

## DIAGRAMMATIC TRANSFORMATION OF ARCHITECTURAL SPACE

*Kenneth J. Knoespel*

### ABSTRACT

If we are to think about diagrams closely, we must register their cognitive significance as they direct work and establish networks of relationships among multiple symbolic fields. Diagrams do not engage a simple horizon of understanding but are part of an integrative process through which structures literally appear in the world. Rather than being hermeneutic in a strict sense, diagrams are heuristic because they are accompanied by an expectation that they participate in a process that turns words and experience into structure. Because diagrams may shift in status, they may be thought of as relays that both create meaning and enable symbolic translation from one mode of representation to another. While a diagram may visually present or reinforce an idea one moment, the next it may provide a means for seeing something never seen before. After commenting on how recent architectural theory has approached diagram, I consider the relationship between diagram and metaphor before turning my attention to the ways that diagrams function within a process that includes design as well as building. Finally, I ask how the use of diagram within architecture points not only to a phenomenology of invention and practice but also to the networks which constitute architecture.

Considering how much work has gone into the study of diagrams in architecture, the place of diagrams within architectural theory and practice still remains somewhat elusive. After all what relation do they have to sketches, plans or elevations? Or is it not so much the single diagram but the linkages that they engender, linkages that mark the teleological nature of architecture itself? Is it not the architectonic quality of diagrams that invites readers to think of them as related to cosmology as early as Plato's *Timaeus*? But while intellectual ground may be found for diagrams in antiquity, far more practiced terrain for approaching diagrams in architecture comes from strategies that would emphasize the

place of diagrams within architectural design. Diagrams are not hermeneutical in a strict sense but heuristic because they are accompanied by an expectation that they participate in a process that turns words and experience into structure. Diagrams engage not simply a horizon of understanding but a terrain in which structures literally appear in the world. If we are to think about diagrams closely, we must do more than simply mark their presence. Instead we should register their cognitive significance as they direct work and establish networks of relationships among multiple symbolic fields. Diagrams are important and indeed so much so that rather than drifting within a hermeneutical setting they should be approached as vehicles of invention and extension.

The ways in which diagrams work to cast meaning is in ample evidence in the daily practice of architecture even though the graphic operations through which architecture is taught and thought are often pushed to the margins of the history of architecture. Diagrams hardly stand as isolated figures but are placed within a narrative setting. They become – or are intended to become – part of a structured argument. We may think of architecture as a process of building logical modalities that entail the representation of diagrammatic space. It is quite true that our scientific conception of space, just as our architectural formulation of space, is thoroughly mediated by diagrams. Just as we can define a taxonomic structure for the genre of story problems, we can identify categories for diagrams. A broad distinction can be made between ephemeral and professional applications. Doodling on a napkin, or the idiosyncratic systems of Corbusier or Hedjuk are in a category separate from the diagrams of textbook traditions. Even here, however, it is not possible to make a rigorous distinction. And indeed it would appear that rigorous distinctions will become increasingly difficult as we follow diagrams into the experimental space of the monitor. Whether one looks at Vitruvius, Palladio, Piranesi, or Eisenman one may be tested to see if one locates their diagrams in biography or in that more ephemeral space of discovery. It is precisely such thinking space that marks the earliest stages of design or, in the retrospective clarification of design aims, that becomes crystallized at the later stages of design even after the completion of the building.

My objective in the following pages is not to consider the interpretation of diagrams but to emphasize the ways in which their continual crossing, linking, holding, and marking both create meaning

and enable the symbolic translation from one mode of representation to another. Just as I want to challenge approaches to diagram that would limit them to passive act of decoding, I want to ask how we use poetic narratives to approach architectural space. Even more specifically, I want to ask how the study of diagram within architecture points not simply to an everyday phenomenology of invention and practice but also to the networks which constitute architecture. My comments are based on a long-standing interest in the interpretive schemas devised to deal with iconography, ongoing research into visualization in science and technology, and a continuous interaction with architects and students of architecture for more than ten years at Georgia Tech. The theoretical issues involved in the symbolic transformation that takes place when one moves from one medium to another have been a major recurring topic in my work with students. After making several observations about the ways recent architectural theory has approached diagram, I will make several comments about diagram and metaphor before writing about the ways that diagrams function within a process that includes design as well as building. I will conclude by asking several questions about the ways that diagrams open questions for integrating architectural theory and practice.<sup>1</sup>

## **1. Diagram and Design Practice**

Although the presence of diagrams within architecture must be regarded as a commonplace, their continual use has also helped render them invisible as constituent parts of the phenomenology of architecture. The three architects glimpsed in the following paragraphs (Christopher Alexander, Bill Hillier, and Peter Eisenman) have all emphasized the use of diagrams in their work but have formulated markedly different ideas about their place within the theory and practice of architecture. Since their work provides both orientation and a point of departure, a consideration of what they say about diagrams is useful. Considered together, they remind us that for architecture the use of diagram marks a graphic strategy that extends well beyond simple ideas of plan and elevation.

