A Conversation with Mitch Joachim and Andrzej Zarzycki

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I drove with Andrzej Zarzycki from our homes in Cambridge to New York City, in order to visit Mitchell Joachim at his Brooklyn studio, Terreform One. As Andrzej and I approached, we saw Mitch waving what looked like a magazine. We realized that he had just achieved significant press exposure from a major publication. On the front cover of the journal was a fantastic rendering depicting an assemblage of ideas, from his proposals under the auspices of his not-for-profit organization/ consortium of designers. He made a round of the desks among the slowly trickling in morning commuters, proudly displaying the triumph. It seemed to be a good morning in the city for all of us. Mitch gave us a delightful tour of the grand old building on Flatbush Avenue, a one hundred year old renovated structure of seven stories of dedicated workshop floor space. It is a veritable candy store strewn with models and presentation boards, scattered among the functional areas used as ad-hoc conference spaces, workstations, kitchen stations, and specialized areas of lab space dedicated to experimental prototype projects. After we all went for coffee and muffins and enjoyed some lighter moments over the hoopla of this most recent coup, we began to chat about the use of form•Z and the fantastic and the constructible, and to contemplate the future of design computing.

Kevin: So Mitch, it's been a while since you last shared your PhD dissertation work in Issue 13 of the Journal in 2003. This spring you were the visiting Chair at the University of Toronto, and now you are continuing on new endeavors at NYU. You have used other rendering programs and have taught various institutions' courses in urban design, but you have championed form•Z all along the way. Tell me something about this passion. What keeps you so faithful in the use of form•Z?

Mitch: Well if this cover art is any validation; it was originally modeled and rendered in form•Z, as you can see… this speaks volumes for me. I mean, yeah, the editors wanted their own look and spent considerable resources and time redoing the rendered style for their editorial taste, which I find quite flattering really. That's some work to do. Using the metaphor of a Samurai, [form•Z] is my weapon, my Katana, for my teachings and for the proposals I make through my designs.

Digital tools, meaning, and pitfalls

Kevin: For me, the digital tools you had mentioned before, in an abbreviated history of computing in the nineties, were less accessible. Maya, Max, and Alias, as powerful as they are, were more production-oriented tools, and were less about a design orientation through its interface, although anyone with talent as a professional operator can make them sing. Form•Z, utilized as a design exploration tool allows me and my students to better maintain the 'design workflow' in one's consciousness while working. I feel that's a major difference in the approach to the software tools and interface. To a critical degree while I'm designing, I'm less concerned about my focus on spinners, whizzers and locating palettes, than actually focusing on a viewport, where by simply clicking and dragging a mouse you're creating three dimensional objects in a virtual space. How do you see this?

Mitch: Much to the credit of form•Z ...one of my favorite thinkers in modeling was Frank Stella, the artist. He started doing architecture, sculpture and "3D paintings". He had access to Bill Mitchell at MIT. He had access to a bunch of folks. He started using form•Z to make these 3D paintings, and his sculpture and his architecture. And honestly when it comes to production (and thinking as a designer there is no computational tool out there that is intuitive), they are all filters of reason. [form•Z] got Chris Yessios and coding behind it, it's got viewports, it's got units, and different types of tools that you had preset to defaults, so that if you're a sculptor, or designer you don't think in terms of units. Frank Stella as a sculptor does not think in units. He doesn't think in view planes, right? Most designers don't do that either. When you start using the software, you immerse yourself in this

language, and therefore you begin setting up many walls of constraints. A lot of things that you want to design, you don't because the tool doesn't let you, or you don't have the knowledge to do it, or you do the design because you just discovered a new tool and that became your design. So the [digital] craft has been a recursive loop back and forth. I definitely think every computational tool will always limit you.

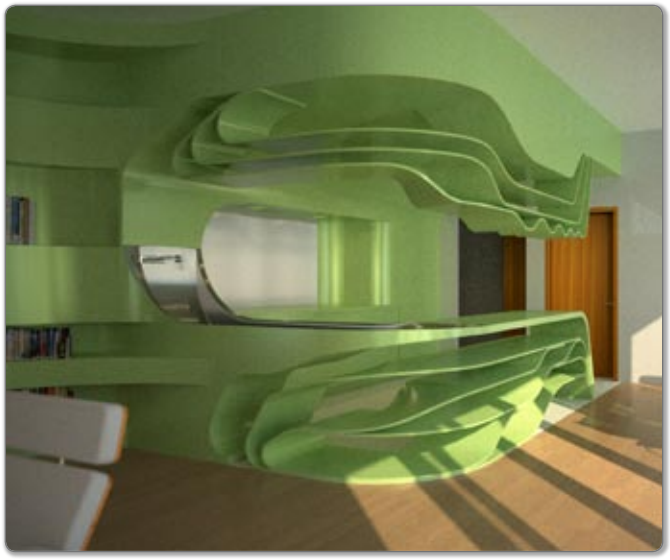
Andrzej: You mentioned that Frank Stella would not think through a viewport, with specific units, or in terms of a particular command such as the loft or sweep. However, this does not make it any more or less relevant and successful as a method. For me, there are a number of interesting computational concepts within form•Z and other similar software tools that allow for broader and alternative design thinking— thinking that may, indeed, be tied to a viewport or to mathematically driven commands, but at the same time, it offers an alternative creative path. For example, when you look at a cube, you can consider it as a single polyhedron, twelve one-dimensional segments (edges), six planes, or eight vertices. It is a single primitive that could have multiple readings based on various topological levels one would consider. Applying exactly the same command or transformation to any of these levels would result in a different design outcome. You could say that the meaning of what you are doing is highly contextualized and dependent on its topological scale. This is something traditional artists or designers would not necessarily consider. They would see separate and independent objects where we would see a geometrically defined continuum. It is inspiring in an abstract way. I wonder what other ways could also come into play if we were to introduce different ways of codifying geometries?

