Standardization: A Fluctuating Horizon

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Few casual discussions about the influence of technology on our lives today proceed very far without the word *standardization* occurring. Indeed, in many minds it is the root cause of much that is alienating about modern technology. A half remembered world of things possessing individuality and difference seems somehow to have been replaced by one of increasing uniformity. At best, this apparent propensity for our world to become subject to standardization is thought to be the price we pay for material affluence; at worst, it is a policy deliberately applied by politicians, economists or business leaders for a variety of seemingly self-serving motives. In the architecture of our day, this popular prejudice finds a tangible vehicle for the expression of such views. The sameness the casual eye observes in commercial high-rise buildings throughout the world results from this regrettable but apparently inescapable force, *standardization*.

But what exactly is *standardization*, and how, if at all, has it acted in this sense as an implacable guiding force in the evolution of architecture in this century? First, some definitions. WebsterÆs offers the following: *standard* is "an authoritative principle or rule that usually implies a model or pattern for guidance by comparison with which the quantity, excellence or correctness of other things may be determined." The importance of the notion that a *standard* is a model to which something can be compared is emphasized by Webster's definition of another word frequently used interchangeably with it in modern parlance - *criterion*: "a rule or principle used to judge the value, suitability, probability, etc., of something, without necessarily implying any comparison." So, it follows that we cannot grasp the meaning of *standardization* in specific circumstances without identifying the "model or pattern" which is being used for the purposes of comparison.

However, a look at a dictionary list of alternative definitions of the word *standard* reveals that they fall into two separate categories in terms of the model or pattern for comparison that is implied. We might term the first, "strict measure" and the second, "approximate measure." The "Gold Standard" or "Greenwich Mean Time" are examples of strict measure. Both are rigid, unchanging yardsticks to which the fluctuations in the value of money and time at various points on the globe are respectively compared. Approximate measure on the other hand refers to an average or normal requirement or condition as a basis for comparison. For example, in "his work this week was not up to his usual standard", it is not necessary to be able to precisely measure "his work" under "usual" conditions - an average work level will suffice.

This apparently petty distinction is important when we consider the evolution of standards in disciplines such as architecture. History shows that strict measure standards are of a comparatively recent origin compared with approximate measure. Their emergence can be traced to the development of modern scientific thought in the sixteenth and seventeenth centuries. As Alberto Perez-Gomez[1] has pointed out, "the 'new science' of Galileo — pretended to substitute for the reality of the live world, infinitely diverse, always in motion and defined essentially by qualities, a perfectly intelligible world, determined exclusively by its geometrical and quantitative properties." The subsequent development of Newtonian physics, the positivistic philosophies of the French Enlightenment, and the influence of industrial technology all contributed to the establishment of standards that were fixed and measurable.

The foundation of all modern measurements is an international system based on seven basic standards that define the modern metric system. They are the kilogram (mass), the meter (length), the second (time), the ampere (electric current), the Kelvin (temperature), the mole (chemical substance), and the candela (light). It is significant that only one of these seven, the kilogram, is based on the actual weight of an existing, physical object. The other six are based on natural, abstract phenomena; i.e., formulae that can be reproduced in laboratories throughout the world because they are derived from natural laws. The standard for the meter, once represented by an actual line on the ground in Paris, underwent revision as recently as 1983, when it became "the distance traveled by light in a vacuum during one-299,792,458th of a second." The current standard for the second is even further beyond normal human comprehension: "the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom"! Work is currently underway at the National Bureau of Standards to find a "natural" definition of the kilogram to replace the cylinder of platinum-iridium alloy (Kilo 20) that since 1890 has represented the official standard. Not the least of the problems faced by the Bureau has been the need to transport this cylinder to Paris approximately every forty years to check that it has not lost or gained weight in comparison with Kilo 4 kept permanently in the French capital.[2]

So inured are we to this idea of precise standards that it is more usual today to think of what I have described as "approximate measure" not as standards at all, but as *norms*. Norms have a lineage in architectural terms stretching back at least to the Greeks, and have not been entirely supplanted by our modern notion of standards. Indeed contemporary architectural discourse is, at one level, a resumption of the dialogue between standards and norms.

