Aggregation

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The necessity for aggregation, or the process whereby many parts are brought into a whole, would seem to be a fact that the discipline of architecture could take for granted. Whether built in wood, stone, steel, or concrete, one would be challenged to find a piece of architecture that is not the result of a painstaking assemblage of elements that attempts to form something larger than the sum of its parts. Even concrete, whose aggregate constitution is launched in a liquid state, is mediated by formwork, whose construction process is the result of fabricational intricacies related to aggregation, and whose imprint leaves an indelible mark on the concrete for its lifetime.

At the same time, there is good reason to reconsider the theme of aggregation, because it arguably points to one of the most irreducible aspects of the medium, something that is either quite often overlooked, or in many cases forgotten altogether as abstract processes come to overwhelm the conceptual basis of the architectural task. How could it be that the conceptual task of architecture could become so remote from problems of building, of putting things together, of making – in essence of aggregating? The answer to that may lie in an age-old and productive problematic that has come to bear on architecture as a discipline: architecture offers something in surplus of mere building, and one of the cornerstones of its theoretical underpinnings, tectonics, tends to dislodge the relationship between building as fact and building as effect.

The persistence of matter – or materials – and their requisite limitations of dimension, weight, and construction modules cast onto architectural practice a set of parameters that force a confrontation between abstraction and the real, perception and fact, the actual and its effects. The problematics of aggregation come to haunt those designers whose conceptual practices are devoid – or innocent – of its omnipresence, but also in the practices of the self-conscious, the presence of aggregation oozes through even where it is being most suppressed – in precise and tailored ways – making its absence an index of its very importance.

Tectonics

The persistence of tectonic thought within the discourse of architecture is a phenomenon whose longevity can be attributed to architecture's inability to escape the conceptual pairing of the facts of construction with the poetics of effect. This persistent presence, however, does not speak to the imperviousness of tectonic thought to the attacks launched by the various movements that have sought to dethrone it, as the study of tectonics has largely been marginalized by, among other things, the development of the spatial narratives of modernism, the paper architecture era, the emergence of the diagram, and the tactical social projects of the informal and the sustainable. Tectonic thought is now often deemed to be a nostalgic and outmoded relic of localized resistance to the supposed nuance of network culture. Vague notions of shape, performance, atmosphere, and ecology have come to dominate the disciplinary vocabulary. In their refusal to address the issue of the building as the primary site of contestation, such formulations of contemporary architecture have effectively managed to sidestep the crucial intellectual and practical concerns prompted by a rigorous study of the means and methods of construction and the way in which they have and continue to be deployed across a range of scales in the production of a vast array of effects. In the absence of tectonic considerations, architecture severs its capacity to generate effects specific to the discipline and risks diluting its social and political agency by ignoring the instrumentality of its medium. So while architecture's recent tendency to relegate debates regarding the act of building to technocrats, developers, and engineers may provide designers with the illusion of greater conceptual latitude, the same tendency also represents a surprising willingness on the part of architects to abdicate a significant amount of their power to influences beyond their control.

