# Towards a Praxis-Based Tectonic Theory:

## Vectors of Necessity, Possibility, and Dissociation

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Mastering the relationship between art and technique of building, between idea and execution is and always has been the work of the architect. The notion of *constructibility,* of making aproject "build-able," is central to the materialization of an idea into a form or a spatial entity.

With industrialization, the concrete notion of *techniques* (instruments of making, erecting, and assembling) has been slowly transformed into the less tangible and far more complex notion of *technology (science of techniques)* that refers to a framework of production and fabrication greater than the craft proper. In other words, technology is not an autonomous discipline, but one that engages its socio-economic and political context.

However, ideological and cultural implications of technology are now in question. Few present day scholars believe in the neutrality of technology, observing that "technology is taking its momentum independently from any benefit to human kind."' Advocates of *substantive* theory of technology acknowledge its power to shape society, but with troublesome political implications, as in the case of Heidegger[2]. *Critical theoreticians* of technology seek instead democratic means ofresisting this independent momentum[3]. Proponents of *sustainability,* such as geographer Berque,[4] invoke human beings' ethical responsibility towards the planet resources, forcing us to rethink the use of technology. Without developing these philosophies, it seems critical to understand that seemingly "objective" or seemingly autonomous propositions have significant cultural consequences.

These observations suggest that technology cannot be viewed in isolation, nor can it be idealized. In fact, whether technology *is souped up* or *unplugged,* is neither an innocent design decision nor is it an individual choice; it results from and has consequences for the larger context of building and culture production. Specifically, the question of constructibility cannot be posited in a theoretical vacuum any more than it can be approached in purely pragmatic terms. It is this dual aspect of constructibility, its influence on the built form and its larger cultural implication, which this paper attempts to uncover.

To this end, a matrix serves to explore means of materializing an idea into a built form that maintains cultural and social significance. It weaves conditions of contemporary architectural praxis into three dynamic vectors that govern design/building processes: necessity, possibility, and dissociation. Using selected examples to illustrate the argument', this paper articulates a notion of *tectonics* that engages current *praxis,* as a way to enhance building quality *and* better serve human beings.

### CONSTRUCTING A MATRIX OF CONSTRUCTABILITY

In technical language, *constructibility* has to do withmeans of fabrication, erection, and construction, affected by material availability and transportation, equipment and techniques, and labor/craftsmanship all impacted by local and global conditions.

In ordinary language, *constructibility* means "capacity of being built." Its primary connotation implies meeting certain requirements, *necessary* for the erection of the project. *Necessity,* the first vector, poses the question of constructibility in seemingly pragmatic terms.

The suffix *able* also infers the notion of that which is possible. *Possibility,* the second vector, calls into question the degree to which architects exercise their creativity and invention to exploit and transcend necessity as well as the driving ideologies that motivate them.

In a rational world, these two concepts might suffice to define constructibility. The art of making a building would consist of enhancing, expressing, or revealing necessity and possibility. But the actual practice of architecture subjects such processes to many external forces that place them in a fragile balance. This introduces the vector of *dissociation,* that which separates. *Dissociation* is defined as the rupture of the unity of an entity, here the rupture of the logical coherence and rationality of the translation of ideas into forms. This intrusion can bend the first two vectors, bringing into the design process and into technological choices the unpredictability and messiness of life's "stuff."

Weaving trends of current praxis into this matrix forces an epistemological understanding of these three vectors. Major

## CONSTRUCTIBILITY CRITERIA summarized from Ed Allen's Architectural Detailing

### 1- EASE OF SSEMBLY

UNCUT UNITS
Most construction materials come in standard sizes
Nominal and actual dimension of materials must be known

MINIMUM NUMBER OF PARTS
Understanding the conditions of the work

PARTS THAT ARE EASY TO HANDLE
The size of materials is related to the type of tools that handle them

REPETITIOUS ASSEMBLY
Special conditions require greater attention and should be avoided unless they fulfill a significant

ACCESSIBLE CONNECTIONS
Allow for a comfortable work position
Design for interior rather than exterior installation
Provide for scaffolding
Think it through. Watch for innocent-looking details that can't be assembled

INSTALLATION CLEARANCES
Clearance has to be provided around most assemblies to allow installation

DIMENSIONAL TOLERANCES
Recognize that different materials have different levels of tolerance, and that different trades perform at different levels of precision
Generally, notwithstanding a few notable exceptions. construction is a low-tech rather than high-tech industry.

NON-CONFLICTING SYSTEMS
Conflicts between building systems musl be avoided
Maintaining a relative autonomy of trades ensure better quality control

### 2- EFFICIENT USE OF CONSTRUCTION RESOURCES

FACTORY AND SITE
Factory conditions are easier to control, and a higher level of precision can be expected. Factory fabricated parts are limited by modes of transportation.

REHEARSING THE CONSTRUCTION SEQUENCE
Rehearsing the construction sequence while designing or detailing is a good habit to ensure constructibility.

OFF THE SHELF PARTS
Use standard building components to lower building cost and to speed its erection.

LOCAL SKILLS AND CUSTOM
It is essential to understand the customs and practices of the area in which the building will be erected. Site conditions may limit import of certain products, and workers who are not familiar with a material will need extra-assistance to install it.

ALL WEATHER CONSTRUCTION
Depending on the schedule of construction. some products can be used because they require less preparation and waiting time and others can't

PRIDE OF CRAFTSMANSHIP
Working with rather than against the contractor, and allowing the contractor to express and use his/her skills will result in a sense of ownership on the contractor's part that ensures a greater quality.

ACCEPTED STANDARDS
Understanding construction custom is critical to the overall success of the work Understanding the difference between skill labor and unskilled labor saves useless battles.
Legislated standards guide the construction industry and the work provided by each party. They define levels of quality & performance

Fig. 1. Summary of Ed Allen's constructability criteria.

trends of contemporary architectural production are intertwined in this discussion: pragmatism, commodification, and lack of autonomy. *Pragmatism*, a doctrine whereby truth lies in practical value, tends to reduce *necessity* to terms of efficiency and ease, confining the project to problem solving. *Commodification*, emphasizing the market value of things, replaces the Modernist notion of progress with that of novelty. It introduces into the notion of possibility a twist that transfigures invention and creativity. Finally the *lack of autonomy* of the architecture subjects any rationality of constructive logic to the capricious whims of global politics, powers, and changes. Within this context, how can architects consider the entire spectrum of constructive *necessity?* How can we exploit and push *possibilities* afforded by technology and in what name? Could the rupture generated by *dissociation* create an opportunity to reclaim architecture's cultural significance?

