# 3

# Design as a Reflective Conversation with the Situation

## The Design Professions

The family of design professions, of which architecture is the best known, includes urban design (the design of urban places), regional planning (concerned with the structure and ecology of whole regions), and the type of town planning that produces plans for the physical structures of cities. For many years, these fields have been changing and in changing relationship to one another. Architecture, once the mother profession, now occupies a somewhat ambiguous position within the larger family.

In engineering there is also a family of design professions.

Product designers concern themselves with the structure and appearance of industrial products. Industrial engineers design the mechanisms and layouts of production processes. And engineering specialists of various sorts design such large-scale products as ships, aircraft, dams, and roads.

In the last twenty years or so, the concept of design has broadened. We have begun to see cultural evolution as an informal, collective, generational process of design, as in Chris Alexander's story of the Slovakian peasant shawls. Herbert Simon and others have suggested that all occupations engaged in converting actual to preferred situations are concerned with design. Increasingly there has been a tendency to think of policies, institutions, and behavior itself, as objects of design.

It is questionable how far in this direction we ought to go. We risk ignoring or underestimating significant differences in media, contexts, goals, and bodies of knowledge specific to the professions. But we may also discover, at a deeper level, a generic design process which underlies these differences.

In this chapter I shall focus on design in the field of architecture, which I have had a particularly good opportunity to study. But architecture is worthy of study for other, less idiosyncratic reasons. It is perhaps the oldest recognized design profession and, as such, functions as prototype for design in other professions. If there is a fundamental process underlying the differences among design professions, it is in architecture that we are most likely to find it.

The search is complicated, however, by the fact that the boundaries of architecture are continually shifting, and even among practices clearly labelled "architecture" there are many variations. The field of architecture proper has been constricted by the emergence of newer professions such as planning, construction engineering, and landscape design. Within architecture itself, following the long reign of the Beaux Arts

tradition in the late nineteenth and early twentieth centuries, practitioners have tended to align themselves with a bewildering array of contending schools, each of which has laid claim to architecture.

Some of these schools have consciously returned to historical precedents, such as the Italian hill towns or the Gothic cathedrals. Others have formed around the stylistic innovations and methods of great men such as Le Corbusier, Wright, Kahn, Aalto, and Mies van der Rohe. Some deplore the intrusions of contemporary technologies and commercial forms, while others celebrate the artifacts of contemporary American culture. Some have aspired to simplicity and purity of design or to the craftsmanlike use of materials, while others exploit the technological possibilities of industrial building technology or the rich cultural store of American vernacular. Some have reacted against the formalism of the dominant styles, treating design as a social process which should respond to the needs and preferences of the people who live and work in buildings.

For a student of the field—and perhaps even more for a student *in* the field—the multiplicity of voices is confusing. How should we regard the controversies among the contending schools? Should we take them as competing definitions of the field, which entail very different concepts of professional knowledge and practice? Or as stylistic variations of a design process that is essentially the same for all schools?

In the following pages, I shall draw from a particular example a description of designing which underlies the differences among schools and suggests a generic process shared by the various design professions. I shall consider designing as a conversation with the materials of a situation.

A designer makes things. Sometimes he makes the final product; more often, he makes a representation—a plan, program, or image—of an artifact to be constructed by others. He

works in particular situations, uses particular materials, and employs a distinctive medium and language. Typically, his making process is complex. There are more variables—kinds of possible moves, norms, and interrelationships of these—than can be represented in a finite model. Because of this complexity, the designer's moves tend, happily or unhappily, to produce consequences other than those intended. When this happens, the designer may take account of the unintended changes he has made in the situation by forming new appreciations and understandings and by making new moves. He shapes the situation, in accordance with his initial appreciation of it, the situation "talks back," and he responds to the situation's back-talk.

In a good process of design, this conversation with the situation is reflective. In answer to the situation's back-talk, the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves.

## An Example of Reflective Designing

In the remainder of this chapter, I shall use a particular example of architectural designing to explore the reflective conversation which underlies the variety of schools of architecture.

I have drawn a case from a design studio,[1] a type of professional education, traditional in schools of architecture, in which students undertake a design project under the supervision of a master designer. In the case I have selected, the studio master, Quist, reviews the work of one of his students, Petra.[2]

This review takes place early in the semester. Its setting is the loft-like studio space in which each of the twenty students has arranged his own drawing tables, papers, books, pictures, and models. This is the space in which students spend much

of their working lives, at times talking together, but mostly engaged in private, parallel pursuit of the common design task. At the beginning of the semester, Quist gave all of the students a "program"—a set of design specifications, in this case, for the design of an elementary school, and a graphic description of the site on which the school is to be built.

In the course of the semester, each student is to develop his own version of the design, recording his results in preliminary sketches, working drawings, and models. At the end of the semester, there will be a "crit" at which the students present their designs to Quist and to a group of outside critics (the "jury"). At intervals throughout the semester Quist holds design reviews with each student, and it is just such a review which Quist, in our protocol, conducts with Petra.

