Mocking the Museum: Compelling Evidence of Premeditation;

Full Scale Mockups as Design Laboratory for the Field

The term "Building" is vague. Here it may refer to a noun or a verb, it is less of a singular object and more like a set of constructions, some temporary and some permanent, but what's striking about the Miami Art Museum, is the degree to which it has already been built...albeit in fragments, at full scale.

Nick Gelpi
Florida International University

PREMEDITATIONS

> "Building. Building is a good solid word. Not just a noun; an object spied in a distant field or an object perused in a magazine. Building is also a verb; a creative act with its own unpredictable unfolding in the physical world. Building as such is not finally determined by the machinations of language or the preconceptions of the studio but demands its own solid ground, its own insightful embrace." [1]

As the new building for the Miami Art Museum, now titled the Perez Art Museum of Miami, is nearing the final stages of construction, a separate set of buildings are being demolished on site. These smaller buildings line the western edge of the site and indeed were more costly per square foot than the museum itself. These buildings were in fact also designed by the renowned architecture firm Herzog and deMeuron but the general public will never see them, rather they will only see evidence of them in the final building.

The term "Building" is vague. Here it may refer to a noun or a verb, it is less of a singular object and more like a set of constructions, some temporary and some permanent, but what's striking about the Miami Art Museum, is the degree to which it has already been built...albeit in fragments, at full scale.

1

These buildings are the full-scale mockups where the architects and contractors came together to collaborate on strategies for building. Building in this case as verb.

These Mockups are the dress rehearsal, they aren't the main event, rather they are an anticipation of the final version, like a workshop intended to negotiate outside influence with locality. Not to rethink the project conceptually, rather to anticipate contingency based on how some ideal representation will be translated into reality, like a series of fine tunings, in this case based on local craft, environment, climate science, material science and economics.

Indeed these mockups make apparent the unpredictable entanglements of reality and site. What results is a negotiated reality, drawn on top of the design documents as the design-drawing phase transitions into the design-building phase. The drawings are merely scaffolding for testing materialization and perhaps more so than any other architecture practice, Herzog and deMeuron make productive practice of these thriving experiments.

The insight Mockups can provide are no-doubt valuable, however they are also costly and full of uncertainty. Two strategies generally present themselves to the architect approaching the construction site. To build as much generic tolerance into the system of construction as possible with the intent to absorb any unanticipated phenomena, or to try to materialize the contingencies of site, to the advantage of the building. Sometimes intentional, sometimes accidental these evidences of practicing on site represent a well-rehearsed practice…strangely Pre-meditated.

Collectively these pre-meditations contribute to a subtle yet hyper-articulate picture of reality on site, negotiating design intent with the camouflaged realities of practice. These myriad encounters with reality, position architecture in alignment with physicists and material scientists, perhaps for its ability to precipitate new and unexpected entanglements with reality.

Figure 1: Full scale visual mockup on site at the Miami Art M*useum*

2

Indeed architecture is in a unique position to not only tread in aesthetic and representational matter, but to also define the degree to which the physical world is embodied or avoided.

MOCKUPS

MOCKUP: noun; A usually full-sized scale model of a structure, used for demonstration, study, or testing. [2]

TO MOCK: to treat with contempt or ridicule, to defy or challenge; serving as an imitation or substitute, especially for practice purposes [3]