Since we are used to working with wood, clay, or other physically based materials, we are not thinking in terms of purely mathematical means and methods. However, I am not sure that either of those ways, traditional or digital, is the best possible approach. We use mathematical or topological definitions because they are the easiest ways to define 3D data within computational environments. Similarly, traditional methods are often a marriage of convenience, or residual values of past thinking and practices. For example, the ordering of stones in an ancient Greek temple, as we know it today, emerged out of earlier wooden structures. The stone-dressing techniques were born out of the way wood was handled and assembled. In this transformation, the logic of a wooden structure was not replaced by that of stone structures, as one would expect. On the contrary, the appearance of an old material was extended to, or forced on, a new technology. For me this seems like a lost design opportunity. And I would not want this to happen on our watch with digital technology. I often wonder to what extent past ways of doing and thinking still reside in what we do today. This seems like an obvious statement, but it is really hard to separate intentional from residual.

Kevin: I agree with you in concept that there is a new paradigm. I don't see it necessarily as posing a limit, but I understand that wisdom in how you use basically any tool is critical. It's a difficult thing when one can be so easily seduced by 3D software tools in the beginning for their immediate feedback and ease of use. You would indeed be a novice, at first. I think with digital tools one has to be more deliberate about how it is deployed, and about the discipline as a 'craft', as you characterized it. That's good. You do the project that is the technique. Whichever digital tool, whatever that original thought was in your mind, it indeed gets translated. The expression is through that tool-- but by degrees through its mutability by other processes. One analogy would be in sculpture. When you sculpt using clay as the medium, you shape the clay with your hands. When you have stone as a medium, you use a chisel and a hammer to make the same gestures in the same subject matter. A good example would be modeling the delicacy of a human ear: using the chisel and hammer as tools is a step away from using your hands as tools in clay, which is a more direct relationship, a direct input through your body, and thus a more direct input to your brain. It takes a tremendous mastery of either tool to come to the same identical solution, in a formal sense. That's why the great masters of the renaissance are so pre-eminent in our imagination for their mastery of materials and technique. The influences of these digital tools are also extensions and tools to your mind, as equally as the body is an extension, and yes, a filter of sorts for the mind's expression.

But definitely, I believe tools are not constraints or barriers and thus to be seen as a limitation, but rather as an extension, just as is your body is both a filter to retrieve information and an extension through which to project oneself into the world.

Mitch: For me, it's the results that I gain through the use of form•Z. It is of no great interest for me, to be a formalist as a means to an end. My approach to design, and I how I treat computing as a tool is less about how the tool informs my design, as it is a part of a feedback loop. Yes, it is an understood area of study, for an explorative formal approach in design, but one that is outside my agenda. I'm interested in reifying



Kitchen proposal, Kevin A. Cespedes.

my ideas. I'm interested in taking an idea from an abstract place in my mind into something that's drawn, measured, and somewhat tangible.

Andrzej: It is the opposite for me, in terms of how I teach digital design. I like the tools to inform projects and to provide the unexpected results. It is a game. I want to be surprised and pushed in a good way. Even if we acknowledge the role of digital tools in the creative process, it does not mean that one has to lose control or authorship of design. You can re-assign intent to these discoveries in a meaningful way with the same intellectual rigor, in conjunction with a sound design evaluation. This becomes a welcome departure from creative avenues that otherwise would have been unseen when working with traditional techniques of known quantities and variables. Certainly, I believe it is the designer who controls decision making, not the computer-- at least it does not *yet*. The educator's responsibility is to make students aware of limitations and impediments that exist within the digital media, and remind them that one can fall under the seduction of the digital tool. At the same time, students should be fully open to the unexpected. This is where design education, or reasoning, in the classic sense gets re-contextualized and re-affirmed. No design moves should be arbitrary.

Mitch: George Stiny, head of the Computation Dept. at MIT, he'll make this argument that when you use a pencil you are actually seeing. What he means by seeing is that there are not only infinite possibilities, but infinite ways to express, through the use of just a pencil or clay, for that matter… one may make the argument as also with the example of a chisel. When you start using software, it's enormously different. Different than a chisel and a pencil, because you're not seeing, you're actually just performing recursion. Acts that have already been given to you, preset. Very complex acts—no not complex actually, they're complicated acts. And what I mean by complicated versus complex, complicated is actually solvable-- complicated may be exhaustive and long and difficult to do it-- but it is definitely solvable. Complexity is not solvable. Music is complexity. No matter how many times you pick up a guitar, there is no such thing as 'solving' it with a guitar. In all of the software that we have seen to date, they are all solvable work environments. It is complicated; you actually solve things and there are very clear limits. Whether it's by force of the memory, by force of the program, or by force of the units, it is actually a solvable condition. It is not as infinite as you would think. It is still vast, so vast that it may be at the point where-- what's the difference? But the difference is enormous. When you pick up a chisel and a hammer, you're not thinking in units, you're thinking in the relationship of the chisel to the hammer, so you're not in a viewport, you're not using a spline, you're not using a set of code and you're not limited by memory; all of those things that happen in software. So we have a kind of a profound understanding of the limitations of all forms of computational modeling.