## 1.1 Christopher Alexander

Even though Christopher Alexander's work on the diagram carries severe limitations, he provided a departure point for a renewed sense of the importance of diagram within the design process. As early as the 1960s, he argued that diagrams were graphic devices that provided a means of generating computational markers that could be translated into natural language. On an everyday level, he saw a way in which diagrams could be used to counter a romantic aesthetic that could still equate successful design with aesthetic intuition. Not surprisingly, his thick diagrams mark his pragmatic anti-aesthetic stance. His emphasis on a strategic and deliberate effort to develop a diagrammatic method of design that would run counter to intuitive or aesthetic approaches deserves attention: "[I]n an era that badly needs designers with a synthetic grasp of the organization of the physical world, the real work has to be done by less gifted engineers, because the designers hide their gift in irresponsible pretension to genius."<sup>2</sup> At a time in which he saw a growing postwar reaction to technology expressed in a nostalgic and elite aestheticism, Alexander argued for skillful design. It is significant too that he recognized the importance of diagram well before the digital transformation of the past twenty years. In his later works initiated by *The Timeless Way of Building* (1979), the quasi-mathematical diagrams that he envisioned as integral to his method of design became replaced by a vision of the patterns that he perceived underlying universal architecture. It is difficult not to see Alexander's early ideas about architecture — ideas that seem to abound with links to Norbert Wiener's *Cybernetics* (1948 and 1961) — replaced in his later work by quasi-mystical argument by design. Each rests on an a priori idea of a coherent whole. Because Alexander sees the individual diagram as part of an extensive pattern of signification, what initially appears as a discussion of diagram becomes a consideration of the whole to which the diagram belongs. There is remarkable irony in Alexander's work because what appears to begin as a repudiation of aesthetic intuition ends in a Taoist-like vision of existence in which everything becomes subsumed in a coherent whole. While his diagrammatic project begins as a critique of aestheticized notions of architectural plan, it moves toward an architectural variation of Feng Shui.

Alexander's interest in diagram has less to do with invention than the

ability diagrams have to show how the structures work as systematic expressions of communities. For him, the diagram works as a visual computational device for asking how individual structures become expressions of social space. A flow diagram from his early work fixes attention on a highway cloverleaf (Figure 1). A sequence of later diagrams shows him exploring the organic evolution of a community along a road (Figure 2). The diagram becomes a conceptual integration of multiple functions and finally works as a checking mechanism to ask whether significant elements are being included in the design process. Alexander's method finally deserves to be regarded as structuralist in the sense that it uses linguistic patterns to call attention to missing elements. Although his anthropology remains naive, his method might be compared to ways in which Lévi-Strauss (the binary structures he uses for the analysis of Oedipus) or Greimas (his application of the semiotic square) have sought to use structural linguistics to play open potential cultural signification. The diagram works by identifying unknown functions that should be part of the overall design problem.<sup>3</sup> This is so because diagrams function as a means for asking what is missing. As Alexander seeks to identify absent or even missing functions, he demonstrates the algebraic operation that may be associated with diagram. Cautious about mystifying individual intuition within the design process, Alexander mystifies the design process itself first through a computational model and then through a theory of patterns whose roots may be found in what metaphysics would call an argument by design.

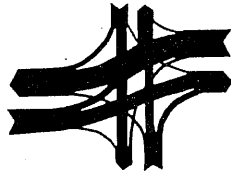


FIGURE 1: Christopher Alexander's highway intersection diagram: capacities are expressed as road widths

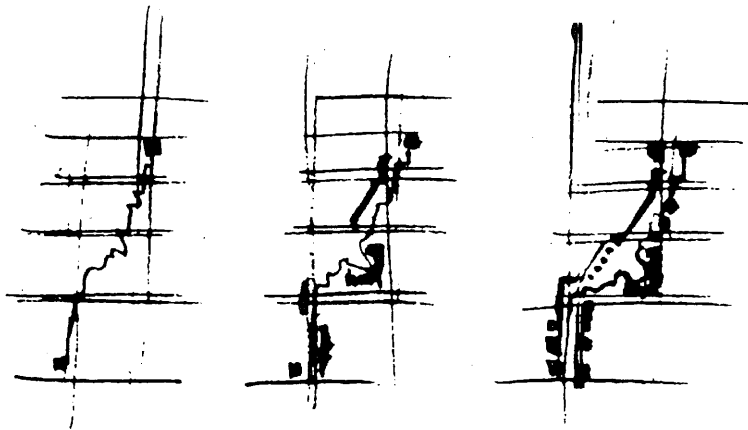


FIGURE 2: Christopher Alexander's diagram of settlement evolution along a road

## 1.2 Bill Hillier

While Bill Hillier has not formulated a theory of diagrams, his work implicitly argues that architecture cannot easily be described discursively or, more precisely, that the description of architecture requires non-discursive analytic techniques.<sup>4</sup> His *Space Is the Machine* (1996) depends on rendering the dynamics of space through a continuous interplay of diagrams. Unlike Alexander, who would see fundamental universal order in a rational continuum of diagrams, Hillier practices a far more local and pragmatic investigation of space. Where Alexander would see a kind of twentieth-century “chain-of-being” implicit in each diagram, Hillier approaches diagrams as vehicles for the exploration of socially constituted space. In contrast to Alexander’s abstract references to “village,” “city,” “country,” Hillier situates his analysis within the spatial evolution of specific urban settings and buildings. Here the matter is never an abstract site but a location within an existing spatial order that may be approached through a diagrammatic process that is far closer to mapping than anything else. However, it is a mapping oriented towards revealing underlying structure, a mapping that becomes a vehicle for identifying underlying principles rather than with recording what is readily manifest. The multiple diagrams in *Space Is the Machine* work simultaneously to represent the simplification of collected data at the same time that they interrogate other representations of the same space. While Hillier argues for architectural theory based on an idea of space, his idea of space is always situated in a physical location rather than in linguistic abstraction. In his emphasis on location and in the analysis of actual space, Hillier also allows architecture to retain an identity separate from the discursive overcoding of philosophy or literary theory.

Hillier’s use of diagrams marks an extension of urban mapping that is quite precise. A diagram of London focuses attention on the connectivity of spaces as this affects the circulation of a population [Figure 3]. Although a map, which might in itself be considered a diagram, provides orientation to an actual setting, Hillier shows how much may be drawn from the information diagrams that he generates through scattergrams, plots, or clustering. It is fundamental for Hillier that diagrams render levels of information rather than conceptual formulations of individual structures. While his use of informational diagrams may lead to the formulation of a drawing or building diagram,

such extension marks a distinctly different level of diagram. Finally Hillier's diagrams should be approached not as vehicles for interpretation but for analysis. Although Hillier's analytical use of diagrams may appear similar to Alexander's from the vantage point of mathematics, a major distinction remains between Hillier's analysis of real space and Alexander's abstract conjectures.