Let us now turn from the model or pattern employed for comparison to what it is that is to be compared. A review of the ways in which standards and norms have emerged and been applied in architecture shows that the object of standardization has not remained constant. Partly this has been because of the dual understanding of standards to which I have already referred. But a hypothesis of more significance perhaps is that such fluctuations have been the result of *changing modes of production* within society. The following glance at some aspects of standardization in the development of American architecture since the early eighteenth century lays emphasis on building construction and the realm of human action by which it is mediated. It is within this aspect of architecture that technological change can best be observed.

THE ERA OF THE ARCHITECT/CRAFTSMAN

Prior to 1720, colonial building was essentially a pragmatic, empirical enterprise. For a better part of a century the primary objective was to make shelters adequate to resist a largely hostile climate. Methods of construction were based on memories early builders had of European craft techniques and practices, but these were modified on an ad hoc basis in response to local climate, resource availability, transportation, labor skills and so forth. Colonial builders were largely go-it-alone individualists.

In 1724 an event occurred in Philadelphia that marks the end of this vernacular phase. In that year, the Carpenters' Company of the City and County of Philadelphia was established. As Carl Condit[3] has indicated, American architecture entered at that moment into a proto-professional stage of its development. Based on the Worshipful Company of Carpenters in London, founded in the fourteenth century, the Company was initially formed to protect the economic interests of building craftsmen. However, by 1734 the Company had begun to collect a library of English treatises on the building arts. From these and their own pooled expertise, a body of principles for buildings in general was developed, ranging from overall design, through structure and construction to building costs. These rules were finally codified in 1786 and set down in a slim volume for members of the Company only, expulsion being the price for its wider dissemination. It was titled *The Rules of Work of the Carpenters' Company*, and, despite rather rough-and-ready quality compared with contemporary English works, qualifies as the first American architectural pattern book.

•"•••The real intent and meaning of what hath been done is, that every gentleman concerned in building may have the value of his money, and that every workman may have the work of his labor."[4] But it also implied an intention to standardize actual building practice. This expressed itself in the form of practical recommendations about architectural elements such as wall framing, and details such as windows moldings, accompanied by diagrammatic reminders of the basic classical orders, Tuscan, Doric, Ionic and Corinthian. No recommendations are given about room sizes and layouts, structural dimensions or anything else that might suggest an attempt to control and codify building types. In other words, by the application of normative rather than strict standards based on a received classical language of architecture, pattern books set out to establish a vocabulary of parts from which architectural wholes might be freely and independently assembled.

Such a relaxed modus operandi was entirely consistent with contemporary craft-based modes of production. Since frequently master carpenters were simultaneously architects and building contractors, construction drawings were few and simple. Decisions could readily be made on site. Apart from the importation of such items as bricks, glass and iron goods, most building elements were manufactured, fabricated and assembled on the site.

NINETEENTH CENTURY: THE RISE OF THE PROFESSIONAL

It has been something of an article of faith in standard historiography that the nineteenth century, unlike the eighteenth, was a period of such radical change in building technology that this transformed not only the design of buildings but fundamentally altered the building industry. "The introduction of iron construction brought with it the necessary transformation of building from an empirical and pragmatic craft into a branch of scientific technology,"[5] Condit asserts. Certainly new building types became necessary, iron and eventually steel were introduced, new structural techniques emerged giving rise to a vigorous engineering profession and machine mass production made itself felt. Nevertheless, the building construction industry as a whole remained largely unaffected by the radical forces of change that were creating new industries and transforming existing ones. In agriculture, economic advantages of specialization and large scale enterprise were learned rapidly. Where at mid-century Andrew Jackson Downing could recommend the growing of 186 varieties of apples and 233 varieties of pears, at century's end the varieties readily available had dropped to no more than 30.[6] Today, this range has dwindled still further as the rosy red, but tasteless "standard" apple appears with greater frequency. The meat packing industry emerged at mid-century in a form little changed to this day as a succession of mechanical devices were introduced to facilitate the slaughtering of animals on a mass production, standardized basis.[7] In comparison, the innovations introduced in building construction techniques — for example, the balloon frame were modifications of earlier construction practices. Only the production of nails had been mechanized; all other aspects of balloon frame construction remained intimately associated with the hand and tools of the carpenter.