There are many tools in form•Z that are fabulous to use when you want design, let's say, this coffee cup-- great. When I teach students how to do that, I tell them there are a hundred ways to do it. And there is that famous analogy in topology, where a coffee cup is the mathematical equivalent of a doughnut. It's the same exact thing, you just replace the holes, and the hole geometry. But from a topological standpoint they are the same thing. So there is a million ways to skin that cat. When I use form•Z, I can think of a million ways that I can do it. It's usually what the ultimate purpose of the model in the end that will dictate which method I use. Whether I'm going to manufacture it, or render it, is the usual choice for me.

on form•Z...

Mitch: You brought up clay-- what comes to mind as one of my favorite form•Z tools is Metaballs, Metaspheres.

Kevin: Metaformz.

Mitchell: Yes, everyone has similar names for the same tool concept.

Kevin: Yes Metaformz, because of the fact that any object primitive can be turned into a meta-primitive, and not just spheres, hence the name.

Mitch: That's true--a great, great tool, an infinite tool. I love it.

I'm not always playing with the tool though, but with memory requirements that create problems with the tool. So even if I get the biggest fattest machine, it's never enough memory to deal with the kind of...let's just say, my mind can go a lot further than my machine and that tool and my mind can work together a lot further, but we can't get there because of the limit of the machine, and what it can do for me. It is probably one of my favorite tools of all in form•Z. It's just phenomenal--It's just very hard for me to think like that, in the real world.

In the real world I can't subtract gravitational elements from another element next to it and create these adjacencies. I love it. You can then preset the expressions, you can get into the details of these things, but at the end of the day though, they are cartoonish at some level. Another great thing about form•Z is that it is a solid modeler, that every floating point operation is calculable. You can find that every inch of space is measurable on something even like Metaformz. It's there, you can pick it up, and you can build it, which I do like about that. All the other software just extrapolate or they interpolate, and that's not the same as working with the hard numbers. So at some level, it is still like the polygon, especially when computers become more and more capable with memory.

Kevin: I find that pretty interesting; and refreshing. You're the first person I've ever heard say that.

Mitch: Well, Dennis Sheldon, the head of Gehry Technologies, is also pretty much into the polygons and also Chris Lubkin, the head of Ove Arup who does all the computation. Chris Lubkin is huge. He also prefers the polygon at some level because you can… from that point in space, it becomes building elements with numbers, and it's very real.

Kevin: I tend to agree with you, that in form•Z, I see the consistency in the program when it comes to solid modeling as its core strength. That is how the software started, although new modeling entities were added over time, such as NURBS, patch modeling, an animation component, etc… I think the most intelligent aspect is its ability to port all different types of entities, rational and non-rational types, and to still be able to share the same modeling environment. And if needed, these disparate entities can be distilled to a common denominator of the polygon entity. For instance, other programs dedicated to one kind of model type are rather poor at trying to emulate a form that is more suitable to another type of environment. An example would be an excellent surface modeler specializing in NURBS. Draw a cube, and it translates it not as a single solid, but rather as multiple entities or groups of entities and only described as six NURBS surfaces or twelve splines, or some other variation-- all are very cumbersome expressions for simple manipulations. Those are modeling environments specialized for one kind of model or topology type.

But with form•Z you can have NURBS that can be a surface, a solid, or both. New hybrid entities have been invented and coded with commonalities, which can now interact in the same environment with each other. You can Boolean disparate entities that otherwise couldn't even exist in the same model space in many other program. For me, this is second only to the interface, as my most favorite feature of the program.

Jewish Community Center proposal, Flemington NJ, Kevin A. Cespedes fromerly oceanD, in cooporation with George Liaropoulos-Legendre..

Mitch: Do you use the new version? Without the Greys?

Kevin: Oh, what, you mean with the new interface Icon Styles?

Mitch: Yes, as opposed to the old Greys.

Kevin: [laughing] Oh yeah, that's funny, I've known "the Greys" for all my years, but I do teach the color icon styles as it is an improvement. Personally, I'm "old school" and prefer the grey icons.

Mitch: It's beautiful, the Greys. And I appreciate that they still keep them in the program.

Kevin: We've already started the conversation by talking about specific tools, your favorite being Metaformz. I would have to say a tool I find interesting is the Macro Transformation tool.

Mitch: Yep, I love Macro Transformations.