The Architectural Figure Configured: Part-to-Whole Relations

The practice of building can be represented by a productive tension between the figurative and the configurative. Figuration in the purest sense involves the utilization of tectonic means
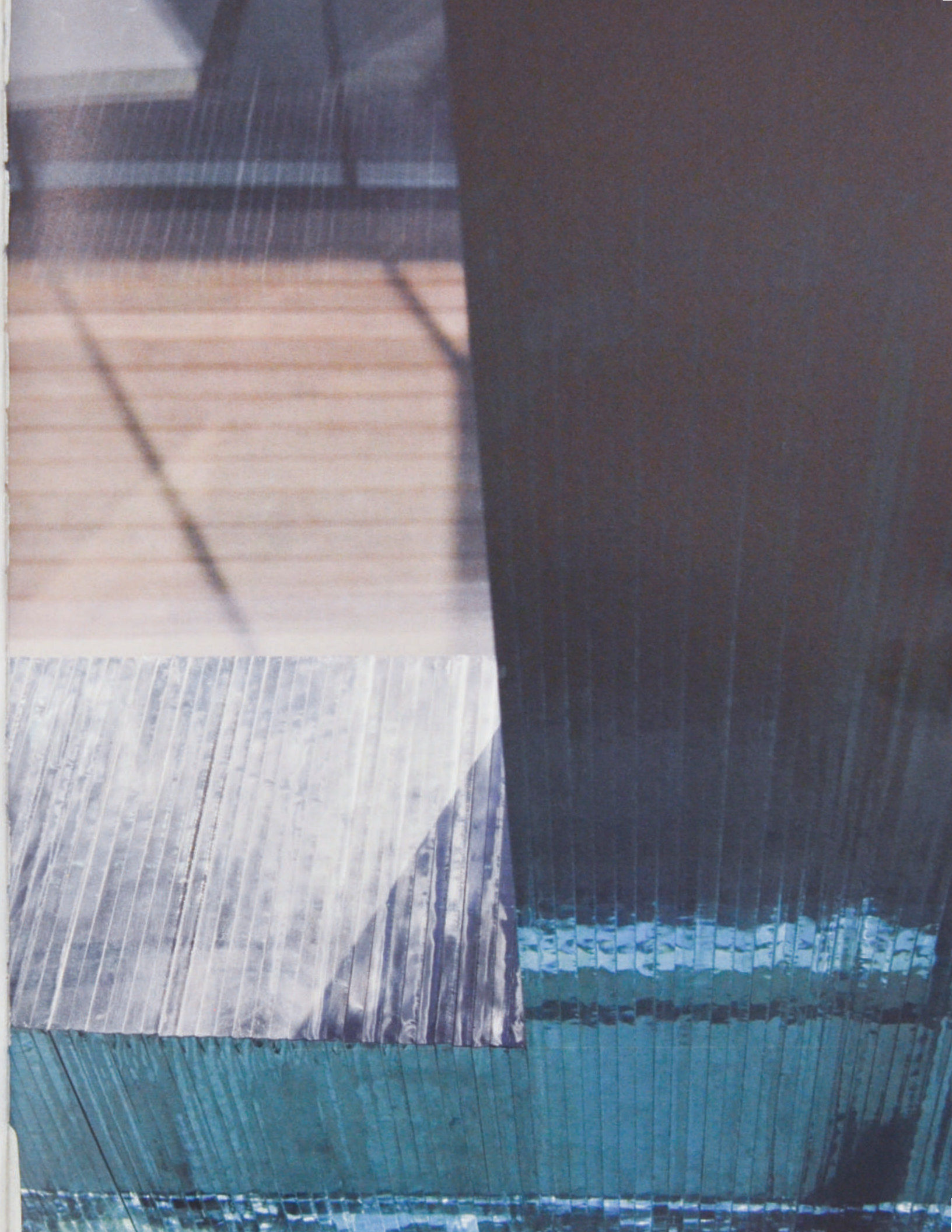
in service of a legible form. The Eiffel Tower is perhaps an obvious example, but broader architectural typologies such as the Basilica or the Rotunda also serve to underline the idea that the discipline has evolved to the point where sophisticated assemblages of parts have come to amass to a larger entity we recognize as a figure. While the figure's component parts may be readily decipherable, the overarching form is neither dictated nor limited by its constituent parts. In turn, external factors such as setback regulations and site boundaries may also figure a building, without any acknowledgement of disciplinary decorum regarding type, language, or construction. Thus, figuration can occur both as an appeal to constructive expression in the vein of Frank Gehry (ills. pp. 63, 67, 71-74) or as an analytical breakdown of pre-existing codes as in the stereotomic operation of subtraction played out in Hugh Ferriss's monolithic renderings of Manhattan skyscrapers.

Configuration, on the other hand, involves the systemic deployment of parts, privileging the unit of construction, whether it be the brick, the beam, or the module of inhabitation. Such an operation of aggregation does not determine *a priori* a legible final figure, yet it precisely anticipates form by way of the materials, methods, and rules of assembly. Safdie's Habitat '67 (ill.) and Kurokawa's Nakagin capsule tower are the prototypical modern examples of such a configurative mode of design, where the aggregation of parts produces a rich and multi-faceted spatial complexity. Despite the predisposition towards informality, these operations are not absolved of a larger submission to organizational rigors, and thus, Safdie's Habitat must measure up to the performance of the "Italian hilltown" inasmuch as Kurokawa's tower needs to absorb and overcome the technical mandates of the skyscraper type.

Gottfried Semper was one of the first architects to recognize the intimate relation between construction and poetics. In his proposed four elements of architecture, he not only identified distinct components of building formation (hearth, wall, mound, and roof), but also tied each to a specific material characteristic (ceramics, textiles, stereotomy, carpentry), which acted toward the production of a unique set of effects. In his system, Semper separated the rigid load-bearing frame

