The Aesthetics of Green and the Embedded Diagram

JASON GRIFFITHS
Arizona State University

Raoul Bunschoten, writing in the OASE Architectural Journal[1], asserts that architecture propagates itself through a diagram of its idealized condition. This diagram, generated as an abstraction of the ideal is also present in architecture in emblematic form. Both the artifacts and the processes that are essential to any particular culture are embedded within one another in a manner that raises both function and décor together inextricably. This paper proposes that green architecture might be seen in this light. It asks what implications this might have upon this movement and particularly what is emblematic of its ideal state. It suggest that currently "green architecture" is divided on such issues, being on the one side an implied functional aesthetic or on the other an undeclared system of "green" iconography. Either way neither position fully recognizes the importance of the emblematic and as such undermines the movement's ability to make a complete response to all aspects of architecture. The paper presents an analysis of the developmental stages of the ASU Outdoor Dining Pavilion as an apologia for a design process that attempts to "embed" an aestheticised diagram within a functioning "sustainable" system. It charts the progress of this project in establishing a visual language that propagates the project's underlying ethical position.

Bunschoten's example pertains directly to the role that the Viking knot played as both a functioning element that typified their existence and "the main decorative motif in their churches once Christianity enveloped them"[2]. For Bunschoten the knot carries with it a spatial diagram of fluid movement of Viking culture as well as a reminder of the highly revered object. Here the object is chosen from all others as it carries "essential" qualities (as if we are asking what one thing would you chose to express your culture). This essential object can also be referred to as a "type". In similar ways we might consider the relevance of these types in other forms of architecture. For Corbusier and Ozenfant the type forms the basis of "type art" or Purism centered on the compositional use of the Briar pipe, wine bottle, glasses etc.[3] Each object selected for its supreme role as a communicator of the highest achievements of that epoc. Likewise Owen Jones identified the essential "types" of Egyptian architecture to be the papyrus and the lotus[4]. For Jones their relevance in establishing true architectural order cannot be underestimated. Everything emanates from these types as they undergo multiple different interpretations around the particular aspects of architecture within which they are deployed. These types were fully embedded within the architecture in a way that concentrated the viewer on a contemplation of their meaning within everyday life. Within each example also lies a particular discussion about the process of diagramisation by which the types were manipulated for various uses. Each example offers a diverse response to this issue although all might conclude that the "type" must never be fully representational.[5]

With this in mind I want to ask what are these "types" today and how are they to be assimilated into contemporary green architecture. These considerations were brought to bear on the program for Integral Studio for senior design students at ASU. The following text explores three sets of examples that describe the assimilation of key "types" associated with the developmental stages of the project. It illustrates three variations of the building according to specific climatic responses and programmatic themes. In all phases we asked:

- What is the design attempting to achieve?
- What are the functional "types" associated with the aim?
- How it is diagramatised?
- How it is the diagram assimilated into the architecture in different ways (structural, decorative, phenomenal etc.)?

SOLAR COLLECTORS - EMBLEM

In the first phase we began to consider the solar collector as the central type. In this variant we where looking for a method to prolong outdoor dining activities during the cooler evening of late autumn and early spring in Southern Arizona. Our proposal was to circulate water over a roof-mounted pipe network that, once warmed by the sun, would be collected in a heat sink below the pavilion floor. This sink, placed directly below the table would warm student's feet on contact and prolong their dining experience into the evening.

