CRAFT, INTENTION AND PRODUCTION

Things in Their Best Order:
Technical Aspects of the Salk Institute and their Role in its Design

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"I do not like ducts; I do not like pipes. I hate them really thoroughly, but because I hate them so thoroughly I feel they have to be given their place. If I just hated them and took no care, I think they would invade the building and completely destroy it."

—Louis I. Kahn, "Not for the Fainthearted," 1971

"I wish our clever young poets would remember my homely definitions of prose and poetry; that is, prose,—words in their best order; poetry,—the best words in their best order"

—Samuel Taylor Coleridge, "Table Talk", 1827

The legacy of Louis Kahn's built and spoken poetry is as enigmatic as it is inspiring, for despite decades of criticism and interpretation, the astonishing effects of his spaces on the human mind resist simple explanation.. Attempts to explain his work through appeals to either a latent classical spirit, or to some transcendental metaphysical sensibility have sustained a generation of critics and commentators. Parallel dissections of his notoriously elliptical design philosophies inevitably point to the resonance between the unmeasurable qualities of his spaces and the unknowable meanings of his writing.

Kahn did nothing to discourage such transcendental explanations himself, describing his architecture as the meeting between the 'measurable and the unmeasurable,' or more famously as that between 'silence and light.' The view of Kahn as an architectural shaman has been most forcefully put forth by John Lobell, in his book *Between Silence and Light*, in which the compositions of Kahn's better known projects are compared with symbols and forms from various examples of religious architecture. (1) Lobell's study is, however, only the most extreme example of the mytho-poetic examination of Kahn's work, and even a critic of such skepticism as Herbert Muschamp has described the courtyard space of the Salk Institute as "the most sublime American landscape ever." (2)

This paper is part of a larger project to gently dismantle the idea that Kahn's work is somehow transcendentally conceived, and it seeks to directly refute the label of "sublime" assigned by Muschamp. This is not to say that the human spirit is untouched by Kahn's spaces, only that the traditional ascription of this touching to forces mystical and poetic fails to account for the formidable technical fluency that underlies virtually all of Kahn's best work. To parse Muschamp's description using the language of Edmund Burke, traditional definer of the term, "sublime" suggests a condition of distraction, of veiling, and of emotional overpowering. The sublime space according to Burke must "fill the mind" while not allowing the mind to "reason on the object itself," only the effects it produces. (3) As I will demonstrate, precisely the opposite occurs at the Salk; the space is so conceived as to offer a full presentation of the constructive, structural, and functional logic within. This is a condition of concentration, of revelation, and of intellectual engagement—not one of distraction. The space does not so much fill the mind as it invites the mind to fill it, and the power of the Salk's courtyard arguably derives from one's reasoning upon it. This invitation to reason occurs through Kahn's ability to forge literate architectural prose from the most basic of materials and functions, a fluency in building science and technique that contradicts claims of 'mere' poetics or metaphysics for Kahn's work.

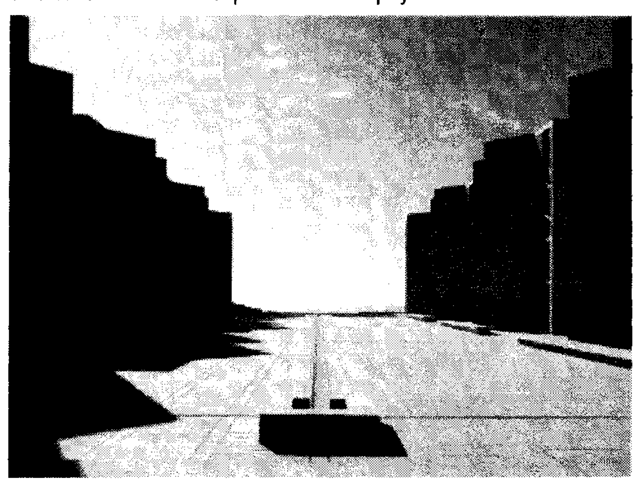

Fig. 1. The Salk Institute for Biological Studies, La Jolla, CA. 1959-1966. The traditional view of the courtyard space. Less, perhaps, of a sublime experience, and more the expression of a fluently integrated approach to function, construction and performance.

In February 1966, Luis Barragan visited the construction site of the Salk Institute at Kahn's request to advise on plant selection for the building's central courtyard. The project by then was nearing completion, with both laboratory wings substantially constructed and laboratory fitting out occurring in the north wing. Since the inception of the project, Kahn had struggled with the idea of planting in this space and its predecessors in the design process. Early schemes showed various trees within the courtyard, notably poplars, which would have lent a distinct Mediterranean atmosphere to the space. However, the pungent salt atmosphere of the site obviated this choice, and it seems likely in hindsight that Kahn recognized the inadequacy of these early schemes. Barragan had been called after Kahn had seen his house published and recognized a kindred sense of balance between architecture and landscape. Upon arrival, Barragan noted the stark concrete of the surrounding study towers, the warm tones of the courtyard's bare ground plane, and the distant Pacific horizon. Seeing these, he said that, in his opinion, any planting at all would be a mistake, telling him that Kahn and Salk should "make a plaza...and gain a façade to the sky." (4) According to Kahn this was agreed at once, although it was not presented formally until late that year. Subsequent studies with Lawrence Halprin only proved the integrity of Barragan's forceful advice, and it may be that Kahn himself had recognized the power of the bare space but had required confirmation by a like-minded designer. The courtyard was thus designed in the negative, its elevations and spatial intricacies derived not from a preconceived notions of proportions or imagery, but rather from the imprint of the surrounding buildings' logical conception. The removal of the assumed planting from the space thus revealed the intrinsic logic of the laboratories' planning, the systematic casting of the concrete walls via exposed form imprints, and the sequential construction of the structure, cladding, and metal fabrications. Barragan's suggestion essentially allowed the intrinsic logic of the laboratory and office blocks to express themselves, to form the elevations, massing, and ornament of the courtyard.

