Taking Turns: Strained Metaphors as Generators of Form in Computer Aided Design

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This paper examines the role of certain graphic metaphors as generators of form in computer aided design. An introduction establishes that representation in architectural design is largely metaphorical, that metaphor is only one among several types of rhetorical turns, and that such turns can be of value in the design process. The paper then describes a case study–a residential design project–in which the author used a 3D computer-based modeling program to produce a type of strained rhetorical turn called catachresis. Through a series of catachrestic moves, conventional representations were made to yield unconventional architectural meanings. Next the paper discusses inferences from the case study regarding the play of rhetorical turns in computer aided design. The paper concludes with suggestions for catachrestic "wild card" and indeterminate functions in CAD systems to keep design processes and products open to uncertainty.

introduction

Figure 1 represents an addition to a house in Eugene, Oregon. It is not out of the ordinary as architectural representations go–it appears to be a simple likeness of some physical object. Yet, like most design drawings, this one embodies a complex web of graphic and verbal metaphors. Below I will examine the role of such metaphors in representation and design, turning first turn to a contemporary work on metaphorical functions in language.

In their well-known study of metaphor, linguist George Lakoff and philosopher Mark Johnson describe metaphor as "...understanding and experiencing one kind of thing in terms of another" (Lakoff and Johnson 1980, 5). Lakoff and Johnson are writing about verbal forms, but their version of metaphor works just as well for any sort of architectural representation. In published discussions of architecture, for example, through both text and illustrations, a reader understands and experiences one kind of thing (a certain building) in terms of another (words and pictures). And by extension, Lakoff and Johnson's description can also be applied to representational metaphors within the working process of design, whether conducted in manual or digital media: the designer understands and experiences a hypothetical building in terms of graphic representations or models.

Other authors, writing specifically on architecture, have commented on graphic metaphor in the design process (Do and Gross 1995; Laseau 1989; Schon and Wiggins 1992). These authors give particular attention to graphic metaphors that designers might use in their work, such as that of a branching column seen as a tree, or Le Corbusier's famous reference to the shell of a crab as his inspiration for the roof of the chapel at Ronchamp. Another author, Richard Coyne, and his colleagues go further. Their research shows that in the studio, design processes are pervaded by explicit and implicit metaphors–verbal as well as graphic (Coyne, Snodgrass, and Martin 1994). For example, at play in their design studio were metaphors of process alluding to the design task as a journey or a search, and metaphors of artifact referring to one building as a secure castle and another as a tentlike structure.

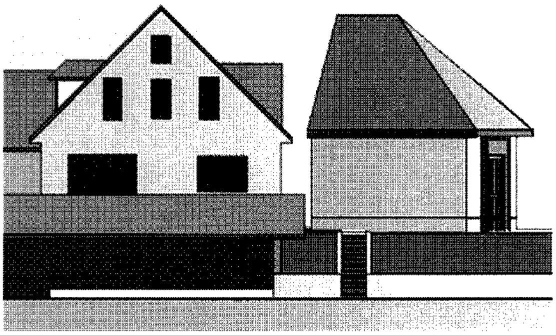


Figure 1 *Early computer sketch of west elevation.*

From all these writings–and from my own experience in architectural practice–it appears reasonable to confirm that, in general, metaphor is pervasive in everyday representation in design. And it appears possible to state specifically that, in whole and in part, and for both digital and manual media, the working processes of design are conducted largely through patterns of verbal and graphic metaphors. This conclusion is of more than passing interest. It offers us–as designers, teachers and researchers–new opportunities for both analysis and synthesis in architectural design projects. I will leave discussion of the analytic aspects of metaphor for another paper, however, and consider here only its uses in design synthesis.

One of the new opportunities for design synthesis–that is, for generative and developmental tasks–is the focus for a design case study I will describe in the middle section of this paper. It explores the use of metaphor in a computer-aided design process. The study relies on three rhetorical terms: *metaphor* (related to the discussion above), *trope*, and *catachresis*. Because these last two terms may be as unfamiliar to my readers as they were to me a few months ago, I will briefly introduce their rhetorical lineage and their bearing on the design task.

metaphor/trope

In the family of rhetorical figures, *trope* is mother, with *metaphor* and *catachresis* two among her many daughters. It will be helpful first to discuss the filial bonds between metaphor and trope, and, later, the relation of these two to catachresis.

Dictionary definitions usually treat metaphor as a type of trope (Greek *tropos*, usually translated as English *turn*). Richard Lanham in *A Handlist of Rhetorical Terms* notes that theorists have differed in defining trope, but that "such consensus as there is wants trope to mean a figure that changes the meaning of a word or words, rather than arranging them in a pattern of some sort" (Lanham 1968, 101). Thus trope generally refers to the figural use of word–that is, the use of words *turned* from their literal sense. Metaphor typically accomplishes this turn by saying that one thing is another, for example, saying of someone "he's an old dog." The metaphor turns the meaning of both man and dog by establishing new meanings for each of them and a new relationship between them. But some metaphors have been used so long and so often that they become worn out, or, as some say, dead. They lose their metaphoric vigor and collapse into what seem to be flat statements of fact: "this is the leg of the table," "I opened the hood of my car."