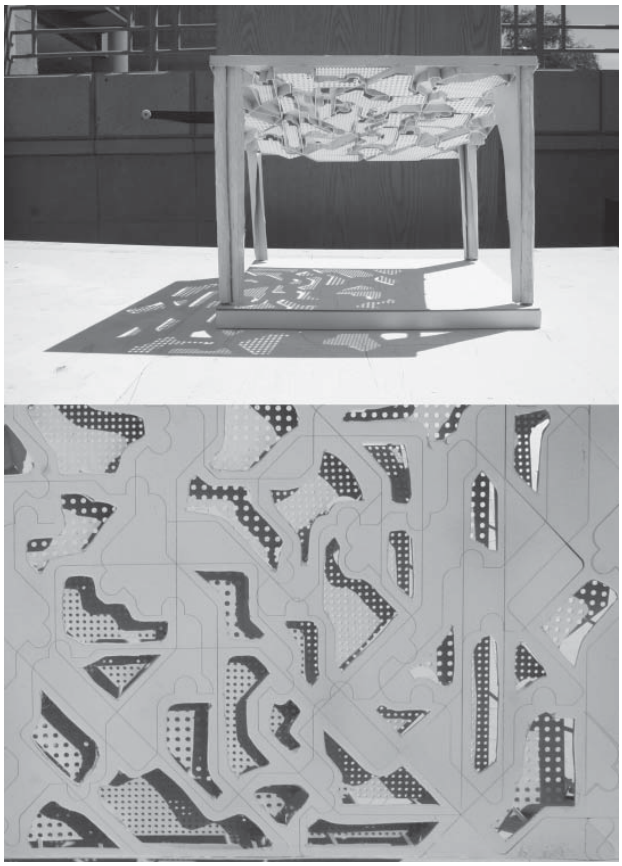

Figure 1. Early design stage model showing assimilated flow-diagram roof structure.

This version of the problem borrowed directly from the simple roof mounted swimming pool heaters that are the most basic form of solar collector. Our hours of operation suggested that we would not need an elaborate "enclosed" solar collector although it was preferable to paint pipe black and use underside reflectors. If this functional system is then relayed by the diagram then how could it be used to relay the role of the collectors beyond it being simply what they are?

The diagrams of solar collectors are typically isometric drawings that indicate flow direction, pipe arrangement, feed and return, pumps etc. They are commonplace and yet they have become, inadvertently, emblematic of green architecture.

Our question as designers is what method do we then adopt to raise the solar collector to an aesthetic contemplation i.e. how would the diagram be used in a way that would also render conscious its nascent emblematic form.

The first and probably to the most important aspect of these diagrams is that they are predominantly isometric. While this is purely a graphic device aimed at clarifying the system it also operates as sign of some sort. Our response was to replicate this device in a wider and more entangled iteration of the original. Here the iteration is a key factor in a composition of the pattern that began to generate a system of its own rules i.e.

- It was always a curve of level 2^6 composed as a concatenation of arcs and lines.
- The enmeshing was of a certain density (for structural reasons)
- It was composed of two circuits each flowing and returning through pairs (one long and one short) legs.

These compositional rules were also as a result of pragmatics of construction and operation. The roof build up then responded to this diagram in the flowing way. The pipe network is then supported by a steel structure that is effectively a downward extrusion of the diagram. Thinner gauge steel sheet is then used to laterally brace the structure that is in places cut out, perforated and dropped to form light baffles. Both the isometry and the level of curvature meant that, while the structure appeared complex it could also be reduced to simple

developable surfaces. In avoiding any complex NURBS curves all bending and laser cutting of the steel could be simplified. Indeed by restricting all arcs to two radii the bending could be carried out over two forms. Similarly the primary structure of the four legs also takes advantage of the extruded diagram gaining its own lateral stability through its curved plan section. Finally the whole structure is then rotated to the optimal 22-degrees to take maximum benefit from the sun angle and to ensure the water mostly flowed down hill (pumped to the top of each leg).

Each of these considerations was brought together in proposal that was designed to allow visitors to visually engage with the structure. The result offers a coffered ceiling that is a functional and yet emblematic manifestation of the buildings program. The role of the diagram here offers a segue between a common graphic mode associated with solar cooling and a legible built narrative. In this manner it attempts to visually describe its workings and so too its position which regard to sustainable functions.

PV - EMBLEM

The second manifestation of this design invested in a similar contemplation of the aim of the environmental response, the typical artifacts that help achieve it and how they may be assimilated into an emblematic architectural quality.

In this phase we began to consider how the proposal could widen the period of operation to the warmer months and early summer. This phase proposed using roof mounted PV panels to generate electricity for two uses i.e. to warm heating coils in a pre-cast concrete floor (replacing the heat sink water tank) and to drive ceiling mounted fans for daytime cooling. The energy generated by the PV panels would alternate between these two operations as they rarely overlaped. Again the floor (this time as concrete floor panels) would act as a thermal mass for the cooler evenings while the fans would operate during warmer days and evenings.