FIGURE 3: Bill Hillier's diagram of the spatial structure of the City of London

### 1.3 Peter Eisenman

In contrast to Hillier's pragmatic diagrammatic exploration of real cities, Peter Eisenman argues that diagrams embody architectural writing. However, rather than only seeking a place for diagram within design — an argument that might be regarded as supporting the aesthetic significance of the blueprint — Eisenman seeks a theoretical validation for a diagrammatic practice through an appeal to a Derridean linguistic decentering. For Eisenman architecture, like philosophy and literature, is haunted by logocentric phenomena that may be counteracted by diagrammatic practice. While both Alexander and Hillier manifest a close relation to mathematics, Peter Eisenman participates in opening the



linkages between diagram and writing.<sup>5</sup> Rather than seeking a set of correspondences through which exploratory postulates might be graphically presented, Eisenman develops the dynamic potential of diagram to lead to more diagrams. "Not only was the history of the form rewritten, but Eisenman would subject 'form' itself to perpetual revision through an exhaustive sequence of operations: transformation, decomposition, grafting, scaling, rotation, inversion, superposition, shifting, folding, etc."<sup>6</sup> If Alexander hints at the computational potential of diagram and Hillier demonstrates the practical use of diagram within the analysis of space, Eisenman anticipates the ways that CAD packages work as diagrammatic machines or generators. For Eisenman, it is precisely the projective capacity of diagram that makes them gestural vehicles for virtual representation. In a sequence of diagrams, Eisenman represents an evolving diagrammatic invention of the Staten Island Art Center from a structural morphing of the New York skyscrapers including the twin Trade Towers [Figure 4]. Through a sequence of digital morphing, each diagram marks an ongoing transformation of shapes that folds the rectilinear shapes of the Manhattan skyline into themselves.

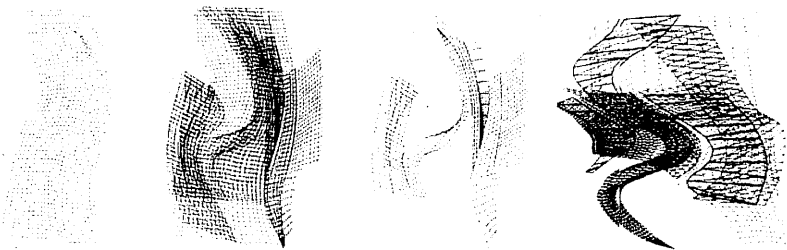


FIGURE 4: Peter Eisenman's morphing diagram

As Eisenman's diagrams show, it is also the virtual turn enabled by computer-generated diagrams that contributes to the description of diagram as a new form of writing. Eisenman is drawn to an experimental spatial syntax that would in effect never obey grammatical rules. Instead of operating within a set structure, Eisenman purposely seeks to create experimental grammars which exist on the edge of communication. In *Diagram Diaries*, he compares the architectural diagram to Freud's mystic writing pad where unexpected figures continue to appear on the writing surface. In contrast to Hillier's diagrams that facilitate access to thinking about urban space, Eisenman's diagrams literally comprise "diaries" or registers of his own design work. Surely Eisenman too engages public space but his engagement comes through the exploration of the projective space of individual structures. It is the cognitive problem of the diagram which allows one to compare his experimentation to the diagrams that Lacan played with in the early 70s.<sup>7</sup> His own active exploration of the relationship of diagrams to Derridean decentering in *Chora L Works* not only asks his reader to consider his projective, idiosyncratic use of diagram in an iconoclastic manner but reminds us of how his work seeks to exorcise the metaphysical haunting of architecture.<sup>8</sup> If Alexander and Hillier can be described as algebraic, Eisenman may be regarded as an experimental geometrician who would like to construct non-Euclidean geometries without preordained axiomatic rules. What is remarkable is that Alexander, Hillier, and Eisenman all use the diagram to intimate absences that they seek to fill.

## 2. Diagram and Metaphor

Given the ranging use of diagram considered above, it is useful to look closely at the word diagram itself. A diagram refers to a simple graphic representation of something that has been or is being thought or conceptualized. Diagrams are simple drawings or figures that we use to think with or to think through. The idea of thinking through a diagram is crucial not only because a diagram provides order and stability but because it is a vehicle for destabilization and discovery. Just as a rich terrain is negotiated between the different meanings of the word *plot* in English, as I will suggest below, multiple valences surround the word *diagram* or *diagramma* [διαγραμμα] in Greek. The root verb of

diagramma [*διαγραφήν*] means not simply something which is marked out by lines, a figure, form, or plan, but also carries a secondary connotation of marking or crossing out. In contemporary Greek the verb *diagrapho* [*διαγράφω*], noun *diagraphē* [*διαγραφή*], means to write someone off. The verb may also be used to describe the movement of planets in the sense in which their movement may be thought of as "inscribed" in the heavens or in subsequent orbits "reinscribed." In such a setting, the planetary trajectories may be thought of as writing over themselves on every orbit.

The connection between making figures and making them disappear is more than a philological curiosity because etymologically, the word itself may be traced to the transitory figure written on a wax table with a stylus and over which or through which another diagram or figure will appear. The definition, as well as its etymology, is useful because it reminds us that diagrams are part of an evolving cognitive continuum. In this sense, *diagramma* embodies a practice of figuring, defiguring, refiguring, and prefiguring. What is interesting is that diagram participates in a genealogy of figures that moves from the wax tablet to the computer screen. From a phenomenological vantage point, the Greek setting of diagram suggests that any figure that is drawn is accompanied by an expectancy that it will be redrawn. Within such a dynamic framework, such expectancy must also be accompanied by an understanding of the ways in which diagram can shift in status. Here diagram may be thought of as a relay. While a diagram may have been used visually to reinforce an idea one moment, the next it may provide a means for seeing something never seen before. Because diagrams mark a gesture or momentum toward definition, they function as vehicles that enplot and invite elaboration through narrative. It is also quite appropriate to think that diagrams provide vehicles for seeing how visual discourse is actually comprised of a genealogy of figures that trace a generation of meaning. For example, a map might be thought of as a diagram that has forgotten it is doing work. We may even extend this idea to artifacts that become used as examples. An example might be approached as a diagram that has been discarded after it has been "thought through." There are important implications here because the agents of thought within the setting of distributed cognition may have very different valences depending on *who* is using them.