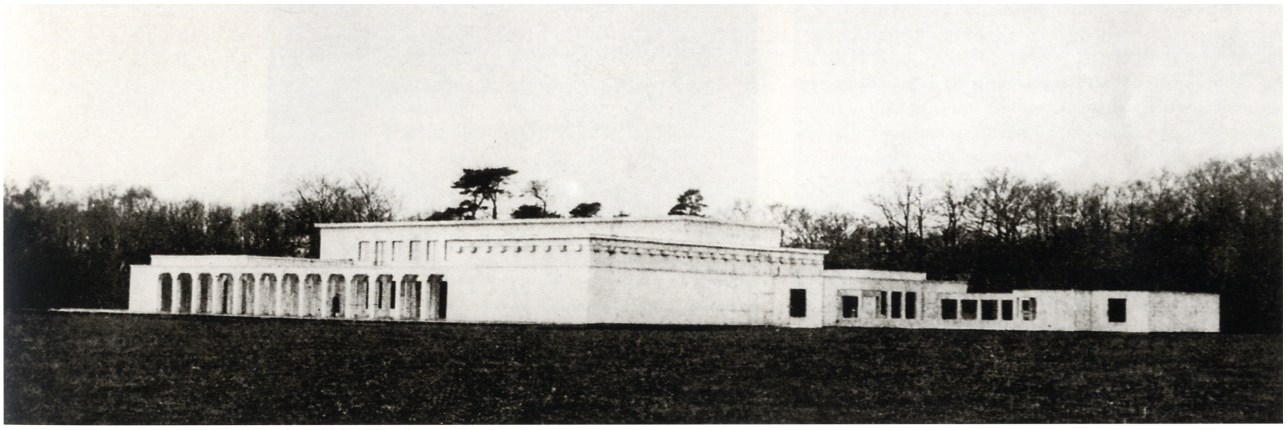
The stories that these mockups tell, demonstrate an indirect route for translating the drawings into reality, however a constant re-routing and re-evaluating based on the contingencies and unexpected variables arising from regional factors.

Two projects provide valuable examples of the types of conversations Mockups can produce. Both projects utilize the Mockup to demonstrate a curious proof of concept for architecture when the disciplinary conventions of the time seemed to lack efficacy. These case studies are built architectures however they are merely tests, or prototypes intended to demonstrate a proof of concept.

Both became necessary due to a lack of evidence inherent in the representational matter of the projects. Quite simply to be understood and judged both projects had to be physically built.

The first is the case of Frank Lloyd Wright's S.C. Johnson Wax Administration building in Racine Wisconsin in 1936. For the 'Great Workroom,' Wright designed flaring dendriform columns which tapered at the base. These columns broke all the rules of the day, a truly non-standard building component, they were too tall for their diameter, they tapered toward the ground, they flared at the top, they were reinforced with a thin steel mesh, and they were hollow. The building commissioner rejected

Figure 2: Frank Lloyd Wright and his column mockup [4]



3

Wright's column design as unable to support the required roof loads due to its unconventional configuration. An insistent Wright proposed a 1:1 scale mockup out of authentic materials to demonstrate the load bearing capacity of the structural member.

Propped up with diagonal supports the column was constructed to specification and top-loaded with sandbags until failure. Wright's column failure test, not only tested geometry for its ability to manage and mediate force and form, but also highlighted a territory of design which remains difficult to represent geometrically, that of performance. Simultaneously a structural test, a geometric test, and client presentation tool, the mockup allowed the verification of expectations, suggesting a new type of judiciousness, which trumps formal concerns. This mockup was a conversation with engineering, testing the configuration of materials in relation to their performance.

Another curious mockup at full scale, seems to test another aspect of reality. Effectively a very large model, the Kroller Muller Villa was one of Mies Van der Rohe's first projects. Mies had renderings and small scale models, however ultimately the clients insisted on the execution of a 1:1 mockup. A representational model at full scale, this mockup clarifies a blurry engagement with reality and authenticity. In 1912 the villa was mocked up, in the definition of the term as an imitation. Entirely constructed to scale, the project was built of false materials.[FIG 2] Mostly constructed of fabric and canvas this Mockup tested at 1:1 scale, what Wright's column failure did not, that is, it tested the project's spatial effects. Deferring from the performance of the projects material concerns, this mockup tested the building's effects on its subject, environmental, atmospheric, and experiential. It is worth noting that upon completion of the mockup, the clients rejected the proposal and the mockup is as close to reality as Mies' villa came.

At the site of the Miami Art Museum, many mockups were constructed and demolished over the course of years. A coherent sequence marks a series of highlighted mockups on the site indicating how they generally unfolded.