Given the genesis of the project, it is to Kahn's great credit that such logic was there to express. Salk's initial program for the complex was based primarily on his visit in 1959 to Kahn's Richards Medical Laboratories, just being completed in Philadelphia. In the Salk Center's early stages, the floor area and proportions of Richards served as a programmatic model, albeit with Salk's charge that the complex should be of such quality that "Picasso...could be invited as a guest.". The vagueness of the laboratory program was eventually structured to assume that 10 major scientists would each require 10,000 square feet of usable, though flexible space with provision for expansion of each research group. These were to be supplemented by study spaces permitting 'privacy and singularity.' (5) While supplemental buildings to this central research core—including housing and a large meeting facility—were indefinitely delayed due to budget issues, the laboratories themselves deserve closer examination, for they demonstrate precisely the orchestration of technical requirements into a unified architectural expression that marked Kahn's greatest works.

Kahn's 1962 scheme, the first developed design shown to Salk, presented a careful layout of the laboratory blocks along well-defined mechanical and structural principles following extensive work with structural engineer August Komendant and mechanical engineer Fred Dubin. In this scheme, four two-level laboratory blocks were arranged on the site around two planted garden areas. On the garden side of each block, a series of ovoid studies overlooked the gardens and the Pacific Ocean some three hundred yards away. The width of each study was carried through the block as a 10' wide hollow beam. This beam carried air and piped services from a me-

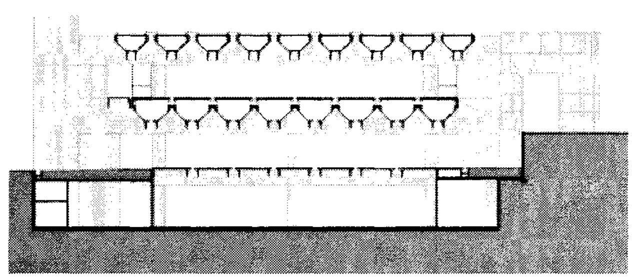

Fig. 2. The initial, 'folded plate' scheme presented to Salk in January, 1962. Services and structure were integrated into a series of 'breathing' beams of precast concrete. The space-making qualities of the overhead structure were intrinsically linked to the scheme's major functional drawback—an inability to provide flexible servicing on a fine enough scale.

chanical structure on the opposite side containing air trunking, as well as major piped services and escape routes. Running longitudinally between these 10' service zones, a series of folded plates carried locally directed piped services in an upper, accessible level, and local supply and exhaust in a narrow underbelly. Downstand beams on either side of the air ducts combined with the inclined concrete walls of the upper plates to form a hybrid element in which structure and services occupied the same sectional space, reducing the required floor to floor height for each laboratory. This allowed the blocks to comply with a local height limit, but more importantly the scheme provided accessible, flexible servicing on a regular 10'-0" module, allowing both standardization and the opportunity for efficient replanning. The folded plate scheme was developed to allow daylight between the folded plates of the upper story, and the transverse service beams formed a natural corridor for fume hoods, chemical closets, and other elements requiring intensive airflow that might otherwise clutter the laboratory areas.

This original scheme was a remarkable synthesis of services and structure, and the resulting laboratory space would have been at once functional and strongly articulated. The deep corrugations of the ceiling would have added a visible order to the functionally necessary chaos of a lab environment, particularly at the top level where the recesses would have been flooded with daylight from above. Kahn's placement of the exterior walls—glass partitions designed to frame into the underbelly of the outermost service beams—would also have provided natural daylight with a significant overhang to reduce glare, all within the order and rhythm of the typical module. The development of the folded plate system would have lent a powerful definition to each module of the labs below, providing a legible organization of the work and space to viewers within. Finally, Komendant designed the beams themselves as prefabricated units, capable of being post-tensioned and thus efficient in terms of both structure and assembly.