Here it is Quist who reflects on Petra's initial designing. For several weeks Petra has worked on the early phases of her design, and she has prepared some drawings. Quist examines these drawings, while Petra describes how she is stuck—how she has set problems that she cannot solve.

After a while, Quist places a sheet of tracing paper over Petra's sketches and begins to draw over her drawing. As he draws, he talks. He says, for example,

> The kindergarten might go over here . . . then you might carry the gallery level through—and look down into here . . .

But as Quist says these things he also draws, placing the kindergarten "here" in the drawing, making the line that "carries the gallery level through." His words do not describe what is already there on the paper but parallel the process by which he makes what is there. Drawing and talking are parallel ways of designing, and together make up what I will call the *language of designing.*

The verbal and non-verbal dimensions are closely connected. Quist's lines are unclear in their reference except insofar as he says what they mean. His words are obscure except insofar as Petra can connect them with the lines of the drawing. His talk is full of dychtic utterances—"here," "this," "that"—which Petra can interpret only by observing his movements. In our interpretation of the protocol, we must reconstruct Quist's pointing and drawing, referring to the sketches which accompany the transcript and, on occasion, making new sketches which clarify Quist's meanings.

Whether Quist and Petra speak in words or drawings, their utterances refer to spatial images which they try to make congruent with one another. As they become more confident that they have achieved congruence of meaning, their dialogue tends to become elliptical and inscrutable to outsiders.

The language of designing is a language for doing architecture, a language game[3] which Quist models for Petra, displaying for her the competences he would like her to acquire. But Quist's discourse is also punctuated by parentheses in which he talks about designing. He says, for example,

> You should begin with a discipline, even if it is arbitrary . . .

and again,

> The principle is that you work simultaneously from the unit and from the total and then go in cycles . . .

These are examples of a *language about designing,* a metalanguage by means of which Quist describes some features of the process he is demonstrating and with which he introduces Petra, however cursorily, to reflection on the action of designing.

In the protocol which follows, both kinds of language are intertwined.

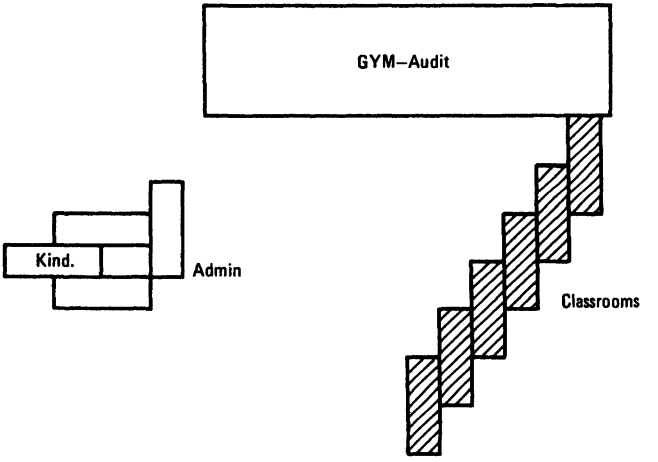
*The protocol* This design review lasts for about twenty minutes, and may be divided into several phases. In the first of these, Petra presents her preliminary sketches and describes the problems she has encountered. Quist then focuses on one of these problems. He reframes it in his own terms and proceeds to demonstrate the working out of a design solution. There follows a brief interval of reflection on the demonstration to date. Quist then sets out the next steps Petra will have to undertake, including one (the calibration of the grid) which leads him to try to get her to look differently at the representation of slopes. There is, finally, a coda of reflection on all that has gone before.

*Petra's presentation.* Petra: I am having trouble getting past the diagrammatic phase—I've written down the problems on this list.

I've tried to butt the shape of the building into the contours of the land there—but the shape doesn't fit into the slope.

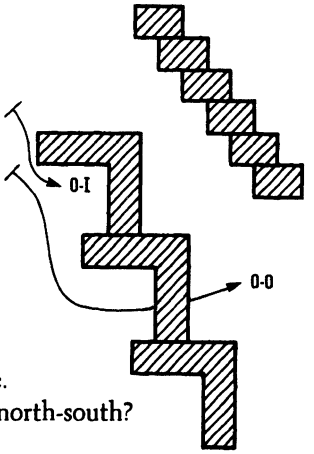
[She has a model with a slightly exaggerated slope; they discuss this.]

I chose the site because it would relate to the field there but the approach is here. So I decided the gym must be here—so [showing rough layout] I have the layout like this.



Quist: What other big problems?

Petra: I had six of these classroom units, but they were too small in scale to do much with. So I changed them to this much more significant layout (the L shapes). It relates one to two, three to four, and five to six grades, which is more what I wanted to do educationally anyway. What I have here is a space in here which is more of a home base. I'll have an outside/outside which can be used and an outside/inside which can be used—then that opens into your resource library/ language thing.

