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“Emergent Grid”: A Conversation with Toyo Ito

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Introduction

“Emergent grid.” This is a phrase Toyo Ito uses to describe the geometrical character of his recent work. It is one of the most important notions in characterizing the developments of late 20th and early 21st century architecture and its relation to engineering and structure. Geometry is an internal quality of structure. But in what sense is its pattern something already given? Consider Mies and Gaudi. Both modulate structural geometry. In Mies, this is defined by standardized dimensions and ideal proportions (and it is rectilinear). In Gaudi, it is derived from the behavior of matter, from funicular chains rather than imposed. These strategies point in opposite directions -- of which one variant is the Greek trabeated system versus the Gothic vault. No one has yet split the difference, except Toyo Ito. The Brugge Pavilion, the Serpentine Pavilion, Todd’s, Mikimoto, etc.: these buildings have intense patterns. That’s the first thing that strikes me. The second is that each is very different in its structural innovation with regard to an unpredictable geometry. But there is a third and it this: the structure is constantly shifting. These features underscore a new relationship between pattern, geometry, and structure. This is where fluids come in. In the early nineties Ito wrote “On Fluid Architecture” in which he wanted to move beyond the history of architecture as static form, as idealized and conceptualized geometry. The mere suggestion of fluids introduces a unique perspective towards structure: architecture as an intense geometrical development of matter. Now between pattern and form, there is an incredible competition -- patterns have infinite extension and form is bounded object -- and between them Ito has found a way to establish an incredible “ecology.” It is a formidable challenge to the history of geometry in architecture.

Peter Macapia
I'm interested in how you've developed geometry over the last 10 years. Your buildings and your process are consistent in many ways but especially in this: there is a constant exploration of the modulation and continuity of structure.

Toyo Ito
I have been interested [for many years] in getting design inspiration from the phenomena of fluids, of things moving. In the 90's I designed or composed with pure geometrical shapes. For example, I would connect several points of one part of a geometrical shape with another. I used simple geometrical shapes was because I was always having difficulty with structural simulations. However, since 2000, I have been using advanced structural analysis tools. We can simulate not only regular geometrical forms, but any surface with computers. These tools allow me to figure out problems and modify them until I find an appropriate structure. At the same time, as a designer in this process, it is difficult to choose between a structure "A" and a structure "B" because there is no specific reason I have to pick between those two. So, at this moment, I am still trying to find the "rules" to create "form."

Macapia
Do you mean that in the shift away from geometrical forms and solids – what you call shapes -- you are looking at "rules" for a particular logic of organization, for example the continued emphasis on things like grids?

Ito
I don't know if it is logic or not. [Ito goes to get analytical model]
In this experiment, I was especially interested in creating complex geometry out of a simple grid. I attempted to control the grid according to the programs by changing the scale and create three-dimensional surfaces [here Ito raises the top grid of the model which is connected to a lower grid by a sheet of mesh, then the mesh distorts into a complex three dimensional grid that connects regular two dimensional grids of the top and bottom] . I'm not sure it is logic that I am looking for. . .The [complex] three dimensional grid is the result of an experiment with the simple grid for the structural system –I would call that system an emerging grid.

Macapia

If you're saying that the system you've developed originates from a regular grid, I think that is an important issue. It is saying that you don't cut it off from the original Cartesian grid, that it maintains a kind of genetic relationship, whereas a lot of architects constantly claim they are trying to get rid of Cartesian geometry. I mean it has become a kind of joke because in the end they always institute some new idealized geometry. But I don't think it is that simple. Because there is something else in the model that you are showing me, which is more than a conceptual diagram. The model involves material behaviors that allow you to *produce* the geometry. And that means not only do you actually *produce* a geometry (rather than just apply one) but also that you can test it, play with it, because it is already internal to a material system. I think that was one of the first things that struck me about the structural model for the Brugge Pavilion – I think that this kind of experimentation is one of the most important ways to reinvent the relationship between geometry and structure. The geometry isn't idealized and imposed from the outside, but rather finds an internal relation to the system you're evolving. Let me also put it this way: it doesn't simply equate innovative geometry with innovative form. It is more complex and more subtle.

Ito

We still are, problematically, keeping the basic concepts of geometry as static objects, as a Euclidean geometry. Cecil Balmond describes geometry as traces of moving points and widens the concept of geometry. However, Cecil's concept of geometry is difficult to apply to architecture because we need to incorporate it with social systems and specific forms of living and life. Architecture is not only form, but also program . . .the floor for example needs to be flat . . . [laughing].

