Fast, Cheap and In Control

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INTRODUCTION

There can be no denying that prefab has really come into its own, as of late. From the glossy pages of *Dwell* magazine to the missives from Alison Arieff in the *New York Times* to sparkling previews in the deserts of California to the sacred halls and courtyards of MoMA itself, "prefab" is clearly enjoying a design moment. Of course, prefab has been around for, well, centuries, as Sears Catalog precut houses date from the late 1800s. But, it seems to have existed before on the fringe of design: assembled, yes, rationally-organized, yes, but always seeming to stop short of the value-added attractiveness that design brings to the equation. Now, glossy finishes are replacing stodgy wood veneers, composition materials are replacing the cheap infill plywoods. Gone are the pressboard interiors, the brass lamps and the beige and blue hotel colors – bring on the redwood slats, the DWR lighting, the splashes of orange, the bold use of white. And, a thousand magazine editors are out there trying their best not to use the term "pre-fabulous!"

So, what's the problem, the editors cry, why the hold-up, they chant, shouldn't every home be prefab now? It's green, it's economical, it's oh-so-Obama, and yet, and yet…They want it cheaply. They want it under $200/square foot. Really under. And, they want it fast. Ready made. Off the shelf. Fast and cheap – and, therein lies the rub.

A Dream

This is not the first time that architects have tried their hand at prefab. One could conceivably argue that ever since Paxton's Crystal Palace, prefab has been an architectural *problem*, one that architecture has had to take to heart, to its core. And, while this could be a chicken-egg equation – it seems that once the technology arrived – to manufacture thinner, lighter supports and infill materials and ship them constructed to the site instead of spot-building – the role of architecture has been to mediate the design between the material fact of this new construction and the desired visual, volumetric, and spatial effects. Paxton's answer was modified greatly by the still-overwhelming ethos of Classicism: connect the iron members to make a barrel vault, count on iron's slimness to hold up the roof without too many visual obstructions, and celebrate the natural lighting offered by the glass. For the most part, it's an abomination, and was decried as such at the time.[1] And, it was hardly cheap. Frankly, as a monument by an architect (as befits an architect), it didn't need to be.

So, it was really modernism that attempted to truly reconcile the technology with the design. And, by this, one means, early 20th century avant-gardist European modernism. Prefabrication must have been seen as a panacea to them. It was undeniably modern in that it was born out of the machine, using mass production processes. It was light, or could be made light, and therefore signal the break from the weight of masonry. It was, at one point in its lifespan, mobile, and so could celebrate the speed of modern life hailed by the Futurists. It could live off of the ground, weightless, floating. It came in rectangular panels and so could be made to participate in a developing grammar of planes, directions and volumes, ala Rietveld, ala Cubism.

It made nice cubic volumes easily. And. because it was mass-produced, it could be delivered and set-up, rather than spot-built, and therefore it would be a boon to the working-man – a labor-saver AND cheap enough for him to afford.

Following from this, there are many examples of schemes for prefabrication abounding among the architects of the European modern movement. Certainly, the most famous is Le Corbusier's Maison Dom-ino, which while perhaps not exactly prefabricated, did call for the use of standardized ferroconcrete elements that could be shipped to the site, proposed as an inexpensive solution to the post-war reconstruction of Flanders.[2] And, of course, one cannot easily dismiss the entirety of the 1929 CIAM based upon "Die Wohnung fur das Existenzminimum." But, the complete list is not as well-known, to name a few: Andre Lurcat's two projects of 1926 – one a development of standardized houses in Cite Seurat and the other workmen's houses in Villeneuve-St-Georges; "Das Wachsende Haus" by Martin Wagner, to be used not just as a weekender house but to also be constructed from standardized parts "in a weekend"; Bruno Taut's scheme for prefabricated "house-dwellings" to be used by survivors of a major earthquake in Turkey; as well as the un-built projects, such as Paul Scheerbart's 1914 vision for "transportable buildings" oddly made of glass; Richard Neutra's plywood demonstration house of 1931, and RM Schindler's charming mobile home of the following year.

(Deferred...)