In this version the diagram of the roof pattern is generated from the optimal orientation of the square PV panel. This version adopts a similar orientation to the sun with a mono-pitched roof structure facing south. PV panels are rotated to

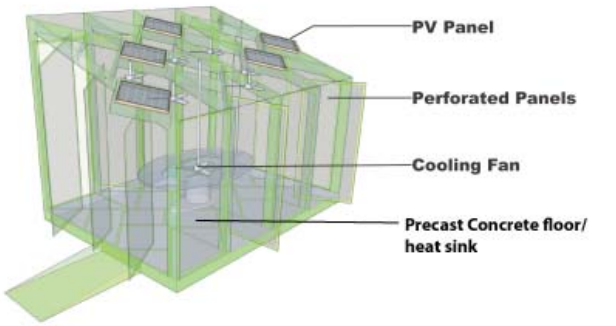

Figure 2. Early design stage design 45-degree PV panel assimilation.

45 degrees of the plan rectangle and pivoted from the top to the bottom angles. This pivot provided for a dynamic tracking response to the movement of the sun to optimize its solar orientation. This 45-degree angle then becomes the concentration of the roof structure and pattern. The panels are scattered over the roof in a similarly iterative

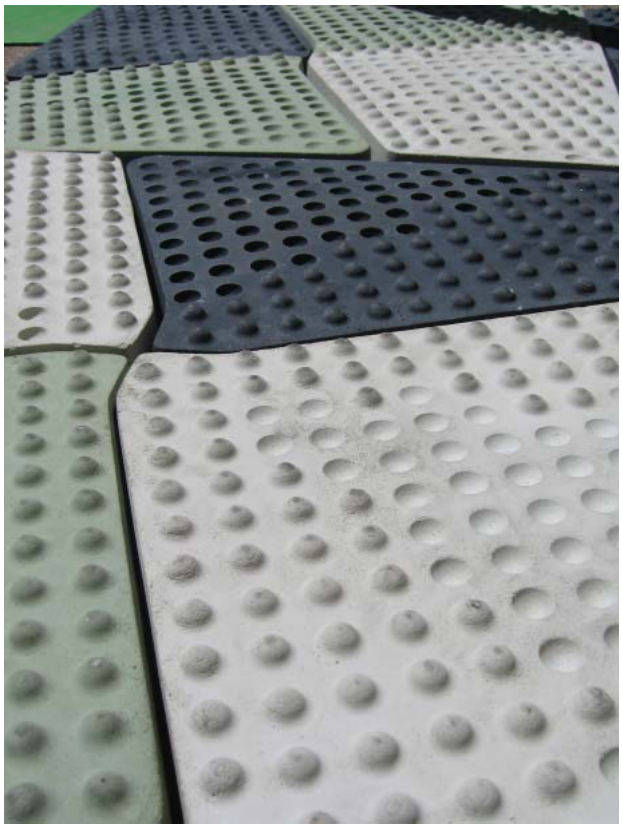

Figure 3. Pre-cast pigmented concrete tile system developing variable surface texture and pattern.

manner that then generates the arrangement of the roof structure into a diamond pattern that is resolved into the vertical structure (doubled to carry the electrical cables).

This idea is then interpreted in the pattern of the concrete tiles that carry the heating coils. In this case the geometry was generated as a secondary interpretation of the roof system. The tiles reflect the roof structure as a means of sustaining the visitor's attention to the primary theme of this version of the pavilion. However in this stage the project lacked a considered interpretation of the floor heating system in its own right. In a sense it was subsumed by the dominant pattern of the roof and presented a problem of design continuity. Here we were forced to consider either a different emblem and a discordant relationship between floor and roof or a predominantly roof driven pattern. Ultimately we settled for the latter.