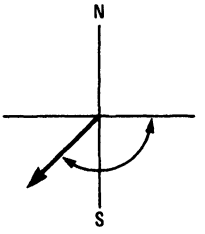



Q: This is to scale?

P: Yes.

Q: Okay, say we have introduced scale. But in the new setup, what about north-south?

[He draws his orientation diagram]



[Showing preferred orientation:]

P: This is the road coming in here, and I figured the turning circle would be somewhere here—

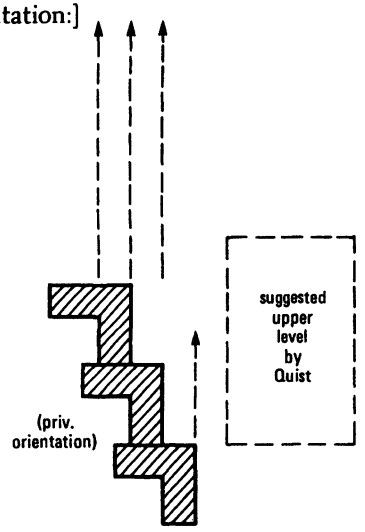



FIGURE 3.1

Petra has taken the contours of the land seriously, accepting the norm that building shape and land contours must fit one another. In her sketches she has tried the experiment of "butting" the shape of her building into the contours of the slope, but the experiment has failed; hence the problem.

Petra has also experimented with the size and arrangement of her classroom units. She has found that classrooms must reach a threshold of scale in order to be "significant" enough for design. By regrouping the six smaller classroom units into three large L-shaped ones, she has tried for "more significant scale." But in doing so, she has also put next to one another the spaces which contain the people who ought most to encounter one another, and she has created a "home base," which sounds like a good place to be, a private outer space

which can be used by the kids, and an inner space which has to do, perhaps, with the circulation of the school.

*Quist's reframing of the problem.* Q: Now this would allow you one private orientation from here and it would generate geometry in this direction. It would be a parallel . . .

P: Yes, I'd thought of twenty feet . . .

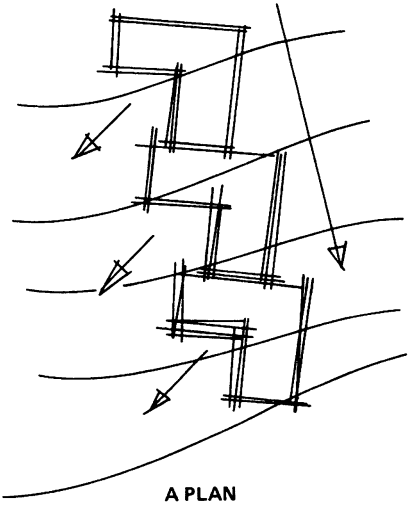
Q: You should begin with a discipline, even if it is arbitrary, because the site is so screwy—you can always break it open later.

The main problem, in Quist's view, is not that of fitting the shape of the building to the slope; the site is too "screwy" for that. Instead, coherence must be given to the site in the form of a geometry—a "discipline"—which can be imposed upon it. In the remainder of this phase of the protocol, Quist plays out the consequences of such a move.

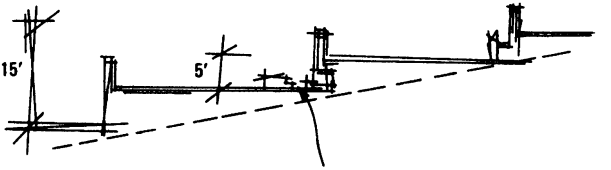
Quist's demonstration will now center on the new problem of coordinating the constructed geometry with the "screwy" contours of the slope. But the geometry can be "broken open" again. I think this means that you can dissolve the original discipline in order to try another one, and that you can later make knowing violations of the initial geometry. In Quist's metaphor, the geometry is a sort of armor which can be broken open in places, once it has been constructed. He will speak often of the need to "soften" a consistent discipline by consciously departing from it.

*Quist's demonstration.* Q: Now in this direction, that being the gully and that the hill, that could then be the bridge, which might generate an upper level which could drop down two ways.

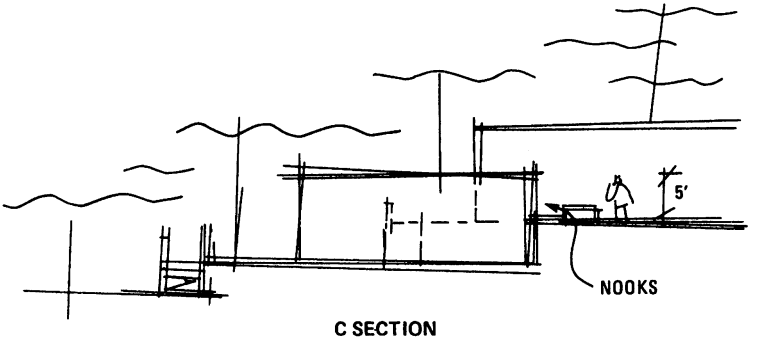
[One way from the classrooms] We get a total differential potential here from one end of classroom to far end of the other. There is 15 feet max, right?—so we could have as much as 5-foot inter-