Seldom recorded or discussed, constructibility criteria have always played a decisive role in the implementation of design ideas. Vitruvius promoted architects' mastery of both scholarship and manual skills.[6] Actively pursued during the Renaissance (by Brunelleschi in particular,) such integration is reiterated by Louis Kahn's[7]: "Listen to the man who works with his hand. He may be able to show you a better way to do it." However, construction processes are increasingly complex. In a spirit of clarification, Ed Allen[5] defines constructibility criteria grouped in two major categories, briefly summarized here (fig 1).

*I-Easing assembly* of materials follows some rules of thumb that facilitate building erection, hence proper execution, by acknowledging labor skill (or lack thereof) and the complexity of building systems. These rules promote the use of uncut units; minimum number of parts; parts that are easy to handle; repetitious assembly; accessibleconnections. They recommend that detailers pay attention to installation clearances and to dimensional tolerances as a means to keep expectations of the contractor within reason. Attention to non-conflicting systems becomes an increasing concern, with buildings' sophistication.

*2-Efficient use of construction resources* entails a judicious choice of site Vs factory construction requiring rehearsal of the construction sequence. It favors the use of off the shelf parts. It recognizes local skills and customs even in a so-called global market. It permits all-weather construction and concerns itself with scheduling issues. It allows pride of craftsmanship. Finally it acknowledges accepted standards

imposed by regulations and/or customs.[9]

Allen's criteria represent excellent pedagogical tools, if placed in its right intention. Many criteria cannot be disputed. But let's scrutinize some of their implications through the matrix described above.

## VECTOR 1. NECESSITY & CONSTRUCTABILITY - *HOW NECESSITY INFORMS DESIGN*

These criteria, full of common sense, constitute a basis for sound design, a necessity; they do not however guaranty good design. We will see how architects use these principles to enhance design but will also examine how such principles can easily be construed as pure pragmatism.

Necessity of constructibility. Architects reveal their understanding of the necessity of constructibility with varying degree of clarity, in a more or less literal manner. Sekler[10] recognizes three strategies of expression a) perfect visibility, b) tectonic negation, and c) tectonic overstatement, all bringing the materiality of buildings to the forefront of our experiences; he acknowledges that few buildings implement perfectly structural principles. This discussion concentrates on visible expression.

Showing means of construction is a way to imbue materiality with human presence. Architects enrich their projects by showing the mark of the craftsman or the process of building in the final product. For instance, Pei's or Tadao Ando's concrete surfaces divulge means of erection, i.e. the formwork. The Louvre's concrete" yields the pristine and rich textures (fig 2) of the formwork's fine wood grain, made of exotic species. Ando reveals the ties of the concrete and even the nails that allow him to achieve perfectly smooth butt joints between panels of plywood. Of course, both processes increase the cost of concrete: through Pei's exotic wood or Ando's need for perfect erection.

Indeed means of construction have direct implication on construction cost. Kahn's famous dialogue illustrates this concept perfectly: "Brick, what do you want to be?" "I want to be an Arch," says Brick; but "Arches," Kahn[12] replies to Brick, "are difficult to make, they cost more money, I think you can use concrete across your opening."

This quote infers the need to consider current construction practices. Rumor has it that Brick would now reply "I want to be a Veneer," with the inevitable evolution of bearing walls into cladding systems." Nouvel for one taps into the possibility of cladding materials to wrap domestic projects (such as Bezons Housing project) with industrial corrugated metal, transforming manufactured syntax into dwellings' aesthetics, building on the necessity to re-appropriate such materials.[14]

Means of production transform construction practices. Industrial production ended craftsmanship as known previously. Bezons shows that manufacturing provides opportunities for expression. At the Central Beheer offices[15] (fig 3), Hertzberger investigated a new tectonic syntax, where the scale of joinery shifts from that of the hand to that of the machine. Intricate assemblies of larger modular elements such as terraces, sills and benches exhibit phenomenological

Fig. 2. Pei's Louvre. The wood grain of the concrete formwork conveys a fine texture to the finished product.

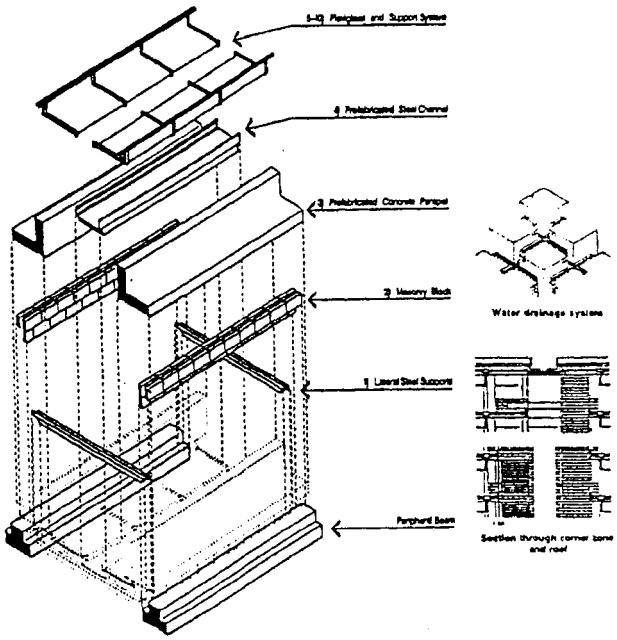


Fig. 3. Herman Hertzberger Central Beheer Office Building. Deconstructed detail of roof drainage and skylight. Drawing by Hans Houser.

intensity. This indicates that craftsmanship may not be dead, but needs to be redirected to acknowledge current means of erection.

While complex and indirect, the dialectic "thinking Vs making" still exists. These examples suggest that Allen's criteria cannot be literally translated; some negotiation (mostly quality Vs price) already affects the expression of necessity. Subject to pragmatic rules, architectural expression is at once fragile and potent.