Kevin: It is an open-ended, algorithmic tool, as you can assign any object to be transformed--very much along the same lines as the Metaformz, as an obvious contrast to say, the stair tool which is a parametric tool of high specificity to one concept. My favorite, and the most applicable use I find for the Macro T tool, is for urban and landscape design, speaking as an architect. It has limitations for sure, but it's a solid concept in my view, and I often incorporate forms using this tool in proposals. At the AA [Architectural Association in London] and the Design Research Laboratory in the early years, we didn't have the technical facilities such as at MIT's media lab or those in Columbus, but we did learn a few things about technique-based approaches to emerging technology for use in design. With the Winy Mass workshops [digital computing workshop as part of the AA Masters program], we used the power of software spreadsheets in the creation of what he liked to call 'Datascapes'; an ability to formulate spatial properties and scale information in a graphical form as a figure to be mutable using defined parameters. We tried to seek out any program that had algorithmic features, to co-opt for design and meaning-making. Macro transformations can be applied, giving an operational meaning and scale to an otherwise open, unitless tool.

Mitch: Yep, I have been using them since the moment they came out. I find very few real uses for them, but if I really want to put the 'funk' in functionalism and just spew out something out wicked cool, I always turn there. I'm constantly trying to find something in that for an outcome, especially for urban planning and urban design, because it's almost built to figure out some of these patterns with small variations. I look at it as the precursor of 'Power Copy' in CATIA.

SOFT Blimp Bumper Bus, Terreform ONE.

Mitch: The analogy again is that we are Samurai, and this is that art of war, so design therefore is war, and you should be able to use any weapon. So I can't subscribe to any weapon (tool) in particular in form•Z, even form•Z as a weapon in itself. If you need the Katana, it's great for a beheading; if you are on a horse, you might want a spear, not a sword.

Kevin: What I try to teach is the application of meaning-making to a certain parameter within a tool, or use of the tool itself, for a purpose as a design variable.

Mitch: Post use of the tool?

Kevin: Yes, a post use of the tool can be a good characterization… Do you teach this or any sort of equivalent?

Mitch: It's not a bad direction, although I'm definitely wary that the artist or the designer uses the medium and the craft as their final work. This is akin to: I'm Leonardo da Vinci, and I just developed a new kind of paint, and all I do is show you how this paint is applied and that becomes the project. Not a picture of the last supper. That's your idea and that's your symbology, that's kind of the whole idiom of your work. No: I just show you how I make this fancy new paint. Or how I produce this type of bronze sculpture, or how I produced this brand new kind of modeling tool and it makes X. More recently we've been doing that with biological architecture where we print cells of meat into shapes and we print those shapes into what we call an in-vitro meat house, but we don't use that actual craft of taking regenerative medicine in a laboratory to make

cells into shapes as our design. It's not that we master our toolset (in this case it's a biological toolset), in order to produce things that we want. To produce the mind's eye. To produce what we see, not to exploit the tool in and of itself as the object or the essence of the project. And, of course: the happy accident. Yes, that's Duchampian, to take pleasure in the accident. I used the tools the wrong way and I made a discovery. That's explorative. That's excellent. Hopefully that discovery has a kind of internal reworking.

Kevin: Yes! It must.

Mitch: But a lot of cases, especially first time users, and even anyone who hasn't been using modeling for more than five years, they actually do this, software does it for them and they don't go beyond because they can't go beyond.

Kevin: About your illustrations: for me it just happens to be the thing I see when looking at your images-- of this quality, an illustrative look that I admire-- and I try to come to terms with my own aesthetic. I understand the explanation of the Lightworks engine being ported to the software, somewhat off the shelf, but for me it's the best adapted situation for this design software. I get mixed reviews from designers about that. Some really love it, and some really don't. I think it gets me where I want to go. It keeps the realness at bay, a postponement of reality, yet simultaneously looks super detailed or clean in an illustrative way; I guess I can characterize it as an "illustrative real". Ultimately, I make that representational choice depending on to whom an image will be presented, and for what purpose, I suppose…

Jetpack, Terreform ONE.

Mitch: When you talk about the illustrative quality of form•Z, what I like about it is this kind of a retro effect. DJs sample from the past into the future and have it be cool again. form•Z and modeling from a certain generation have this same kind of feel. They have a show right now in LA from at the Ace Gallery on Neil Denari's work. Neil's work certainly predates the computer age. His drawings come from aerospace and sci-fi. Contemporaries of his like Syd Mead, H.R. Giger, and let's not forget Archigram, they were all building up an aesthetic. It's the same thing in digital media; one has to find an aesthetic. Not only are you a Samurai with your own thoughts about design and the art of design-- so too with concerns of aesthetics-- you find your own sword, and it is, again, how you use that sword that defines the kind of warrior you want to be...