A PLAN




B SECTION

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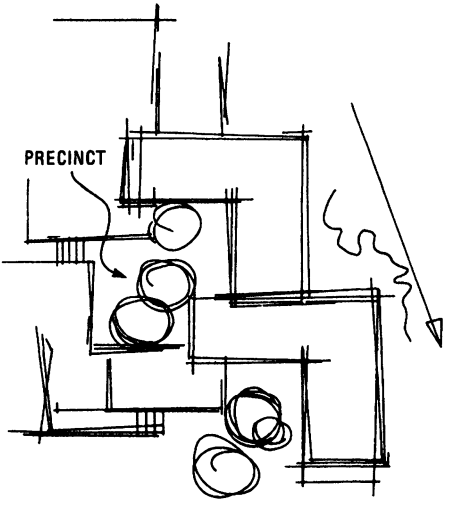
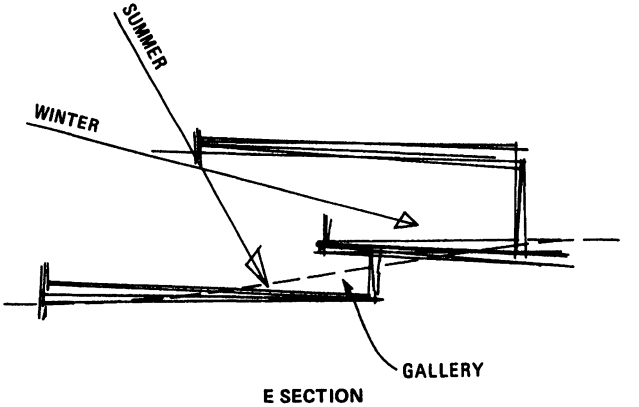



D PLAN




E SECTION

> vals, which for a kid is maximum height, right? The section through here could be one of nooks in here and the differentiation between this unit and this would be at two levels.

The sketches in figure 3.1 will help to make clear what is going on in this passage. Quist now proceeds to play out the imposition of the two-dimensional geometry of the L-shaped classrooms upon the "screwy" three-dimensional contours of the slope. The L-shaped classrooms are carved into the slope, as in sketch A. The "differentiation potential," as shown in the sectional sketch B, is from the near end of the classroom lying highest on the slope to the far end of the classroom which is lowest on the slope. The "15 feet max" is given by the total drop in the slope over the distance represented by the three classrooms. The slope is now divided into three levels, one for each of the classrooms, as in B. C shows the "interval" from the ground on one level to the roof of the classroom which stands on the next lower level. The roofs of the classroom will rise five feet above the ground at the next level up, and since five feet is "maximum height for a kid," kids will be able to be in "nooks," as in sketch C, which are approximately as high as the tallest kid.

A drawing experiment has been conducted, and its outcome partially confirms Quist's way of setting the L-shaped classrooms upon the incoherent slope. Classrooms now flow down the slope in three stages, creating protected spaces "maximum height for a kid" at each level. These Quist sees as "nooks," something he could not have done had the level difference come to very much less or more than five feet. To say that the section "could be one of nooks" is to invest these spaces with a special kind of value made possible by the level differences, and it is this which partially confirms Quist's earlier move.

Q: Now you would give preference to that as a precinct which opens out into here and into here and then, of course, we'd have a wall—on the inside there could be a wall or steps to relate in downward. Well, that either happens here or here, and you'll have to investigate which way it should or can go. If it happens this way, the gallery is northwards—but I think the gallery might be a kind of garden—a sort of soft back area to these.

The kindergarten might go over here—which might indicate that the administration over here—just sort of like what you have here—then this works slightly with the contours—

The "nooks" open out into "precincts" whose treatment is a new problem. Retaining walls are required at each level, as in D, but they also mark the different levels. Walls or steps now function as punctuation, marking boundaries and relationships. Quist invites Petra to consider the gallery as a "soft back area," as in sketch D, which would go well with the "hard" classrooms. It can also be "a kind of garden."

The resulting array—L-shaped classrooms, gallery, kindergarten, and administration—now "works slightly" with the contours of the slope. With this, Quist harks back to his reframing of Petra's original problem. When she couldn't butt the shape of the buildings into the screwy slope, Quist imposed on it a geometry of parallels suggested by the L-shaped classrooms. Now the resulting configuration "works slightly" with them. The fit is not very strong, but it is enough.

Q: Then you might carry the gallery level through—and look down into here—which is nice.
Let the land generate some sub-ideas here, which could be very nice. Maybe the cafeteria needn't be such a formal function—maybe it could come into here to get summer sun here and winter here.

P: Now this gallery is more a general pass-through that anyone can use.

Q: It's a general pass-through that anyone has the liberty to pass through, but it is not a corridor. It marks a level difference from here to here—it might have steps or ramp up to it.