*Pragmatism **and** necessity.* Let's discuss pragmatism further. "Technical prowess has lost its value as a symbol" states Architect Rafael Moneo. The Modernist belief in technology as salvation for human kind is eroded. The atomic bomb revealed the destructive nature of technology; the 1973 energy crisis underscored the danger of unrestricted technological proliferation. Colquhoun[16] remarks that in the US, technological fascination is now replaced by pragmatism, i.e. a desire for efficiency. Emphasis on pragmatism coincides with increasingly dominant economic principles of globalization." As a result or as an excuse, many buildings are put together rapidly and for a short life span. Is that all architecture can be today?

A narrow understanding of constructibility criteria leads to condemning many historical examples. Edward Ford refers to Johnson Wax Building[18] as a puzzling example of Frank Lloyd Wright's defiance of contemporary methods of construction. Going against common building practices of the time, Wright's desire to build monolithic masonry walls and innovative glass tubing created severe technical failures. Wright's perfectionism and strict adherence to theoretical material integrity led to schedule delays and more than doubling of construction cost. Does that render Wright's work culturally insignificant? Why is such energy spent on preserving his buildings? Could contemporary architects experiment the way Wright did?

Pragmatism leads Robert Mark[19] to criticize vigorously Utzon's Sydney opera. According to Mark, Uzton failed to understand the true nature of concrete; once he realized the impracticality of forming a concrete shell, Utzon should have used a steel structure instead of using pre-fabricated concrete units, all different from each other.[20] The individual casting of units (fig 4) caused acrobatic engineering, delays, and cumbersome methods of construction that eventually led to the outrageous cost of the project. Nonetheless, the Opera is now Australia's icon and contributes in its vigorous sculptural quality to 20th century's architectural heritage. The original investment generated a return, and funding for the building continues.[21]

Pragmatic criticism can sometimes be turned against itself, but it gives a dangerous twist to criteria of constructibility. Reducing necessity to ease and efficiency deprives architecture from its cultural role. This may explain why Frampton[22] dedicates a whole chapter to Utzon as an exemplary tectonic architect.

Current tectonic discourses[2'] reinstall the art of making, the expression of materials and structural behavior. Such discussions invariably celebrate Carlo Scarpa, whose work displays sophisticated tectonic expression through articulated joints and detailing. The Banca Populare di Verona[24] is a case in point, synthesizing his penchant for the rhetorical joint. The window detail (fig 5) reveals technical mastery, poetic and phenomenological intensity. Ensuring a seamless flow between the act of drafting and the act of making, Scarpa however rejects any systematization associated with modernist functionalism and production. Relying on local craft, his "enchanted disenchantment" towards the contemporary world promotes luxurious custom solutions. While serving as a critique of technological utopia, it endorses a nostalgic return to craftsmanship that is out of reach for the majority of people. In that sense, such reaction, in its elitism, places itself outside most praxis.

Evidently, architecture is posited in a delicate balance today. On the one end, pragmatism rejects much of its cultural value and negates phenomenological richness, on the other tectonic theory fails to fully recognize current praxis. Recognizing the vector of necessity does not infer full compliance with its inferences, nor does it suggest a singular path. Understanding construction and recognizing the need for efficiency and practicality need to be modulated with other concerns; it is not sufficient.

## VECTOR 2. POSSIBILITY, CREATIVITY & INVENTIVENESS – *HOW ARCHITECTS EXPLOIT POSSIBILITIES*

Louis Kahn[25] stated "I don't believe in need as a force at all. Need is a current everyday affair. But desire — that is something else again. Desire is the forerunner of a new need. It is the not yet stated, the yet not made which motivates." Hence we need to review how architects *exploit constructive possibilities*, how they push design practices to a critical level, when they choose to respect or disregard rules of constructibility and in what name.

Ed Allen's categories provide clues as to which criteria of constructibility dominate the market, and as such, constitute major opportunities for creativity and innovation: ease of assembly and efficient use of resources. We have seen that pragmatism rules necessity; can it also serve as possibility? The point here is to identify strategies of transcending necessity into desire today.

*Invention & creativity rooted in materials/techniques understanding*. Some architects root their creativity within construction technology itself, using it to inform, enrich, and even determine form. Jean Prouvé's and Renzo Piano's inventiveness rely respectively on *bricolage* and engineering processes. Their designs rest upon empirical knowledge of materials and constructional processes.

Prouvé's search for quick erection techniques led to new structures and assemblies. The Maison du Sahara resulted from the desire to erect a structure in a week with only two men. The pre-stressed cladding system of the Maison du peuple[26] could be snapped on easily. However inventive, these projects lack formal appeal. Renzo Piano's studio is