Andrzej: A movement away from geometries, meshes, et cetera, and going to some—let's call them *smart geometries*—geometries connected to properties of materials, scale, and thus capable of participating in environmental simulations. A bloated term, sure, but it is hard to find a better name for it. There's "BIM database" at one end of the spectrum, a dry one, and then there are kinds that involve dynamic processes to derive geometries. It could also be used for form emergence and to provide validation criteria for design. Other programs have these extensions, but form•Z has one in particular, "metaformz," a simpler set of parameters than particle emitter simulation. Metaformz behave like mercury. The resultant geometry looks for the minimal surface tension, so to some extent it exemplifies the material properties of an object. I think this is a very enticing direction for incorporating physically-based behavior into design. I tell my students that if you want to do a design simulation, you should try to play a Jenga blocks game, or even a Wii game. It can be a physical game, Wii, or just a simulation within a 3D software package. When you pull the head block out of the Jenga stack, you get an immediate response, an instantaneous reaction to the set of parameters. It can be gravity, or it can be another force. It is important to try to get this level of response into digital design practice, both for structural and non-structural simulations. I like to think of it as a design dialogue with a console. However, this is not an ultimate goal for digital practice. It is great to mimic reality, but even better is to dictate actions or parameters outside the physical world: propositions that transcend what we know. The next frontier in

experimentation is how these virtual constructs would behave with materials that do not exist, but that could be defined within a computational framework. One would define desired properties first, and then see what material would ideally result.

Mitch: Unobtanium…

Andrzej: [laughing] yes, precisely.

Mitch: We used to say that at MIT all the time…

In memory of Bill Mitchell

Andrzej: On the subject of MIT: Bill Mitchell…

Mitch: Yes, it's horrible… A terrible tragedy… He brought CAD to architecture. He's a hero. It would be nice to imagine a memorial for Bill. Maybe it's a… some kind of glazing system in the lab or a pathway named after him, or a garden or a seat area, some kind of a permanent thing connected to a digital thing where there's an archive of everyone that has been one of Bill's people, for a very long time…

Andrzej: I think that's a very nice idea… Something virtually permanent and perpetuating…

Mitch: And yet, and this is interesting, people still long for the physical; there must be a geographical location, an object or space, a garden where you can go and can commune with the memory of what it was like to be a part of Bill's story. The digital experience doesn't provide that exactly. You probably have to do both.

A second liberation moment

Andrzej: It is really hard to be critical of ourselves and to surpass limitations we set for ourselves. Obviously, we don't have the necessary temporal perspective and emotional detachment to remain unbiased. When we discuss the present state of thinking, in this case computational design, we only can see a fragmented view. Personally, I like to think through analogies or parallels to get outside this frame of reference. When I watch movies from the thirties or twenties, especially silent films, they seem overly staged and theatrical. Everything is static and formalized, starting with dialogues and ending with scenery. Scenes often take place inside buildings as on Broadway shows. These movies, and this is a personal observation, don't feel much different in the way actors spoke and acted from traditional theater productions of the day. The medium has changed, but without adaptation of a content or a story into a new format. On the other hand, when you watch David Lynch, or current art house movies of today, they are completely unthinkable within the movie thinking of the thirties. The narratives, discontinuities, etc.… The cinematic medium needed time to develop and to establish its own identity. So this analogy goes back to your point that students continue to permute projects with Voronoi patterns or other similar out-of-the-box tools. Perhaps this is a necessary part of the process, where we need to get oversaturated within a medium to be able to use it critically and innovatively. Many designers, even very sophisticated ones, try to react to what they see around them, not to the inherent nature of a tool or a creative framework these tools provide. They go through the motions of computational creativity, rather than playing it like good music and following where it leads with a good dose of improvisation.

Much of the contemporary criticism of computational design misses the fact that this is a young medium, really still in its infancy, with much more to come. It is like criticizing films of the thirties for being too much like, or not enough like, their stage counterparts. Over time, the film medium proved to be a distinct art and communication form, with its own identity. Only when time allowed for disassociation with the past models did new modes of filmmaking stop referencing traditional theater and develop original narratives. In this sense, perhaps, computation will have its second liberation moment.

Mitch: And we will see that soon enough; that's a great analogy, and I would make an analogy to Hip-Hop: it was born in the eighties, it evolved into a generic house hip hop, and now every time we hear it, it sounds the same. So we are waiting for that second renaissance in Hip-Hop, where it's a whole new shift.

Rover from the Lunar Vehicles series, Kevin A. Cespedes.

Kevin: Yes, also being mindful that a renaissance has happened already in cinematography because of the first age of digital media. The camera began with a fixed viewpoint, and then it evolved to the dolly, then to the steady cam, and now it can completely and seamlessly merge in and out, independent of the subject, due to the capabilities of digital processing and virtual camera movements.

The Future...

Mitch: Computation should have that. In fact, we could probably talk about what the future of computation might be.

Andrzej: I agree that this is a critical question. How do you motivate designers, students and professionals, to go beyond pushing a particle button (let's just say Maya, overtly), and looking for coolness, or simply trying to repeat some effect seen in a design magazine? I guess less desire and more intent.

Mitch: Yeah, we covered that with Renzo Piano, saying that computers take below average/ poor designers and make them average to above average. It's only the ones who had talent and truly creative instincts in the first place, that when you start to give them this kind of craft, they will supersede, they will do things above and beyond, and they will make explorative discoveries that truly transcend the medium.

Andrzej: This does speak to the need to go beyond the seductive part of digital tools: instant gratification with deferred judgment. This also touches on the veil of seduction, almost addiction to these tools. This is not a criticism, just a reflection on some of the practices. The immersive and evocative quality of digital tools is critical, but it can make a designer intellectually and artistically lazy through the overemphasis on in-the-moment thinking/ existing. I wonder when we will have enough of this newness to see it and to explore it for what it truly is.