from the soft enclosure that defined interior space. Though originally based on Semper's observation of the hanging textile enclosures of Assyrian dwellings, such a formulation also has a certain linguistic ontology, as some languages, such as Spanish, differentiate between the interior corner (*rincón*) and its exterior equivalent (*esquina*). The implications for this distinction have reverberated throughout the history of modern architecture, from Adolf Loos's distinction between the abstract public facade of his homes from their sumptuously clad interiors, to Koolhaas's separation of the Manhattan skyscraper envelope from its programmatic logic in his analysis of the Downtown Athletic Club, to the willful disconnect between Gehry's sculptural surfaces and the geometries of his interior spaces. To a greater or lesser extent, however, these examples fail to capture Semper's rigorous logic of reciprocity between the material quality of the component and its respective method of deployment within a larger system of construction and signification. And though one may reject the essentialism of Semper's choice of material associations and his preference for monumentality, what can be adopted from his line of thought is its focus on the systemic linkage of form and material as a generator of precise architectural effects that originate from within the discipline, yet exert an impact within the greater realm of cultural production and communication. If Eisenman pursued a conception of architecture based solely on the linguistic constituents of architectural form devoid of material considerations for purposes of disciplinary autonomy and cultural critique, then a reconsideration of Semper's mode of architectural thought should be seen as an alternative method of disciplinary specificity offering, perhaps, an even more incisive model of extra-disciplinary agency – essentially linking formal and linguistic operations to material agency and its requisite means of aggregation.

Patterning and the Problem of the Corner

A discussion on aggregation is invariably linked to certain techniques, modes of construction, and their loopholes. Aggregation is also linked to patterning, as all assemblies are somehow bound by systemic configurations that establish the rules and exceptions of a building practice. For instance, the aggregation patterns of brick construction speak directly to the innate relation of the tectonic unit – with the particular demands imposed by its material characteristics – to the effects produced through its systemic deployment. As with any traditional system of pattern-making, the problematic moment is the way in which the system addresses the corner or the edge. This moment of exception forces tectonic systems to either privilege the dominant field of the pattern – only to break it at the corner – or to recalibrate the system such that the exception is called on to generate the logic of the pattern itself. In brickwork, the common bond, with its staggered alternation of stretcher courses, must break its logic and incorporate headers once every six rows giving the wall lateral strength, and in turn address the exceptionality of the corners by cutting bricks. The Flemish bond, by contrast, incorporates the exceptional moment of the corner to produce a syncopated arrangement of headers and stretchers across the field of the pattern, giving a more integrated and distributed lateral strength to the wall. The distinct logics of these two modes of aggregation produce markedly divergent structural and aesthetic effects.

Although Semper was a proponent of the material expression of building tectonics, he took a position supporting the idea that ancient Greek temples had been adorned with polychrome paint. Such a notion was vigorously opposed at the time by Kantian scholars who held fast to the idea that material purity was a more profound and rational way to build and that, by extension, a society as enlightened as ancient Greece would no doubt build in such a manner. The tendency to speak of tectonics in ethical terms, thus assigning a moral imperative to a particular style of building, has been a key factor in the contemporary marginalization of tectonic thought. Kenneth Frampton has maintained a critical bias throughout his career that has tended to conflate the poetic production of effect with the appeal of an ethical imperative. Such an argument suggests that effects lose their moral validity when detached from a holistic sensibility of tectonic articulation and material expression, thus perhaps ruling out the possibility of certain complexities and contradictions that are part and parcel of every construction system.

An alternative to this stance would be an acknowledgement of the fundamental rhetorical status of the surface as a positive fact, acknowledging the superficial structure of a building as its tectonic imperative, and seeking reciprocity between deep and superficial aspects of the building not as inevitable facts, but rather as curated and imposed points of emphasis. To replace the legacy of Frampton's largely top-down approach to tectonic scholarship would require an almost grassroots re-conceptualization of tectonic practice as a mode of inquiry that investigates and exploits the specific potentials embedded within particular materials and their respective systems of aggregation. The ghosts of tectonic essentialism can only be exorcised by such an analysis of the limits of material potential, as a practice that both embraces and struggles against these limits will invariably be equipped to offer architectural solutions based on the negotiations of actual performance and expression, not one or the other.

Two- and Three-dimensional Patterns

For the most part, tectonic culture has looked at modules and units as the main protagonists of aggregation. Field patterns, for example, have historically fallen within the domain of two-dimensional thinking, consisting of processes of single-variable manipulation, focusing on the figure or the ground, but rarely both. Such limited thinking exists across a range of scales from wallpaper to urban plans where primacy is usually devoted to a consideration of the guiding module, or that produces a pattern. The herringbone is such an example, using the relationship of perpendicular units to characterize the overall directional field. Some notable exceptions have offered a different view, imagining not only the figure but the ground – the space of residue – as an equal partner in the formulation of patterning. Sigurd Lewerentz, for instance, used the space of the mortar, not the brick, as a malleable figure, enlarging it at will to create openings within the field of the brick wall. This simple observation has been the most central consideration of the expandable/contractable bonding that Office dA envisioned for the Casa La Roca (ill. p. 53), adopting the dimension of the mortar as a parametric vehicle to introduce the possibility of light and air in an otherwise impermeable wall. The notion of

the variable tectonic pattern has also been extended to achieve spatial results; SHoP's Urban Beach project for PS1 established a systematic taxonomy of flattened sections that became spatial only upon the moment of their serial proliferation – a two-and-a-half-dimensional process that extrudes patterns with incremental shifts, as it were (ills. p. 172).