P: My concern is that the circulation through this way—the gallery is generating something awfully cute, but how to pass through here [the library space]?

[More examples of Quist answering questions before they are asked]

Q: So don't think of the auditorium as a hard-edged block there.

Quist draws the extension of the gallery as he voices its possibility, imagining the experience of a person who would be following such a path, and he finds the result "nice," once more creating a confirmation of the string of moves made to date.

Petra has not "let" the cafeteria diverge from its regular geometric shape. He invites her to "soften it" by taking advantage of the site's north-south orientation which will cause the sun to fall on the slope at different angles in summer and winter, as in sketch E. Similarly, he invites her to "soften" the auditorium by relating it to nearby spaces.

*Intermediate reflection.* P: Where I was hung up was with the original shape; this here makes much more sense.

Q: Much more sense—so that what you have in gross terms is this [he points to his gallery]. It is an artifice—the sort of thing Aalto would invent just to give it some order. He's done that on occasion. So in a very minor way, that is the major thing. This repetitive thing in an organized way—there is this which is not repetitive. It is very nice and just the right scale. It also has a sort of verbal order that you could explain to someone.

The gallery, which had begun in Petra's mind as a minor element of the design, a "general pass-through," has now become "in a minor way . . . the major thing." Quist's reframing and reworking of the problem have led to a reappreciation of the situation, which he now evaluates in terms of norms drawn from several domains—form, scale, and verbal explainability.

*Next steps.* Q: Now you have to think about the size of this middle area. You should have the administration over here.

P: Well, that does sort of solve the problems I had with the administration blocking access to the gym.

Q: No good, horrible—it just ruins the whole idea—but if you move it over there, it is in a better location and opens up the space.

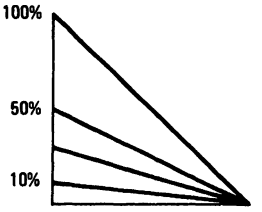
The size of the middle area (not its detailed design) can come up now that they have solved the big problem of adapting the geometry of the classrooms to the screwy slope. In the middle area, they are again concerned with the location of major programmatic elements in relation to one another. And with his criticism of the position of the administration, Quist implies that everything he has so far done—the construction of a basic geometry, the imposition of that geometry upon the slope, the creation of the gallery—constitutes an internally coherent whole, all moves having been made with fidelity to the implications set up by earlier moves.

Q: Now the calibration of this becomes important. You just have to draw and draw and try out different grids.

P: Well, there seemed to be a strange correlation between the two.

Q: No—look at it sideways. It looks much steeper in sections. You see, sections always seem much steeper in reality. Try

driving up a ten-degree road—you think you would never make it [draws his slope. diagram]




*Coda.* P: Yes, this was the main thing to get down—how that basic unit—I was thinking in much closer terms coming through the thing.

Q: [Cuts her off] Yeah, and the other thing is the subjection to a common set of geometry. You'll see that that will be a common problem which will come up with everyone, either too much constraint or not enough. How to do that, that is the problem of this problem.

P: It's amazing—intuitively you look at the shape and you know it's wrong, but it's very hard to get down to the reason . . .

Q: Yeah, well, that is what you are here for. So—I'd worry about the basic geometry on the site. I wouldn't concentrate on the roof.

Q: The principle is that you work simultaneously from the unit and from the total and then go in cycles—back and forth, back and forth—which is what you've done a couple of times stutteringly. You have some ideas of the whole which is the grid thing, but you don't know its dimensions. You've done something about this by eliminating that idea, which I think is a good decision. You keep going on—you are going to make it.

Quist returns to his earlier theme ("You should begin with a discipline, even if it is arbitrary"), but now develops it. The basic geometry should bind the designer, but under a norm of

moderation. And in fact Quist has continually urged Petra to "soften" her "hard" geometric forms and to depart on occasion from the basic geometry—but only after it has been established.

Quist has been able to give Petra reasons for her intuitions. Now he makes a basic design principle explicit: attention must oscillate between the "whole" and the "unit," the global and the local. Under the metaphor of designing as speaking, Quist contrasts her "stuttering" with his own smooth delivery.

## Analysis of the Protocol

Quist's designing takes the form of a reflective conversation with the situation.

At the beginning of the review, Petra is stuck:

> I've tried to butt the shape of the building into the contours of the land there—but the shape doesn't fit into the slope.

Quist criticizes her framing of the problem, pointing out that she has tried to fit the shapes of the buildings into the contours of a "screwy" slope which offers no basis for coherence. Instead, he resets her problem:

> You should begin with a discipline, even if it is arbitrary . . . you can always break it open later.

Petra should make the screwy site coherent by imposing on it a discipline of her own, a "what if" to be adopted in order to discover its consequences. If these are unsatisfactory, she can always "break it open later."