In part, however, this strong modularity seems to have doomed the folded plate scheme. After a year of work, including full structural design and initial approval from Salk, the folded plate scheme was abandoned, and the laboratory blocks redesigned. The initial scheme's strong definition of the spatial module, and its suggestion of a studio-like space for each lab, worked against the ideal of total flexibility, and the ten-foot module appears in hindsight to have been too coarse to fully service Salk's planned activities. At the same time, there were apparent difficulties in fitting services into the folded beams, a conflict that becomes apparent when the final scheme's duct sizing is noted. Likewise, the pipe chase within the folds of the plate did not allow large-scale re-piping due to its restricted space. (6) Finally, Salk had grave misgivings about the overall plan of the site, and the diffusion of the complex' social space into two separate but equal courtyards. Salk and Kahn agreed to redesign the laboratories around a single courtyard, with the sectional logic of the pipe space simplified to "give the pipes a floor of their own." (7) Kahn and his office, while noting that they 'felt the loss of the folded plate scheme,' nonetheless worked with Komendant and Dubin to design a simpler, more efficient sectional scheme employing Vierendeel trusses with services woven between their vertical members. In Komendant's opinion, the revised scheme was less structurally pure than the original, however it allowed greater flexibility in the laboratories' mechanical layouts. The overall footprint of the laboratory block was reduced in size and a third level was added to maintain the floor area. Komendant and Fred Dubin worked to integrate the new structure with the laboratory requirements, while Kahn's office and Salk's in-house laboratory designer Earl Walls developed the interface between the 'pipe floors' and the flexible space below. The trusses supported a perforated concrete lab ceiling that allowed air, pipes, lighting, and exhaust to drop to the floor below on a 5'-0" module, allowing full access to the range of services in each interstitial space.

This change is notable for two reasons. First, with comparatively little objection, Kahn agreed to give up the 'space-making' folded plates in favor of a technically better solution to the lab problem. Compared to the original scheme, the resulting lab spaces have little of their own architectural character, yet they are profoundly more functional. This is a recognition of the radical performance required of an advanced medical lab, but also that the quality of the overall building lay not merely in the 'served' space of the scientists, but also in the 'servant' space of the ducts and pipes. Second, the relatively enthusiastic response from Kahn to Salk's order reflects a recognition of the value of iterative process, in which the scheme benefited from the recognition of shortcomings in the earlier attempts. The design team did not universally share this enthusiasm, in particular Komendant, whose extensive work on the folded plates had led to, in his opinion, the 'correct structural solution.' (8) In one sense, Komendant's criticism is correct, in that the Vierendeel achieves its performance not only through its shape but through a change from concrete to steel tendons in order to support large bending forces.

However, it is worth examining the resulting sectional solution in some detail, for it demonstrates the extent to which Kahn and his consultants understood the integrated nature of the laboratory servicing problem. If the Vierendeel was not the 'purest' of structural solutions, it nevertheless was far superior for both services distribution and laboratory planning on the floors below. The choice of a Vierendeel system stemmed in part from Kahn's earlier work with Komendant at Richards, where piped and ducted services were woven through the interstitial spaces of similar—though smaller scale—trusses. At the Salk, Komendant developed an efficient section using cantilevered ends to reduce the maximum bending moment in the middle of each floor plate. These cantilevers provided walkways for moving mechanical equipment in and out of the pipe space while providing shade to the glass laboratory walls below. To reduce the overall floor-to-floor height, Komendant employed pre-stressed cables in the bottom chord of the truss rather than simple steel reinforcing. Vierendeels provided not only the cross-sectional porosity required to move air and services from the mechanical wings located at the eastern edge of the complex, but also freed the concrete slabs between for service drops. Rarely noted, Komendant's solution to the problem of such a rigid concrete frame in a seismic zone was equally ingenious, involving a series of lead-zinc plates installed between each truss and its adjacent columns. This allowed sectional ductility in the event of an earthquake, restrained only by a set of relatively loose steel tendons passing through each column. (9) The laboratory structure occurred between two sets of outlying structures in each wing, one containing the courtyard studies and the other containing toilet rooms, vertical service runs, stairs, and elevators. To allow seismic separation, these three zones were clearly separated by movement joints rendered in red neoprene gasketing.

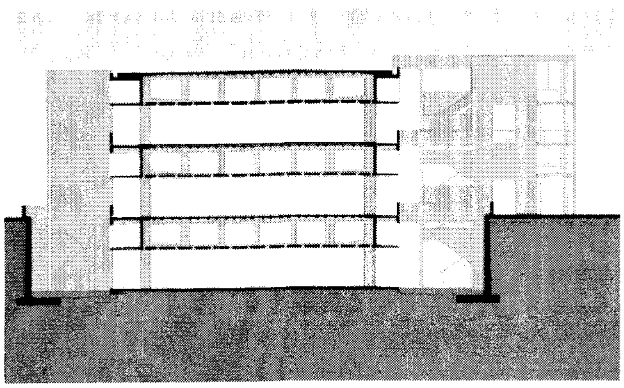

Fig. 3. Final sectional scheme, developed between April and September, 1962. While the spatial qualities of the original folded-plate scheme have disappeared, the final sectional scheme displays a remarkable synthesis of structure, servicing, and flexibility. The interstitial spaces have proven themselves in practice, allowing rapid change-out of lab services.