FOA's Yokohama ferry terminal project is also indebted to the lineage of modular thinking, even if its form does not betray the marks of such a lineage. Here the pattern emerged from a decidedly three-dimensional conception of construction. A certain feedback operation occurred whereby sections were extracted from a larger form, yet these components were structural necessities for the formation of the whole rather than mere orthographic slices through an abstract volume. The visual trope of modular inhabitation reached its seemingly premature climax with Moshe Safdie's Habitat '67, a work whose tectonic legibility set the standard for parallel explorations by the Metabolists and more recent projects organized around cellular inhabitation (ill. p. 50). In the case of LOT-EK's prefab shipping container camp, the module of the unit is kept intact in terms of its visual signification, yet the method of aggregation is not necessarily derived from the unit's inherent material characteristics.

Frames, scaffolding, and other mechanistic devices are often employed to produce the effect of aggregation. In the work of Lynn, Rahim, and others, the isolated module is often less discernible and becomes eroded within a more seamless whole that approximates the performance of an aggregational assembly without exhibiting the more overt visual traces of construction (ills. pp. 93, 98, 169). At the same time, however, even the most seamless design conceptions can only reach actualization through a rigorous negotiation with necessities of fabrication such as module dimensions, construction joints, and environmental dictates which all reveal the rhetorical status of continuity as one of many possible architectural alibis.

This conflict between the performance of tectonic aggregation and its image is a major point of contestation regarding the role of effect in tectonic thought, returning again to the tension between tectonic facts and the poetics of construction. Beyond

purely tactical explorations of material layering for purposes of technical investigation, practices that utilize such means must embed them within a larger spatial or effect-driven narrative. Ultimately, processes of aggregation are a means to an end rather than an end in themselves. Such techniques cannot be divorced from the way in which they are situated and integrated within the larger logic of any particular built project.

Along these lines, one can begin to formulate a range of configurative approaches and scenarios that vary in both their techniques of aggregation and their desired effects:

1. Literal Configurative Expression ("Honesty") for Figurative Spatial Abstraction

Constructed as a temporary structure for the Hanover 2000 Expo, Peter Zumthor's Swiss Pavilion utilizes timber beams in a relatively orthodox and undifferentiated fashion in the production of a series of abstract atmospheric spaces. To achieve the effect of a lumber yard, massive horizontal planks of ruddy pine separated by thin larch members with square profiles are stacked without the use of bolts or artificial adhesives, forming dense, yet porous walls held together by stainless steel rods in tension that run vertically across the stacked members, holding them in compression with the stressed steel springs attached to the rods. This spring-loaded construction system allows for the walls to gradually contract as the timber dries and accommodates any additional deformations in the wood. By avoiding the use of secondary joinery methods, the wood used in the pavilion could be sold as seasoned timber at the close of the Expo, demonstrating awareness that the lumberyard metaphor can be transformed into ecologically grounded performance without diluting the original design intent.
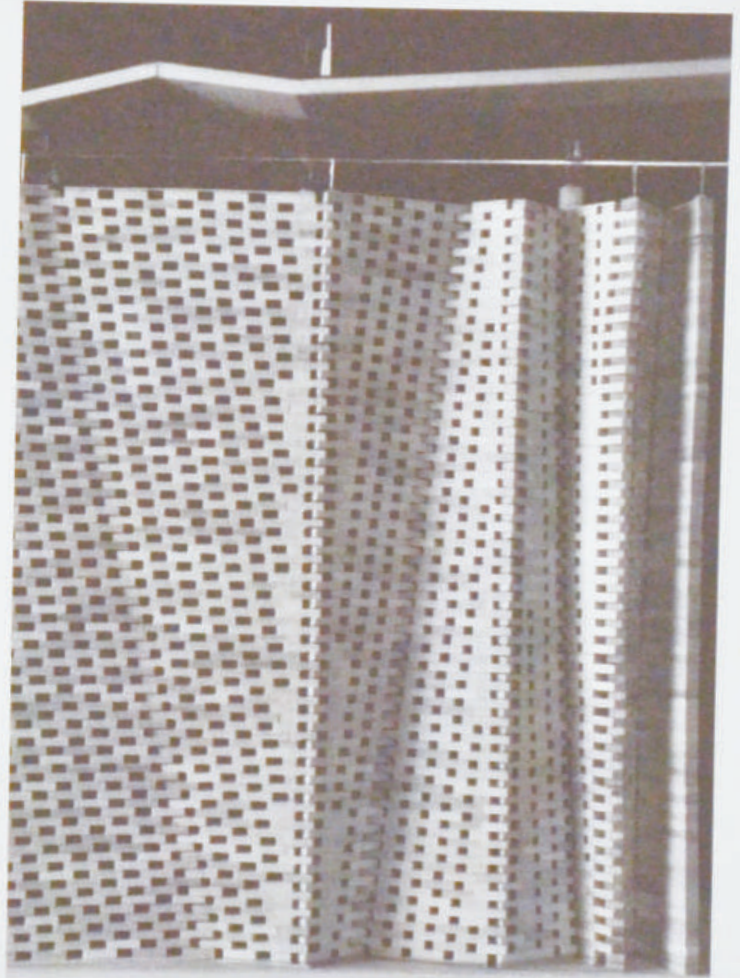
2. Literal Configurative Expression for Phenomenological Effect