As I noted above, architectural design is pervaded by metaphors of process and artifact, some verbal and some graphic. Moreover, some of these design metaphors are alive, some are dead. Live metaphors are those that are made explicit, like Le Corbusier's crabshell or the reinterpreted metaphoric sketches in Coyne's design studio (Coyne, Snodgrass and Martin 1994, 122). Dead metaphors in design are those that seem, like their literary counterparts, to be simple, neutral statements of fact. Without any qualifying preamble, for example, a teacher, student or researcher might say that "the design process is an exploration of a problem space." Or a designer might say [pointing to part of a drawing], "this is the major axis," thus committing at least three dead metaphors in one breath: two verbal, i.e., *major* and *axis*; and one graphic, i.e., *an aspect of a possible building is to be understood in terms of a certain line*.

In design we treat most graphic representations as dead metaphors, that is, as neutral and transparent statements of fact about a real (or potentially real) object–the west elevation of the house in *Figure 1*, for example. But as I have shown elsewhere for handmade drawings, such usage is misleading. Graphic media in the design process are neither neutral nor transparent, they always affect the content of the work: "the designer cannot choose to work in such a way that media have no effect," and design media "introduce substantial issues into the design task…." Furthermore, I have shown that the designer may deliberately choose to exploit media issues as a resource by bringing them from the background to the foreground of the design task (Herbert 1993, 66), or, in terms of this paper, changing them from dead graphic metaphors to live ones.

Thus it appears reasonable to consider metaphor as an explicit factor in design media. We can state that the designer cannot choose to work in such a way that media *and metaphor* have no effect, that *metaphors* as well as media introduce substantial issues into the design task, and, presumably, the designer can choose to exploit such issues as a design resource by taking them from the dead background to the live foreground. It also follows that design intentions are always affected (or *turned*) by the designer's choices in media and metaphor. These propositions, then, provide a basis for the case study: I chose to make metaphoric content and digital media explicit foreground issues as generators of form. Moreover, I chose to sharpen the treatment of metaphor by summoning a related form of trope called catachresis.

trope/metaphor/catachresis

Catachresis is metaphor's twisted sister. In a more formal definition, Max Black quotes from the O.E.D.: [catachresis is the] "abuse or perversion of a trope or metaphor" (Black 1962, 33). But Black adds that he would exclude the pejorative–he wants catachresis to cover only instances of stretching old words to fit new situations. Philosopher Paul Ricoeur agrees with Black: "every trope that results in a pure extension of meaning is a case of catachresis" (Ricoeur 1975, 62). Lanham keeps the pejorative, though, describing catachresis as a misused or misapplied metaphor, either "using words wrenched from common use, as when Hamlet says 'I will speak daggers to her,' or an extravagant, farfetched metaphor, as when a weeping woman's eyes become Niagara Falls" (Lanham 1968, 21).

Evidently one is allowed some latitude in definitions of catachresis. For purposes of the case study project, I favored the notions of extravagance and perversion from Lanham and O.E.D. because they added an edge to the role of catachresis that seemed right for electronic media. To combine these notions with Ricoeur's and Black's idea of stretching, I chose to think of metaphors as *strained*, incorporating the engineer's sense of structural deformation under stress.

In sum, it appeared that moving metaphoric and catachrestic turns from the background to the foreground of the design process could offer opportunities especially suited for work with computers. Thus the rhetorical basis for the case study that follows and for this paper's title: *taking turns: strained metaphors as generators of form in computer aided design.*

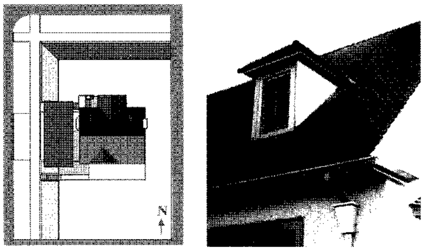


Figure 2 *Site plan and photograph of dormer*

Figure 3 *Computer diagram showing connection from house to proposed addition and long view at upper floor; access to yard, entry and long view at lower floor.*

case study: a residential addition

The following case study is both current research project, as reported here, and preparation for eventual construction. It describes schematic design and design development for an addition to my house in Eugene, Oregon.

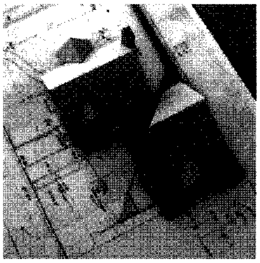
premises

The house is located in an urban residential neighborhood near the University of Oregon. My wife and I have owned the house for twenty years. It is a modest two-story structure with about 1500 square feet of finished living area. It is located right in the middle of a 9000 square foot corner site. Built in 1934, the house has a stucco exterior over wood frame construction. It has a prominent shingled roof whose simple gable form is broken by a variety of dormers. *(Figure 2)* In the proposed addition, we intend to add a master bedroom and bath, and to provide a family room with an expanded eating area connected to the kitchen. We also want the addition to preserve the view from the existing first floor study, to provide a private outdoor space accessible from the kitchen, and to provide a secondary entrance from the street. *(Figure 3)*

process

Like any project, this one had discernible roots. Some years earlier, a model for an aborted addition at the southeast end of the yard had introduced a sliced form *(Figure 4)*–a failed effort to preserve the view from the existing study. From other earlier sketches emerged a fuzzy notion that the shape of the addition might include a hipped roof such as that in the existing small dormers on the north side of the roof (figure 2, again). Still earlier, a library building designed by my architectural firm had demonstrated the potential of a dialogue between hipped and gabled roofs. *(Figure 5)*