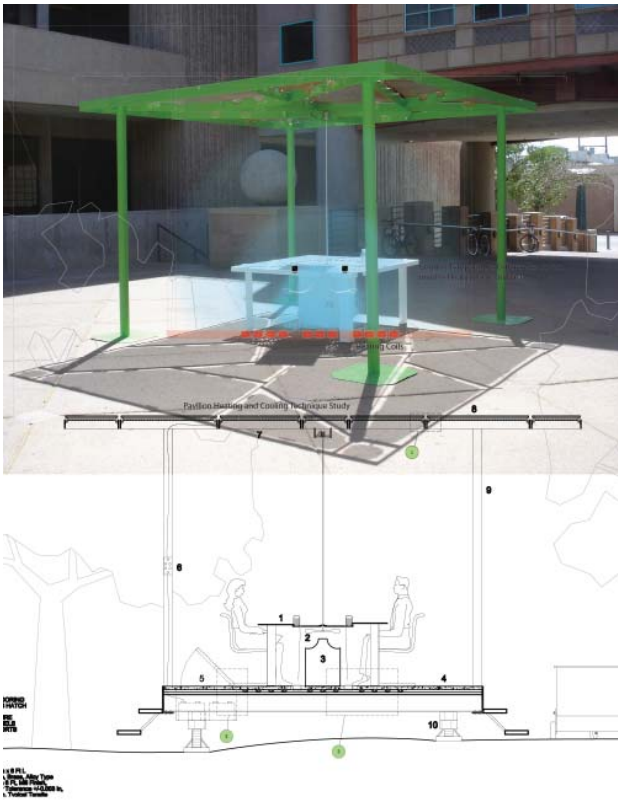

Figure 4. Full scale fabrication of shade structure and "cooling table."

FANS AND SUPERIMPOSITION

However the issue of the tile arrangement and the overall coherence were resolved in the final phase by adopting a simultaneity of pattern and emblem between each functioning element by using an overall "type".

This final phase of the project was in some senses a composite of earlier versions. Here the aim was to extend the use of the pavilion to warmer months by adopting methods of evaporative cooling around a centralized table we called the "Cooling Table". This system worked like a desert fridge by using the osmotic pull of a hanging "inverted table cloth" as a membrane through which cool air was blown via a PV driven roof fan.

In this case we settled on the fan as the emblem of the function and proposed archetypal "type" object associated with sustainability. If the recent history of sustainable design were to be considered in iconographic terms then the iconography of the fan might be central to this contemplation. While the role of the fan is crucial to the physical operating systems of sustainable design it is also a key element by which the ethic is promulgated within the widening debate on sustainability. At times the iconographic power of the fan exceeds its ability to perform effectively.[7] While this may be debated it is clear that the appearance of the fan, particularly as wind generator, has come to signify green architecture in many instances. Here again we wanted to use the fan in the "both and" manner where by its function role was considered

Figure 5. Laser fan pattern functions to allow passage of cooled air through the steel table and to reduce thermal mass.

in an emblematic way. In this case however the fan would become the main "type" that was to be assimilated into the various other elements of the building.

COOLING TABLE

This "both and"[8] interpretation of the fan has a particular take on the project and, in particular the design of the dining table. The functional necessity of the under-table air places the fan out of sight and below the table and ensures that it plays a subservient role as a communicative architectural element. However the design of the table addresses this issue by developing its language through a projected pattern of enmeshed fans arranged to make up the table surface. This pattern is laser cut into ¼" paintlock mild steel sheet that is then bent and formed into the table[9]. However this projection is also developed from a functional reading of this particular type of table and of outdoor furniture generally. In this case the level of perforation is designed to allow the passage of cool air through the table and onto the diners. The perforation also borrows from the functional typology of outdoor furniture that is perforated to allow rainwater to pass through it and also to reduce its thermal mass in hot temperatures. In this way the fan acts as a visual communicator and simultaneously a functional element.

Figure 6. Roof structure and perforated panel pattern from standard steel section

STRUCTURE

However the size of the table means that it can only effectively communicate its performance within close visual proximity. It is too small to propagate its message to the wider context of the campus.