Mitch: Right. We are going to be done with the newness real soon, if guys like us aren't already done with newness. Do you know Axel Killian?

Andrzej: Yes.

Mitch: Yeah, he's definitely done with newness. At Princeton he's still teaching these kids, trying to look for the next thing. But our minds, our minds are not done with newness. We are actually the same as we were in the Renaissance, but with different exposure units. We still have infinity...we are nowhere near finished.

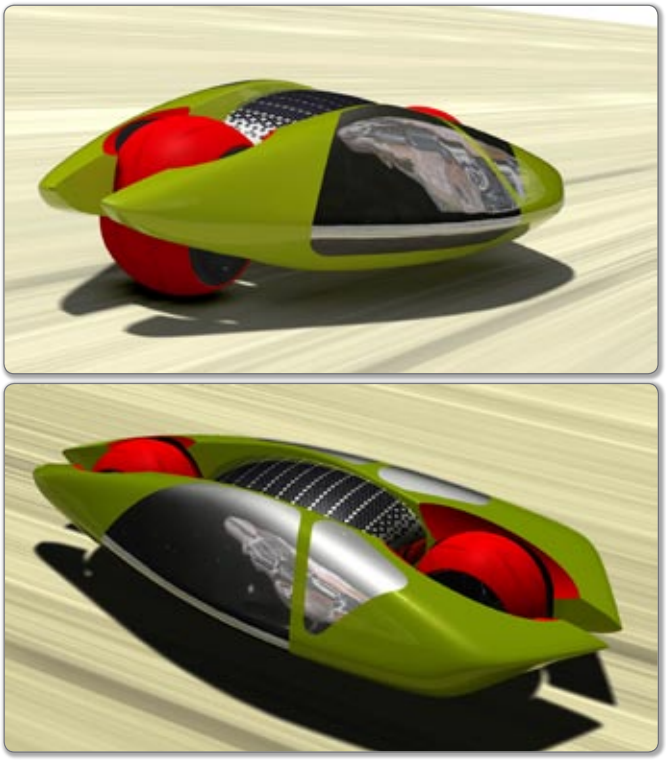
Kevin: Our problem is that our lives have been mediated by the image, so that breaking or evolving out of this pattern of simulacra is daunting.

Mitch: There is a program called Google SketchUp. Overlooking the software's obvious technical limitations as a modeler, lacking both depth and quality, it has a few advantages over other software that include: (1) It's free; (2) it's easy to learn, and most notably (3) it has a library of *everything* as three dimensional models. The search for form using libraries is of particular interest.

Other companies are getting involved; certainly BIM has prompted major companies (Permasteelisa, or Lutron) to start making all their lighting solutions in a BIM format and then you give them to people. But that's not everything; I'm talking about *everything*, right? I want to search *everything* in the 3D realm of everything. If I am a designer, and I want to design a chair, I don't need to design the casters for my chair because there are seven million of them already as 3D models out there. It is actually more about the search, a finder, to pull in the right caster quickly, and then design the rest of my chair above it. Or an armrest, or an airplane wing, or, if you look at just a host of electronic components, 3D versions of making in the next cell phone; I don't need to redesign entire circuit boards, transistors, I actually can find those components already, insert them, and, it would be pathetic if all I do is redesign the housing. I am going to be seeking other things that are already out there. 3D in the future is actually going to be a culture of finding the existing objects if they already exist. Then they are not defined strictly as virtual objects. So now you actually assemble it in 3D and it's done.

Andrzej: You bring up an interesting point. I am not saying BIM is there yet, and it may not be ultimately called BIM. However, BIM, or another database with smart geometry ideas, will be there. If you look at General Motors (GM), it takes them a couple of billion dollars to produce a new model of a car. On the other hand, there are private car manufacturers who will custom design and build a car for you based on parts that are already available on the market, for 200,000 or even 100,000 dollars. The car is pretty expensive if you compare it to the mass-produced models, but there is almost zero development cost because they use components that can be easily customized and ordered from China for a small premium. The parts can be solved for compatibility and required performance specs. This is already happening.

Based on what you are suggesting, once there is a relationship established between a virtual and physical model, one could use virtual model assemblies to check for compatibility as well as to test and simulate performance of physical models or products. Consequently, one could order his or her LEGO car and assemble it oneself with virtual road testing and



LAR coupe from the Lunar Vehicles series
Kevin A. Cespedes.

safety check, or perhaps send it to another person who knows how to physically put it together.

Continuing the same thought: If one could trace all the physical and digital libraries and understand how these libraries correspond with each other, assuming that this future SketchUp also understands physical behaviors properly, one could custom design and produce one's own car—not merely the body design, but the entire car with all the components and interoperabilities. This is not that different than designing your own kitchen in IKEA or Home Depot.