Explorations with paper and pencil established a general plan organization for the current addition. *(Figure 6)* Hand drawings also suggested using the second floor access from an existing stair landing, controlling location in plan as well as floor levels and room heights. Other hand drawings and foamcore study models *(Figure 7)* showed that a rotated axis for the addition would be spatially effective but so complex that I would need computer modeling to investigate it. I began the CAD part of the process by modeling the existing house *(Figure 8)* and



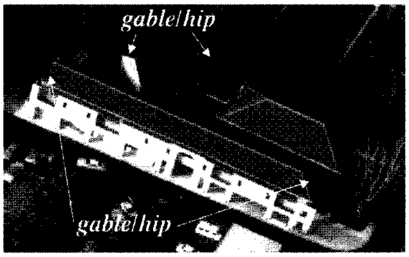


Figure 4 (top) *Photograph of paper study model for earlier project.*
Figure 5 (bottom) *Aerial photograph of McMinnville Public Library, McMinnville, Oregon.* Photo courtesy of Herbert and Keller, Architects.

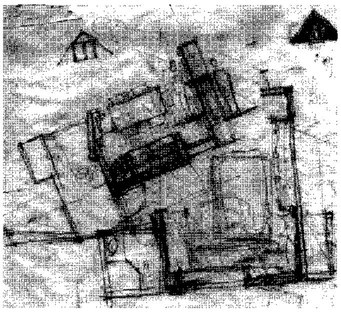


Figure 6 *Tracing paper sketch of lower floor plan.*

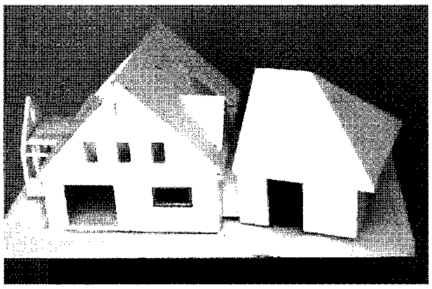


Figure 7 (left) *Foamcore study model showing addition rotated with respect to existing house.*
Figure 8 (right) *Computer model of existing house.*

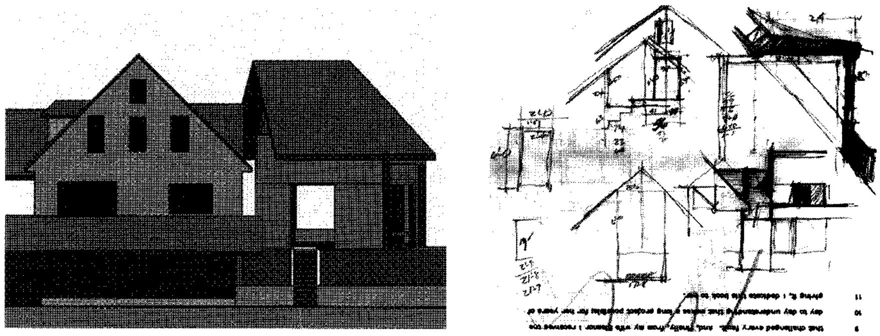


Figure 9 *West elevation of computer study model and contemporaneous paper study drawings.*

continued development with a combination of computer models and freehand sketches. *(Figure 9)* I made all computer models in Design-Workshop (version PPC 1.2.1; Artifice, Inc.), on a Macintosh PowerMac 7100; I formatted unrendered images taken directly from these models in Adobe Photoshop (version 3.0) for publication in this paper.

Issues of metaphor and catachresis emerged from within the design process; they were a direct outgrowth of the computer models. As a curiosity, I had extracted a copy of one of the existing small dormers *(Figure 10)*, and shown a colleague the amusing effect of a 6.7X scale version taken literally as an addition structure. *(Figure 11)* This colleague is an academic whose business is analyzing cultural artifacts, and he observed that both the rotated axis and the outsized dormer were graphic equivalents of rhetorical tropes–especially the variety of exaggerated metaphor he called catachresis. For me, these rhetorical terms opened a way of thinking about what had occurred to that point, and they appeared to offer other opportunities for exploration. Thus I decided to extend the list of generators of form for further work on the project. To the customary issues of program, context, and technology (my shorthand, meant broadly to include the whole range of issues architects address in design), I added trope and catachresis. These terms also provided a route to more research in the literary analysis of