From the vantage point of phenomenology or cognitive science,

diagrams have an optical foundation because they suggest the ways in which connections are made within a visual field. It is their optical foundation that also affirms their haptic role as recorders of operations such as drawing, tracing, or plotting. But we might also identify a linguistic orientation in which the visual field is shaped from the vantage point of grammatical or lexical structures. Here we may see where something that is embodied reaches language. In other words, diagrams may mark a way to follow the body into language and even more a way to follow language into the spatial experience of the body. Historically, it is possible to relate the dissemination of the idea of diagram to optical geometry. It is quite appropriate to think of diagrams as being constituent features in the process of perception analyzed by Locke or as figures that Hume describes as instrumental in the evolution of the thought process.<sup>9</sup> Diagrams are phenomenological agents within the cognitive process and work as elemental mental constructions that enable us to hypothesize about the world.<sup>10</sup> Given the optical basis of diagram, its association with architecture is natural because it serves as a vehicle of spatial analysis. Diagram, however, cannot be simply associated with the analysis of external objects but also with the patterns that may be projected onto them. It is possible that the experience of both seeing and projecting shapes onto the visual field underlies intro- and extra-mission theories of vision. Extra-mission theories of vision may indicate that vision had agency and participated in making things happen. Extra-mission reminds us that vision is fundamentally experienced as directing sight that may be perceived abstractly as extending a visual line to a particular object. As such, vision may be experienced as a practice of continuous diagramming. I think it not at all inappropriate to think of such visual experience as another way in which embodied experience comes to stand behind our use of metaphor.

My emphasis on diagram should not be separated from metaphor. Similar to metaphor, the diagram never exists by itself but always works by establishing linkages. Since both diagram and metaphor become situated within narrative and may at times even embody or represent such narrative, they are both cognitive vehicles for modeling and exploration. One way to approach the similarity between diagram and metaphor is to consider the narrative settings used to frame or control them. From the vantage point of narrative theory, it is useful to think of the diagram as graphic short-form.<sup>11</sup> In particular, we may compare diagram to a

linguistic short-form such as the enthymeme or *exemplum* because, like the enthymeme, the diagram never exists in isolation but is always deployed within the context of some other discourse. Consequently diagrams like enthymemes function as enclosing devices that also generate meaning. Elsewhere I have suggested that the enthymeme is associated with three primary functions including closure, extension, and subversion.<sup>12</sup> I refer to these functions because they remind us that diagrams too have multiple functions within architecture. To understand how these functions apply to both enthymeme and diagram, we must remind ourselves how both the linguistic and graphic figures are deployed within settings of teaching and learning. An enthymeme may confirm a particular conclusion which follows from a premise, provoke an extension or application of the simple story, or lead to its subversion and the formulation of an entirely new story. Diagrams too can direct one to a conceptualization or formulation of space that may be compared to closure if the diagram is used within an instructional setting. It is not, however, an idea of closure that carries the most significance but the ways in which the diagram may lead to reformulation. Even more than the enthymeme, the diagram is a transitory vehicle that participates in or *prefigures* the development or elaboration of the complex plan. In architecture the diagram functions as a short-form that can be entailed either discursively or quantitatively. Even more the diagram comes within the project to be ordered or nested within other forms of visual representation including the model, the plan, elevation, or the perspective drawing. Above all, diagram functions as a means of abbreviation or commentary. Similar to the enthymeme or example which can reinforce stability or challenge an existing conceptualization, diagrams may confirm or challenge visual and spatial order.

Just as it is useful to compare a visual form like a diagram to a linguistic form like enthymeme, it is useful to compare the diagram to plot. While plot conveys the dual idea of placement and measurement with an idea of narrative, diagram retains a fundamental analytical function associated with geometry. Unlike plot, which carries an idea of a physical intervention that places something onto a surface, diagram functions more abstractly. Plot is associated with locating oneself while diagram marks a step in a process of thinking. Plots are already located somewhere; diagrams mark a stage in a process that anticipates meaning and as such interact with other systems of signification. Diagrams can

receive their meaning from their context or become figures that generate meaning. It is the generative function of diagrams that has allowed them to be compared to a form of writing.<sup>13</sup>

Diagrams also have a temporal dimension that allows us to identify them not only in the present but in the past. This is quite evident in regard to maps. It is also this that allows Newton to think of alchemy as a history of matter. Hence it is quite logical to think of diagrams as a means of opening a kind of cognitive archeology or genealogy. It is this aspect of diagram that Deleuze uses to describe Foucault's transformation of the archive.<sup>14</sup> From such a vantage point it is quite appropriate to ask whether we can trace the genealogy of a particular diagram. It is equally logical to ask about the ways that the genealogy or history of a diagram may contribute to the ways that we project or prefigure what we might anticipate in the future. The diagrams associated with the practice of magic as well as the diagrams associated with astronomy provide examples of the ways that such short-forms not only explain what *has* happened and what *has* been seen but what *will* happen and what *will* be seen. It is precisely the recognition of continuity in such visual patterns that explains why visualization technologies are of such utmost importance for the registration of continuity also permits the detection of variation. The genealogical characteristic of diagram carries much importance for architecture precisely because it reminds us that diagram is present throughout the continuum of architectural design and practice. Diagrams are instrumental in the design and construction process in architecture and provide a vehicle not only for studying extension but also symbolic translation.