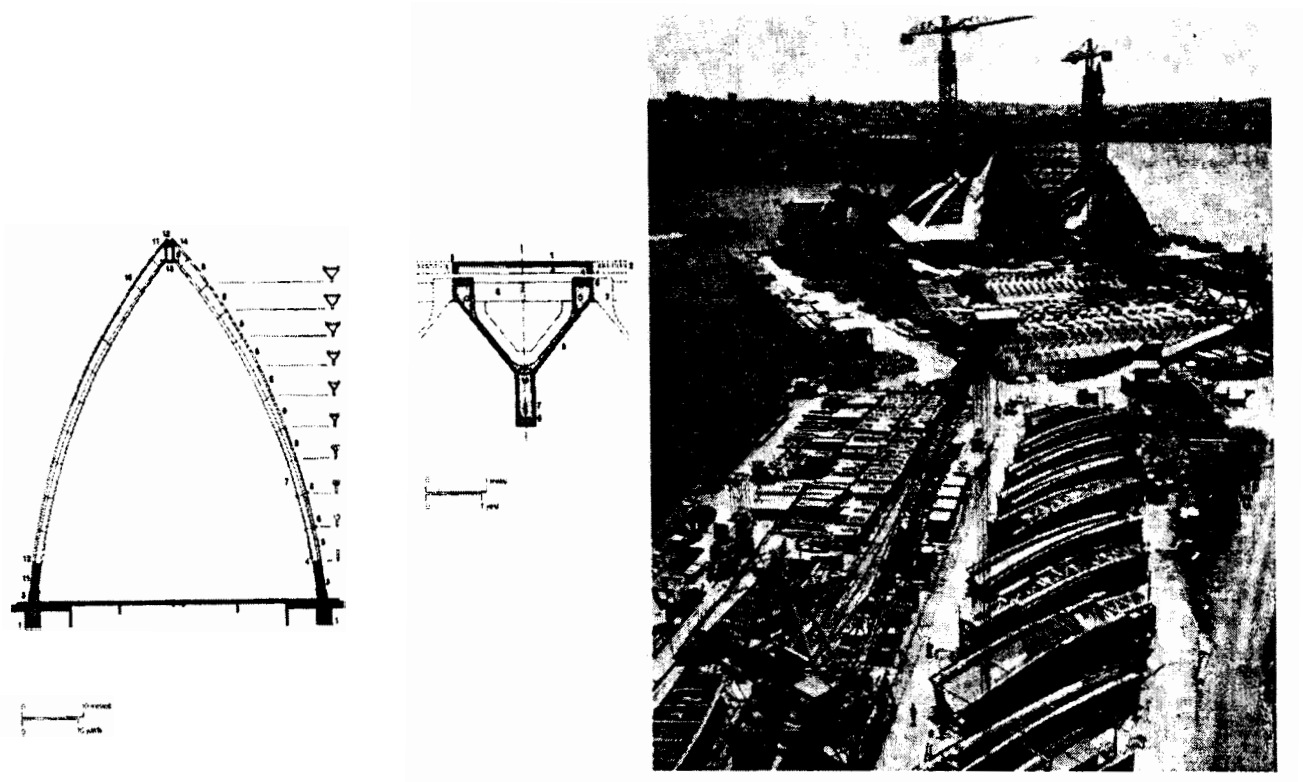


Fig. 4. Sydney Opera section and construction slide. Concrete prefabricated elements all different from each other had to be numbered. Courtesy of Phaidon (see bibliographical notes).

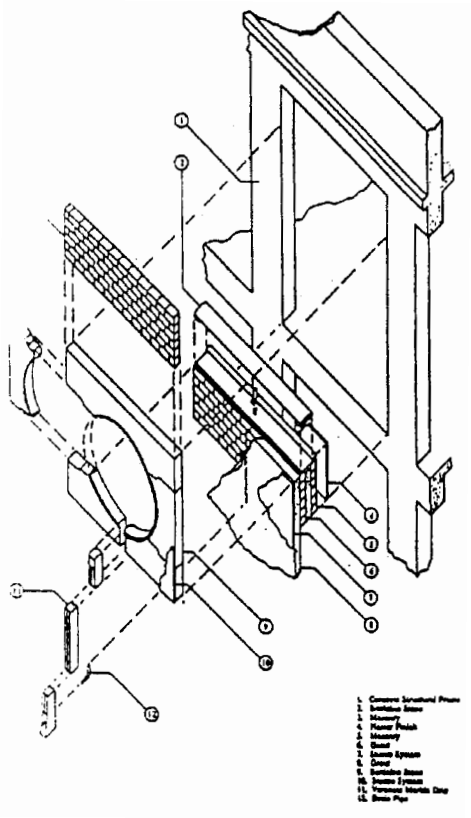


Fig. 5. Carlo Scarpa Banca Populare di Verona. Window detail. Drawing by Gavin Smith.

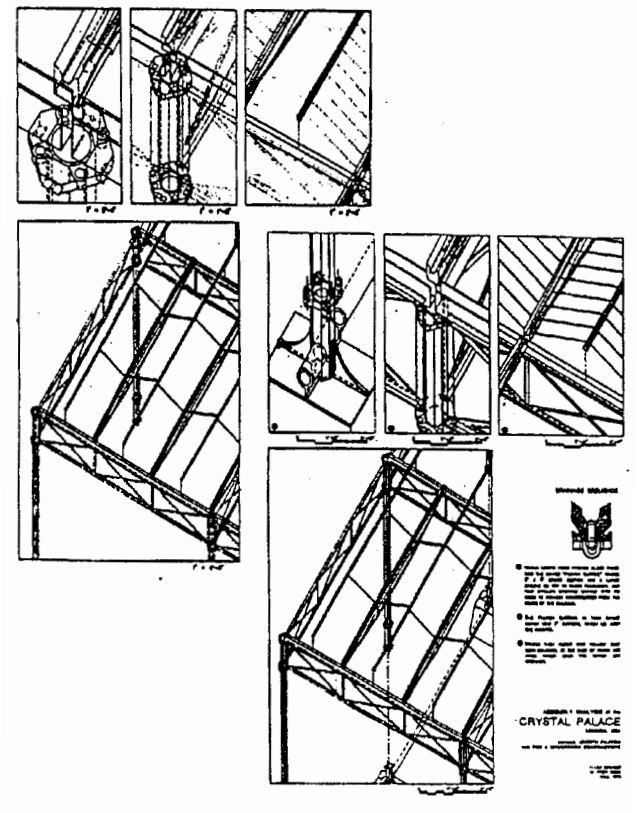



Fig. 6. Paxton Crystal Palace. Details are meant to facilitate easy and quick erection. Drawings by Ellen Ignacio.

called "Building Workshop," stressing that research on materials and techniques are integral parts of the design process.

Yet, these approaches are in many respects atypical. Other architects team up with strong engineering firms to achieve some degree of technological invention, or at least formal expressions that are supported by technical concerns. For instance the creative records of Ove Arup engineering need not be recalled here.[27] Such knowledge of erection techniques becomes essential, as scheduling becomes increasingly critical.

***Invention: strategies that ease and speed erection.*** Instead of hindering creative processes, pressures for short and complex construction schedule have been and still can be sources of invention.

Paxton's Crystal Palace [28] is often cited as the first industrialized structure, the first lightweight building. Of interest here is that Paxton took advantage of an incredibly brief schedule left by much political quarrels. This project represents a culmination of creative yet empirical methodology applied to wood and then to cast iron elements (fig 6). Parallel research into machines and tools necessary to fabricate and assemble them allowed Paxton to build his astonishing concept at the right time. It is a synthesis of structure (understood as concept), constructional concerns (manifested in the care given to detailing), and tectonics (or poetic expression).