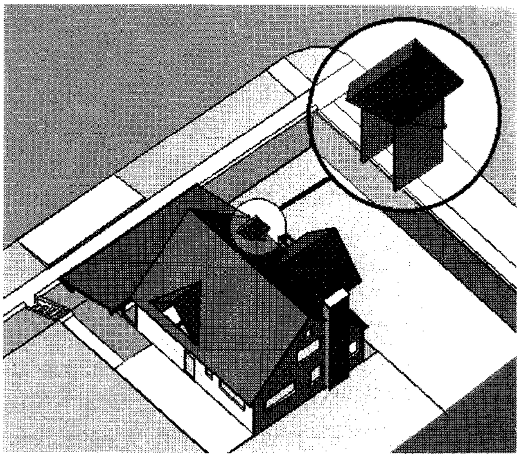


Figure 10 *Dormer extracted from existing house.*

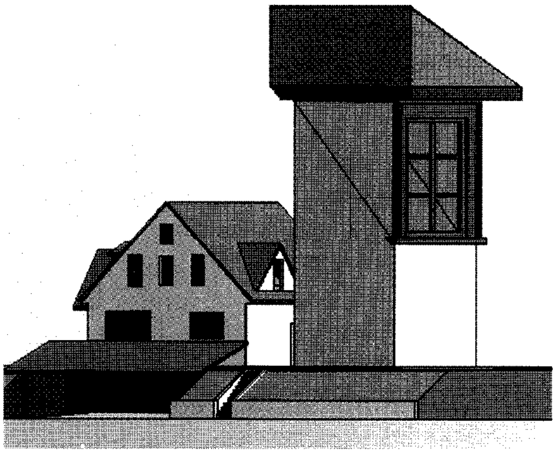


Figure 11 *Dormer scaled to 6.7X and set in position on site.*

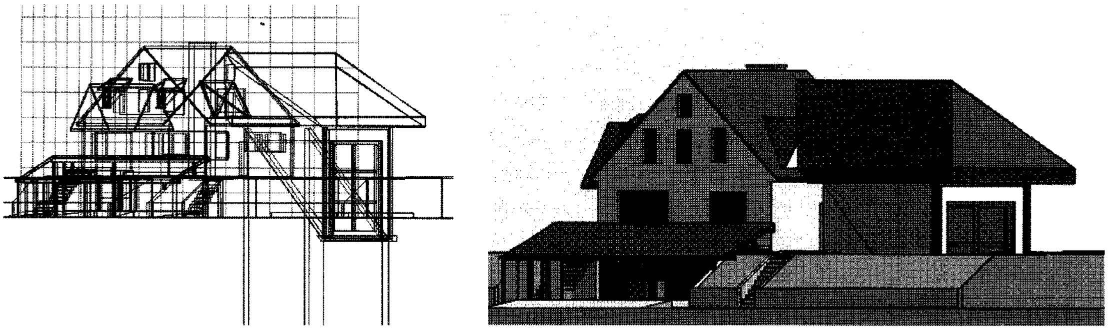


Figure 12 *Wireframe and shaded computer model of 6.7X dormer "pounded down" into the ground*

rhetorical figures. As in normal design processes, all of these issues were brought into the design not as literary but as graphic expressions.

Work with the extended list of issues involved four turns. I will briefly describe each turn and its rhetorical entailments below.

the first turn: 6.7X scale

The 6.7X enlargement came from the 20' width needed for the addition divided by the 3' width of the existing dormer. Rescaling all dimensions (LWH) rather than just the width appeared to raise more provocative issues, so I chose to do so. I treated the entailments of the rescale as proposals from an outside critic to be considered along with conventional concerns in design. That is, I judged catachrestic entailments like any other issues as to whether emergent forms would be appropriate. For example, I rejected the enlarged height of the dormer, but reasoned that I could "pound it down into the ground" until it satisfied zoning restrictions and did not dominate the existing house. *(Figure 12)* I accepted the resulting entailments that the outsized detail of the window trim and sash could serve for the south facade *(Figure 13)* and that the eave line of the addition could be higher than that of the existing house *(Figure 14)* – both of which were foreign to my normal assumption that elements of an addition should resemble and align with existing forms. I disassembled the enlarged window sash so its hori-

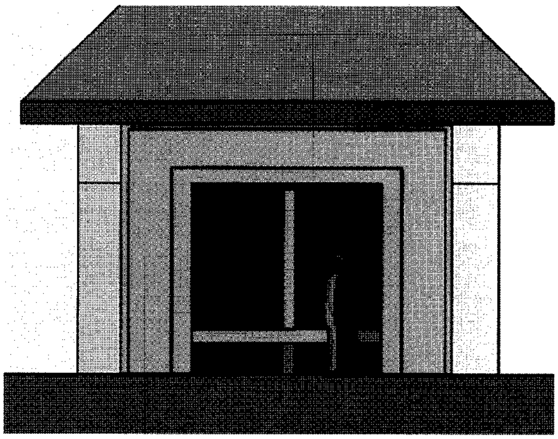


Figure 13 *South facade of addition.*

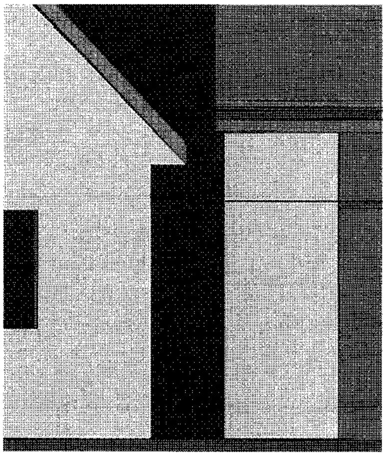


Figure 13 *South facade of addition.*
Figure 14 *Comparison of eave heights.*

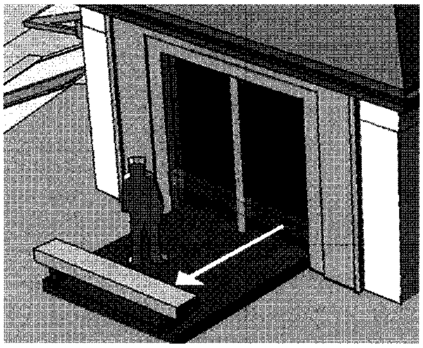
zontal muntin became a bench at the edge of a small deck. *(Figure 15)* I rejected the proposal that wood shingles could be scaled up to have 3" butts and be installed with 33" to the weather.

the second turn:
blank, studs, reflection, or vegamatic?