Before WWII, there were literally thousands of prefabricated houses, or at least houses assembled from prefabricated components in Europe, and the number had grown exponentially in a very short period of time. In Great Britain, the Calway company had been making cement panels since 1903, and J.A. Brodie devised a system for housing in Liverpool based on hollow-core, precast concrete units (Elton Flats) as early as 1908. Between the end of WWI in 1918 and 1925, Great Britain alone became home to over 10,000 concrete panel housing units, about 3000 steel-clad dwellings, and approval by the Ministry of Works for 110 new systems of construction.[3]

In Germany, where the Weimar republic quickly recognized the need for efficient housing, the story was not altogether different. By the end of WWI, industrialists oversaw hundreds of prefabricated dwelling units produced using steel frames and clad in either very thin (3mm) steel plates, as in the Kastner houses, or in copper, as in the Hirsh-Kupfer houses. There were not as many prefabricated houses produced in Germany between WWI and WWII overall (the Christoph & Unmack houses emerged as the clear winner: one, because they were the oldest and therefore the first to be granted factory rights; and two, because they manufactured prefabricated wooden barracks useful to the beleaguered Prussians).[4] However, Germany was also home to the clearest examples of architectural prefabrication.

Architectural prefabrication, meaning prefabricated houses and buildings designed by architects to reflect current design trends, was spearheaded by the unflagging enthusiasm of Walter Gropius. When, in 1910, a young Walter Gropius presented his scheme for prefabrication to his then-boss, Peter Behrens, he was told unequivocally that his scheme would find no practical advantage (a position Behrens quickly amended by 1914 when the young Jeanneret presented his Dom-ino scheme). Undeterred, Gropius sought alliances between himself and the same industrialists who were enamored of the possibilities of mass housing, even going so far as to "steal" Behrens former client, Emil Rathenau, in order to produce panel system housing. Once head of the Bauhaus, Gropius effectively used his position to openly celebrate and advocate the advantages of prefabrication. For Gropius, and most elaborately described in his later text "The New Architecture and the Bauhaus," prefabrication came to signal an apotheosis of the "art and technics" that lay at the core of the new sensibility. In addition, he became the greatest proponent of the idea that prefabrication was perfectly suited to the cubic volumes and planar treatments of the new design.

From the "Ziel fur der Wohnbau" diagram designed together with Hannes Meyer, to the Toerten-Dessau housing scheme, to the built examples of the Bauhaus instructor dwellings, Gropius cannily used the elements of prefabrication as a kind of quickie-formula for the production of an undeniable architectural modernism. In fact, his work on prefabrication was a common course for the students at the Bauhaus, presented as a series of architectural problems that could be solved through the use of prefabrication. These were often couched as social

problems – for example, "a factory needs 100 new workers" – but the nature of the assignments was to mostly arrange and play with block and plane elements to create satisfying, i.e., modernist, design outcomes. Certain features soon emerged that would characterize these designs: the main volume block with a narrower (typically by one-half) tower type block in a slightly asymetrical or stepped-up arrangement, a flat roof accentuated by flat canopies overhanging rectangular doors, and tripartite windows usually darkened in contrast against the white walls (see fig.1).

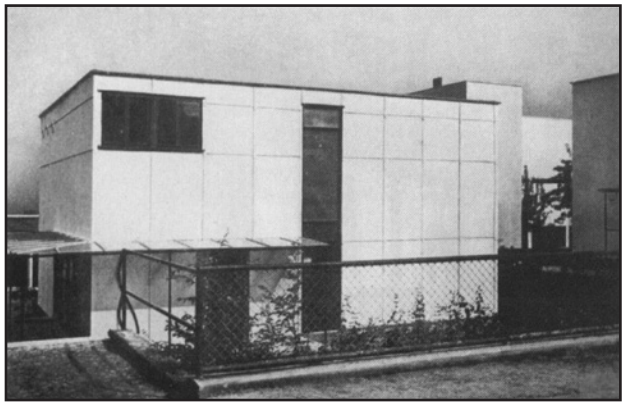

fig.1. The Weissenhof house by Walter Gropius, 1927

Among architects associated with the Bauhaus, these modernist characteristics remained more or less constant as many more jumped on the prefabrication bandwagon. Gropius himself boldly redesigned the houses for the already-successful Hirsch Kupfer copper housing company, approaching the problem in a quasi-scientific way with a right-angle connection system for the copper panels as well as a catalogue of design choices designated as "Type K1" or "Type M2" depending on layout. More or less, the same was true for houses designed by Johannes Niemeyer for Bohler, Josef Hoffman for Vogel and Noot, and Hans Scharoun for Christoph & Unmack, all exhibiting a marked preference for flat roofs, hovering cubic volumes on 9-12 small footings and tectonically-expressive panel seams.