### 3. Symbolic Translation

The capacity diagram shares with metaphor to build models and shape narrative is central to its role in symbolic translation. Architecture not only provokes dialog with other aesthetic forms but moves to translate or embody metaphor and narrative into architectural structure. While such translation often remains viewed as a problem of interpretation, it is necessary that it also be situated within the practice of design. The persistent exploration of writing, painting, and sculpture in the work of Cy Twombly resonates in many ways with the diagrammatic exploration

of architectural design.<sup>15</sup> (Figure 5)

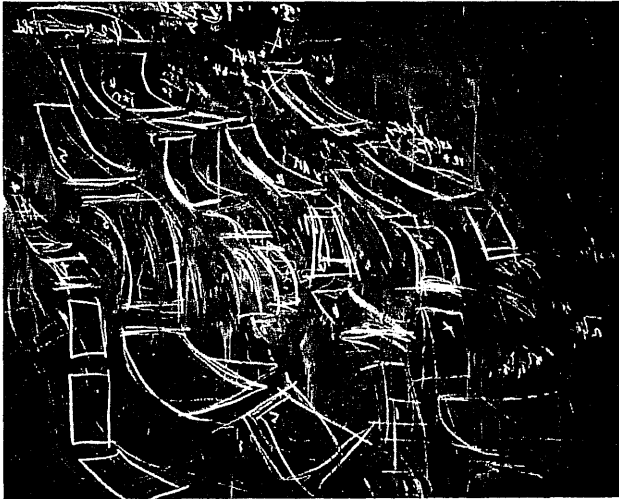


FIGURE 5: Painting by Cy Twombly

Twombly in particular invites us to see how our earliest writing is also a form of drawing (and vice versa that drawing is a form of writing) and that both may be called diagrammatic. An early setting for my own work on symbolic translation within architecture came from working with Jennifer Bloomer on the relation between Joyce and Piranesi. Above all, the project was comparative and thoroughly demonstrative of the ways that interpretive strategies are invented to make relationships. Bloomer's argument was never a simple comparison, however, but a question about surplus of writing as experienced through the metaphors of Joyce and the engravings of Piranesi. Bloomer's project plays open the multiple ways in which verbal and drawn strategies resonate with each other. Aarati Kanekar's recent project on Terragni's *Danteum* provokes another setting of conjunctions between text and architecture. While Bloomer's project discovers theory as an architectonic bridging structure — theory as diagrammatic —, Kanekar insists that Terragni's drawings embodied not

only an architectural commentary on Dante but an impetus to ask how a textual tradition could create a momentum for architectural extension.<sup>16</sup> The issue is not a modernist conceptual synthesis nor playful post-modern irony but a practiced implementation of design strategies for exploring the translation of space. Her repeated use of diagrams within the design process is the most fundamental element for such exploration. Her insight comes in the linkages she sees in the diagrammatic archive of commentary on Dante and Terragni's invention. The single best demonstration of this comes in the fluid relationship between her diagrams (See Kanekar's article in this collection) and the CAD construction of Terragni's structure. The Alice Project (See Peponis, Lycourioti, and Mari in this collection) by Iris Lycourioti also challenges the observer not to become entangled in a hermeneutic exploration of text but to practice the ways that we can free ourselves through an unfolding design process that rests in the continual discovery made through diagrams. The discovery that diagrams constitute commentary within architectural practice unfolds in each of the projects.

Another opportunity to shape a quasi-diagrammatic laboratory was afforded through an architecture seminar taught with my colleague John Peponis. As arranged, the course was taught simultaneously in Athens, Greece, and Atlanta.<sup>17</sup> Our work was encouraged by visits to the seminar from our colleagues, Barbara Stafford and George Lakoff. Stafford's challenge to render or articulate visual analogies within Baroque architecture reinforced the diagrammatic work of students.<sup>18</sup> The cognitive setting provided by Lakoff provided a means not only for linking diagram to metaphor but for seeing both diagram and metaphor as vehicles of bodily extension.<sup>19</sup> In addition to reading theoretical work related to diagrams, students kept a record of their diagrammatic translations as they worked from narrative episodes from Homer, Virgil, and Ovid. The choice of the classical texts was purposeful. Thirty years ago students were expected to know classical texts. Depending on their institution, and the degree to which the architecture program was shaped by art history, they could well have been familiar with the iconographic methodology of the Warburg and Courtauld era that linked narrative meaning and visual representation through allegory. But what use could we make of material that now at the end of the post-modern era appears so desiccated? How would students respond not to the doctored mechanism of allegory but raw narrative itself? We were immediately



intrigued by the response to the space created in the texts and the ways narrative space became translated into diagrams. After several meetings students were given marking pens or chalk so that they could draw on the board at the same time they spoke of their responses to Ovid's *Metamorphoses* or Virgil's *Aeneid*. We were less interested in the ways narrative structure could be transformed into recognizable motifs than in the ways that the phenomenology of space within the narrative worked as a site for architectural invention. Our discussions depended not on the linguistic interpretation of space cognitively modeled through reading but on the diagrammatic extension of space previously limited to reading. Students developed diagram diaries of their own as the course progressed. Sean O'Hara recorded the transformative diagrams used in a project devoted to an urban housing development around the state capital building in Atlanta, Georgia. His work demonstrated how diagrams function both as the aesthetic rhetorical agents as well as analytical vehicles. This was especially apparent in the ways that diagrams provided a way for distilling or simplifying a layered development of an urban environment. His diagrams became genetic-like structures representing the transformation and constancy of urban space (Figure 6). In another project, Weiling He rendered the structure of the Chinese film *Ju Dou* by Zhang Yimou through a reading of the *Metamorphoses* in Chinese (Figure 7). Although there is no direct relation between Yimou's film and Ovid's poem, the text provided a means for the imaginary mediation of the intersection of plot in narrative and diagram. A project by Chrissy Karadima, from the Athens seminar, explored the myth of Orpheus and Euridice. Her project envisions movement in which Euridice and Orpheus may see each other but never meet or touch (Figure 8). After first modeling the myth through a series of vertical walls, she thought of Euridice walking in a circular orbit inside a prismatic shell that would never intersect with the path of Orpheus. Inside the shell, light is only indirect, reflected from a water pond underneath. At the point where their paths seems to cross, there is a viewing tower for Orpheus to climb. Although he achieves an overview, he can never meet Euridice. Erik Conrad's diagrammatic presentation of the *Metamorphoses* (Book 4) explored the poem's liquid space and found it a departure point for interaction within virtual space. His objective was to explore the ways diagrams could generate new forms of digital writing that could be used in an interactive book (Figure 9).