Enlarging the prototype dormer to the 6.7X proportional width made the dormer not only too high, but too long. How to adjust this length? The perverse sense of catachresis suggested that some enormous falling blade might unaccountably have cropped the dormer to the right size, and thus had left it adrift as a fragment its abandoned, fragmentary character accentuated by its rotated axis. *(Figure 16)* The sliced north face of this fragment lacked normal architectural antecedents: it was neither inside or outside; it was circumstantial rather than deliberate; it did not begin or end a building; the dining area at the lower floor passed right through it. Computer modeling and image manipulation made it possible to consider a variety of alternatives *(Figure 17)*, but this element resisted (and still resists) architectural resolution.

the third turn:
taking turns literally and interacting grids

As noted above, the rotated axis for the addition had roots in earlier studies. Validation for this turn came from conventional diagrams showing its effectiveness for visual access to



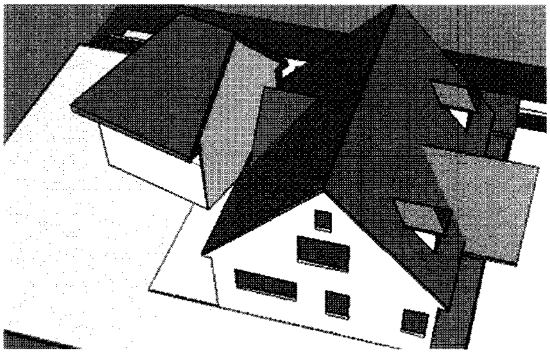


Figure 15 (left) *Window disassembled: muntin becomes bench.*
Figure 16 (right) *Addition seen as fragment abandoned and left adrift on site.*

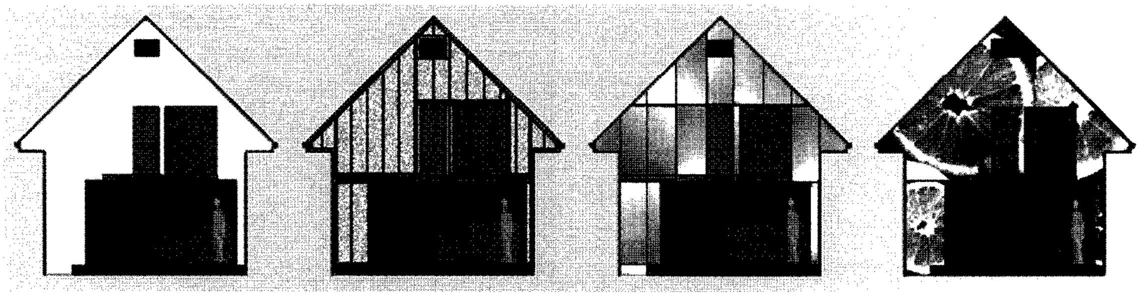


Figure 17 *Four alternatives for the "sliced" north face of the addition: (left), a blank–silent as to what the surface is composed of; (left center), exposed construction, requiring clear glass protection over studs and insulation; (right center), faceted mirrors over plywood sheathing; (right), recognizing the adjacent dining area, a bas relief of sliced fruit. I favor the faceted mirrors.*

the yard and to the principal long view to the south. *(Figure 3, again)* These are not in themselves catachrestic issues, but they had triggered the notion of the rhetorical turn and, again as noted above, this rotation emphasized the differences between the house and the addition. Thus the idea of taking the rotated axis "literally" as a rhetorical turn (or, to put it the other way round, taking the rhetorical turn "physically" as a rotated axis) twisted an innocent graphic metaphor into one with a strong catachrestic entailments.

These entailments followed from overlaying the rotated and unrotated grids in the new construction. *(Figure 18)* Collisions and near misses between the overlaid grids act catachrestically to produce circumstantial, unresolved spaces and relationships. *(Figure 19)* For example, at entrances (but not at windows), the unrotated grid insert is exposed through openings in the rotated shell of the addition; in this ambiguous context it is unclear whether the inner grid or the outer one is rotated. *(Figure 20)* Many computer model studies suggest that the difficult transition between the existing house and the addition should be part of the rotated grid of the addition. *(Figure 21)* As a practical matter, such studies of complex alternatives are easier and more precise in computer modeling than in handmade drawings or physical models