And, perhaps because of their professed alliance with an emerging new sensibility, these architects were also unabashed about public exhibition and publication. Certainly, one of the lesser-known facts of the famed Weissenhof Siedlungen in Stuttgart in 1927 was that it was intended as a full-scale show of prefabricated houses by architects. This is not to say that Le Corbusier's example was a prefab, nor was Mies, but Walter Gropius' and Marcel Breuer's were. The fact that there is a perceived seamlessness between the non-prefabs and the prefabs in terms of design only reinforced the position that prefabrication was utterly suited to this new ethos.

So, given such early interest, especially among the most influential architects of the day, sheer numbers of evident opportunities, and a seeming one-to-one correspondence between the tectonics of prefabrication and modernist design outcomes, what happened to architectural prefabrication? To put it bluntly, did architectural prefabrication succeed or fail?

If it succeeded then I suppose we would not be standing here today, behaving like the nuns in *The Sound of Music* wondering (amidst an era of state-sponsored terrorism, I might add), what to do with *a problem* like prefabrication? Or, if it had succeeded historically, then there would be no needless attempt at persuading this audience or any other of the apotheosis that prefabrication had offered to the European modernists, as I have just now illustrated. Or, and this is more to the point, supposing it had succeeded among these influential architects, why, why, why does every succeeding generation of architects seem to "discover" and herald the dawn of prefabrication, even while us historians wag our finger and say, "no, not quite"?

OK, the other option is of course less preferable. Architecture likes to do a lot of things. Failure is not one of them. So, instead, the usual answer to my queries of success versus failure (despite the more maddening, postmodern answer that goes, "define success, define failure") is that it was not architecture's fault. There were larger historical forces – across Europe and America, reaching from popular criticism in 5-cent newspapers to severe postcolonial critique, that have marred the potential relationship between prefabrication and architectural design. The world got in the way.

And so the story goes …

The most popular version is probably also the oldest – out of the mouths of people like Tom Wolfe's scathing *From Bauhaus to Our House* but there are echoes in Colin Rowe's introduction to *5 Architects* as well as in much of the critical work that has

touched on the issue. This version reports that the European avant-garde architects who jumped over the Atlantic in the interwar years took up elite positions in major universities and taste institutions in the US, and thus, by the end of WWII, they were so co-opted by their new found comfiness that they no longer had need to advocate mass housing or to press an ideology based on providing functional habitation for workers. Their "morale/word" had become corporate – it was now TAC, it was now Seagram – and elite – it was Harvard, it was Yale. It no longer "interested" them to work on prefabrication for social reasons.

In this telling, "failure" is not really Failure – it's more like disinterest, a forgotten project left on the shores of the old country, and since only a few of "their" examples had ever been built, the entire project could be easily dismissed. On top of that, this story gets corroborated by a general sense that the populace would not buy prefabrication after the war – that there was suddenly (due to the horrors of war) a turn in social consciousness that made consumers decide they just didn't like prefabrication after all. And, even though the former European modernists were at the helms of powerful universities and cultural institutions, the architects were either too disinterested, or as some suggest, too helpless to change the minds of the populace.

Really?

Donald Albrecht argues that prefabrication won the war for the Allied Forces, *won the war*. If had not been for the ability of the armed forces and the defense workers to set up shop, make airfields, barrack troops or workers, establish mobile HQ's and so forth, using prefabrication, then they could not have survived the intricate assaults by the Germans in the forests of Europe nor the massive assaults of the Japanese.[5] It was not merely speed, nor efficiency – it was the ability to mobilize. And, the fact was that the Americans, whether because of Manifest Destiny or just a willingness to adapt quickly, were experts at mechanized, technologized mobility.

On top of that, prefabrication could be done efficiently and cheaply just at a time when housing was desperately needed to meet demands by returning servicemen who had been promised housing under the 1942 GI Bill. Certainly "cheap" was a powerful buzzword. "Cheap" is after all what propelled the Case Study House program into existence. And, of course, many household lifestyle magazines such as the far-less avant-garde House Beautiful launched previews and articles on houses built under $3000, or under $5000, or in the case of the more upstate version $8000. Up until about 1942 or 1943, these same magazines routinely featured modernist plans, and schemes for flat-roof houses, as if it were part of a "style palette" that would become available after the war.

