated to relieve accumulated solar heat gain inside the wall layers.

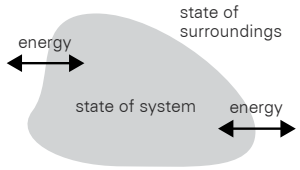


8 Schematic representation of Mike Davies' polyvalent wall. Davies proposed that the exterior wall could be a thin system with layers of weather skin, sensors actuators, and 'photoelectrics.'

The quest for an envelope that performs all of these functions seamlessly while maintaining a slim profile has been the holy grail of façade design for decades, beginning with Mike Davies' 1981 proposal for the 'polyvalent' wall,[8] and including the Smartwrap skin exhibited by the firm Kieren Timberlake in 2003.[9] While this approach might seem to be a shift away from the concept of 'wall' as a static artifact, it instead reinforces the hegemony of the wall as the overarching (and permanent) determinant of the interior conditions.

9 Mike Davies, when he was an associate of Richard Rogers, proposed that the exterior wall could be a thin envelope comprised of layers of weather skin, sensors and actuators, and "photo-electrics." See Mike Davies and Richard Rogers, "A Wall for All Seasons," RIBA Journal 88 (1981). The architects Steven Kieren and James Timberlake realized Davies' vision for a polyvalent wall in their Smartwrap product, which combines weather proofing, a layer of OLED lighting, insulation, and photovoltaics into a thin skin suitable for wrapping buildings. Although the material has been demonstrated in numerous art installations, it is not commercially available.

The polyvalent wall may seem to possess the characteristics to negotiate energy exchanges, but it falls short in three ways. First, it is predicated on maintenance of the homogeneous interior; as such, its primary role is to protect and preserve an autonomous, unchanging environment. Second, the site of the envelope is presumed to be the definitive site of the phenomena. And third, it is assumed that decisions at the architectural scale govern phenomenological behaviour. All three of these unquestioned beliefs tether phenomena to the wall, and in so doing, treat phenomenological characteristics as geometric entities rather than transient behaviors. In privileging




10 A thermodynamic system is any identifiable collection of matter that can be described by a single temperature, pressure, density, or internal energy. A boundary arises whenever there is a change in one of the conditions—energy crosses the boundary to bring the conditions to equilibrium.

11 Schlieren thermal image depicting the convective boundary layer rising from the human body. Image courtesy of Gary Settles, Pennsylvania State University.

12 This phrase is a slogan of the United States Department of Energy's Energy Star program. The underlying premise is that the building envelope must be extremely tight to prevent any outside air from leaking in, so as to reduce the amount of energy consumed by the mechanical system for heating. But, as human occupants require fresh air, the mechanical system is then made responsible for conditioning and delivering that air, which ironically must come from the outside.

architectural scale and surfaces, the performative envelope is no more 'active' than a common concrete wall.

Active energy exchange occurs at the boundary between a thermodynamic system and its surroundings. The classic diagram of a thermodynamic system depicts its boundary as soft, deformable, and malleable.[10] The boundary emerges whenever the conditions of the environment develop a minute difference in temperature, pressure, density, internal energy, or composition. A human body walking through a room will create numerous shifts in conditions: the temperature difference between the human skin and the surrounding air will produce an exchange of heat between the body and the air; this exchange of heat will create a density difference; the density difference will produce convective movement of air; moving air will affect the humidity immediately adjacent to the body, thereby setting up a mass transfer of moisture from the body to its surroundings.[11] As long as the human body is alive and present, the various energy exchanges will occur, with their intensity and duration dependent upon the magnitude of a given difference at any moment. Of course, one energy exchange has rippling effects upon many others, with the result that boundaries are constantly emerging, mutating, and dissolving. Some of these boundaries might emerge along the walls, but most will not. The architecture of the building—as determined by surface and geometry—is but a subordinate player.