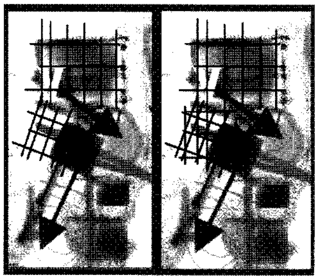
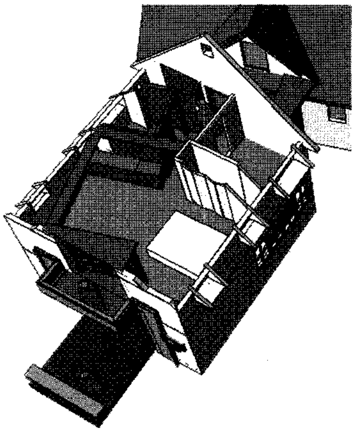
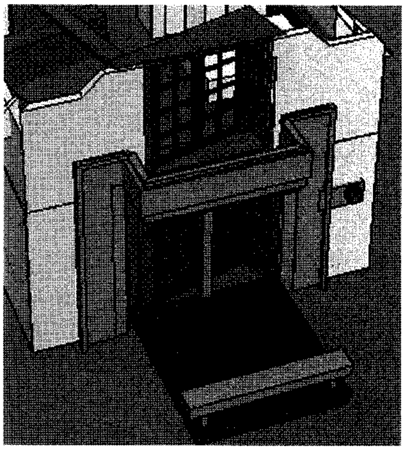




Figure 18 (left) *Computer diagram of grids for existing house and addition (left) combined to overlap in addition (right)*
Figure 19 (middle) *Perspective of second floor showing circumstantial spaces.*
Figure 20 (right) *Shell and insert: which is rotated?*

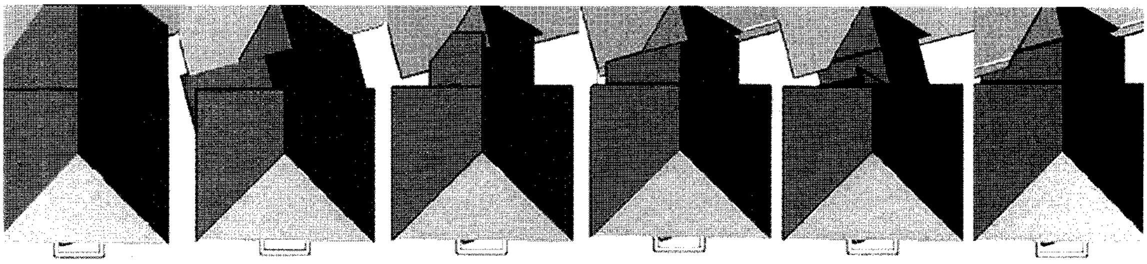


Figure 21 *Studies of alternative treatments for transition between house and addition.*

the fourth turn: reflexive dormers

The upper floor bedroom in the addition needed windows, but the prototype dormer at 6.7X provided only the single window assigned to the south facade of the lower floor, now mostly buried. *(Figure 12, again)* Considering the dormer's origin as a one of the appendages of the existing roof, I proposed additional windows to reflect it, inverted and replicated, on itself. That is, to the addition (derived from a hip on a gable), I added new "dormers" (in the form of a gable on a hip). Now the basic rescaled dormer form had catachrestic gables and dormers of its own. *(Figure 22)*

The current state of the design is shown in *Figure 23*.

discussion

This discussion section will consider implications of the case study. [Note: Many observations about design and metaphor made by Richard Coyne in his book *Designing Information Technology in the Postmodern Age* (Coyne 1995), relate to the discussion section next below and the concluding section that follows it. In these sections I will refer to citations from Coyne's book only by parenthetical page numbers, e.g., (140).]

Richard Coyne notes that metaphor in design "is primarily a discursive tool to keep a conversation alive..." (140). In the case study above it appeared that metaphor, or more sharply, catachresis implemented by the computer, can assist in keeping the design process alive and open by continually posing challenges from outside the designer's usual range of control. The rationalist assumption of control is a contested issue in postmodern philosophy: Coyne observes that "advanced technological systems...sometimes appear to be 'out of control'; in other words, we do not have a well-established praxis that incorporates them" (142). As Coyne implies, we do have an established praxis and associated control for handmade media. But I have commented elsewhere on "an impending break of design with its own past as architecture catches up with other disciplines

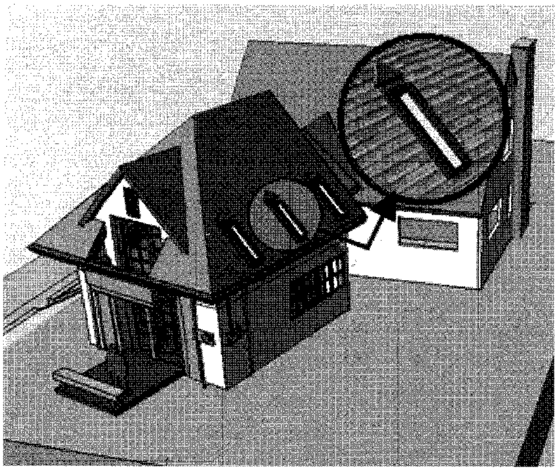


Figure 22 *The south gable dormer of the existing house is repeated on the south end of the hipped addition, and abstracted and attenuated "dormer" skylights added to the dormers east and west sides. The triangular plinths above the skylights provide an inlet for ventilation of the joist spaces above them.*