Feeding popular taste as well were the government programs aimed at re-tooling mobilization for the coming peace. In 1940, *Architectural Forum* began running a column entitled "Headways and Headaches", a selection of short informational pieces on new governmental contracts; changes in policy that could affect both demand and design; a running account of persons in positions of authority with the various agencies in charge of defense-related building; reports from projects in varying stages of completion from patents through to occupation, and short pieces on industry innovations in materials, construction and building. In these columns, there is an almost naturalized acceptance of prefabrication and a clear mandate set for architecture. The USHA even went so far as to sponsor a show at MoMA for post-war housing. Its booklet advocated "Not These" (row houses, spot-building, Victorian squalor), "But These" (prefabricated dwelling units, flat roofs, modern cleanliness).

The Post-Modern House

So, while for all appearances, it looked like a general disdain grew up for all things war-ish, could it also have been possible that the populace was ripe for propagandizing? One argument is that the American populace felt a longing to return to the safety of tradition – and from that longing, the developers and building industries responded by giving them suburbs like Levittown: modest single-family houses (pretty much) spot-built on specific single-owner lots, miniature imitations of their Victorian-era ancestors, minus parlors, servant quarters and too much overt decoration, but typically wood, with pitched roofs and defined, door-closed rooms.

On the other hand, modern architecture was quickly becoming the style of choice for urban centers and cities that were growing at a tremendous rate at war's close. Banks, office buildings, factory con-

versions, apartment blocks – was the American public so schizophrenic that it desired progress for its cities, aestheticized by architectural modernism, and retrogressive Victorian-era comfort for its suburbs, its bedrooms?

By 1945, the stated desires of American taste-making had changed dramatically. Yes, this may have been due to a back-home backlash against perceived European elitism, and yes, it may have found causation, or at least reinforcement, in people's fears. Prefabricated housing could perhaps not escape the taint of a remembered belt-tightening that was, by all accounts, supposed to recede into memory when you win the war. Nor, perhaps, could prefabricated housing escape the taint of an even earlier memory – of the now non-patriotic libertarian attitudes of permanent-vacationing American trailerites (and tax evaders, many of them) who chose mobile lives in the many trailer camps across the country before the war. I'm not implying that there were not powerful social forces at play – but what I am saying, most urgently, is that maybe, just maybe, the rejection of architectural prefabrication in housing – the abandonment of projects dedicated to prefabrication by noted architects as well as a sea-change in attitudes towards prefabrication as a "failed experiment" – came not from popular rejection, *but from architecture itself*.

Consider the words of Joseph Hudnut – in a 1945 article entitled, "The Post-Modern House" in which he begins, "I have been thinking about those factory-built houses, " and then relates an experience flying over the immense parking area of Jones Beach, and likens the factory-built houses to the cars as "standardized mass-produced shells, indistinguishable from those of its thousand neighbors." The house-car analogy is nothing new – but what is different is an attitude which suggests that factory-built houses are products of merely scientific thinking, or "Our architects are too often seduced by the novel enchantments of their techniques, " and "There is way of working, sometimes called art, which gives to things made by man qualities of form beyond those demanded by economic, social or ethical expediency."[6] Now consider that Mr. Hudnut was the Dean of the Harvard Graduate School of Design, the very same person responsible for hiring Martin Wagner and Marcel Breuer while promoting Walter Gropius to Chair of Architecture in 1937: hardly the sort who would be hostile to the cause of architecture.