Mitch: The general theory already exists. Just because you model it, it doesn't mean it's fake, if all the parts are real and you just need to assemble it; it's already there. Mostly these modeling programs today are just propositions for remaking things that are already made, in a culture that's slowly building a library of Borges, right?--The infinite library where all this stuff is already found. Or like this building, a big tool shed of old robotic parts, biological parts, architectural components, ready to be assembled and built. Big companies like Pella Windows are already game to this. No architect sits there and actually designs, well unless your job is to design a very special skylight and you're I.M. Pei (which is possible), mostly you just take the default. Now defaults are everything. Walls, floors, you name it, the space itself, so the more we'll understand these products and materials, the less time we will have to do these custom model things, the assembler systems will come to the fore, and then there will be a new realm of design that will be very exciting but it will actually be just like it used to be in the real world. Now you're stuck with infinity all over again… now you can take any parts…

Andrzej: See, but this position still requires something that combines functionalities of BIM and SketchUp in a single, unified platform. You certainly want to have a "SketchUp" or "bonzai3d" feel for simplicity, accessibility, and transparency in a design tool, but you also need BIM to be able to handle embedded information, including budgets, performance data, and generative design feedbacks. So I still maintain that it is not all about geometry, but rather about properties that can incorporate and permute other data.

Mitch: I totally agree. Let's say we're an architecture firm: The Three Brothers. Client says he or she has a brownstone; "I need a heater in my basement, a boiler." First we get to argue who gets to do that crappy job, but we need the money, so now we're going to use a new 3D modeling system in our future, which is totally BIM-based. Actually you just ask a drill down menu, the square footage of the basement, the amount of heat needed, and you open up probably a menu port for just heating systems, and then you input the height of the basement, the concrete padding, the existing stuff, and boom! It starts asking you some basics, "Do you want water based? Do you want steam?" And then suddenly now, it's totally about product selection. Now you're in a product by carriers, specific systems with all the BIM specifications, and then now all you do is just fit out cost, performance, and all the other particulars-- you're not even drawing-- and you're done.

Andrzej: It is an interesting observation. I just went through an analogous procedure in other circumstances. Last winter my furnace broke, and a technician's recommendation was to replace the entire piece of equipment. Naturally, I wanted to have it fixed in as short a time as possible. I called my plumber, a person I did a couple of projects with for my clients, and I told him all the specs of my furnace: the height, the ductwork size with all the connection arrangements, and the BTUs. I mentioned that a replacement could be more expensive, within a couple of hundred dollars, as long as it came with exactly the same specifications as the old furnace, so that he (the plumber) could just slide a new furnace into the old location without much additional miscellaneous work. My plumber had to make a number of calls, more than usual, and had to go to another supply store to pick up the furnace, but at the end everything was done within three or four hours, and with a very reasonable price. At this point,

all the job parameters were optimized for the minimum amount of on-site work, considering what was available on the market. The same procedure can be easily applied to digitally-assisted design, manufacturing, and assembly. Suddenly everything will be done in a shorter time, and not only for architects but for service repairs, facilities management, etc. The key here is to be able to connect the dots, availability with needs, ideas with capabilities. Computation could help us to get it done. More capable future-BIM systems could coordinate among design, market conditions, and local practices to deliver effective and efficient buildings. This is not necessarily a new approach. Many precast or stone veneer buildings are commonly designed with the eight-inch module so that they could easily be adapted into brick masonry structures, in case budget would not allow for a more expensive facade. However, in this case, the idea of a module is much more abstract—virtual and adaptable to market forces and other design circumstances.

Mitch: For anything. Companies would do it for electronics because there is the greatest amount of money in it. The cell phones are all the same, actually there is a limited industrial ecology of materials that go into them. You throw them out mostly, not because they are obsolete, rather it's a perceived obsolescence. "My razor is no longer cool, it still works just fine, or I can get a whole new battery, but I'll just buy a whole new thing." They help you see things you would normally never see… If you were doing a lighting system, as an architect, and you decide that at this point you're specifying the lights. Then Lutron tells you with its BIM information, guess what? You've got the physical geometries working, the physical look working, the performance working, but oh, these are these things called ballasts; you need to put them someplace, and your circuit boards, and these are your switching mechanisms, and these are your actual switches. And all those things you haven't thought about, suddenly they get imported with that model, so now you're becoming more in depth with how you approach your model, all because the company has set itself up to give you all the possible data so that when you really specify their particular lights, you get the whole soup-- soup to nuts. Then in the end, what the hell are we 'designing'? There will probably be this field, I can imagine computation having an 'age of recovery', meaning you just recover or assemble systems, like information retrieval guys, like in the film 'Brazil'; we just become these 'retrievalists', but very sharp because we have the capacity to put massive puzzles together.

I think it's an important milestone date in computation that every industrial design object before 1995, it's safe to say, wasn't done with CAD of any sort. There will be a huge market for what I call 'scanners': people who go out with 3D hand laser scanners and take, a Louis the XIV armoire, and scan half of it (the only part you need to reconstitute the whole design).

They will do it for a number of reasons: some antique dealer is selling it for 10,000 dollars, but only has a picture on eBay. That's a lot different than having the 3D model, so designers can see it in spaces, but also someone in China wants to make replicas of the thing. They only need half of it because it's symmetrical. If you want to start scanning everything, now more of these things become accessible to the search engine database, and now there is nothing left that's out of the loop. We've got antiques, we've got modern objects, and so then inputting the BIM information will be part of it. What is the BIM information for a Louis the XIV armoire? There are a lot of things; actually a lot have been lost, how they made this thing out of wood, did the beautiful inlays, so it's kind of this retroactive BIM-ing that will be fantastic.