Macapia

I think that's an important distinction because for about 15 years now architects are trying to get rid of Euclidean geometry through the development of complex curvature. And one of the reasons is to avoid traditional "compositional" techniques (and I think the development of your work is similar in this regard). The result has been an explosion of dynamic surfaces and forms. But in a way, I would say, they've continued to idealize form. I think your work is instructive because it shows that you don't have to do this in a sculptural or plastic way, you can do it more internally in architecture through pattern and geometry and still make it dynamic – your interest in fluids is important here.

At the same time, it seems that the way you get to this is through material experiment or observation about the structure of matter. And as it evolves in the project, it unfolds across and shifts other categories, like circulation and space. In the Tawian stadium, the spiral woven system is the structure but it also becomes circulation ramp and form . . . so there's a continuity. By contrast the Sendai Mediatheque is a box. Here you redefine the tradition of column, which, through pattern and structure becomes dynamic. I guess I would say you are not looking for an organic image in the form of the building. You can still develop a dynamic condition when the form of the building is a box. I don't think anyone else has really done this.

Ito

When I propose a new geometrical form, I often encounter some difference between my concept and reality. For instance, in the Taiwanese Stadium project I wanted to express the structure as continuous woven lines, but what is most difficult in the structure is the actual dynamics do not follow the spiral lines, even though I was articulating those lines as structure. [Ito drawing the spiral] If you see the section, the engineers have placed vertical trusses between the spiral lines, but that is not the ideal solution for this design, the concept of continuity disappears. Actually, I am still arguing with the engineers to find a better solution.

Macapia

I guess the problem is that of introducing a primary and a secondary structure. The idea of using grids, for example, is supposed to suggest a continuous system – and interestingly, yours has a kind of heterogeneous continuity. Again, that is unique in architecture. I guess the question is how to keep consistency of the members . . . consistency between an apparent geometry and the main structural geometry. But I like also how the problem relates the rectalinearity or orthagonality of the grid to curvilinearity. A grid is usually homogeneous, flat, and regular. But you keep changing it, as though you require it to shift. Cecil's work is really interesting because he generates this transformation by using algorithm, and by using mathematical operations. Mathematics is among other things discovering patterns with numbers. He always these principles, it is a way of saying that it is not arbitrary . . . I think that is important.

I see this as an essential aspect to your work too. But I also see your work differently, as an investigation into the relation between pattern, geometry and matter. This is the fourth thing I would say, but it is perhaps also the most important.

You make these analytical models and develop a geometrical logic. You don't just apply an algorithmic diagram to a building – I guess you would say pattern has to emerge.

Ito

I have discussed algorithm with Cecil. He describes algorithm as some kind of rule that can create something new and more dynamic situation than some random lines. And in order to get rid of arbitrary decisions it is necessary to set up the rules and get the result automatically. I understand what he is saying. However, I think algorithm (pattern) is sometimes different from structure, or structural problems. For example, in the Serpentine pavilion we used a rotating square algorithm. In the beginning of the process, the rotation had made more sense than just using a regular grid, the algorithm can divide 18 meter spans into 12 m spans. However, once we extended the line of the rotating grid to the line of the walls the structural dynamics didn't follow the lines anymore. Structure and algorithm seemed to be matched, but they're not, they're a little bit shifted. That is the difference between structure and something composed by pure algorithm. I still think algorithm is very important because the space will be different from the normal grid. As pattern, algorithm can create very different spatial effects.

Macapia

That's true, but I also think that much of this insight begins with some of those observations about fluids in your essay. It opened up a unique direction in which you pretty much insisted that you are going to re-situate the relation between architecture and geometry through pattern. And I say this because, among other things, the behavior of fluids is of course geometrical, but it is a geometry related to pattern rather than form or geometrical shape. For instance, fluid behavior is either laminar or turbulent and the emergence of turbulence is an effect of various environmental pressures – this is discernible through pattern. The laminar is in a way like the grid. It never changes. It is the same all the way through. But in turbulent conditions you get something else, you go from a Cartesian grid to a kind of random or stochastic organization – and yet they two are still related. You can see this in studies of convection were the cells pass from parallel to grided and finally to irregular formations depending on the various pressures and the internal consistency of the fluid medium.