Consider also the words of Sigfried Giedion in the book that followed the seminal *Space, Time and Architecture* that heralded the balloon frame and the American landscape as a "perfect setting" for prefabricated houses. While *Mechanization Takes Command* may sound promising, it is instead a horror show of mechanized processes simultaneously churning out objects for the home as it does turn out steaks for the table. And, in a particularly pointed passage, Giedion exclaims, "A house is neither an automobile or a trailer. Houses do not move. Houses stand on specific sites and must adapt themselves to the environment. Houses rolling ready-made off the assembly line will but rarely satisfy on this score… For neither he who dwells in the house nor he who designs it should suffer himself to be tied. That is, the task of mechanization is not to deliver ready-made, stamped-out houses but flexible elements admitting of various constellations…".[7] Now consider that the aforementioned book was actually a series of lectures delivered at the GSD at the behest of Walter Gropius, and so, effectively ends on Gropius' achievements as prefabricator as the mark of human progress, and that *Mechanization Takes Command* followed by only 7 years, and well…

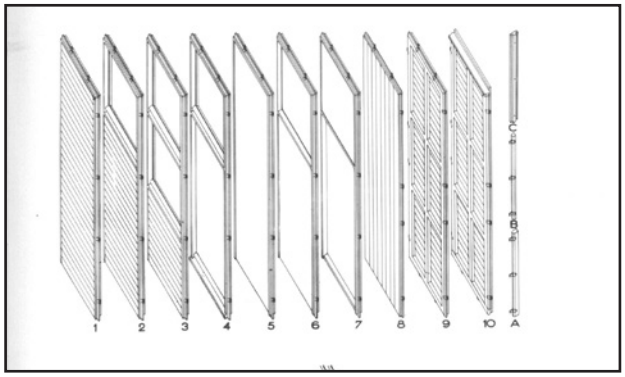

fig. 2. Gropius & Wachsmann, Panel system for General Panel Houses, 1940-1946

Less is a Bore?

As mentioned before, never had there been a more vocal advocate for prefabricated housing than Walter Gropius. After his time with the Bauhaus came to an end, and as soon as he was offered a position at Harvard in 1932, right after the International Style exhibition (and after JJP Oud rejected the job offer), Gropius set to work on making prefabrication a widespread fact in America. His

archive is testament to his dedication – spilling over with letters to building industry leaders and government officials, and speeches before ladies clubs, labor unions and frankly anyone who would care to listen – all extolling the virtues of prefabrication and exhorting one and all to participate in a unified system of building construction. At the GSD archive, the story is similar, with many assignments given to the students using prefabrication as a basic tenet, and in turn, many theses exploring the potential uses of the coherent building system. Teamed with Konrad Wachsmann by 1939, Gropius was finally blessed with a corporate contract to design and supervise manufacture of a series of houses by the General Panel Corporation, using a system that he and Wachsmann devised based on 12 panel-types and an ingenious 6-sided universal wedge connector. During the National Emergency in 1941, Gropius even testified before Congress on the advantages of this panel system for defense housing. By 1943, Gropius had overseen production of a few hundred houses, and…by 1947 the project with General Panel was abandoned. And by 1954 or so, the letters, the writings, the very vocal Mr. Gropius was, on the subject of prefabrication, curiously silent.

So, to return to "fast and cheap": one way of looking at this story of Gropius and the war is to say that "cheap" did not survive the post-war period of patriotic consumerism (the world got in the way), or similarly, "cheap" was no way to run an architecture business after the war when there was so much more to be had in the truly corporate urban world. However, I wish to propose here instead that "fast and cheap" was (and perhaps is still) overseen by an ethos guided by its modernist heritage. In other words, it either needs to look like the modernism that celebrated the machine – the right angle, the cube, the delicate lift from the ground plane – or, it needs to look fast. From a machine or like a machine. And, furthermore, I want to argue that this is not merely a socio-economic bias, or the oppressive weight of some cultural memory – rather that the architectural side of prefabrication is guided by an imposing series of tectonic limits, limits so powerful as to ultimately impair the dream that had been prefabrication.

In the Gropius example, we have a clear case of modernist ambition based on the dream. If everyone could get on board - the banks, the real estate speculators, the building industry, the populace and the architects – as Gropius argues time and time again throughout the archive, then we can solve housing shortages once and for all. The system is utterly rational, efficient and easy to organize, especially if we all can agree on a specific module - and to this end, Gropius often advanced the 4X8 panel. Or, straight from Mr. Gropius himself, repeated in some form continuously from 1932 to 1946, "We are approaching a state of technical proficiency when it will become possible to rationalize buildings and mass-produce them in factories by resolving their structure into a number of component parts. Like boxes of toy bricks, these will be assembled in various formal compositions." The phrases "boxes of bricks" and "variations within preordained limits" appear very often, along with this, "My idea is that the architect is a coordinator – whose business it is to unify the various formal, technical, social and economic problems that arise in connection with building."