COMPETITIVE MOCKUP

In what was the first full scale Mockup of the project, the architects held a competition to construct a series of walls and finishes.

4-5 contractors were given a document with a set of instructions, written by the architects describing the mockup that each was to construct. The

Figure 3: Kroller Muller Villa Canvas Mockup [5]

project brief specified 4 various concrete surface finishes which were to be found in the final museum building, Chipped, Ground, Out of Form, and Bag Rubbed + Polished. What's important is that the project brief didn't specify how to construct the mockups it only described the outcomes.

In a sense the architects were shopping for the process and looking for innovative approaches towards problem solving as well as results. The architects clearly had an idea about how these could be done, having commissioned these details in many of the firm's previous museum projects, however tossing it up to a variety of local craftsmen did two things, it allowed the architect to gauge generally the range of workmanship regionally selecting the highest quality craft, but it also allowed the architects to potentially see new possibilities for the means and methods of construction.

In some cases contractors were rejected as a result of avoiding the reality of process which would be encountered on site, for example one team had a beautifully chipped vertical exterior wall, however they had cast a flat horizontal slab, chipped it while horizontal, then tilted it up into a vertical orientation, an impossible solution when integrated into the final construction sequence.

The architects team reviewed these wall fragments looking for a consistent quality of work across the range of finishes, and selected one team to pass on to the next stage for construction of the visual mockup.

4

Figure 4: Temporary Integrative Mockup

VISUAL MOCKUP

If a set of drawings are all the design moves isolated onto singular pages, the Integrative Visual Mockup are all of the design details projected off the pages and reorganized into space.

The second Mockup differs from the first performative mockup in that its area of study is integration. Generally this type of test is referred to as a Visual Mockup, not concerned with the physical mechanical properties of any singular material component, but rather concerned with the orchestration of multiplicities. Think Mies' full scale mockup of canvas, this mockup is the place where the various trades come together, having only been concerned in isolation until this point, this mockup acts more as a symphony where the various trades are collectively calibrated with adjacency. Here on site of the Museum the Visual Mockup was designed to merge the various trades as well as the difficult moments of the museum. Here in the Second Mockup, two different gallery heights were built, multiple surface textures were arrayed in place, the interior design met the exterior shell, glazing transitioned to concrete, and generally hard and soft were connected.

This Mockup takes the form of a spatial symphony of design studies, apparent everywhere are the multiple considerations for materialization and finish. What's most striking about this mockup is the arrangement of material samples in 3 dimensional space. We see here multiple options for final finishes arrayed in space to make apparent their various affects. This mockup became a living evolving laboratory on site, as new finishes were explored the mockup was modified and decisions evolved based on the vitality of this very small building.

PRESCRIPTIVE MOCKUP

After the execution of the Integrative Visual Mockup, the architects weren't satisfied with the quality of the concrete work so came back to a group of

contractors to host a second round of competitive mockup. The contractors were asked to reconstruct a series of interior gallery walls with finishes including the new Void Former slab system overhead.

Generally a new technology, the museum is one of the first three projects in north America to utilize the Void Former slab system with the proprietary name "Cobiax" slab. The Void Former system allow a significant reduction in the mass of the slab while maintaining structural integrity by integrating voids into the thickness of the floor. The technology works by inserting hollow plastic bubbles into the middle of the slabs during the process of pouring. These bubbles remain inside the slab and lend it a more bonelike structure similar to birds wings. The voids make the slab lighter, allowing it to span further.

Specifications accompany the Cobiax system detailing the spacing of the bubbles and the amount of reinforcing required however upon the execution of the third mockup and inspections of the underside of the slab, visible surface cracking was apparent.

The Mockup had served its purpose which was two-fold, first to physically practice the act of casting a new type of slab system, and secondly to exhibit to the contractor that the specifications needed to be followed to a greater degree than what they were previously familiar with. Indeed a slab with voids in it is less forgiving than a standard reinforced slab which has much redundancy built into the reinforcing, however in this lower density material, any deviations from the specifications could more apparently lead to flaws both visual and structural.