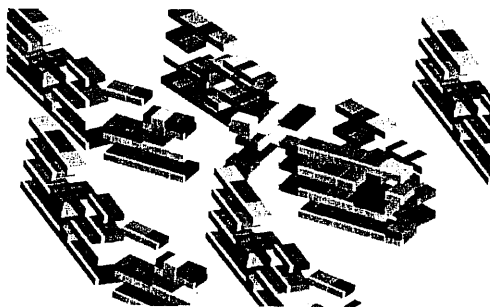


FIGURE 6: Sean O'Hara's diagrams of building block compositions

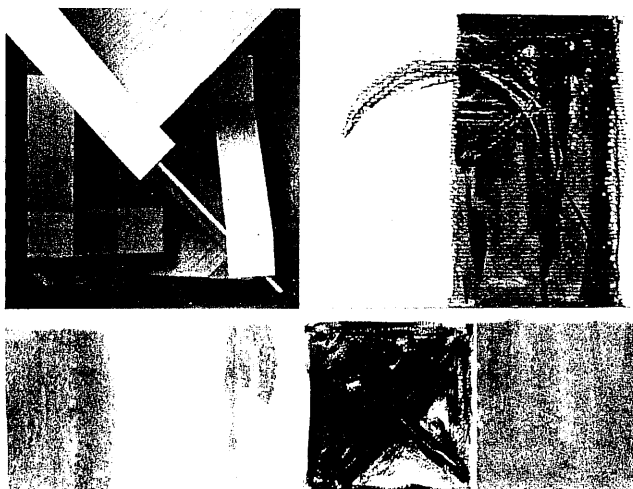


FIGURE 7: Weiling He's diagram of *Ju Dou*

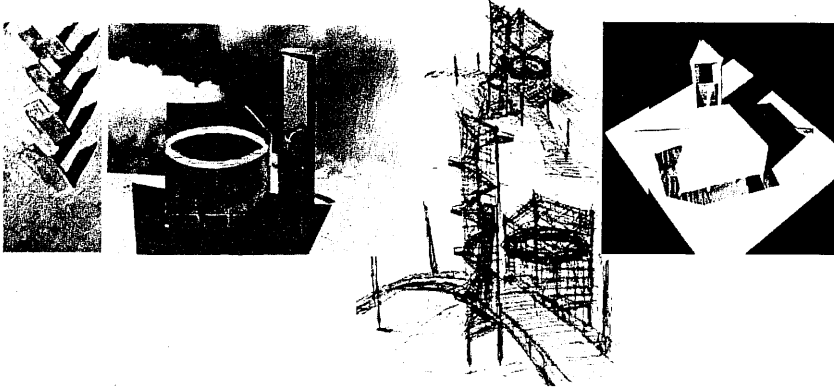


FIGURE 8: Chryssoula Karadima's diagram of *Orpheus and Euridice*

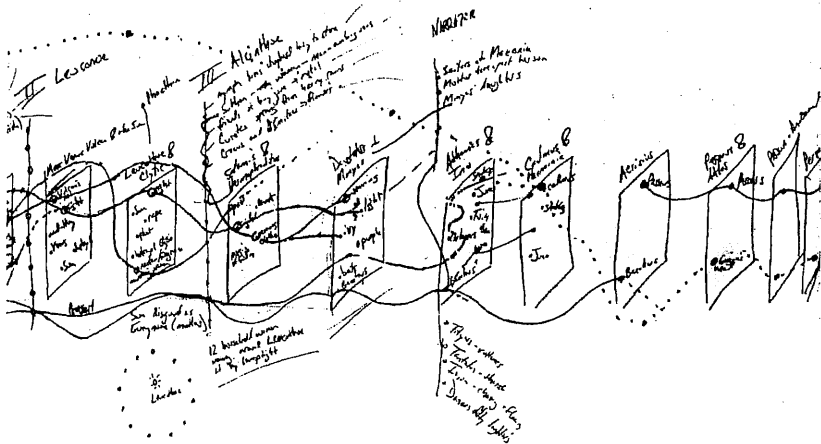


FIGURE 9: Eric Conrad's diagram of liquid space in the *Metamorphoses*

Rather than discussing the spatial representation of episodes from particular texts, students enabled their discussions through diagrams.<sup>20</sup> As the students scribbled diagrams on the chalkboards surrounding the classroom, I thought of the crucial role played by such writing in mathematics where, rather than incidental features for the instructor's prearranged staging of an axiomatic performance of mathematics, diagrams mark crucial sights for insight and transformation.<sup>21</sup> Rather than nesting diagram within theory, diagrams were experienced as ephemeral forms of architectural writing. What I said above about narrative and diagram was manifest repeatedly through our work. Diagrams, like metaphor, may be policed to conform to an already established narrative. However, diagrams, like metaphor, also subvert order and in their subversion either work as anarchistic vehicles of control — vehicles for confirming why something is the way it is — or vehicles that open new vistas. Just as the secret of metaphor lies within its capacity to show that narrative is always open, so the secret of diagram shows itself in its capacity to reveal again and again that architecture involves not the study of closings but of openings. Although we anticipated that our seminar work would be theoretical, we discovered quickly that our attention became directed toward design. Our work showed architecture so stifled with the rhetoric of theory that it has become self-conscious rather than experimental. The question — how do you theorize this? — is sometimes asked so often that the structure one is working with becomes lost. I learned again and again in the social anthropology of our small group how productive it is to ask questions about how we use diagrams, or how we think we use them. Just as I have become aware of the highly idiosyncratic ways that diagrams may be used in the process of design, I have also become aware of the ways in which diagrams function as vehicles of social understanding.