From "you should begin with a discipline" to "this works

slightly with the contours," Quist plays out the consequences of the new discipline by carving the geometry into the slope. In the medium of sketch and spatial-action language, he represents buildings on the site through moves which are also experiments. Each move has consequences described and evaluated in terms drawn from one or more design domains. Each has implications binding on later moves. And each creates new problems to be described and solved. Quist designs by spinning out a web of moves, consequences, implications, appreciations, and further moves.

Once the smaller classroom units have been made into L-shaped aggregates, they are "more satisfactory in scale," "put grade one next to grade two," and imply ("generate") a "geometry of parallels in this direction." Given these changes, Quist invents a new move: "that being the gully and that the hill, that could then be the bridge." The bridge also generates something new, an upper level which "could drop down two ways."

Each move is a local experiment which contributes to the global experiment of reframing the problem. Some moves are resisted (the shapes cannot be made to fit the contours), while others generate new phenomena. As Quist reflects on the unexpected consequences and implications of his moves, he listens to the situation's back talk, forming new appreciations which guide his further moves. Most significantly, he becomes aware that the gallery he has created, the "soft back area" to the L-shaped classrooms, has become "in a minor way . . . the major thing." Seizing on the gallery's potential, he "extends it here so as to look down into here." Later, he carefully avoids placing the administration building on the site in a way that would spoil "the whole idea."

Thus the global experiment in reframing the problem is also

a reflective conversation with the situation in which Quist comes to appreciate and then to develop the implications of a new whole idea. The reframing of the problem is justified by the discovery that the new geometry "works slightly with the contours," yields pleasant nooks, views, and soft back areas, and evokes in the situation the potential for a new coherence. Out of his reframing of Petra's problem, Quist derives a problem he can solve and a coherent organization of materials from which he can make something that he likes.

Three dimensions of this process are particularly noteworthy: the domains of language in which the designer describes and appreciates the consequences of his moves, the implications he discovers and follows, and his changing stance toward the situation with which he converses.

*Design domains.* Quist makes his moves in a language of designing which combines drawing and speaking. In this language, words have different roles. When Quist speaks of a cafeteria that could "come down into here to get summer sun here," "an upper level [which could] drop down two ways," "steps to relate in downward," he uses spatial action language. He attributes actions to elements of the design as though they were creating form and organizing space. At the same time, he anticipates the experienced felt-path[4] of a user of the building who could *find* that the upper level drops down or that the steps relate in downwards. Quist also uses words to name elements of the design ("steps," a "wall," an "administration"), to describe the consequences and implications of moves and to reappreciate the situation.

Elements of the language of designing can be grouped into clusters, of which I have identified twelve (figure 3.2). These design domains contain the names of elements, features, relations, and actions, and of norms used to evaluate problems,

FIGURE 3.2
*Normative Design Domains*

| Domains | Definitions | Examples |
|---|---|---|
| Program/Use | Functions of buildings or building components; uses of buildings or site; specifications for use | "gym," "auditorium," "classroom"; "5', which is maximum height for a kid"; "no city will plow a road that steep" |
| Siting | Features elements, relations of the building site | "land contour," "slope," "hill," "gully" |
| Building Elements | Buildings or components of buildings | "gym," "kindergarten," "ramp," "wall," "roof," "steps" |
| Organization of Space | Kinds of spaces and relations of spaces to one another | "a general pass-through," "outside/outside," "layout" |
| Form | 1) Shape of building or component<br>2) Geometry<br>3) Markings of organization of space<br>4) Experienced felt-path of movement through spaces | "hard-edged block," "a geometry of parallels," "marks a level difference from here to here," "carry the gallery through and look down into here, which is nice" |
| Structure/Technology | Structures, technologies, and processes used in building | "a construction module for these (classrooms)" |
| Scale | Magnitudes of building and elements in relation to one another | "a 20' parallel," "too small in scale to do much with," "just the right scale" |
| Cost | Dollar cost of construction | (none in this protocol) |
| Building Character | Kind of building, as sign of style or mode of building | ("warehouse," "hangar," "beach cottage"—but not in this protocol) |
| Precedent | Reference to other kinds of buildings, styles, or architectural modes | "an artifice . . . the sort of thing Aalto would invent" |
| Representation | Languages and notations by which elements of other domains are represented | "look at it in section," "1/16 scale model" |
| Explanation | Context of interaction between designer and others | "the sort of verbal order you could explain to someone" |

consequences, and implications. As he designs, Quist draws on a repertoire of design domains to fulfill a variety of constructive, descriptive, and normative functions.

In the domain of program/use, for example, such terms as "classroom," "administration," and "kindergarten" name buildings according to their uses. Phrases like "maximum height for a kid" and "how to pass through . . . the library space" describe the experience of using the buildings.

In the siting domain, Petra uses "contours of the land" to describe her problem, and Quist uses "hill," "gully," and "slope" to construct some of the early steps by which he carves the geometry into the slope.

In the domain of organization of space, Petra speaks of the "outside/outside" created by her L-shaped classrooms, and Quist characterizes the gallery as "a general pass-through that anyone has the liberty to pass through, but . . . not a corridor."