LARGE MISSILE IMPACTS

The glazing of the museum building appears to be held in place by petrified wooden mullions, a theme often visible throughout the project, as what appear dimensionally to resemble wooden members are actually various states of concrete. There is a consistently deceptive material language in the museum, one developed through evaluation of performance and visual bias, and in the case of the concrete mullion system, certainly there was no off the shelf product of its type. For the Museum, this meant verification of their custom fiber reinforced concrete Mullion glazing system.

Notices of Acceptance (NOA) are used in hurricane-prone areas to help assure that glazing systems have passed appropriate impact and wind cycle tests. For building in Miami-Dade county, you either have to specify an off the shelf product which has previously been tested for NOA approval, or if you propose a custom glazing system it must be subjected to NOA testing at considerable expense.

The architects proposed a glazing system in two orientations. On the ground floor the mullions faced out exposed to the exterior, while on the upper floors the mullions were flipped to face inside. Following the reading of a smooth polished object on the upper floors, the architects wanted the glazing flush with the ground concrete surface to read as a smooth continuous surface. On the bottom floor the exposed Concrete mullions produce a rustication in accordance with the chipped surface texture. The pressure caps are exposed on the interior where the Mullions are outward facing and when flipped they are embedded in the joint between insulated glass panels maintaining a flush smooth alignment.

Because of this customization based on the formal consistencies of the project, the NOA test needed to be conducted twice. Six times the glazing system had to be mocked up as impact specimens. Test specimens are impacted with 2x4 dimensional lumber weighing 9lbs and fired at a speed of 50ft/sec, simulating 110mph wind speed, in what is termed a "Large Missile Impact Test." The test standard calls for 3 identical test specimens, each specimen to be impacted twice, once at the center and once within 6" of the corner.

This test simulates the particularly destructive scenarios during a hurricane when debris is picked up by wind and effectively becomes a "missile." This impact test is followed up by what's termed a "Cyclic Wind Pressure Test."

During this test the glazing system which has previously had missiles fired at it is then subjected thousands of times to inward and outward acting pressures simulated within a pressure chamber constructed on the backside of the glazing wall. The architects described visually observing the glass wall flexing or "breathing," becoming convex and concave under positive and negative pressures.

The general testing criteria for NOA state that the test specimens shall resist the missile impacts prescribed and resist the cyclical pressure loading with no cracks forming longer than 5" through which air can pass or with any opening through which a 3" diameter sphere can pass. For buildings in Miami Dade county, stricter requirements further specify that the three specimens must reject the missile impacts without penetration and that no cracks may form longer than 5" and 1/16" wide through which air can pass.

The NOA test standards come from a combination of building code specialists and County insurance officials collaborating on what not only provides safety but low financial risk considering the potential for category 5 storms being in a subtropical climate. Ultimately this mockup is a conversation with the building commissioner, similar to the S. C. Johnson Wax Administration building, the conversation here is to convince through very precise metrics, that what will be constructed on site will be safe, irrespective of appearance. This conversation is much more based on economics, liability, life safety and material science.

BARELY SCRATCHING THE SURFACE

Many surface finishes at the museum required long processes of redesign and negotiation.

Early design studies for the museum conceptualized its materiality in the form of petrified wood construction. Initially the museum outward appearance was to be constructed of precast planks in the shape of boards hung as cladding in front of an insulated wall section. These planks were to cover the exterior referencing a wood cladded wall, yet out of cementitious material. This petrified wood construction can still be seen in the final cast paver designs for the various decks in the final museum, however the exterior surfaces of the Museum ultimately took on the materiality of Cast-in-Place construction. The decision was made to chip the smooth finish exposing the interior aggregate of the walls with an organic texture, referencing Herzog and de Meuron's, Schaulager-Laurenz Foundation building in Basel. At the Schaulager, locally excavated gravel from the site is used as the aggregate in the construction of the cast in place walls with the surfaces scratched to reveal the pebbles from the building work excavation.