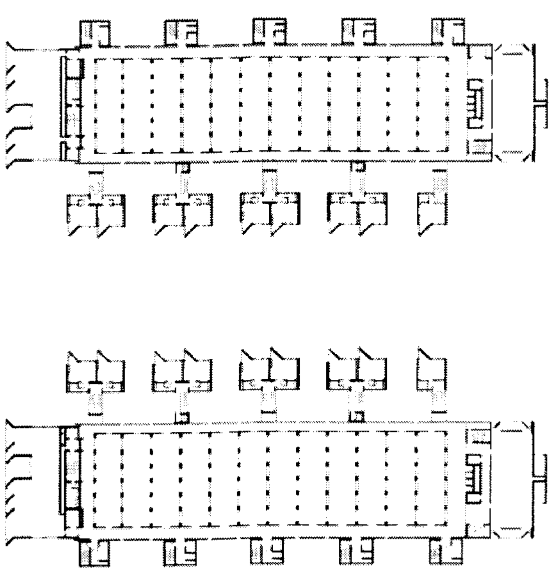

Fig. 4. Plan of interstitial level showing (left to right) office blocks, major interstitial 'rooms', and mechanical wings. Each block is flanked by studies and service towers.

The full functionality of the 'breathing structure' was developed by mechanical engineer Fred Dubin. Where the folded plate scheme had relied on a series of vertical towers and transverse trunking, the Vierendeel structural scheme suggested a more straightforward approach. At the eastern end of each laboratory block, a "mechanical wing" was designed to accommodate chillers, air handlers, and equipment for liquid and gas services. These two wings were connected to one another at the east end of the complex, underneath the raised wall that separates the courtyard from the eucalyptus grove. At each level, the major supply and exhaust ductwork for each laboratory floor enters the interstitial space at the center of the block, where the voids in the Vierendeel trusses are largest. At each 20'-0" laboratory module, branch supply ducts carry hot and cold air to the edges of the block, where blending boxes mix air to the required temperature. Local ductwork then carries blended air to alternate service slots in the slab. Woven between the supply system, exhaust ductwork takes air from the remaining service slots and returns it to the central trunk. (10) This arrangement places the high-maintenance blending boxes closest to the outboard service corridors, while allowing access to pipe runs in the outer thirds of each interstitial space. The 4'-0" major ducts, located at the center of the floor plate, do not restrict access to any of the service slots, allowing far greater maintenance and reconfiguration than the folded plate scheme. Additionally, as laboratory planning diagrams by Earl Walls show, the fine grain of the exhaust and supply patterns on the lab floors allowed major reconfigurations to occur—even during the design process—with little or no impact on the services above.

To Kahn's great credit, the execution of the laboratory section was as disciplined and rigorous as its conception. The functional and conceptual clarity of the Vierendeels was carried through to the various interior and exterior systems. In particular, a series of details deployed throughout the building shows the careful attention paid by Kahn to the physical and technical nature of all building elements, and to their proper place in the experience of the building. This care should necessarily be attributed not only to Kahn, but also to his office staff, in particular the Salk's site architect Jack MacAllister, and Marshall D. Meyers who remained based in Philadelphia. (11)

Most notable to the visitor of these are the precise yet rugged details of the concrete, which like the Vierendeel trusses performs multiple functions despite its simple conception. Kahn had previously used exposed concrete as a finished surface in the Yale Art Gallery and at Richards. However at Yale the ceiling surface of the galleries were broken up by the tetrahedral grid, while at Richards the surfaces were precast and therefore predictable—or used as relatively hidden soffit panels. Salk was therefore Kahn's first use of exposed concrete as a primary visual element, and the explorations

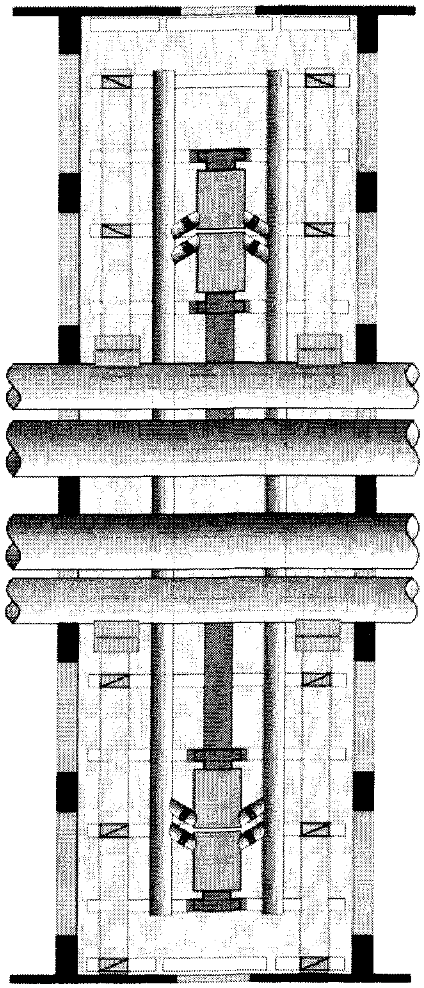

Fig. 5. Typical bay of interstitial space showing modular air handling scheme as developed by Fred Dubin. Major trunking runs through the center of each bay, with mixing boxes located toward the access corridors. Alternating supply and exhaust registers allowed rooms as small as ten feet square to be fully ventilated.