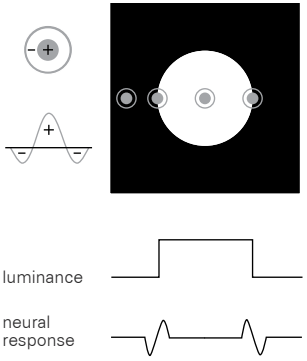
## heat, light, sound

The building systems responsible for creating the interior environment are tautologically intertwined with the concept of the envelope as boundary, as container, as hermetic seal. A homeostatic interior with steady-state, unchanging conditions is only possible if it tightly sealed. A hermetic seal can only function if what it contains is unchanging. The United States Department of Energy's current slogan "Build Tight, Ventilate Right" [12] is a demonstration of this circular reasoning: buildings are to be made as tight as possible to prevent air from leaking in, but then a ventilation system must be designed to provide the fresh air needed by occupants. Essentially, the human body is treated as a problematic perturbation that disrupts the optimum functioning of systems whose only purpose is to maintain an environment for the human body.

The dynamic phenomena of heat, light, and sound determine human perceptual responses, yet our building systems are predicated on creating an unchanging field of neutrality. The accepted goal of HVAC design is to produce an environment in which "eighty percent of the occupants do not express dissatisfaction," or, essentially, an environment that is not noticed.[13] An empirical index known as the PMV, or Predicted Mean Vote, is one of the most commonly used assessment tools for determining degree of satisfaction. Use of this index results in a bulk temperature and humidity that is acceptable for a statistical majority of occupants. Lighting standards mandate a uniform delivery of illumination to a horizontal plane across the entire floor plan, regardless of the field of view of the occupant, and irrespective of whether the source is daylight or electric light. With the exception of buildings designed for their aural qualities, such as performing arts venues, sound is treated as noise to be dampened, so that it too is unnoticed. The very phenomena that define the human experience are precisely the ones that the building environment is designed to nullify.

13 ASHRAE (The American Society of Heating, Refrigeration, and Air-Conditioning Engineers) defined thermal comfort in this manner for decades. Their most recent guidelines are published in ANSI/ASHRAE Standard 55-2004, which defines comfort as "that condition of mind which expresses satisfaction with the thermal environment and is assessed by subjective evaluation."

The human senses respond only to change. Thermo-receptors in the skin are only activated when the difference between skin temperature and core temperature changes; environmental temperature is one of many factors, but not the direct cause of thermal sensation. Photoreceptors in the eye only respond when specific clusters in the retina encounter a change in the rate of photon strikes (a difference in luminance); otherwise, the eye is incapable of distinguishing between white and black.[14]




14 Schematic of the eye's receptor field and how it responds to changes in luminance. Photons that strike the center of the field 'zero out' photons that strike in the periphery; constant luminance levels, whether completely dark or completely light, produce the same neural response. Only when the receptor field encounters a difference in luminance is there any change in response.

Indeed, for all of the attention given to constructing the ideal environment for the human body, the designed environment is incidental in the determination of perception (as are the static surfaces that enclose it). As an example, consider the perceptual characteristic that is most often attributed to the architecture of a building: image. We presume that formal decisions regarding massing, geometry, proportions, materials, and ornamentation made during the design of a building are the fundamental determinants of its ultimate visual reading. Whether considering the highly articulated façade of the Rococo period or the taut façade of early Modernism, the presumption is that the form determines the image.

This is not, however, how the eye perceives image. The modernist building could easily by visually read as Rococo, and the Rococo as modernist, by

15 The installation Disque sans carré / carré sans disque demonstrates that luminance is a greater determinant of depth and perspective than form itself. The 'circle minus square' appears to be on a transparent picture plane, but is actually painted bright red onto the columns and vaults along the colonnade. Image courtesy of Felice Varini.

quite simple shifts in luminance. Removing differences in luminance flattens surfaces; adding differences can articulate a three-dimensional form. One only has to experience the light installations of James Turrell or the anamorphic projections of Felice Varini[15] to see how directly luminance determines the reading of form. Image is contingent upon the fleeting energy transactions between photons and the retina, and not constituent of the formal object. The surfaces we make are not the authors of their own appearance.

## the interactive boundary

Achieving more direct engagement of the body with its surroundings is at the heart of a burgeoning movement in the design of interactive environments. Urban screens, media walls, and responsive surfaces are pro forma components of every hip young architect's portfolio. Digital images may appear on a mute surface as a human body nears; the color of a wall may change when touched by a hand. Many of these installations are less about rethinking the body in its environment and more about demonstrating the technological tour de force of new materials. Thermo-chromics, which change color in the presence of heat; piezo-electrics, which generate electricity when deformed; and shape-memory alloys, which change form after an input of energy, have now joined the lexicon of architectural materials and technologies.