Baumschlager Eberle's Rohner port building presents a deviously simplistic figure of a cantilevered rectilinear volume of reinforced concrete, balanced and anchored to the ground at a single core. The figure's perceptual defiance of gravity is but the first of its phenomenological manipulations. The interior, too, is almost banal in its spatial organization and its material

palette, but here, wood is deployed in a configurative manner to amplify the effect of the narrow space. Larchwood planks of uniform width are placed end-to-end upon each of the room's longitudinal surfaces, directing the view outward through the glazed room-sized aperture framed by the relentless outward directionality of the room's seemingly continuous wrapper. What is unique about this interior is the way in which a technically unsophisticated unit and system of aggregation are placed into tension with an atypical approach to interior cladding that refuses to acknowledge the traditional distinction between floor, ceiling, and wall. In this system, variance is ignored altogether in favor of a literal directness of material presentation that simultaneously heightens and dissolves the appearance of the material. The directionality of the wood is indispensible in the construction of its argument, and the graining effect established through the consistent method of material deployment conspires with the perspectival intentions, expanding the perceived depth of the space and extending the bounds of the volume into the landscape beyond. The Rohner port project exemplifies a way of working that achieves a complex effect through leveraging a minimal systemic logic against typological conventions.

3. Literal, Yet Counterintuitive, Configurative Expression for Phenomenological Effect

Methods of material layering or aggregation are often deployed in a manner that displays a certain literalness or deference to the traditional properties of specific materials. If Zumthor's Swiss Pavilion can be seen as an abstraction of log cabin construction techniques that leverages the inherent structural potential of stacking wood, then Kruunenberg Van der Erve Architecten's Laminata House exhibits an equally abstract, yet counterintuitive handling of their material of choice, glass (ills. pp. 49, 54). The Laminata House, built as a celebration of the city of Leerdam, Holland's glass capital, is constructed of 13,000 sheets of precut laminated glass arrayed sectionally in a manner that parallels SHoP's PS1 project. Using transparent glue, the layers of glass are adhered together at their surfaces, producing striated walls that vary in thickness from 10 to 170 cm. Though this variation adjusts to define different spaces within the house, the glass layering acts less as a programmatic register, as in the SHoP

project (ills. p. 172), but rather modulates the presence of light throughout the house, producing a syncopated sequence of phenomenological conditions ranging from complete transparency in the wall apertures to the total opacity of a masonry *poché* wall. Refraction effects, heightened by the air bubbles present in the glue between glass layers, produce ghosted images of inhabitants as they move through the main corridor. The house does not offer a radical reinterpretation of interior space, and in fact, its austerity betrays its position within a lineage of stereotomic thought, where the rooms appear carved from a solid. Nevertheless, this effect is achieved via an additive layering process that performs in ways that masonry construction cannot. The normative organizational layout of the Laminata House may actually work to its advantage in the sense that its phenomenological manipulations become more legible when placed in tension against its clearly defined residential type.

## 4. Configuration That Erases Its Own Trace for Figurative Motives

Steven Holl's body of work straddles the line between the figurative and configurative, as his projects tend to reflect his desire to "build the site" by addressing programmatic considerations via a figural language. Among others, his Fukuoka housing project in Japan is largely concerned with an indexical registration of the interior program on the building facade. The interlocking surfaces convey the volumetric interplay within. Simmons Hall, by contrast, attempts to employ a neutral surface grid of windows so as to heighten the contrasted effect provoked by the carved voids that signify communal spaces within the normative dormitory block (ills.). The programmatic legibility that characterizes much of Holl's early work appears here in a more perverse form that frustrates the perception of scale. To achieve a regular gridded surface effect, Holl uses L-shaped aluminum panels that aggregate across the surface to produce a series of equally sized square apertures. Floor slabs occur at an interval of every third window and no trace of the structure can be read on the facade. Surface aggregation is thus employed in a sleight-of-hand manner to dissolve the spatial aggregation of the dormitory modules behind the facade, revealing two distinct aggregation systems being deployed at cross-purposes to erase the perception of the unit of construction.
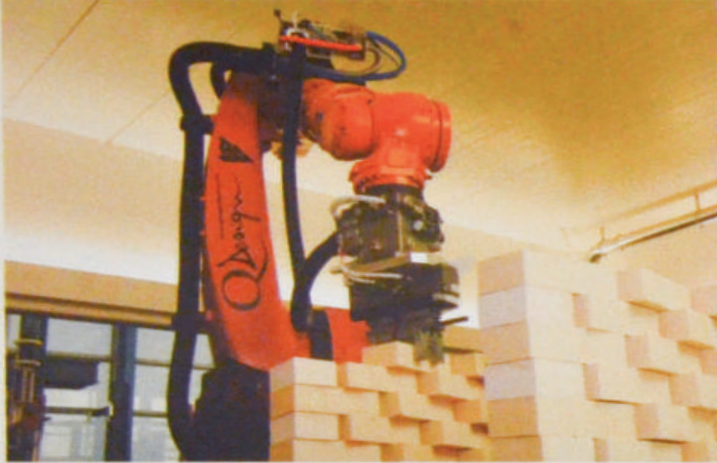
5. Configuration as Structure and Image