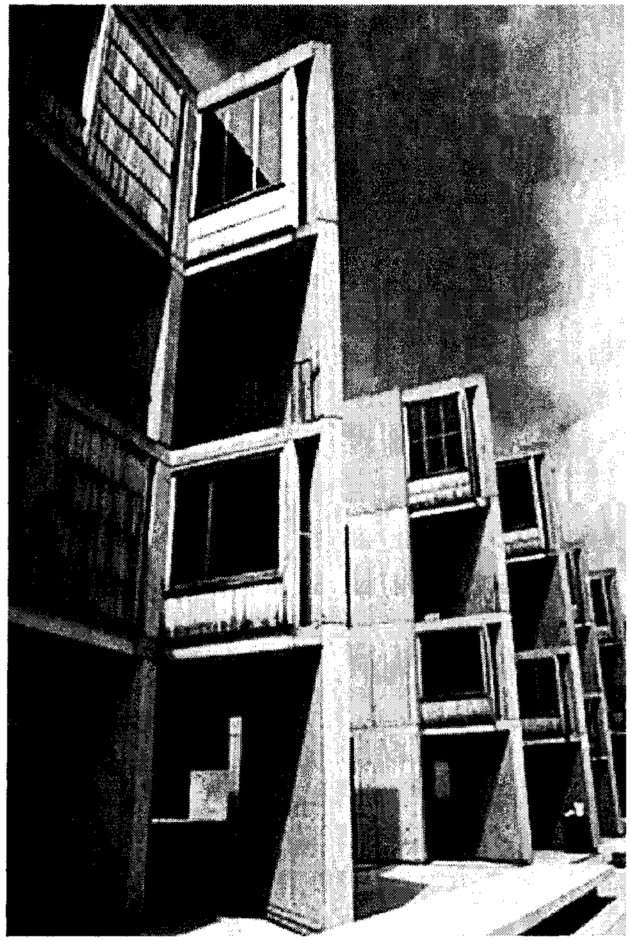

Fig. 6. 'Portico of Studies' from the courtyard. Concrete formwork joints show both division of floor slabs and an overall 4' x 12' construction module. The teak window frames are set off from the rougher concrete by frameless glass, emphasizing the demise lines of two distinct constructional and functional systems.

and experiments involved in its casting reveal a careful attention to the process of concrete construction, and an empirical process in developing details and systems. Kahn's office employed a full time staff to work with the contractor, George Fuller, to develop the concrete formwork. Plywood forms based on standard 4' x 12' sheets were organized to provide a consistent module of form joints and tie holes, which were then elaborated by chamfered form edges and dark lead tamping, respectively. This is perhaps the purest expression of Kahn's idea that ornament can spring from the joining of elements, in this case the result of the casting and waterproofing processes. Experiments in color were carried out during the basement pour, and the agreed mix of pozzolan was used in the remaining walls. In the courtyard, the concrete frames surrounding the studies were filled with teak and glass infill panels, with shadowgaps and wood edging used to emphasize the demise lines between poured and assembled elements.

Less apparent than the concrete were a series of metal details that reveal an often-unexplored area of experimentation in Kahn's office. In the development of the laboratory curtain wall, service slots in the interstitial floor slab, exterior doorframes, and handrails, one sees an attention to a series of details on a finer scale than that of the concrete. In each case, the detail's expression is an integration of the overall building's grain or pattern with the specific, smaller-scale function of the component or assembly in question. in this realm, the 'pure' expression of the detail's performance is subordinated to the explication of the whole complex. in other words, the details themselves may appear simple, however this is a 'complex simplicity' in which the overall order of the Salk benefits from the restraint of the particular.

The curtain walls of the Salk occur within the overall framework of the laboratory structure, set back from the overhanging walls of the interstitial space and thus less immediately visible from the courtyard. This is a continuation of the 'eyebrow' sun shading seen in the earlier folded plate scheme, though it is also a result of the structural configuration of the interstitial floors in that the exterior walls of the service corridor provide lateral stability to the Vierendeel system. As a result, the laboratory wall is deeply recessed and obviously a secondary element to the overall concrete system, similar to the teak and glass infill panels of the studies. Upon approach, the glass and steel system further reveals its position in the overall scheme by its relationship to the concrete columns. Unlike contemporary dialogues between frame and skin by, for example, Mies or SOM, the curtain wall here is set outside the column faces, yet it does not continue past them. Instead, the panelization of the system is made apparent by stopping the curtain wall entirely in front of each column, thus expressing the position and dimension of the concrete structure. Here again, the order of the overall building is the primary expression, however the logic of the window wall's function and fabrication is also clearly expressed. In developing the details for the wall, Kahn's office was ordered to 'program every detail,' that is, to treat the arrangement and configuration of each component and junction as a new design problem with clearly stated functional and constructional goals. (12) While research on curtain wall systems included standard commercial offerings, including an off-the-rack system from Kawneer, the final solution involved brake-shaped steel elements and exposed fixings that could be fabricated locally. A similar idea had been employed on the Richards windows, however the window wall at the Salk was a much larger, more prominent installation. Steel was therefore bent to a variety of shapes to provide structural support between the floor and ceiling, to span between the main vertical supports, and to hold glass panes in place. Two types of curtain wall panels were produced, with and without a pivot-hinged door in the center. A large transom piece was included in each type to permit changing out of the doors and glass as laboratory planning changed, however this proved equally useful during the lab design process as access and routes of escape changed to match an evolving program. On each frame, the raw edge of the steel was typically left exposed, to make the fabricational process apparent. There is no possible confusion, as there would be in a typical aluminum curtain wall, as to what elements are solid and what are hollow extrusions. Here, the edges of the steel reveal that the structural elements work not by mass but by shape, and that the frame members originated as planar elements. Similarly, the exposed bolts of the system reveal both its assembly process, and its status as a flexible system, as it is apparent to the viewer that any given panel could be simply unbolted and either reconfigured or removed entirely.