The domain of form has four meanings, distinct but interrelated. First there are the geometrical shapes of buildings, like Petra's "hard-edged block." There is also the sense of global geometry, as in "the geometry of parallels generated by the L-shaped classrooms." There is form as a visible sign of the organization of space, as in Quist's observation that the gallery marks level differences in the slope. And finally, there are frequent references to the felt-paths of those who will travel through the organized space, apprehending the figures, qualities, and relations which arise in the experience of movement from place to place.

In their appreciations of the situation they are shaping, Quist and Petra employ feelingful or associative terms such as "home base," "nook," "garden," and "soft back area." "A kind of garden" is not literally a garden, and the "soft back area" is not literally soft, but the metaphors of "garden" and "soft" are used to convey particular values of experience.

Often moves are found to have consequences and implications that cut across design domains. The retaining walls are necessary to the structural soundness of the buildings carved into the slope, but they also mark off formal differences in the levels of the slope. The gallery, which Petra finds "awfully cute," also creates problems of circulation. When design terms are ambiguous in this way, they may create confusion, but they also call attention to multiple consequences. Terms like "stair," "ramp," and "wall" refer both to particular building elements and to formal functions such as "marking" and "relating in." "Gallery" refers both to an organization of space and to a particular precedent ("the sort of thing Aalto would invent"). Aspiring members of the linguistic community of design learn to detect multiple reference, distinguish particular meanings in context, and use multiple reference as an aid to vision across design domains.

The designer's repertoire of domains has a structure of priorities for attending to features of situations. In our protocol, there are many references to organization of space, especially to the location of major building elements such as the gym, turning circle, bridge, and kindergarten. There are several references to scale, building elements, program/use, and the several senses of form. But there are only single references in each of the domains of precedent, structure/technology, and explanation. The domains of cost and building character do not appear in the protocol at all. The relative frequency of reference to design domains reveals Quist's priorities for attention at this early stage of the process.

*Implications.* When Petra says,

> This is the road coming in here, and I figured the turning circle would be somewhere here . . .

and when Quist later remarks that

> the kindergarten might go over here—which might indicate that the administration [goes] over here

they are noting the implications of earlier moves for later ones, on the basis of a system of norms that governs the relative placement of major building elements. This system includes norms for access (the administration building's central accessibility to all other units), circulation (ease and clarity of movement from one unit to another), and use ("opening up the space"). Thus a decision to locate a road or a kindergarten "here" has implications for the location of a turning circle or an administration "there." In this sense, there is a literal logic of design, a pattern of "if . . . then" propositions that relates the cumulative sequence of prior moves to the choices now confronting the designer.

Because of the contextual relatedness of norms drawn from the domains of site, program, geometry, felt-path, structure, and the like, the designer's moves yield systems of implications. These constitute a discipline. *If* Petra chooses to "locate the site here because it would relate to the field there . . . [and] the approach is here," *then* "the gym must be here." As Quist says, however, a discipline can always be broken open later. The implications of prior moves must generally be honored but may be violated on occasion if they are violated in a knowledgeable way.

The web of moves has many branchings, which complicates the problem of discovering and honoring implications. Given the layering of the classrooms on the slope, for example, there could be "a wall or steps to relate in downwards" which might "happen here or here." These are choice-points. As he reflects-in-action on the situation created by his earlier moves, the de-

signer must consider not only the present choice but the tree of further choices to which it leads, each of which has different meanings in relation to the systems of implications set up by earlier moves. Quist's virtuosity lies in his ability to string out design webs of great complexity. But even he cannot hold in mind an indefinitely expanding web. At some point, he must move from a "what if?" to a decision which then becomes a design node with binding implications for further moves. Thus there is a continually evolving system of implications within which the designer reflects-in-action.

The testing of local moves is partly linked to, and partly independent of, this system of implications. Quist discovers that the three classroom levels carved into the slope yield a "total differentiation potential of fifteen feet maximum" which would permit "as much as five-foot intervals" and he subsequently notices that these spaces, seen in section, could be made into "nooks." Here he affirms a local move because he finds that it has produced a situation out of which he can make something that he likes. In this he makes use of his knowledge of the relations between slopes of various grades and their uses. But he finds further support for the dimensions of the geometry he has carved into the slope when he discovers that the resulting configuration "works slightly with the contours." His method of carving the geometry of the classrooms into the slope is affirmed in one way when he sees it as a local experiment and in another way when he sees it as part of a global experiment.

Moves also lead to the apprehension of new problems such as the treatment of the "precincts" which flow out from the nooks, and they lead to new potentials for the creation of desirable artifacts such as the softening of the hard-edged shape of the cafeteria by allowing it to "come down into here to get summer sun here and winter sun here." In the designer's con-

versation with the materials of his design, he can never make a move which has only the effects intended for it. His materials are continually talking back to him, causing him to apprehend unanticipated problems and potentials. As he appreciates such new and unexpected phenomena, he also evaluates the moves that have created them.