So, one could imagine that Gropius was immensely pleased by the partnership with Wachsmann that resulted in the invention of the very simple wedge connector (a small six-sided metal piece that could connect two panels together along an indented seam in the short-width edges), especially as Gropius had advocated panels over any other system. With the panel system (fig.2), Gropius could achieve his dream, his box of bricks, his role as a coordinator.

In "fast and cheap" parlance, this meant that the architect could exist not at the beginning of the process, but somewhere between production and delivery/set-up. By thus removing specification based on desired spatial and other architectural outcomes, the factory need only worry about producing the one module – in this case, the panel. Since assembly-line Taylorism was established to do just that, it was (and is still) also understood as the most economical, most direct solution. When the panels can also be used for structure, for doors, for windows, for floors, and so on, then all the better as there is no need to re-tool the entire assembly line when variations are required. Moreover, and this was really the deal-sealer, because the panels were based on the 8-foot cut, they could be made according to an already established building standard that emanated out of the 4X4 module, and that had already resulted in the plywood sheet that we are acquainted with today.

If that were not enough, and again we must credit Gropius' vision for uniformity and unity here, the 4X8 panel did very well on the back of a flat-bed delivery truck. In 1956 under the Interstate Highway Act, standard lane widths were specified as a 12-foot minimum width. In rural areas, the lane width minimum can reach 15-feet to allow for ditches. Any highway lane under the minimum must apply for a variance to be allowed as an Interstate highway or feeder, and thereby qualify for federal funds. Of course, this portion of the act caused tremendous furor, especially among more mountainous states, for most roads were initially cut in 8-foot lane width minimums, when large, fast-moving traffic was almost unimaginable. When Gropius devised the *panelbausystem,* 10-foot minimums were the norm for most highways, and despite the Highway Act, what we still encounter in most rural areas today. Thus, by using existing trucks on existing roads, delivery could be made quite easily, and therefore also quickly and cheaply.

Sounds fine so far, right?

To return to Hudnut's lament or Giedion's admonishment, it actually does not appear that the problem, *the failure*, came from rationalization in the service of "fast and cheap." Rather, the problem seems to be more on the end of imagining the architect as a coordinator in service of the "fast and cheap". To reducing the architect to a mere organizer of parts, both Hudnut and Giedion seem to mourn the loss of art.

For many years, Gropius held fast to the idea that his "box of bricks" would provide architects with variation – as he said (often) "the greatest possible variation." However, as his familiarity with prefabricated house design increased so also the caveat was added (that I alluded to earlier) "the greatest possible variation within the preordained limits." In other words, the panels may have been a relatively small module but they could only do so much. Because of the wedge connector, they could only connect in parallel or at right angles to each other. Even if one played the width against the length of the panel, a rather strict orthagonality would almost surely ensue.

To become rather contemporary very quickly (and pardon me for the whiplash here), we can see the problem of tectonic limitation in the rather large module of the shipping container. If we take the container as a module, we can sit them side-by-side, or stack them, or make an "L" or an "H" (if we're really feeling daring). One can of course cut into a container to gain more space but that would destroy their "natural" load-bearing abilities. So, unless we introduce another system, of construction, of structure, or to be more exact, of tectonics, we're just going to have a bunch of blocks, looking block-ish. If we go smaller and thinner, say to the panel system of Gropius, that only connects at right angles, we encounter a similar problem – very right-angle-ish. Moreover, like the spatial limitations of the container example, an 8-foot length cannot span very far without an additional structural system, such as a column. However, once we introduce another system, we have voided many of the principles based on the efficiency of "fast and cheap" from the building industry standards to the very width of the roads.

So, architectural logic, the logic that propels the need for variation, would suggest that the smaller (and thinner) the module, the more variation it offers. Indeed, that is the case. Here are a few of the General Panel houses as they were envisioned using the single-module system by other architects, in this case, Harkness, Schindler and Neutra. And, here are General Panel schemes by Gropius' students at the GSD.