The diagrammatic practice of moving between different symbolic codes is also accompanied by the human voice. Although this might seem a truism at first, it is a crucial but often overlooked element within the theory of architecture. Just as we now readily acknowledge the place of oral tradition in the transmission of Homer or in the shift from philology to linguistics, we need to acknowledge the importance of speech in the transmission of architecture. The integrative function that relates the diagram to the text is one that occurs through speech. The centrality of speech in performing these translations is exhibited every day in

classrooms around the world. There is a sense in which the texts assembled by the history of architecture (as science) amount to cues or a score waiting to be performed or enacted. I have already suggested that diagrams are controlled by modalities. These modalities must be approached as having aspects that are both written and oral. Speech may be thought of as a carrier wave of architecture. As Robin Maconie has said, “[w]estern civilization springs from a culture of the ear.”<sup>22</sup> We must be prepared to conceive of orality not simply as a phenomenon that may help us understand a particular experiment but as a constant phenomenon that contributes substantially to science. The study of diagrams should also be viewed as a component in the study of technology. In effect, schools of architecture might become more recognized as laboratories for the philosophy of technology. The question of diagrams in technology is important for, as genealogical structures, they can reveal the theoretical grammars and social codes used to enforce them. From a sociological perspective, diagrams might be thought of as comprising the circuit system of networks. I noticed how the word diagram bears a notion of the technologies of writing. Diagrammatics, however, invites us to consider more than wax tablets. Diagrams point toward that which can be enacted in the world. Construction technologies often appear separate because they are black-boxed rather than integrated into the work of architectural theory. We need to think of technology as a continuous set of interactions with signs that become increasingly reified. The diagram is an important mark within the genealogies of sign systems. Here the point is that technology should be regarded not as a jump from an idea to an artifact but as a complex process of increasingly complex sign systems. One way to enter this zone is to approach diagrams as vehicles that register a process of becoming. Diagrams are central to a theory of emergence. I make these observations in order to suggest that the idea of architecture would be strengthened by a fuller understanding of the ways that diagrams function in all aspects of design and construction. My point is *not* the naïve argument that a single rational continuum of diagrams moves from idea to structure but that the relationship of imagination, shape-logic, and building is one that is repeatedly negotiated through diagrams accompanied by speech. From a philosophical vantage point, there is not a single rational continuum (Descartes) but an infinite number of possible connections (Leibniz). From the vantage point of architectural theory, the point is not the

idealized continuum of early Alexander but the experimental connectionism described by Rajchman. Diagrams not only participate in building design but mark the regulation of building construction. But no matter how formulated they are, they can always be written over, marking a moment of change. What is important is that diagrams don't work by themselves. They constitute genealogies of diagrams which constitute the building. They also constitute a time-line which orders the ganglia of construction. What is also interesting is that the design process continues into the construction phase. The collection of diagrams then becomes not simply an archive but a genealogy of building construction. What once described where to place electrical outlets becomes a diagram that helps in locating an electrical outlet. Diagrams participate in the shift from construction to maintenance. This is not insignificant but represents diagram as vital component that stages moments in the construction process. Where the design stage authorizes multiple narrative tangents, the construction stage works to integrate diagrams into a common narrative. The looping back is important because it reminds us that the constructed building becomes a departure point for further design and further invention. It may be remodeled or it may become a visual exemplum within the spatial continuum.

The iterative use of diagrams within architectural practice and construction coincides with the iterative use of technological extension. Here diagrams reveal an instrumentality that permits them to move from being agents that negotiate space to being instruments that manipulate space. The capacity of diagrams both to work as heuristic vehicles in the process of design and to dictate how something is to be constructed reinforces the diagrammatic continuum within architecture theory and practice. It is of no small importance as well that it also contributes to an understanding of technological extension. Technology is an iterative process facilitated by the continuous use of diagrams. Let me emphasize this by also observing that technology too remains facilitated by the continuous interaction of diagrams and speech not only by an interaction of diagrams and written language. The distinction carries significance, for our philosophies of technology have been dependent on a semiotic foundation that has separated artifacts and their systematic relations from an idea of written language. Technological artifacts, as well as the technological systems of which they are part, remain defined as the *signified*, marked and denoted by natural language. In contrast, it is

useful to envision a theory of technology in which technology itself through the mediation of spoken language and diagram becomes language-like precisely because it can be witnessed not as "what is signified" but as a "signifier" in its own right. From the vantage point of semiotics, the diagram marks a locus where there is a continuous set of exchanges between signifier and signified — a bundling of systems of signification — and where the structure becomes a sign or referent in its own right and where its existence does not depend on the word as signifier. Architecture seems haunted by a Janus-like identity that requires a continuous negotiation between its historical record and its continual efforts to resituate itself.<sup>23</sup> Just as science may be demythologized by viewing it as composed of "ready-made science" and "science in action," it may be helpful to think of architecture as a complex negotiation between networks traceable by the diagrams they have left or the diagrams that are so crucial to the process they engender.