Thus the designer evaluates his moves in a threefold way: in terms of the desirability of their consequences judged in categories drawn from the normative design domains, in terms of their conformity to or violation of implications set up by earlier moves, and in terms of his appreciation of the new problems or potentials they have created.

*Shifts in stance.* As Quist spins out his web of moves, his stance toward the design situation undergoes a series of changes.

Sometimes he speaks of what "can" or "might" happen, and sometimes of what "should" or "must" happen. He shifts from a recognition of possibility and freedom of choice to an acceptance of the imperatives which follow from choice. He urges Petra to step into the problem freely, imposing her own constructs upon it. Without this freedom, there can be no "what if?" But he also calls attention to the discipline of implications generated by her moves. The geometry of the L-shaped classrooms must be followed. Degrees of slope imply constraints on possible uses of the site. Implications for access to sun, circulation, boundary marking, nook-ness, street plowing, consistency of scale, access to gym or administration, fate of trees, are at stake in a relatively uncomplicated series of moves. As Quist draws out these implications, he demonstrates fidelity to the "musts" by which the freely chosen "what ifs?" are to be judged.

He also demonstrates how the whole is at stake in every partial move. Once a whole idea has been created, a bad place-

ment of the administration can ruin it. Hence the designer must oscillate between the unit and the total, and—as Quist points out in one of his infrequent meta-comments—he must oscillate between involvement and detachment. Quist becomes at times so involved in the local development of forms that the design appears to be making itself. But he also steps back from the projected experience of passage through the space in order to take note of the larger relationships on which the qualities of the whole idea will depend.

Finally, as he cycles through iterations of moves and appreciations of the outcomes of moves, Quist shifts from tentative adoption of a strategy to eventual commitment. This shift enables him to achieve economy of design, simplifying the evolving web of moves to make his thought-experiment manageable.

## The Underlying Process of Reflection-in-Action

Petra's problem solving has led her to a dead end. Quist reflects critically on the main problem she has set, reframes it, and proceeds to work out the consequences of the new geometry he has imposed on the screwy site. The ensuing inquiry is a global experiment, a reflection-in-action on the restructured problem. Quist spins out a web of moves, subjecting each cluster of moves to multiple evaluations drawn from his repertoire of design domains. As he does so, he shifts from embracing freedom of choice to acceptance of implications, from involvement in the local units to a distanced consideration of the resulting whole, and from a stance of tentative exploration to one of commitment. He discovers in the situation's back-talk a whole new idea which generates a system of implications for further

moves. His global experiment is also a reflective conversation with the situation.

It is not difficult to see how a design process of this form might underlie differences of language and style associated with the various schools of architecture. Designers might differ, for example, with respect to the priorities they assign to design domains at various stages of the process. They might focus less on the global geometry of buildings, as Quist does, than on the site or on the properties and potentials of materials. They might let the design depend more heavily on the formal implications of construction modules. Their governing images might be framed in terms of building character, and they might allow particular precedents to influence more frankly the order they impose on the site. But whatever their differences of language, priorities, images, styles, and precedents, they are likely to find themselves, like Quist, in a situation of complexity and uncertainty which demands the imposition of an order. From whatever sources they draw such an initial discipline, they will treat its imposition on the site as a global experiment whose results will be only dimly apparent in the early stages of the process. They will need to discover its consequences and implications. And though they may differ from Quist in their way of appreciating these, they will, like him, engage in a conversation with the situation they are shaping. Although their repertoire of meanings may be different from Quist's, they are likely to find new and unexpected meanings in the changes they produce and to redirect their moves in response to such discoveries. And if they are good designers, they will reflect-in-action on the situation's back-talk, shifting stance as they do so from "what if?" to recognition of implications, from involvement in the unit to consideration of the total, and from exploration to commitment.

This underlying process might emerge with greater clarity if Quist's demonstration were not so masterful. In his unfailing virtuosity, he gives no hint of detecting and correcting errors in his own performance. He zeroes in immediately on fundamental schemes and decisions which quickly acquire the status of commitments. He compresses and perhaps masks the process by which designers learn from iterations of moves which lead them to reappreciate, reinvent, and redraw. But this may be because he has developed a very good understanding of and feeling for what he calls "the problem of this problem." If he can zero in so quickly on a choice of initial geometry which he knows how to make work with the screwy slope, it is perhaps because he has seen and tried many approaches to situations like this one. Like a chess master who develops a feeling for the constraints and potentials of certain configurations of pieces on the board, Quist seems to have developed a feeling for the kind of conversation which this design situation sets in motion. He does not need to play out all of the trees of moves which might follow from his initial reframing of the problem. It is this which permits him so confidently at the outset to describe the site as screwy and to dismiss it as a starting point for design coherence. From this source, perhaps, comes the confidence, the directness, and the simplicity of his demonstration. But Quist reflects very little on his own reflection-in-action, and it would be easy for a student or observer to miss the fundamental structure of inquiry which underlies his virtuoso performance.