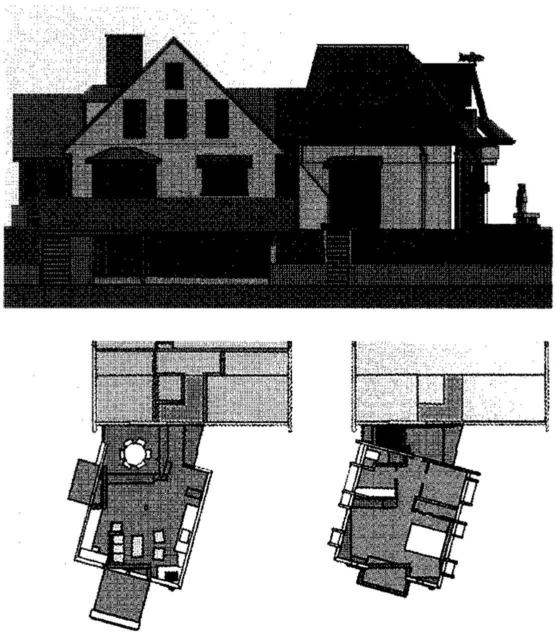


Figure 23 *West elevation of existing house and addition, lower floor plan, and upper floor plan.*

in facing questions about the origins of knowledge" (Herbert 1993, 34). This break raises new issues of control and closure, and, as I will suggest below, it also presents new opportunities to keep the design conversation alive.

Readers may note that the design conversation for the case study included both a tactical and a strategic role for the computer. In its conventional tactical role, the modeling program made it possible to explore more development alternatives in more detail than would have been practical by hand. For example, in the transition zone between the house and the addition, formal considerations of the rotated axes were complicated by problems of headroom, as well as the iterations needed to work out the consequences of the initial turn. The many studies required would have meant either prohibitive amounts of redrawing by hand or reconstructing physical models.

Less conventional was the computer's strategic, or conceptual, role. Conceptually, the catachrestic treatment of the dormer as addition emerged directly from basic computer functions: grouping and scaling, cutting and rotating. Perhaps such operations might be done separately in handmade graphics (say, with photocopying), but their integration in the computer modeling program permitted new possibilities not available through other design media. The layer of technology through which the designer works can magnify the extravagance, the *strain* that changes metaphor into catachresis. It appears, however, that although usable computer functions are necessary, their mere presence will not automatically extend the designers normal range of forms. The designer must either be open to accepting accidents (as in the case study) or be ready to make a series of deliberate choices to bring metaphor, catachresis, or media into the foreground of the design process.

Such choices confront a designer with issues of contemporary philosophy and culture

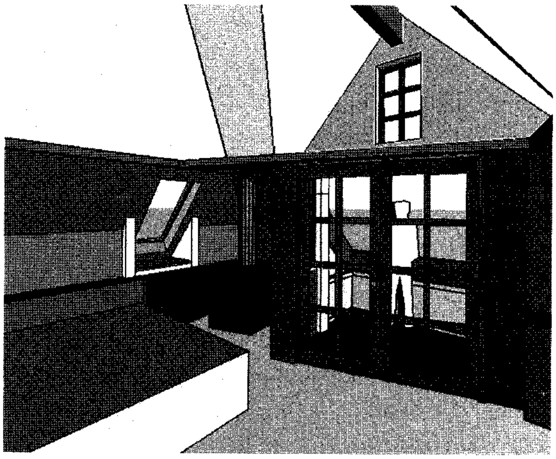


Figure 24 *Interior perspective of upper floor bedroom. The perspective is "correct," but the conventional geometry of the computer perspective does not adequately represent non conventional shapes of spaces.*

discussed in Coyne's book: uncertainty, indeterminacy, the impossibility of control or closure, open processes, and, I will add, imposed order (Herbert 1993, 53). In his closing chapters Coyne implicates metaphor in these issues and concludes that "metaphor can be shown to preserve the tensional and indeterminate nature of understanding" (307). The third turn from my case study confirms Coyne's statement: the effects of metaphor and catachresis, where they are expressed in the addition's interacting grids, produced tensional, unresolved spaces that allow only indeterminate understanding.

During the design process, the effect of such ambiguous spaces is to undermine the believability of computer perspectives. *(Figure 24)*. This unbelievability presents a serious problem in graphic representation. Architectural training makes designers want resolution and predictability in their representations so they and their clients will know what they are getting. Thus conventional graphic representation presupposes–and so reinforces, normalizes, and valorizes–conventional spatial organizations in a closed feedback loop.

Other forces also act to normalize design products. As the case study showed, even the deliberate use of catachrestic extravagance and perversity do not necessarily produce crazy architectural forms. Conventional concerns for program, context and technology in design development exert strong pressures toward normalized forms–floors that are level; roofs that shed water; windows that meet codes for light and air.

As a final point of discussion, I found two effects of catachresis in the case study: direct and indirect. Direct effects included proposals (some accepted, some not) from outside my previous design experience–those resulting from the 6.7X scaling, for example. Indirect effects of catachresis included its having established an enabling climate for the design process: a disposition to consider new interpretations–such as the invitation to develop the initial turn into a play of interacting grids. (I have designed other projects with multiple axes, but had heretofore kept them separated, as in the library building shown in *Figure 5*).

conclusions

Discussion of the case study suggests possible conclusions about the role of metaphor in our work. To pursue these conclusions, I will return to parts of Richard Coyne's book and then propose two new metaphors for use in future development of computer aided design.