More recently, Rogers and Partnership won the design competition for the Lloyd's of London[29] by proposing a strategy rather than a design solution. Even though not initially favorite, their design was based on construction strategies destined to enable the Lloyds to operate continuously during construction. Initially conceived in steel, prefabricated structure and building parts[30] were meant to speed erection. The Fire Marshall's request for a switch to concrete structure only affected mildly the strategy.

These two examples indicate a significant shift in the realm of inventiveness. Increasingly, design and construction strategies matter just as much as design products. Logically, pre-fabrication afforded by industrial production should be privileged. Even though shop fabrication allows better quality control, transportation stresses become major design/dimensioning criteria. Since Modernist attempts, many prototypes have been developed, but few have been mass-produced." The 70s renewed interest for prefabrication led to proliferation and repetition, discouraging the profession to investigate much further. Pre-fabrication is limited to building components rather than to entire buildings, or relegated to industrial and farming projects (trailers, barns, etc.) Have architects fully explored the possibility of pre-fabrication? If so, what motivates creativity today?

***Possibility and commodification***. Creativity is to be driven by something larger than the task itself in order to achieve the status of art. André Malraux[32] states that art is humanity's way of transcending its limitation. Modernists utopian views on technology's possibilities are now challenged. As a counter-current to self-propelled technological escalation, the energy crisis challenged ostentatious display of man-made techniques/materials, reminding us that the world relies on limited physical wealth. Such reality checks might reduce technological growth.

Paradoxically though, architects are increasingly subject to economic pressures to produce faster, cheaper buildings treated as commodities. This increasing commodification, placing economical factors first, minimizes the cultural vocation of architecture. Architects, now part of a "service" industry, have to meet consumers' demands. Can architects transcend economical needs with an ecological agenda? Speed of erection and efficient use of resource are not necessarily incompatible.

For instance, Renzo Piano achieves formal refinement with technical development. The mastery and sophistication of his museums' natural lighting evolves from the De Menil to the Brancusi to the Beyeler museum. This coincides with a questioning of artificial lighting and of its energy consumption. Similarly, Piano's rain-screen cladding system is re-

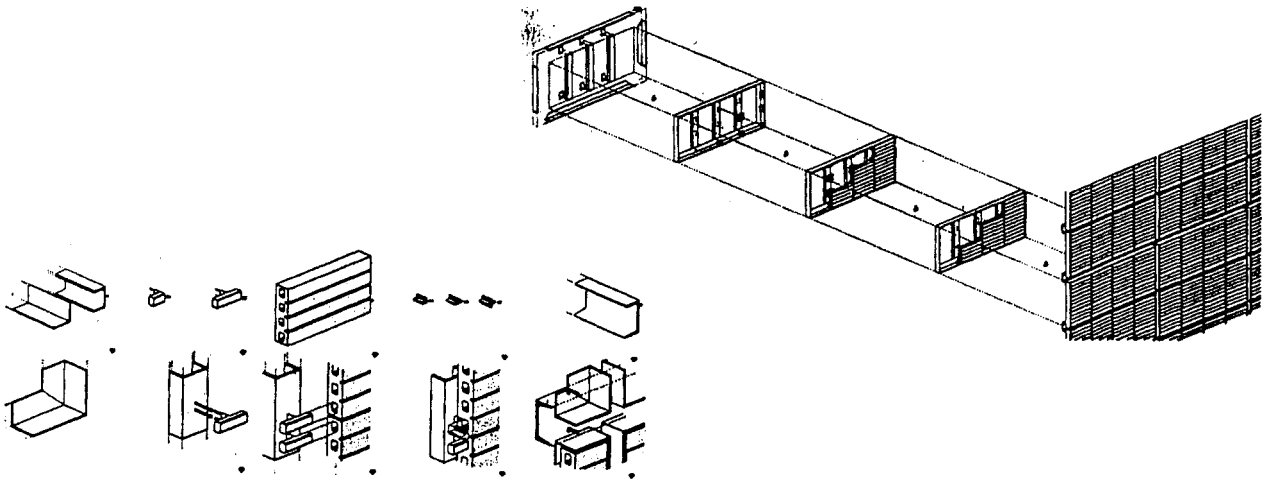
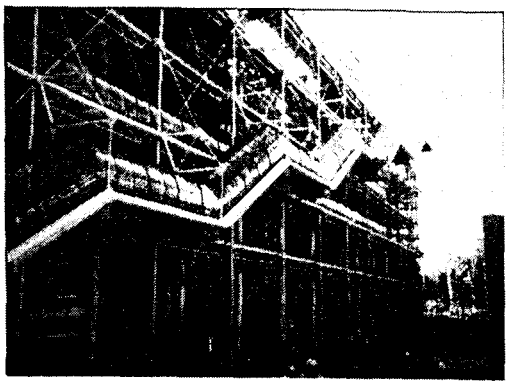


Fig. 7. IRCAM cladding system, showing how Renzo Piano rehearsed the construction/erection sequences. Courtesy by Phaidon. Peter Buchanam, Renzo Piano Building Workshop, Complete works, Vol. 1 Phaidon, 1993.



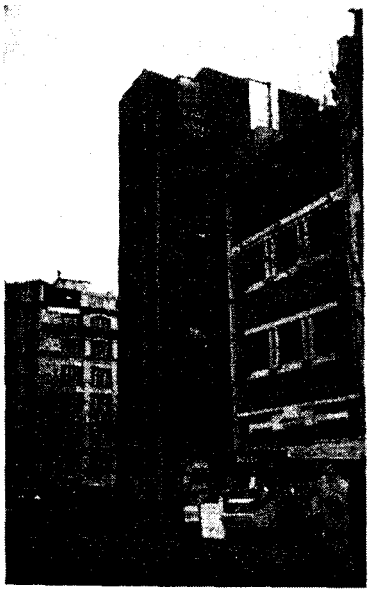


Fig. 8a (above left) Baubourg and Fig. 8b (right IRCAM show Piano's evolution. The purely technological expression of Baubourg is modulated ten years later by attention context; the choice of clay elements and the size of modules relate to adjacent buildings.