5

Figure 5: Chipping Mockup with contractor

Back in Miami, the architects elaborated on the scratched texture of the Schaulager by chipping the 'out of form' surfaces, exposing the aggregate used in its construction but also giving the walls a texture more like the local Florida limestone of the region.

The chipping pattern proved to be the site of much study and concern. The Visual Mockup reveals the various patterns tested at full scale with the ambition to strike a balance between a consistent technique and something which looked organic. After the first mockup, several "Scratch" techniques were demonstrated including a Raked finish, an acid washed finish which involved coating the form liner with acidic solution to etch the lime-based concrete as well as several manual chipping procedures.

Ultimately the architects selected the Raked surface finish because it gave the most organic appearance to the concrete surface. The procedure involved releasing the form work after only a few hours of curing time so that the wall was sturdy enough to hold itself together but soft enough to be manually raked, which was fast in terms of coverage and desirable in its organic appearance. Months after the mockup was executed the realization was made in consultation with the architect, engineer and contractor that due to various design factors the Raked finish would be impossible to integrate into the final building. The biggest issue was the structural diagram of the museum. The concrete walls and floors contribute to a continuous structural shell, that is to say that the exterior walls aren't hung on the structure, they are a part of the structure and must not only hold themselves up but support the overhead slabs which tie into their reinforcing. In most cases the formwork needed to remain shored for close to 30 days when the upper floor would be cast and completed. As a result when the formwork was released the concrete was no longer soft enough to be raked but incredibly hard and impermeable due to the duration and presence of blast furnace slag in the recipe.

This required a revision to the surface treatment and as a result the architects had to devise a solution which dealt with an incredibly hard material as its canvas. Multiple chipping patterns were attempted with the challenge being how to make the chipping look random enough without being able to read the rhythm of the process. Several factors were considered and tested in combination as an iterative chipping process, the size of tool selected, the size of chips produced and the speed of the coverage. Various attempts to only utilize a pneumatic chipping tool all appeared too repetitive, with a legible pattern visible in the final textures. The final surface finish was the result of a combination of procedures, first a pneumatic chisel was used to "Spall" the surface and then secondly a hammer was used to manually blend the surface Spalling. Spalling refers generally to spall which are flakes of a material that are broken off a larger solid body.

Typically concrete walls have a Marine Environment Cover specified as not less than 2" of coverage on top of the walls interior steel reinforcing. This is to prevent moisture from making contact with the embedded steel which could oxidize in the presence of water, particularly the saltwater present in the bay where the museum is perched at its edge.

Because the chipping removed material, and in this case the material is structural, an additional 1.25" of coverage was added to the walls exterior somewhat late in the process. This addition made the structural engineer

nervous, as the building loads had been calculated with the centers of the load bearing walls in mind and everything had been sized for this calculation. Adding a mere 1.25" to the walls exterior had two effects, first it shifted the center line of the walls out three quarters of one inch, and when considered across the surface area of the entire building it added many thousands of pounds to the supported weight. The structural engineer stipulated that the entire 1.25" of extra thickness should be removed in its entirety during the chipping process but not more than this. The engineer insisted that a stainless mesh be added to the wall section, embedded 1.25" deep marking a visual barrier between the sacrificial chipping layer and the structural layer so the craftsman would have some orientation as they excavated the surface of the building.

The effect of this new procedure was twofold, for one, the chipping pattern changed from something organic, fast and soft to something hard, repetitive and much more laborious requiring many hours of laborers chipping at the smooth surface of the concrete to reproduce the effect of something similar to Florida limestone.

FROM GREEN BUILDING TO BLUEISH-PURPLE

Due to the buildings proximity to saltwater, sighted on the edge of Biscayne Bay in Miami and considering the very wet and humid climate of the subtropics, a particular mix of concrete was devised to help mitigate the corrosive effects of moisture on steel.

Slag is a partially vitreous by-product of smelting ore. Ground granulated slag is often combined with Portland cement to reduce permeability and develop strength over a longer period of time. Since the quantity of Portland cement is reduced the concrete is less vulnerable to alkali-silica and sulfate attack.