Coyne characterizes prominent metaphors of computer systems–the computer as calculating device, as drawing tool, as intelligence, and as ubiquitous resource–each metaphor with an infinite regression of sub-metaphoric entailments. He concludes that the computer is not one thing but many; no one metaphor will do (308–9). My experience with rhetorical turns, metaphor, and catachresis in the case study goes further, however; it suggests that existing metaphors may be inadequate, and that new principal metaphors may be needed to represent indeterminate design processes. Specifically, this experience suggests that some sort of intervention must occur to break what is usually a closed self-referential loop. In this loop, the design task and the conventional metaphors we use to describe it continually represent and reinforce each other. Therefore, as a way to break the loop–without necessarily displacing the computing functions we now find useful–I propose two supplemental metaphors for computing in design: a specific figure of the computer as *wild card*, and a general one of computer aided design as an *indeterminate system.*

By the term wild card I intend not just metaphor but catachresis: strained and extravagant. *Wild* alone can be turbulent, unruly, boisterous, savage, passionate, reckless. But a wild card in not just wild, it is a card in play. This means that while its occurrence is unpredictable, its potential causes the player to reinterpret current and future possibilities; its value is open yet subject to certain constraints. It offers new opportunities. Similarly, some computer functions might act as wild cards in the design process, providing new formulations of the project's premises. These new formulations –kept fresh and lively by catachresis–could produce a set of unexpected proposals from outside the current design process (perhaps some of them outrageous) that would demand reevaluation of current and future assumptions about program, context and technology. The case study shows how such a wild card can intervene by accident rather than by deliberate choice from within a conventional working program.

But suppose we are unwilling to wait for happy accidents? Can we deliberately propose ways to make deliberately indeterminate choices? Perhaps we can, although realizing proposals for wild card interventions is not a matter of deciding beforehand exactly what is to be done. Coyne makes a relevant point in terms that designers from any field would recognize: "you [i.e., the software designer] frequently do not know what a program should deliver until you have investigated what is possible, which is often not known until the end of the project" (296). Nevertheless, it will be useful here to state a direction for development and offer a few speculative examples. I propose, then, that CAD systems include indeterminate functions that would allow architectural designers deliberately to invite uncertainty into the design task. These functions should be conceived as formally indeterminate. That is, they should provide more than just a set of specified transformations with user-set parameters like those offered in image processing programs. Rather, indeterminate functions should provide menu access to transformations whose structure and parameters are themselves indeterminate *up until the moment when they are invoked*, so the designer cannot anticipate and thus influence the form of the intervention.

How could a working computer program include such a wild card function? One way might be to employ a version of Branko Kolarevic's experimental *reDRAW* program (Kolarevic 1994). This program automatically maintains previously established positional relations in a drawing. Kolarevic notes that within the program, drawings "...become semantically charged and could be manipulated in a semantically sophisticated fashion" (Kolarevic 1994, 51). To set up the wild card function, variations of the program might be built into (or available to) an otherwise normal 3D modeling program. When the designer invoked the wild card, specific portions of the current drawing, as determined by connection to a random number generator, might be transformed according to *reDRAW* parameters taken from another, unrelated design project also selected at random. Thus both the transformation and its object would be indeterminate.

Or, wild card functions might include the use of Mark Gross's *Stretch-A-Sketch* (Gross 1994). This prototype program identifies spatial relations in a designer's diagram–with the risk, as Gross notes, of "incorrectly guessing what the user had in mind..." (Gross 1994, 107). Wrong guesses could be valuable, however: they might act catachrestically, to keep a designer's working process–and products–thematically open. When invoked as a wild card, *Stretch-A-Sketch* might overlay on a current elevation lines copied from another project (or an image from some non-architectural on-line database like that day's weather map), and offer its circumstantial suggestions for new directions.

Coyne offers another, less specific example: "what if we reverse the priority of drawing systems on binary logic and instead begin with the concept of drawing? What sort of machine or computer system would support a non-Cartesian system of drawing?" (268–69). Or, as I have suggested elsewhere (again), "a program might randomly introduce non-Euclidean transformations of the design geometry during design explorations so that the designer would always have to consider other possibilities than he or she had intended" (Herbert 1993, 123).

For each of the examples above, the wild card function acts to bring forward proposals from outside the current design task, outside the pre-existing order of the computer program, and even outside the designer's working experience, all similar in principle to Le Corbusier's picking up a shell on the beach or my stumbling across the intriguing image of an outsized dormer. It is important also to note from these examples that wild card functions should be introduced in a graphic format. Although designers may bring other sorts of metaphors to their work (verbal or musical ideas, for example), these metaphors can be effective only if they are incorporated into the graphic dialogue that constitutes the design task. I have argued (again in other writing) that in this evolving dialogue–in the designer's moment-by-moment interpretation of marks on the page or on the computer screen–are located the most powerful sites for influencing design outcomes (Herbert 1993, 123).

The case study and the discussion suggest that the metaphoric content of representation can serve as a valuable resource in computer aided design. But, because the metaphors of our conventional closed systems fail to represent the inevitable uncertainty of design processes and products, we need supplemental new metaphors entailing new processes and new ways to represent them. It appears that new metaphors intended to invoke indeterminate functions could provide effective ways–unique to electronic media–for designers to break the constraints that practicality, convention, and habit impose upon their work, constraints that are implicit in every ordered system.

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