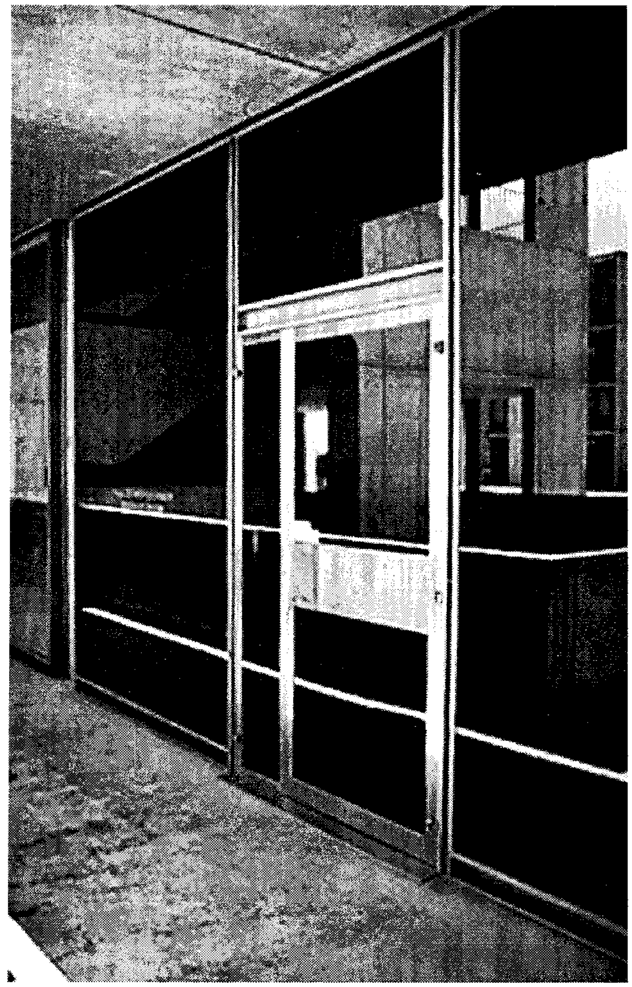

Fig. 7. Laboratory curtain wall, typical module. Brake-shaped stainless steel forms all major structural elements, supporting large sheets of plate glass. Each door could be changed out through a simple unbolting process from the transom above, or the entire curtain wall module could be removed by unbolting it from the structural columns.

If the laboratory curtain wall transmits a secondary level of building organization on the exterior, breaking down the scale of the lab blocks while elucidating its own internal logic, the ceiling details within the laboratories themselves perform a similar duty on the interior. A major concern regarding the initial folded-plate scheme had been its relatively large module—10'-0" on center. As the Vierendeel scheme developed, a tighter grain was necessary for services access. At the same time this access needed to be coordinated with Komendant's development of slab and beam reinforcing. The result was a regular spacing of slots in the concrete floor on 5'-0" intervals in either direction. Each slot was five feet long by ten inches wide, oriented parallel with the long dimension of the lab floors. As the design progressed, this early decision enabled Dubin's office to work to a regular, reliable module in planning services and air trunking and distribution, while giving Komendant the security of knowing that any late changes to lab services would not result in structural changes. Essentially, the slot scheme enabled integration by elimination, isolating two systems that would ordinarily find themselves competing for space and position in the concrete system. To form the slots, a custom extrusion was detailed to form continuous aluminum channels, with tracks along either side to accept standardized clips for light fixtures and air diffusers. Alongside each slot, power cables and boxes were positioned to provide power. The tracks were mitered together to create boxes of in-place formwork as the floors were cast, resulting in regularly pierced ceiling and floor slabs. Supply and exhaust registers, pipe drops, and power cables were thus simply organized on an efficient grid that adds regularity to the otherwise chaotic lab spaces. While the space-making effects of the folded slab would have undoubtedly been more powerful visually, the position of the slots in the ceiling—the one surface in a laboratory that remains uncluttered by equipment, etc.—nonetheless presents the overall scale and grain of the laboratory block to the users within. The 2' x 4' light fixtures that provide illumination to the laboratory areas are a surprisingly effective example of this. Early in the design development phase, Kahn's office worked with manufacturer Edison Price to develop these custom fixtures. Price suggested that the best performance would be achieved by orienting the fixtures parallel to the slots, distributing light along lab benches presumed to be perpendicular to the slots and windows. However, the final arrangement reversed this logic, orienting the fixtures perpendicular to the slots. While this slightly lessened the efficiency of the fixtures, it nevertheless provided a strong cross-grain to the laboratories, emphasizing the regular order of the plan from both inside and out. Lights aligned with the slots would have emphasized only the length of the blocks, and it is apparent that Kahn's office was willing to make a small sacrifice in local efficiency in favor of this emphasis of the building's regularity. (13)