This previously unwanted recycled product is used in the manufacture of high performance concretes, especially those used in the construction of bridges and coastal features, where its low permeability and greater resistance to chlorides and sulfates can help to reduce corrosive action and deterioration of the structure.

A custom mix of slag blended concrete was developed for the museum project and several curious and unanticipated consequences affected the outcome of the building. Most striking was the unexpected surprise of bluish purple concrete. Having commenced with the final building construction, once the concrete formwork was released the concrete had a strange bluish-purple color which was quite vivid. This had never been encountered in the mockups and a slag representative was consulted to great initial bewilderment. The slag representative re-examined the process on site and determined that the coloration was most likely due to 2 factors. First, leaving the formwork on the concrete for such a considerable length, over 30 days in many cases, actually starved the concrete curing process of oxygen. Other contributing factors seemed to be humidity and temperature as the effect was much more prevalent in the wet rainy summers than in the winter months which are Miami's dry season. The Slag representative knew about the possibility of this happening, but had never encountered it first hand, most likely because formwork is typically removed much more rapidly.

The representative estimated it would take close to a week for the coloration to gray out, with Ultraviolet light speeding up the process, however on the site of the museum it took close to 9 months for the concrete to go back to the anticipated tone. In some instances on the museum's interior galleries, the ceilings needed to be treated with special acidic concrete cleaner to fade out the peculiar color. This concrete was alive and reactive, and needed to be coaxed back into something cooperative.

In an essay titled "Murder in the Court" Nader Tehrani discusses the dilemma in architecture where the architect has significantly been disempowered by a divorced relationship between the means and methods of construction and the image of a building. Tehrani states, "

"*The architect is charged with the design; the builder is responsible for the means and methods of its construction-as long as it remains faithful to its 'design intent'. While this legal provision may seem a guarantor of design implementation in general, it significantly disempowers the architect and presents several theoretical predicaments. First, the law effectively severs the architect from the "specific" relationship she or he can construct between the technical specification of an artifact and its corollary effect-the assumption being that the architects investment is in the image and its rhetoric, not in its constructive makeup. Second, it further problematizes the relationship between design intent and material construction...as if to suggest that any detail or any material will suffice, so long as the general effect is delivered."* [5]

Tehrani doesn't argue here for radical new forms, rather a re-linking of the image of architecture with its constructive means and methods. As our environment continues to demand a more thoughtful engagement with design, material science, economics, climate and culture all become active agents in how we think of design, not merely a buildings image.

While the image of buildings might not look much different at all, a new type of collaborative convention is demanded of architecture. This new convention is actually an old one which finds new capacity for insight, drawing on practice, culture and climate, and one which Herzog and de Meuron have been making productive use of for years. These mockups help to correct the various bad-behaviors encountered onsite, from turning blue, to cracking in uncontrolled ways in a practice of domestication. These stories are the considerations of design not legible in the image of the museum. They require the physical act of building to be encountered. Perhaps this highly premeditated practice of building as both noun and verb becomes a productive new territory, for architecture to resolve itself and find new collaborations between climate, material science, and cultural conventions.

ENDNOTES

1. Mike Cadwell, *Small BUILDINGS, Pamphlet Architecture* 17, (New York: Princeton Architectural Press, 1996) p6.
2. http://www.thefreedictionary.com/mock-up
3. http://www.thefreedictionary.com/mock
4. IMAGE CREDIT - Wright, Frank Lloyd, Frank Lloyd Wright Monitoring Building Site, 1937. Racine, Wisconsin. http://www.wisconsinhistory.org/whi/fullimage.asp?id=1911 (Accessed July 17th, 2009).
5. IMAGE CREDIT - Riley, Terence and Bergdoll, Barry, *Mies in Berlin*, The Museum of Modern Art, New York; illustrated edition, August 2, 2002, page 169, fig. 26.
6. Tehrani, Nader, *A Murder in the Court, Strange Details*; Cambridge, The MIT Press, 2007; (ix).