Georgia Institute of Technology

## NOTES

1. For recent work on diagrams see my "Diagrams as Piloting Devices in the Philosophy of Gilles Deleuze" in a special issue devoted to the work of Gilles Deleuze, *Deleuze-chantier*, in *Théorie, Littérature, Enseignement* 19:2001 (Paris: Presses Universitaires de Vincennes, 2001) 145-65; see also my introduction to Gilles Châtelet, *Figuring Space: Philosophy, Mathematics, and Physics* (Dordrecht: Kluwer, 2000).
2. Christopher Alexander, *Notes on the Synthesis of Form* (Cambridge: Harvard Univ. Press, 1964), 11.
3. See Algirdas Julien Greimas, "The Interaction of Semiotic Constraints" in *On Meaning: Selected Writings in Semiotic Theory* (Minneapolis: Univ. of Minnesota, 1987), 48-62; for a detailed discussion of the evolution of semiotic square see Ronald Schleifer, *A. J. Greimas and the Nature of Meaning: Linguistics, Semiotics and Discourse Theory* (Lincoln: Univ. of Nebraska Press, 1987).
4. See Bill Hillier, *Space Is the Machine: A Configurational Theory of Architecture* (Cambridge: Cambridge Univ. Press, 1996).
5. Peter Eisenman, *Diagram Diaries* (New York: Universe Publishing [Rizzoli], 1999).

6. R.E. Somol, "Dummy Text, or the Diagrammatic Basis of Contemporary Architecture," Introduction to Peter Eisenman, *Diagram Diaries*, 15.
7. For background on the phenomena of Lacanian diagrams see Elisabeth Roudinesco, *Jacques Lacan* (New York: Columbia University Press, 1997).
8. Jacques Derrida and Peter Eisenman, *Chora L Works*, ed. Jeffrey Kipnis and Thomas Leiser (New York: Monacelli Press, 1997).
9. For example see John Locke's discussion of ideas and figures: "[B]y considering these as they relate to one another, in all parts of the extremities of any body or space, it has that idea we call *figure*, which affords to the mind infinite variety. For, besides the vast number of different figures that do really exist in the coherent masses of matter, the stock that the mind has in its power, by varying the idea of space, and thereby making still new compositions, by repeating its own ideas, and joining them as it pleases, is perfectly inexhaustible. And so it can multiply figures *in infinitum*." John Locke, *Essay concerning Human Understanding*, Vol. I (New York: Dover Publications, 1959), 221.
10. See John Rajchman's discussion of Hume as a constructionist. "Hume was a great empiricist because a great 'constructivist,' for he asked how, from 'impressions,' we build up a life, form beliefs, bring together our passions in the conventions of a society." *Constructions* (Cambridge: MIT Press, 1998), 2.
11. Although there are many catalogs or indices of technological shapes (i.e., *Manual of Mechanical Movements* (South Orange, N. J.: W. M. Clark 1933 [1868])), I am unaware of any compilation of graphic short-forms that would be analogous to André Jolles' work in linguistics. See André Jolles, *Einfache Formen* (Tübingen: Niemeyer, 1982).
12. See Kenneth J. Knoespel, "The Emplotment of Chaos: Instability and Narrative Order," *Chaos and Order: Complex Dynamics in Literature and Science* (Chicago: Univ. of Chicago Press, 1991), 100-22.
13. For a general introduction to diagrammatic writing and architecture see John Rajchman, *Constructions*. Rajchman's overview rests primarily on a reading of Deleuze in which "writing" is generally equated with natural as well as synthetic languages. I think such an equation privileges natural language in ways that obscure the real connections between architecture and technology. Three texts by Deleuze are crucial for his discussion of diagram. See Gilles Deleuze, *Foucault* (Minneapolis: Univ. of Minnesota Press, 1988); *The Fold: Leibniz and the Baroque* (Minneapolis: Univ. of Minnesota Press, 1993); and Gilles Deleuze and Félix Guattari, *What Is Philosophy* (New York: Columbia Univ. Press, 1994).



14. Deleuze calls the first section of his work on *Foucault*, "From the Archive to the Diagram," 1-44.
15. For Cy Twombly see Kirk Varnedoe, *Cy Twombly: A Retrospective* (New York: The Museum of Modern Art, 1994); Cy Twombly: *Painting and Drawings* (Milwaukee Art Center, 1968); see Roland Barthes, "Cy Twombly: Works on Paper," *The Responsibility of Forms* (Berkeley: Univ. of California, 1985), 157-176.
16. I have also explored the movement from text to diagram through an architecture seminar devoted to Russian iconography and its importance for constructionist architecture and design. Besides providing an orientation to Russian iconography through the work of Yuri Lotman and Boris Usspensky, I particularly looked at constructionist stage design and its relation to architecture.
17. Although I do not have room to recognize in detail the work of the five students here, I would like to acknowledge all their contributions to our work. The five students in the class were: Roberto Carretero, Erik Conard, Weiling He, Sean O'Hara, and Wilfredo Rodriguez.
18. See especially Barbara Stafford, *Visual Analogy: Consciousness as the Art of Connecting* (Cambridge: MIT Press, 1999).
19. Our discussion with George Lakoff was particularly directed by his work with Mark Johnson (*Metaphors We Live By* [Chicago: Univ. of Chicago Press, 1980]) and by his recent book (with Rafael E. Nunez), *Where Mathematics Comes From: How the Embodied Mind Brings Mathematics into Being* (New York: Basic Books, 2000).
20. We experienced versions of the cognitive experiment described by Nicholas of Cusa when he notices how complex abstractions can be simplified through visualization. Although Cusa may seem remote from such a discussion about diagram and metaphor this is hardly the case. Cusa discovered repeatedly how diagram and metaphor could stand outside existing scholastic discourse and provide vehicles for insight and discovery. Cusa's recognition of model-based reasoning marked a shift in thinking. If we think about his importance in northern Italy, Cusa deserves to be associated with a growing interest in visual thinking.
21. Mathematics is not agentless but dependent on the generations who have scribbled diagrams on surfaces. Mathematics is not passive but requires mechanical intervention in ways that textual interpretation does not. For blackboard writing in mathematics, see Gian-Carlo Rota, *Indiscrete Thoughts* (Boston: Birkhäuser, 1997).

22. Robin Maconie, *The Science of Music* (Oxford: Oxford Univ. Press, 1997), xi.
23. Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge: Harvard Univ. Press, 1987).