Gramazio & Kohler's facade for the Gantenbein Winery in Fläsch, Switzerland, addresses issues of structure, light, and image with a single surface strategy (ills. pp. 56, 57). Utilizing parametric digital design processes to situate 20,000 bricks in a pattern meant to evoke oversized grapes bulging from the volume of the winery, designed by Bearth & Deplazes, the architects used a robotic arm to assemble the units into larger rectilinear surface modules that could be assembled on site within a grid of concrete bays. Here, the surface is simultaneously calibrated to produce a specific image, acting as a billboard for the building program, and to produce a variable range of openings to permit indirect light and air to penetrate the facility to aid in the grape fermentation process. The overt pictorial effect, coupled with the production of a seemingly plastic surface, is accomplished via a single unit of construction that both reinforces and erases its materiality. This material consistency, which is leveraged for a range of effects, stands in stark contrast to work by BIG and Herzog & de Meuron, which often goes to great lengths to achieve a similar pictorial and phenomenological complexity. Bjarke Ingel's Mountain apartment project presents a more virtuosic barrage of means to achieve a similar pictorial effect. The rich aggregational logic of the apartment units determined by programmatic requirements and the desire to provide ample light and terraces to each apartment produce a powerful image. The entire arrangement, however, is both symbolically reinforced and preemptively undercut by the screenprinted image of a mountain at the base of the complex. Its presence represents a certain one-liner provocation that emerges from the notion of the building as iconic metaphor rather than a coherent work where literal representation emerges from configurative logic. Semper's distinction amongst different tectonic elements paved the way for such an extreme separation of pictorial expression and structural logic, yet the Gantenbein Winery facade offers perhaps a more operative mode of practice that produces a variety of effects through the calibration of limited means without resorting to either a nostalgic notion of material honesty or a wanton deployment of dissonant techniques.
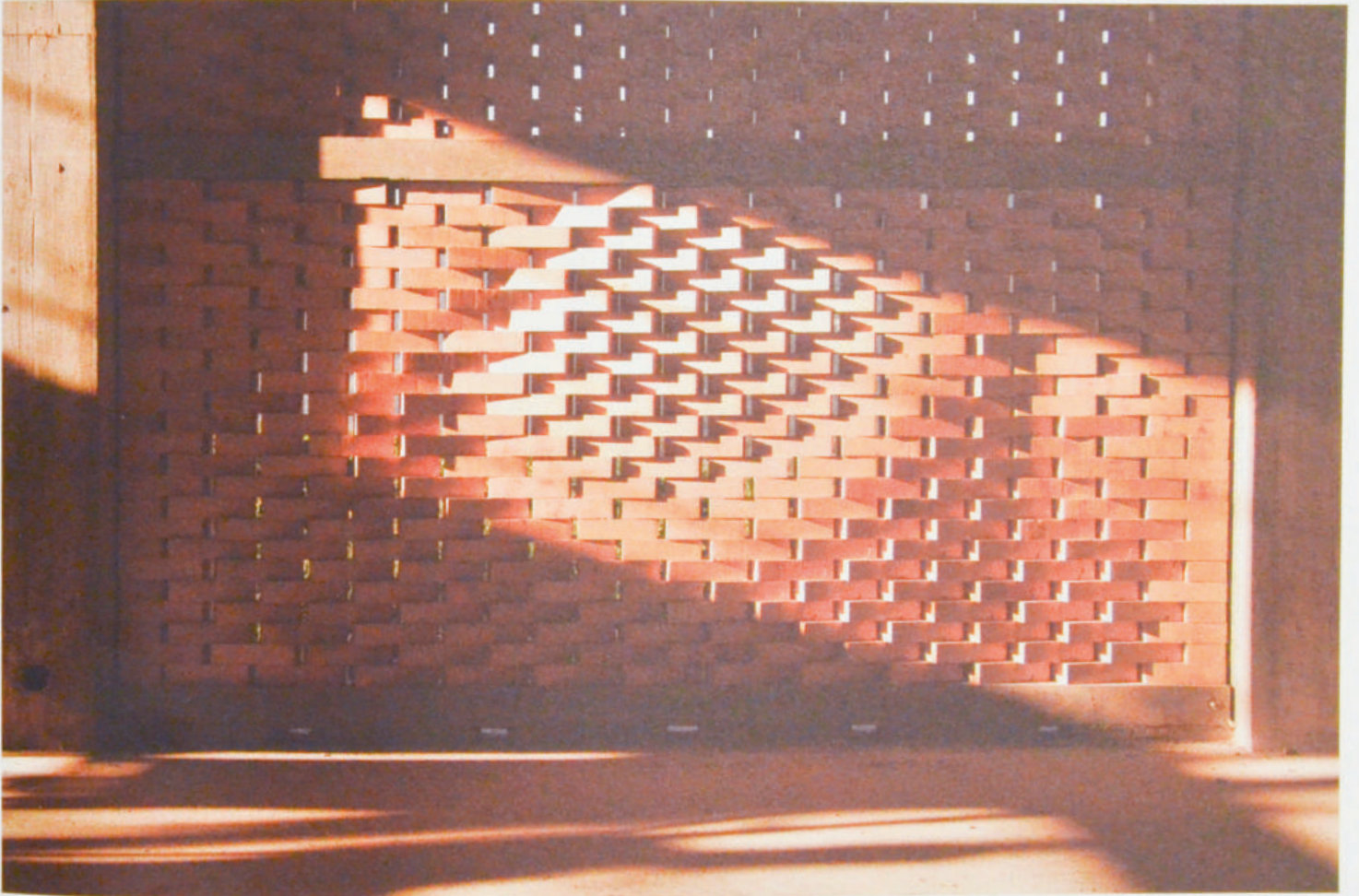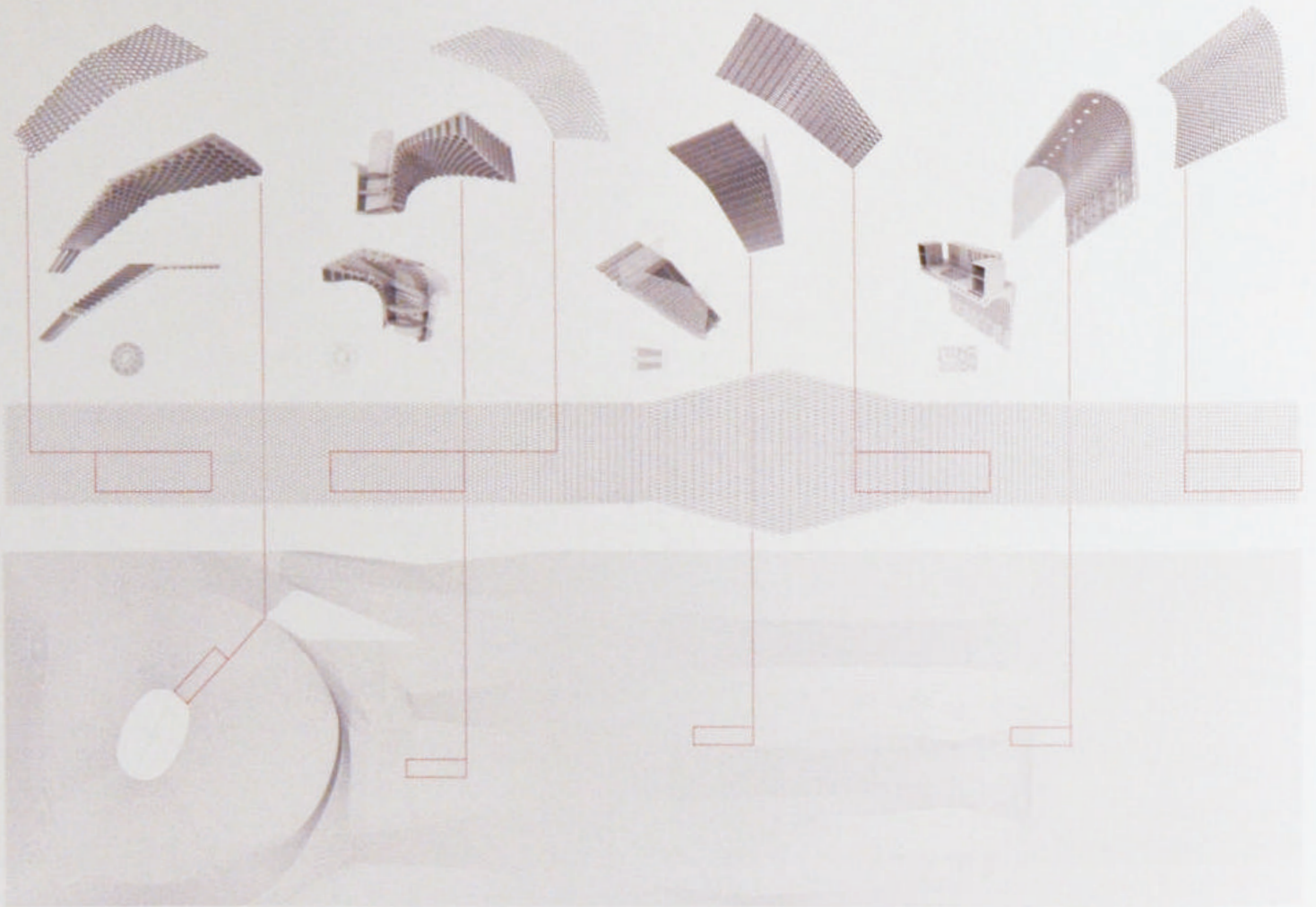
6. Configurative Variance for Spatial and Tectonic Performance