This scale of communication is then transferred to the shade structure that sits above the table. Here again the emblem of the fan is assimilated into the building as a mesh of primary and secondary structural roof beams along with perforated infill patterns. In this case the fan iconography was developed by generating a Veroni diagram of the regulating lines of individual fan axes. The underbelly of the structure (lit at night) presents a prospect of this assimilated pattern language seen from afar and from various angles around the campus. Again these emblematic elements are inextricably bound to the structure's functional responsibilities and place in the chain of activities that can be traced back to the fan. In this case the structure is designed to support a sequence of PV shade panels. These panels are set above the perforated shade panels and comprise of polycrystalline PV elements laminated between sheets of toughened glass (again this is "as proposed". The actual prototype incorporates a conventional framed PV panel). Each panel is designed to directly charge the batteries that are stored below the suspended floor. The process of diagramatising the fan into the structure is illustrated below.

FLOOR

The final interpretation of the fan emblem is then projected onto the floor (see figures). In this case the practical problems of casting floor panels meant that each panel had to be the same (quasi fan shaped tessellating forms) while presence of the pattern demanded a level of flexibility. This dichotomy was carried in the arrangement of the pattern of spherical bumps in the tile texture. In order to do this we developed a system of mould making that allowed us to customize the texture layout through different arrangements of marbles within a set grid atop the dummy mould. In this way marbles could be moved around the mould to create different textural zones and simulations of the fan emblem.

CONCLUSION

> "I invest the ordinary with a higher meaning, the everyday with mystery, the familiar with the dignity of the unfamiliar, the finite with the semblance of the infinite"[10]

Eisenman suggests[11] that the "functionalist predicament" periodically arises in the history of

modernism. For him the postwar period of late modernism presents a renewed version of ethic positivism and aesthetic neutrality wherein moral criteria are substituted for formal considerations. This text is based on an assumption that the green architecture faces a contemporary version of this predicament i.e. the misconception that its rationale will deliver its own aesthetic. In presenting the development of this project in terms of emblematic qualities of "types" I am suggesting that green architecture can have greater depth and visual richness than is implied in a purely recondition functionalist aesthetic. However I would also suggest that this issue of aesthetics is born of a set of constraints and rigor by which decoration cannot be generated as superfluous signification. By attempting to identify the role of "types" in the history of architecture I am suggesting that there are important precedents by which we can evaluate what these types are today. As both Owen and Bunschoten suggest types are identified as the objects that characterize everyday usage but are revered as essential to any particular society. Our role as architects lies partly in generating a diagrammatic process by which these types are assimilated aesthetically into the programmatic necessities of our buildings.

ENDNOTES

1. "Stirring the city" OASE Architectural Journal. No.48/1990

2. Ibid pp.73

3. Stanislaus Von Moos. Le Corbusier: Elements of a Synthesis. The MIT Press (September 29, 1982)

4. Owen Jones. The Grammar of Ornament. L'Aventurine, Paris 2001. Along with the palm branch, feather and twisted cord forming the basis for an immense variety of ornament of Egyptian architecture

5. Ibid pp.27 . For Owen the process of converting these types into decoration is an act that gradually removes direct representation until as in the Moresque there is no direct likeness to the original type.

6. For description of different levels of curvature and degree see p. 40. Rhinoceros NURBS modeling for Windows . Training manual 2. Version 4.

7. For example the RIBA center in Portland Place, London proposed a wind turbine on the roof.

> "RIBA's wind turbine hopes blown out by council planners. The RIBA's plans to provide a model for sustainable architecture have been foiled by Westminster City Council, which is set to refuse planning permission for two wind turbines on the roof of its headquarters building in Portland Place. Planning officers are recommending that the Allies and Morrison scheme to add the 20m turbines to the top of the building should not go ahead. Officer Robert Ayton said the objections were 'on the basis of visual impact'.

8. Learning from Las Vegas P.72 – Venturi Scott Brown Izenour – The MIT Press

9. For 20 gauge the laser ran at 2900 mm/minute at 3600 Watts while for the ¼" ran at the same feed rate but at 3600 Watts.

10. Novalis, Fragment und Studien, 1797-1798" quoted in: Klaus Sommerhage. Deutsche Romantik, Cologne 1988

11. Peter Eisenman – Post-Functionalism. Theorizing A New Agenda for Architecture. An Anthology of Architectural Theory 1965-1995.