Yes, there is certainly more variation. But not much. In fact, it was these very schemes that led Klaus Herdeg to critique the GSD as a sort of "design factory" churning out little more than "decorated diagrams." The same sentiment appears 10 years earlier in William Jordy's *Impact of European Modernism in the Mid-Twentieth Century*, as well as 10 years later in Alofsin's description of the GSD studio system in *The Struggle for Modernism*[8] One could even argue that this perception at least colors Colin Rowe's account in the aforementioned introduction to *5 Architects*. It was all very heroic sounding and may have seemed like functionalism, but it all looked the same. Even Henry-Russell Hitchcock, as early as his 1929 book Modern Architecture, dismissed the Lurcat schemes, praised for their orthagonality in modernist terms, as "monotonous and uninteresting in expression."[9]

A New Day

This is, I suppose, a cautionary tale. Prefabrication may seem an exciting sort of solution, and certainly it is in dire need of the value-added attractive features that design can bring, and is bringing currently. It feels almost noble in an age when architecture hasn't felt that way in awhile.

But, avoid "fast and cheap" if what you want, at the end of the day, is architecture. If architecture has had episodic encounters with prefabrication, historical spasms that momentarily celebrate and herald prefabrication, and then just as quickly disappear again; then it is likely that there is a great limiting factor. I have argued here that the single-module, reinforced by mass-production operations and ethos, may be that factor, always running short of the expressive need of architecture. In the end, the need for expression, against the limits of the module was enough to make (the very-vocal) Gropius hang his hat on the issue once and for all.

One could ask at this point, what of mass customization, and other contemporary advantages of computer-aided design and construction? What about CATIA and BIM and other countless acronyms? To which I will withhold judgment – but might suggest that an imposed waviness is really no different, tectonically-speaking, than an imposed orthagonality. Obviously, one solution is to make the module very, very small – the size of a pixel perhaps – but as long as industry remains industrial and as long as delivery relies on trucks and roads or ships and railroads – it's going to get very costly, very quickly, and in a really 19th century way.

The real test, therefore, lies in the ability to introduce multiple systems, whether those be structural (to create variations in span and/or aperture), volumetric (to create spatial variations), or as we are seeing currently with the *Dwell* versions, multiple sheathing systems and finishes, while still retaining some level of supposedly-inexpensive mass-produced efficiency. As the Dwell example shows us however, in the winning scheme from Res4Architecture, the competition may start at $175/sqft, but to achieve architecture, that cost went up to almost $400/sqft. And, hey, if people can afford $400/sqft, they tend to still prefer spot-built houses in all of their deliberate, inventive, intricate variation. I'm just not entirely sure where they get that idea from…

ENDNOTES

1. See James Ferguson, third volume of *History of the Modern Styles of Architecture*, titled "Being a Sequel to the Handbook of Architecture," on the "tertium quid" in which he decries the thinness of the iron members as "inappropriate" to the imitation of Classical style (London: John Murray, 1862).
2. Le Corbusier, *Oeuvre Complete, 1910-1929* (Zurich: Les Editions d'Architecture, 1964), p.23.
3. Burnham Kelly, *The Prefabrication of Houses* (Cambridge, MA, Wiley, 1951), p.15-16
4. The best discussion of this, and to whom much of this work is indebted, can be found in Gilbert Herbert, The Dream of the Factory-Made House (Cambridge, MA, MIT Press, 1984).
5. See the introduction by Donald Albrecht and Peter S. Reed "Enlisting Modernism," in D. Albrecht ed., *World War II and the American Dream: How Wartime Building Changed a Nation* (Cambridge, MA, MIT Press, 1995).
6. Joseph Hudnut, "The Post-Modern House," *Architectural Record* 97 (May 1945), pp.70-75
7. Sigfried Giedion, *Mechanization Takes Command* (New York, Norton, 1948), p.711
8. See Klaus Herdeg, *The Decorated Diagram: Harvard Architecture and the Failure of the Bauhaus Legacy* (Cambridge, MA, MIT Press, 1983); William Jordy, *American Architects and their Buildings 5: The Impact of European Modernism in the Mid-Twentieth Century* (New York, Doubleday, 1972); and Anthony Alofsin, *The Struggle for Modernism: Architecture, Landscape Architecture and City Planning at Harvard* (New York, Norton, 2002).
9. Henry-Russell Hitchcock, *Modern Architecture: Romanticism and Reintegration* (1929), reprinted by (New York, DaCapo Press, 1993), p.172.