These materials can be classified as thermodynamic materials in that they all involve some form of energy transfer in order for their transformations to take place. Architects who have lusted after the active façade have seemingly had their desires sated. If these active materials form the surfaces and walls, if these surfaces and walls are interactive and respond to the human body, do we now have the merging of architectural boundary with energy boundary? Unfortunately, not yet. The hegemony of the picture plane subjugates any active response by these surfaces into a series of stills: a hand touches a wall; the wall changes color where the hand touched it. The point of the interaction is didactic: to visibly demonstrate that an interaction has indeed taken place. The body itself is pushed to the background; the hand is nothing more than a proximate switch. Bodily sensation is irrelevant.

How can the body occupy the foreground? How does one directly design for perception? What and where are the determinant boundaries? These

questions are very much at the heart of Philip Beesley's investigations. His use of textiles, meshes and matrices challenges the impenetrable barrier of the normative architectural envelope, while explicitly demonstrating that the territory marked by man-made objects is an abstraction not bound by the laws of physics.

16 Haystack Veil, Philip Beesley, Warren Seelig, and Haystack Mountain School for Craft students, Deer Isle, Maine, 1997.

*Haystack Veil*, installed in Maine in 1997, covers a quarter acre of woodland with a triangulated grid of twigs.[16] There is a profound sense of humanity asserting ownership and claiming territory, while simultaneously, the forces of nature adhere to their own rules: animals penetrated and eroded the structure, layers of plant debris settled into and onto the grid, tangled overgrowth usurped its form. Dominion belongs to the dynamic flows of energy, and not to static structure.

Beesley's latest installations engage the human body in this push and pull between the objective constructed surface and the subjective energy interactions. His Hylozoic series of immersive environments fully decouples the phenomena from the architectural surface—each energy exchange is discrete and localized. The physical components for creating those exchanges are pragmatic, functional constructions, completely alien to the architectural lexicon. The textile mesh defines territory, but it is clearly not the generator or even a primary determinant of the various exchanges. Rather, the mesh serves as their armature. The site of architecture relinquishes the phenomenological behaviour to the site of the discretionary exchange, enabling direct engagement between body and phenomena. The constituent stasis of the mesh as armature yields to the transient contingency of the body's interactions with its environment.

Unlike the interactive installations of his contemporaries, Beesley's environments always question the idea of boundary, and in doing so, question the very nature of architecture. Not content to activate a surface or automate a building system, Beesley reconfigures the concept of interactivity through layers of sensors and actuators feeding forward from the body and back to the body. The body essentially sets off a localized chain of events that appears analogous to sensor pod system that agencies such as NASA are developing.[17]

17 D. Michelle Addington and D.S. Schodek, Smart Materials and New Technologies for the Architecture and Design Professions (Oxford, 2004), Chapter 5.

The sensor pod system operates between the two extremes of an autonomous environment and an interactive network. Sensors and actuators are distributed throughout an environment, but they communicate and collaborate in small clusters known as pods. Each pod has a master node that carries a higher level of decision making capability than the local sensors and actuators in its cluster, and it is this node that has the freedom to engage and disengage. In Beesley's environments, the body operates as the master node around which a locus of activity hums. The body now forms the constituent architecture, whereas the surrounding physical objects—the field of mechanisms—are rendered contingent. Architecture emerges in the space of activity.

The architect and theoretician George Baird turned to political philosopher Hannah Arendt for inspiration when he wrote The Space of Appearance in 1995.[18] Arendt had posited that what constitutes the public was not the community at large, or even that which was not private, but rather the body politic in action.[19] As such, the public only appears through the processes of speech and action. Baird carried this concept further by defining the public realm as the physical place that creates a space for this appearance. Baird's concept, however, can be much broader than his description of urban public space. Architecture, whether as room, building, or urban setting, establishes the tangible armature that allows for the contingent appearance of phenomena. For Baird, the need for tangibility kept image and surfaces in the foreground of architecture, even as he conceded that the purpose of that tangibility is enabling action. For Philip Beesley, the purpose of tangibility is not to create the space of appearance, but to create appearance itself. Architecture is no longer object; the boundary is no longer surface. Architecture only appears through tangible action.

18 George Baird, The Space of Appearance (Cambridge, MA, 1995).

19 Hannah Arendt, The Human Condition (Chicago, 1958).

# Hylozoic Ground

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