Office dA's Villa Moda Sports Club and Issam Fares Institute employ configurative tactics to achieve effects that go beyond the expression or erasure of its material means and attempt a direct negotiation between the local dictates of their respective sites (Kuwait City and Beirut) and a discipline-grounded experimentation with geometric and aggregational variability.

The basic organization of the Villa Moda proposal can be described by four decks of varied thickness and geometries (ill. p. 58). Beneath the ground level, there is a parking deck, which supports service deliveries, mechanical space, and technical support equipment for various programs. The ground level is characterized by an undulating public surface, supporting the main functions of the arena, convention hall, souk/mall, aqua center, and hotel lobby; the surface dips and rises in accordance with the programs (i.e. swimming areas and the arena), but also in relation to the extended public zones such as the commercial level. The public ground is covered with a singular and extended canopy: a coffered structure that accommodates blended programs, circulation itineraries, structural mandates, and vertical cores. The identity of the proposal is in great part the result of this invention – a large "carpet" or the canopy of a great banyan tree, giving shade to the public zones and protecting the ground from the sweltering Kuwaiti heat. Though undulating, this canopy is based on a conventional grid, drawing from a more repetitive layout of residential units that coffer as the fourth layer of this system. The housing forms a two-storey crust to the canopy, excavated to draw light and air into the courtyards, as well as allowing the passage of light into the public spaces beneath.

The project's aesthetic effect emerges from a more direct confrontation with the advent of geometry and patterning as displayed in Kuwaiti history, though implemented in abstract and allusive ways. Since each building type manifests a need for its own autonomous organization, form, and figure, there is no universal geometry to bring together the various fragments. To this end, the appropriate geometry was identified for each type, based on the figural biases they display: circle for the arena, triangle for the theater, and square for courtyards, among others. The way in which these geometries are brought together is unique: instead of typological aggregation or fragmentation, we assemble the dissonant geometries through the technique of metamorphosis, grafting together a wide range of irreconcilable types. As a technique, this is deployed by the transformation of geometric cells onto which we keep adding vertices. Thus, for instance, a square cell may be altered by the additions of two vertices to create a hexagon, and in turn negotiate the transition of a square courtyard type and a radial arena. The precise orchestration of plan typologies and a correspondent structural condition creates an opportunity to maintain the seamlessness of an organic geometric logic while permitting typological diversity and heterogeneity. This aesthetic effect is also augmented by the adoption of and reaction to local materials, climate, landscapes, and textures – again adopted as allusive signifiers of the regional flavor.

The structure in this typology is not independent of the architecture. The scale of the programming allows the structure to inform the specificity of the architectural shape. The structure is analogous to the sponge-like form and material-to-weight ratio of human bone: a trabecular structure in which material is concentrated efficiently in response to the applied, or anticipated, loading while minimizing weight as in Wolf's law for human anatomy. What appears random in bone, or as mass customization at the scale of building structures, is in fact an efficient use of materials, providing material for strength and stiffness where it is needed most and reducing the material quantity in areas where it is not needed. This effect can be provided as distinct, crisp changes in material cross-section or in a more sinuous nature as proposed here. In areas of high moments, shears, or in response to concerns of serviceability, the form of the slab system morphs from a typical, orthogonal, uniform depth rib system into a system of deeper ribs, wider ribs, and/or more closely spaced ribs. The changing shape responds to the intensity of the loading and the need to provide strength and stiffness to the system. This variability in coffering geometries is at once structural and aesthetic, signifying programmatic diversity through configurative dissonances.

Office dA, Issam Fares Institute,
Beirut, Lebanon, 2006, exterior renderings.