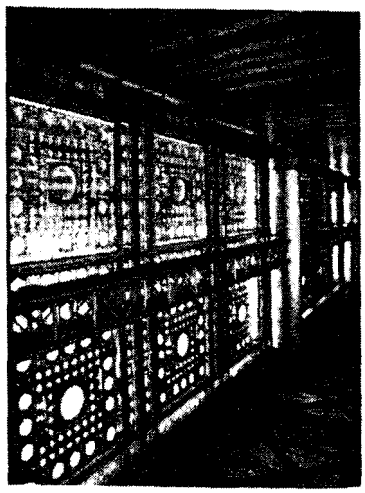


Fig. 9. Nouvel's IMA. Theenclosure's pattern relates to muslim culture and to Paris' climate.

fined from the IRCAM to the rue de Meaux to Lyon's Cité Internationale. Rain-screen cladding recognizes that redundancy is necessary for detailing building enclosures, that air pressure differentiation need to be built in thin envelopes, while acknowledging the prevalent cladding market (replacing bearing walls.) These intricate systems are energy efficient, take erection techniques into account (fig 7,) while guiding a new vocabulary. They illustrate how architects can transform necessity into opportunity, exploiting both materials and praxis possibilities.

Exploiting possibilities allows architects to devise new systems and forms. Invention stems from the desire to exploit actual conditions into assets and transcend need into desire. It seems that today's possibilities lie primarily in strategies of assembling building parts, still to be perfected. These comments also begin to point out the ambiguity and conflicts between the ideas and the reality of construction.

## VECTOR 3. DISSOCIATION - *HOWARCHITECTS INTEGRATE DISSOCIATION.*

Architecture lies at the intersection of many seemingly divergent concerns. "One of the perverse wonders of architecture is its propensity to bind together barely compatible concerns, like representation and waterproofing" states Tim Culvahouse.[33] We saw how necessity and possibilities can become positive forces. This section investigates how divergent forces of dissociation, conflicts between theory and practice, intentions and interpretation create opportunities for significant expression. In fact, mediation of cultural and ethical concerns conciliates aspects of tectonic theory, "a form-making strategy emerging from the architect's immersion in the real substance of materials and constructional processes," [34] with praxis dissociation.

Two ***forces of dissociation*** seem particularly influential: the first, complexity of systems, has to do with choices of

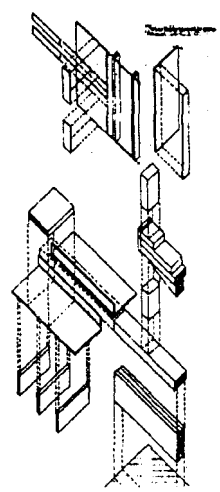


Fig. 10. Gamble House, showing discrepancy between furring suggesting structure and actual members above ceiling. Drawing by Michael Kleeman.

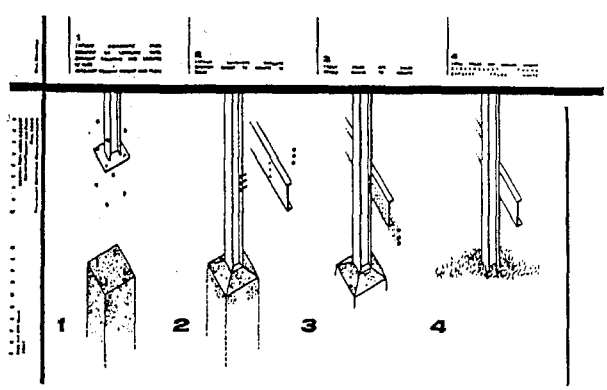



Fig. 11. Mies Van der Rohe. Farnsworth House. Detail showing how bolts necessary for assembly are later cut off for clean appearance. Drawing by Bill Beauter.

materials/methods; the second, lack of autonomy, deals with design and construction processes.

1- *Systems dissociation.* The increasing complexity of building systems expands technological concerns beyond structure and materials. To build a sustainable environment and to conserve energy, architects must integrate many systems, some of which have seemingly little tectonic potential, others more than meets the eye. Reyner Banham[35] demonstrates how Johnson's glass house makes use of radiant heat and convection to creates a masterpiece, seldom cited for its energy control.

Louis Kahn's Kimbell[36] is a sublime example of how Kahn overcame his hate for mechanical systems: "I do not like ducts; I do not like pipes. I hate them really thoroughly, but because I hate them, I feel they need to be given their place." The interplay of tectonic form and light demonstrates how Kahn integrated into the fundamental building structure both "essential services and character of the served space/form to neutralize the destructive aspects of 20th-century technology."[37]

Since then, Norman Foster, Richard Rogers, and many others have used mechanical systems as significant design elements. Foster's Sainsburry combines mechanical systems into a three-dimensional enclosure, freeing interior spaces of any constructional features. Of course the current renovation of Baubourg cautions against free play withexterior mechanical systems.

2- *Lack of autonomy.* Historically, the mutuality of art and technique was supported by a clear relationship between architect and contractor, whether at the service of the Prince, the Church, or the State. The Hellenic or Roman architect would instruct the contractor,[38] the Middle Age master builders would perform both tasks, and the Renaissance architect would distinguish himself from the *Tekton.* With the advent of industrialization, a third party entered the team, the engineer.

With engineering, materials and assemblies became tested and regulated. Now, codes regulate praxis and often transform canonic and intuitive material use. We saw that the Lloyds' structure was modified to accommodate London's fire Marshall. Examples of the sort abound. Constructive logic no longer depends on idealized concepts of materials1 methods. The heterogeneity of intervening parties and related interests contributes to the lack of autonomy of architecture, a major characteristic of current praxis.

Peter Rice[39] warns us that the design team no longer leads construction; instead the construction industry tends to dictate the course of a project. Driven by complex political and economic powers, the industry's regulations and standards impact both design and construction. Material use often results from forces exerted by the industry rather than by the project's needs. A case in point is the development of concrete over that of steel in England. One wonders if such tradition did not affect the Lloyds' Fire Marshall. Lucien Kroll[40] stresses that profit incentives guide constructibility. Clearly, economy, ruling the construction industry, constrains tectonic culture.

With the multiplicity of construction systems, the weight of codes and regulations, the excess of players, the pressure of accelerated schedules, the entanglement of contractual battles, architects are increasingly remote from constructional processes and even from technical concerns left to engineers.