Stepping down in scale further, one finds a similar integration of economical construction, expression of materiality, and honest presentation of function in the detailing of various interior and exterior fittings. Throughout the complex, entry doors occur within concrete walls. This is a difficult detailing problem due to the imprecise nature of concrete placement, and the requirement for very precise tolerances in door hinging and closer operation. A typical solution to this problem is to wrap a doorframe around the wall, giving the hinge a reliable edge and allowing the wall to 'float' within the frame. However to Kahn this resulted in a confusing assembly, as the doorframe's dimensions inevitably recalled timber detailing. The search for an articulate expression of the relationship between metal mechanisms and concrete structure led to a simple though elegant detail in which a piece of unistrut was cast into the concrete surrounding the door. A brake-shaped frame could then be bolted to the fixed unistrut, and made true by adjusting the bolts connecting the two pieces of metal. Pivots were then placed at the top, base, and midpoint instead of hinges to ensure smooth operation, and prefabricated doors could then be installed into a reliably vertical frame. The dividing of the door into those elements requiring mechanical precision and those requiring connection to structure enabled very rapid installation, however its final expression is notable for its crisp separation of cast and fabricated elements.

Kahn's office paid similar attention to the 'programs' of function and fabrication in numerous other details throughout the Salk, including the development of a movable partition system for the laboratories in conjunction with Hausermann, a metal partitions manufacturer in Cleveland, and the hand and guard rails throughout the external staircases. The handrails in particular show both knowledge of the material involved and a resolute confidence in a carefully conceived, though ultimately quite straightforward, approach to detailing issues. Each handrail was formed from a single extrusion of stainless steel—an uncommon process as the resulting surface is often rough from the stress of the metal being forced through a die. In this case, however, the extrusion was designed to include a circular section at the top of the rail, and the grainy surface of this steel shape served to welcome the grip of the hand. It is unlikely that this ultimately inexpensive and quite simple solution to the question of the handrail would have emerged had Kahn not impressed on his staff the need to understand materials not merely from a visual sensibility, but also from a technical and scientific point of view.

The handrails at the Salk reflect at the most intimate scale the spirit of investigation and testing that occurred throughout the design of the entire complex. Kahn's office was not only a studio, it was also an informal research center guided largely by senior architect David Wisdom, in which materials, components, and assemblies were investigated as much for their physical and functional properties as for their aesthetics. In this respect, the buildings produced by Kahn and his staff are in many ways related as much to industrial design as they are to architecture. Throughout, an empirical approach to design and problem solving in which iterative process, testing of hypotheses, and integration of technical and compositional knowledge played key roles are all much in evidence. (14) The value that Kahn assigned to this methodology is evidenced by the expressions of these systems and details within the overall building. Ordering principles—whether they be the overall module of the complex, or the anthropomorphic dimensions of the human hand, or the dimensions of material based on production processes—are all made clear to the eye, and are referenced to one another in complex though apparent ways. The lab curtain wall, for example, displays at once the module of the structural grid, the working dimensions of plate glass, and the fabricational procedure of brake-shaping steel. At the same time, the wall allows us to see the laboratory module beyond; it admits diffused, shaded daylight into the work areas, and points out its status as both an infill system and a (potentially) temporary construction. In their extraordinary multivalence, these systems attest to the balance achieved between function, constructional efficiency, structural performance, and human perception, a constant process of revelation and explanation rather than a sublime experience of overwhelming and mystery.

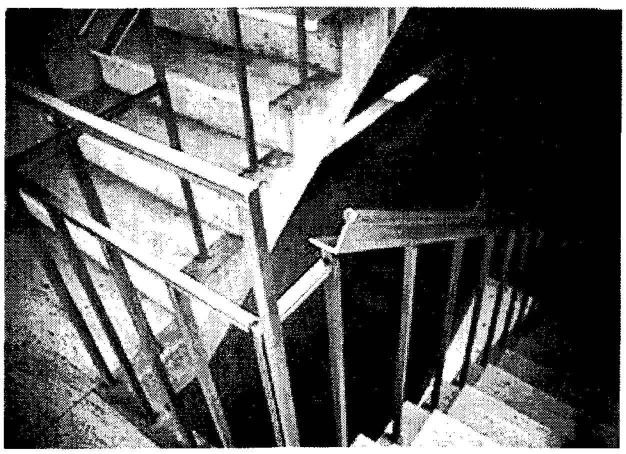

Fig. 8. Typical exterior handrail showing section of extruded stainless steel grip rail. A neat condensation of Kahn's concern for the fluent balancing of function and fabrication.

At the dedication ceremonies for the Salk, Rabbi Morton J. Cohn spoke of the relationship between God and man in terms of the scientific work to be performed in the laboratories:

"Finite man cannot penetrate all the mysteries of the Infinite. Yet the manifestations of the Divine Reality are all about us, and it is from the rearward that we know God. Even as a ship sails the ocean and leaves its wake behind, so God may be known by his divine footprints in the realm of our physical universe...