Andrzej: It is interesting because design was integral to the ways a product was implemented: the certain types of cuts, the chisels or tool marks. Now, when you use a CNC machine to try to mimic the traditional tools with their outcomes, does that make sense? Or should you rather pursue another kind of Louis XIV, as the designers would do today based on today's state of knowledge and sensitivities?

Kevin: [laughing] I have in my mind a vision of milling grooves as an artifact from the manufacturing of them.

The fantastic and the constructible

Kevin: What do you think when you hear the terms 'the fantastic and the constructible'?

Mitch: Well, you're preaching to the choir. The first thing that comes to mind is something Moshe Safdie taught me. Actually he still uses form•Z (in his office), and that's pretty good. His term and my term would be that in architecture there are really two big positions, and they are the heroic feat of architecture, and inherent buildability. Inherent buildability means that you fall within the ways and means and scales of economy associated with making a building real. These are known measurements or quantities, such as the size of windows, the scale of the machines, the use of elevators and all of the component mechanical parts,

from the ability to phase in cranes to get things right. This is basically how you build a building. And about 95-99% of the world's construction falls under inherent buildability. Designing within the realm of inherent buildability, you still can produce a hell of a lot, and you really know what those limits are, and you're supposed to because that defines who we really are as architects. In other words, you wouldn't do something stupid like make an entire building out of plywood sheets that are 9'x5' because you can't buy them, as they don't exist. The heroic feats of architecture are something like Rem Koolhaas when he proposes CCTV, this building in China. It's an impossible skyscraper, because it breaks all the rules, and that basically means every element has to be customizable. It is customizable to the point that you can no longer think of economy. Sure, the building can exist-- I don't even believe anything is a fantasy-- fantasies can reify themselves if you have the capital, so it's a matter of money, I don't believe there is any geometry that isn't buildable anymore, I mean Zaha and the Gehry generation have proven that. It's just a matter of the cash and the ability to optimize. So, CCTV is something where you a have a typology that's deeply understood, in this case tall building design, that requires 50% more of your floor plate devoted to elevatoring, which means less occupiable square footage, less rentable space, less feasible of a building by far. But that's what he does when starts making this 1970's sculpture and turns it into a building: a heroic feat of architecture.

Probably another person to look at is Freeman Dyson, and his book *Infinite in all Directions*. Freeman Dyson was on the Manhattan Project. He's the most sagacious professor at Princeton in the physics department, where he has said that science fiction is actually a better indicator of reality than economic forecasting. Science fiction is Mr. Spock using a 'tricorder' in communicating to the Enterprise from across a planet below.

And this is something that in 1973 seemed to be absurd and impossible but actually becomes a fantasy in the heart, mind, and imagination of everyone, from accountants to lawyers, to people who eventually start working in the electronics industry, to engineers, and to designers. You eventually design something called the iPhone, which reifies itself and is extremely realistic. So science fiction is actually where we pull a lot of our concepts of the future.

Mitchell Joachim, PhD, is a leader in ecological design and urbanism. He is a Co-Founder at Terreform ONE (a nonprofit organization and philanthropic design collaborative that integrates ecological principles in the urban environment) and Terrefuge. He earned a Ph.D. at Massachusetts Institute of Technology, MAUD Harvard University, M.Arch. Columbia University, and BPS SUNY at Buffalo with Honors. Mitchell is an Associate Professor at NYU and previously was the Frank Gehry Chair at the University of Toronto. Earlier, he was on the faculty at Columbia, Syracuse, Washington, and Parsons. He was formerly an architect at Gehry Partners, and Pei Cobb Freed. He has been awarded fellowships at TED2010, Moshe Safdie Assoc., and Martin Society for Sustainability at MIT.

Andrzej Zarzycki is an assistant professor in the College of Architecture and Design at New Jersey Institute of Technology (NJIT). Andrzej is a designer and educator who employs digital tools to create experiential architectural spaces. His research focuses on media-based environments and on validation methodologies of generative design through building performance analysis and simulation tools. He is a co-winner of SHIFTboston Ideas Competition 2009 and a co-founder of TUTS, a design initiative focusing on innovative adaptations of infrastructure into contemporary public spaces and on the integration of digital technologies into urban life.

Kevin A. Cespedes is an architect, educator, and co-founder of oceanD. He received both a Bachelor of Arts for sculpture, and a Bachelor of Architecture at the University of Miami. His interest in three-dimensional design computing led him to advance his training at the Architectural Association in London, where he studied under Patrik Schumacher, Director of Zaha Hadid and Architects, where he worked after graduation and contributed to early studies of the recently completed MAXXI, the National Museum of XXI Century Art in Rome. Upon returning to the United States, he co-founded oceanD, an association of architects and designers dedicated to the exploration of new digital tools and processes for design, construction, and product development. He currently lives in Cambridge, Massachusetts and teaches advanced 3D modeling and animation at The Boston Architectural College, and Wentworth Institute of Technology (WIT) using form•Z as the chief software for his investigative digital processes.