**Mediation of dissociation.** Ambiguity in architecture may be a by-product of dissociation, but should not be the result of architects' inadequacy to transform formal ideas into buildings. Conceptualizing and making are no longer directly linked nor mutually informed, as for the Masterbuilders. Since the Renaissance, architectural theories suggest that intentions have consequences on and are determined by the cultural scene. How do architects integrate dissociating vectors with a larger order, when there is no consensus on what that order is, when we live in a pluralist culture? Resolving dissociation engages another thought level, an ideology.

*The mediation of cultural and technological dimensions.* Pure technological expressions are hard to justify any longer. Norman Foster's Hong Kong Bank [41] is perhaps the ultimate *souped up* building, appearing built by an aeronautical factory. Its constructional perfection relies however on a level of tolerance that far exceeds construction standards and limits its application.

Architectural works that only consider constructibility criteria may not incite awe any more. Piano's evolution suggests that modulating technological expression to mediate site and cultural context might trace a significant path, at least among the so-called hi-tech architects (fig 8.) Catty corner to the technological Baubourg, the IRCAM offers sensitivity to its immediate neighbors and to Parisian context that make it a jewel. The innovative rain-screen cladding affords a delicate modular scale, rhythm, and tectonic quality. Likewise Nouvel's IMA employs a sophisticated mechanized enclosure, that expresses both the Islamic culture within, and the silvery Parisian landscape around it (fig 9.) Projects that integrate technology and cultural representation gain subtlety and richness to define new vocabularies.

While technological expression confronts issues of accountability in architecture, cutting edge technologies continue to pursue a gigantic future outside the discipline. Paul Valery's 1926 statement "We must expect great innovations to transform the entire technique of arts, thereby affecting artistic invention" would most likely be pronounced today with the computer in mind. Where does that leave architecture? The visual paradigm shift of the virtual world privileges form over content, appearance over substance. The excess of images creates what Baudrillard calls *The Murder of the Real.* Such demands generate architectures of icons and a Disney-like environment. Essentially physical, does architecture need to mold itself to the virtual world or can it stand as physical reminder of permanence, of the dignity of living?

2- *Integrating dissociation through an ethical order.* The words "integrating" and "integrity" have the same root. Criticisms of Wright or Utzon indicate that integrity is now

frequently sacrificed for pragmatism. Whether *instrumental,* substantive, or critical, most theories of technology face the question of its ethical use; even ecology does. Instrumental theory claims that human beings can choose to use technology constructively. Substantive theory invokes 'other' powers that would relieve the negative effects of technology. Critical theorists seek ethical and democratic strategies of controlling technology. While often mixing ethical registers (as Berque points out,) ecologists inevitably pose ethical questions. Yet, applying integrity to architecture meets the difficulties of any attempt to act from ethical principles.

The Greene Brothers, proponents of the Arts and Crafts movement, adhere only superficially to Ruskins' moral *Lamp of Truth.*[42] The Gamble House uses visual trickery. The visible ceiling furring for instance does not correspond to the actual structure but to a conventional idea of what it may be (fig 10.) It represents a form of architectural deceit devised by Ruskins: "the suggestion of the mode of structure other than the true one". This suggests thedifficulty of applying rigorous structural/material integrity and perhaps an inevitable need for taking interpretation liberty.

Jencks[43] accuses Mies Van der Rohe, father of "God is in the detail," of being untrue to the nature of construction by insisting on detailing precision. Ford[44] suggests that his details respond to abstract aesthetic concepts rather than to constructional logic. But the Farnsworth House's column detail suggests that sequential concerns guided Mies as much as spatial syntax (fig 11.) The two are not mutually exclusive.

Through architectural history, integrity of materials/structure has been debated, pointing out discrepancies between architectural discourse and practice. Ford[45] recognizes: "there are styles of design in architecture and there are styles of construction in architecture, and the two don't necessarily coincide." Does it mean that striving for integrity is absurd? Or does it simply confirm that human nature is imperfect?

Congruence between constructibility and form cannot reduce architectural concerns to a single perspective. Technological rationality needs to be modulated with larger concerns. In fact, the mediation of dissociation provides opportunities to bring poetry and life to the technological object.

## TOWARDS A PRAXIS-BASED TECTONIC THEORY

The notion of constructibility lies at the intersections of vectors whose trajectories are bent by forces of praxis. Specific professional, societal, economic, and political forces have the power to transform design intentions. No checklist of criteria of constructibility could be significant to the designer; in fact all projects occupy a unique position at a given time in the space of this matrix. The tectonic work (i.e., the artful or poetic expression of structure and material behavior) results from a subtle dynamic fluctuation amongst the planes of this matrix. But an awareness of the ideological and political consequences of propositions that are seemingly objective, or seemingly restricted to the discipline of architecture needs to be present, for any technology theory to have some significance for human beings.

Encompassing praxis within theory does not mean subverting architecture to present conditions for it would deny ideology. Beyond the how of building construction, technologists need to consider the why of material choices and their implications for and contribution to a larger tectonic and architectural culture. Conversely, beyond idealized concepts of materiality, it may be necessary to understand how actual conditions of construction guide, restrict, or modify building aesthetics. Celebrating craftsmanshift does not mean returning to the pre-modern state of civilization. Such assertions often place tectonic theory in amarginal and nostalgic posture that threatens its applicability.

While underscoring the necessity of understanding constructibility criteria, this paper suggests that pragmatism is not sufficient to create meaningful architecture. Desire must transcend necessity into possibility. Circumstantial and contextual dissociation provides opportunities to mediate technological, cultural, and ethical concerns. As the faith in technology erodes, weaving technological expression with humanistic concerns leads to an architecture that acknowledges life rather than exhibit technological self-referentially. In other words, the *Tekton* needs to remember Arkhê.

For architecture to be
It is not enough for the Tekton to master his art and his skills
No
He/she needs *Arkhê*
*Arkhê* is that which initiates, that which directs
It is a matter of decision of determination
It is neither an order nor a beginning but
It is an idea an intention an attitude of sharing
With the other with the City

– Philippe Madec. L'En vie[46]

## NOTES

1 Jean-François Lyotard, Le Postmoderne *Expliqué* aux *Enfants,* (Paris: Galilée, 1988).

2 Tom Rockmore ("Heidegger on Technology and Democracy", Ed. Langdon Winner, Democracy in a Technological *Society*, Netherlands: Kluwer, 1992) denounces Heidegger's theory, demonstrating that for him, only superior forces can only counteract such momentum, the superior race for instance promoted by Nazism that Heidegger supported.