"The great sages of science, too, have revealed God's glory as they have unfolded the secrets of God's universe and man's being. Surely the man of science, in his search for the 'how' of nature and of human nature, is the collaborator of the philosopher and the religionist, who seek to answer the 'why' of human conduct." (15)

There is here a neat parallel with Kahn's definition of architecture as a link between the 'measurable and the immeasurable.' (16) His discussions with Salk during the design and construction of the Institute undoubtedly gave impetus to his developing neo-Platonist architectural philosophy, as Salk's occasionally mystical pronouncements seem to presage much of Kahn's later musings. In both cases, there is the idea of physical science as a touchstone by which the mysteries of nature and science might be made known, the 'wake' by which we recognize whatever deity may be present. In Kahn's case, it is apparent that the technical achievement of the Salk's architecture—its materiality, detailing, and overall pragmatic organization—provides the manifestation of something greater, as the experience of the courtyard attests. The 'how' and the 'why' of architecture are, as in the physical world, connected by our perception, intuition, and internal conception of a greater order—the "Oneness" of the Neo-Platonists represented by the "Order" of Kahn. On a simpler level, Rabbi Cohn's observation that science is at its highest levels an activity with philosophical and religious overtones is a precise parallel to Kahn's bivalent practice of architecture. In Kahn's case technical knowledge, as banal as the metallurgical properties of a handrail material, could be productively integrated into an overall orchestration of material and sensation with striking effects. Kahn's architecture thus transcends its earthy origins, productively blurring the 'how' and 'why' of architecture even as the scientist examines the overlap between the mechanics and meanings of human nature and conduct.

In large measure, the achievement of such elegance in the Salk Institute's overall solution was due to the balance achieved by Kahn in orchestrating such a diverse set of often-contradictory requirements. No single system dominates the composition—not the architectural, the structural, nor the environmental. Each element, each function, is assigned its own carefully assessed position in the overall, synergetic whole, and out of the pedestrian requirements of each a synthesis is achieved that touches not merely our senses, but our deepest feelings of spirituality and poetics. Kahn did not have at his disposal the 'best things' of Coleridge's epigram—"Gold," he had said in his 1944 address on Monumentality "belongs to the sculptor.' (17) Rather, out of crude earth, concrete, glass and metal, the Salk stands as testament to the power of architectural prose. Like the steel frames of the laboratory windows, it is not the material itself that we recognize, rather it is how that material has been intelligently shaped, and the expression of the forces at work in that element that touch our senses and our consciousness. This is a 'how' so thoughtfully conceived and executed with such discipline that its very technical realization touches on the 'why' of its own existence, and of architecture as a whole.

NOTES

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[1]John Lobell, *Between Silence and Light: Spirit in the Architecture of Louis I. Kahn* (Boulder: Shambala, 1979).

[2]Herbert Muschamp, quoted in Dan Friedman, introduction to *The Salk Institute: Ezra Stoller.* (New York: Princeton Architectural Press, 1999).

[3]Edmund Burke, *A Philosophical Inquiry into the Origin of our Ideas of the Sublime and Beautiful.* (rep. Oxford; Oxford University Press, 1998) Part Four, Section I, "On the Efficient Cause of the Sublime and the Beautiful." 117-118..

[4]Barragan quoted by LIK in letter to James Britton of Urban Design Review, 12 June 1973. LIK Archives, University of Pennsylvania, Box LIK 27—"Salk Institute for Biological Studies, La Jolla, CA."

[5]"Abstract of Program for the Institute of Biology at Torrey Pines, La Jolla, San Diego." N.d. LIK Archives, University of Pennsylvania Box LIK 27—"Salk Institute for Biological Studies, La Jolla, CA."

[6]Conversation with Jack MacAllister, La Jolla, CA., 12 June 2001

[7]ibid.

[8]August Komendant, My 18 Years with Architect Louis Kahn...

[9]"Laboratory for Life Science Designed to Defy Time...Designing the Concrete Vierendeels." Engineering News-Record January 27, 1966. 79-83.

[10]This arrangement occurs only in the north wing, which was the first to be completed. The south wing, shelled for several years, was outfitted with a more energy-efficient VAV air system in the early 1970s, although the access strategy remains similar. I am grateful to Bob Lizzarraga, facilities manager at the Salk, for allowing me access to these interstitial spaces and clarifying their functional layouts.

[11]The following overview of the Salk details is based on a conversation with Jack MacAllister on site in La Jolla in June 2001, to whom credit is due for pointing out the "five details" described below.

[12]Conversation with Jack MacAllister, La Jolla, CA, June, 2001

[13]31 July 1963 letter from MDM to JM, Box LIK 27, LIK Archives, University of Pennsylvania, "Salk Institute for Biological Studies, La Jolla, California"

[14]It is interesting to note that the frequently stormy relationship between Komendant and Kahn can be largely described as a conflict between the empirical approach of the latter, and the more rationalist approach of the former.

[15]Rabbi Morton J. Cohn, *The Address of Consecration Dedicating the Site of the Salk Institute for Biological Studies at San Diego California.* 2 June 1962. Contained in Salk Institute for Biological Studies file, the San Diego Public Library 'California Room.'

[16]LIK, "Form and Design, 1961." In Allesandra Latour, op cit 112.

[17]LIK, "Monumentality, 1944" in Allesandra Latour, op cit. 18.