Ito

The most interesting thing about the concept of fluidity for me is the way things are constructed in a relative fashion. For example, trees. The reason why trees never make symmetrical formations is that the rule is very simple: the growth depends on the relative conditions, like wind, light, or balance. Everything is decided by the relationship with the surroundings. In Mies's grid system, everything can be decided at once. For example, in the Mikimoto project I tried not to design the pattern all at once but rather make one opening, and then see where the forces moved, and then make another opening, and through this make continuity. It isn't as complex as a tree, but I was trying to make it like a tree would grow. I am interested in designing things relatively. These forces produce the structures. That is why I call them emergent.

Macapia

But you see that distinction is extremely interesting. I mean, it suggests that not only is the geometry an expression of material/environmental forces, but that through architecture, one can organize these forces in radical ways. Maybe this is where the question of analysis comes in . . . that you assemble or relate a series of forces (they could be light, they could be program, the could be convection, heating and cooling, etc., obviously they are often structural) and you develop a system that can relate them together. In other words, one doesn't combine but rather transforms geometry. But one also finds a way of reorganizing relations between matter and energy and shifts the traditional identity of architecture's categories, like envelope, space, lighting, etc. This is one of the things I think about with the Sendai Mediatheque.

Ito

There are many ways to describe what I did with Sendai. I make a hole in the cube, then light and air come through the hole. The tubes were meant to recreate a relationship between inside and outside of volume which is completely disconnected.
[Ito drawing between inside and outside of the column's geometry]

But there was another thing I discovered that was important. In the competition phase, the engineer suggested for the floor slab a simple grid system. However, when they inserted the tubes in the design phase, the grid gradually transformed according to the flows of the large forces around them, and a very complex pattern started to emerge.
[Drawing of Grid]

Macapia

The idealized and static geometry that you pointed to in the essay on "Fluid Architecture" was the image of the Vitruvian figure – the man positioned between a circle and a square, the two perfect geometrical forms – usually we see DaVinci's image as an example. In contrast to this, you discuss the behavior of fluids. I think that despite the fact that Da Vinci produced the best image of the Vitruvian figure during the Renaissaince, he was more interested in turbulence. I think I remember reading that more than a third of his analytical drawings relate to problems of fluids and turbulence.

And there's another reference here which is Tati's film Playtime and the relation between an apriori model of geometry, such as the modernist grid (which he comically adopts from Le Corbusier's the City of Tomorrow), and the geometry of material behavior which changes under pressure and tends towards turbulence. This is also about the transformation of the grid. Tati is this bumbling character that wanders into the organized flow of the modernist Cartesian grid and constantly disturbs it. And as this progresses throughout the film the effects become catastrophic (and comic too). The climax happens in a restaurant where he accidentally pulls down this grid, which is an emblem of the modernist city. Once he does this, all the social relations between people begins to change, progressively, from the restaurant out to the rest of the city, reconfiguring its geometry eventually into that of a merry-go-round. . . it is another description of an emergent geometry. You know this condition of geometry and its organization and regularity is really maybe one of the most basic questions about design today . . . and it begs the question of how one produces rather than applies geometry. For many architects, geometry is a kind of brand. You've really avoided this, I think. I never get the sense from your work that you think of a method of geometrical reasoning as sufficient in itself.

Ito

I think it is about going beyond rationalism of 20th century towards something else.

For me, design is not how it looks, but the process itself. The appearance is not important. I am not depending on single methodology, but rather always trying to find several paths, possibilities, even though sometimes, I cannot get exactly what I want to see. When I pick one way the design is completely different from the other way, one isn't sure what is going to happen. Sometimes that is very scary but also exciting. The process depends on the relativity of each situation. The most frightening thing for me is seeing results without having any process. If my design has only one fixed method, it is really uninteresting. Recent design inspiration really comes from collaborations with structural engineers and my

office staff. I want to keep doing innovative challenges. It is not primary for me to argue which design is the best and I think it is meaning-less. That is the difference between my production and Mies's production. Mies manipulated the same thing again and again, then refined the grid. But I want to look for different directions with every single project like a growing tree.

Macapia
Maybe it is about constantly testing the possibilities of a system again and again until it changes . . .

Ito
That is the biggest difference with the 20th century. The basic concept of the 20th century is to repeat something again and again in a single-minded pursuit of lucidity . . .

Macapia
You mean like two different kinds of intelligence, one applied and the other emergent? I mean it is really under the latter that a system comes together out of a process . . .

Ito
. . . but when I do the same thing again, I get different results.