3 Andrew Feenberg, Critical Theory of Technology (New York: Oxford UP 1991).

4 Augustin Berque, Etre Humains sur Terre (Paris: Gallimard, 1996).

5 Further elaboration of case studies is done in a graduate seminar. This scholarly audience is most likely very familiar with examples cited.

6 "architects... who have a thorough knowledge of both [manual skills . . . theories and scholarship], like men armed at all points, have the sooner attained their object and carried authority with them." Vitruvius, On the Art of Building in Ten *Books*(Joseph Ryckwert et al. Ed., (Cambridge: MIT Press, 1996), 6th Ed.

7 Louis Kahn, Light is the Theme, Nell Johnson Ed. (Texas: Kimbell Art Foundation, 1975). p. 54.

[8] Edward Allen, *Architectural Detailing: Function Constructibility Aesthetics* (New York: John Wiley & Sons, 1993).

[9] To this list, one would need to add "judicious choice of materials depending upon their availability."

[10] Edward Sekler, "Structure: Construction, Tectonics" G. Kepes Ed., *Structure in Art and in Science* (New York: Braziller, 1965), pp. 89-95

[11] Audiovisual: Le Grand Louvre, Etablissement Public du grand Louvre/Centre Audiovisuel de Paris, New Dimension Media, 1993.

[12] Louis Kahn, 1972.

[13] Dominique Bonnamour-Lloyd, "Inevitable lightness of Buildings," *ACSA Art-Act of Building Conference* (Raleigh: NC UP, 1993).

[14] "like in Bezons, using a structure covered with cladding does not create any cultural nor aesthetic problems, on the contrary" Jean Nouvel, Realiste et Moderne, M.H Contal "les Habits Neufs du Bardage" *Architecture Intérieure Créée* #240, 1991, p. 64.

[15] For further references, see Herman Hertzberger, *Buildings and Projects* (Den Haag: Arnulf Luchinger Arch-Ed., 1987).

[16] Alan Colquhoun, "Symbolic & Literal Aspects of Technology" *Essays in Architectural Criticism* (Cambridge: MIT, 1995), p. 26.

[17] This short format does not allow full development of such ideas, discussed during the IASTE 1996 conference, Berkeley.

[18] Edward Ford, *The Details of Modern Architecture* (Cambridge: MIT Press, 1991), pp. 321-349.

[19] Robert Mark. *The Mystery of the Masterbuilders* (Nothbrook, Il.: Coronet Films, 1988).

[20] D. Bonnamour-Lloyd, "Tectonic Materiality: Poetics Vs Praxis," ACSA International Conference, Berlin 1997.

[21] Currently a 66 millions Australian dollars renovation project is in process, to adjust to new performance requirements.

[22] Kenneth Frampton, "Jorn Utzon: Transcultural Form and the Tectonic Metaphor" (MIT 1995).

[23] To oppose pragmatism deprived of poetic dimension and to resist architecture's commodification, tectonic theory stresses the need to reconnect with the act of making buildings. First formulated by Kenneth Frampton, tectonic theory claims that the art of building needs to be reinstated and that one must again pay attention to the act of putting buildings together. It relates the visible expression of structure (order) and construction (act of making and assembling) to their poetic potential. Reacting against post-modernist scenographic effects, tectonic theory seeks an authenticity of aesthetics and construction rooted in phenomenology.

[24] Kenneth Frampton "Carlo Scarpa and the Adoration of the Joint" (MIT 1995), pp. 299-333; Marco Frascari, "The Tell-The -Tale Detail", *Via 7: the Building of Architecture.* (Cambridge: MIT Press, 1984), pp. 23-27.

[25] Louis Kahn (1975) p. 69

[26] For furtherreference, see Peter Rice, "On Invention. Jean Prouvé" (Artemis, 1994), pp. 81-85

[27] Ove Arup indeed were keynote speakers at the Seattle's ACSA Technology Conference in 1995.

[28] John McKean, *Crystal palace Joseph Paxton and Charles Fox,* Architecture in Detail (London: Phaidon, 1994).

[29] Kenneth Powell, *Lloyd's Building. Richard Rogers Partnership,* Architecture in Detail (London: Phaidon, 1994).

[30] Prefabricated toilets whose resilient rubber flooring was switched per owner's request to marble that cracked upon crane lifting

[31] For instance, The Eames' Palisade House, Pasadena, sensitively sited in its landscape and topography, was not produced in series

[32] André Malraux, *Les Voix du silence* (France: La Gallerie de La Pleïade, 1951).

[33] "Tectonics Unbound," *Anyone* # 14 (1996).

[34] Thomas Fisher, "TheTectonic Aesthetic" *P/A* (Jan. 1995), p. 37.

[35] Reyner Banham, *The Well Tempered Environment* (Chicago: U of Chicago UP, 1984).

[36] For further reference, see Kenneth Frampton (MIT, 1995) pp. 209-246; David Brownlee et al. (Rizzoli, 1992).

[37] Frampton (MIT 1995), p. 223

[38] Lecture "Les Rapports du Pouvoir et de l'Architecte *ti* Rome et *ti* l'époque Hellenique" by Pierre Gros, Le Louvre, Paris 10/24/97.

[39] Peter Rice, "Chapter 13. Working with industry," *An Engineer imagines* (London: Artemis, 1994), pp. 133-34.

[40] Lucien Kroll, "Chapter 1. The present situation," *An Architecture of Complexity* (Cambridge: MIT Press 1987).

[41] For further reference, see S. Williams, *Hong-Kong Bank, the Building of Norman Foster Masterpiece* (Boston: Little Brown, 1989).

[42] John Ruskin, *The Seven Lamps of Architecture* (Toronto: General Publishing Cie, 1889).

[43] Charles Jencks *The language of Post-Modern Architecture* (New York: Rizzoli, 1987) 5" Ed.

[44] Edward Ford "Ludwig Mies Van der Rohe and the steel Frame" (MIT 1991), pp. 263-287.

[45] Edward Ford (MIT 1991), p. 15

[46] Philippe Madec, L'En vie; Paris L'Epure, 1995.