What did constitute a new factor was the development of the architectural and engineering professions as enterprises increasingly separated from the location of actual building. As a results, each tended to focus on its own area of expertise at the expense of collaborative, integrated effort at the site. Engineers naturally gravitated to projects in which structural engineering factors were clearly paramount and uncompromised by complex programmatic and functional considerations: bridges, warehouses, railway stations. Architects concerned themselves increasingly with architectural style as determined extrinsically by literary, archaeological and aesthetic factors rather than intrinsically by vocabularies born of a demand for commodity, firmness and delight. The nineteenth century schism between architecture as art and architecture as engineering was as much the result of professionalization and the attendant instinct towards protection of territory as it was of any implacable, Promethean intervention by machine technology between architectural idea and its implementation.

So what might be said about nineteenth century modes of building production is this. Production by the craftsman at the building site itself was supplemented by essentially new modes of production in the offices of design professionals. The former underwent steady but unspectacular modification in response to changes in technology at large, but in themselves these were insufficiently radical to upset the norms of classicism. The decisive factor in the eventual destruction of these norms was the intermediation of professionalism in which the latitude to exercise judgment formerly invested in the craftsman was removed into the realm of special interest represented by the architect and the engineer.

Paradoxically, as the collective professional identity of architects gathered strength, so, amidst the Battle of the Styles, expectations weakened that new architectural norms with the authority of the previous century might emerge. In part this was a recognition by architects that they lacked actual legislated power over the total building process. It was not until 1897 in Illinois, for example, that any state instituted licensing laws for architects.[8] But it was also the result of limitations imposed by architects upon themselves in the form of the Beaux Arts system of education adopted wholesale from France. While this helped to consolidate the identity of the profession by nurturing specialized expertise in composition and planning available to no one else, it produced generations of Beaux Arts trained architects largely unconcerned with building technology.

The sense architects had that industrialization was usurping their control over the constructed parts of buildings was matched by an inherent tendency of the Beaux Arts system to codify and standardize the organizational whole. The most excessively rationalized version of this had appeared in French architecture in the early years of the century in the form of Durand's regularized plan and elevational studies for public architecture. It persisted throughout the nineteenth century in the form of standardized plan "partis" for specified building types. For many practitioners, architecture resulted from the manner in which these "received" partis were expressed in elevation.

TWENTIETH CENTURY POLEMICS

American attitudes to standardization in architecture during the early years of the twentieth century were strongly affected by successive waves of influence from Europe: first the Arts and Crafts movement, then modern functionalism as advocated and practiced by such figures as Walter Gropius and Le Corbusier. The ambivalence that these two such sharply contrasted approaches engendered has persisted to this day. Both rejected the immediate past but on different grounds. The Arts and Crafts set its face implacably against machine technology. It sought the redemption of society from the evils of industrialization in a new marriage of traditional craftsmanship and vernacular style. It found neither the normative standards of eighteenth century classicism nor the strict standards of nineteenth century Beaux Arts academicism consistent with these goals. It viewed pattern books as rigid and destructive of original thought on the part of the architect and craftsman, and Beaux Arts classicism as dishonest for its marriage of convenience with the machine. It stuck grimly to the ultimately illusory idea that the interests of architecture as art could best be served by maintaining a kind of purified and innocent mode of production entirely untrammeled by standards interposed between the architect and the built work.

Twenties functionalism shared the Arts and Crafts distaste for the Beaux Arts but little else. The movement's prophet, Le Corbusier, declared in 1925:

> Il faut tendre a l'établissement de standards pour affronter le problème de la perfection. Le Parthenon est un produit de selection appliqué à un standard établi. Depuis un siècle déjà le temple grec était organizé ans tous elements. L'établissement d'un standard procède de l'organization dÆélements rationels suivant une ligne de conduite rationelle également. La masse enveloppante n'est point préconcue, elle résulte.[9]

Le Corbusier proposes here a doctrine of aesthetic Darwinism quite opposed to the Arts and Crafts idea of originality. The Greek temple is a type-form representing a strict standard; even in its unperfected form (Paestum) it has all the necessary ingredients of the type. A process of selection, or refinement, of the parts and details leads rationally and inevitably to the perfect total form (Parthenon). It is this teleologic process that he sees at work in the production of goods by the machine. Ergo, an architecture of the future must not only imitate but actually be produced by the machine. The sleight of hand involved with this shift from analogy to prescription can be easily missed as we are further exposed to the rhetoric of his argument. The building industry must be re-oriented towards the mass production of components and the "made-to-measure" building phased out. Standardization emerging out of analysis and experiment will introduce advantages already realized in the automobile industry: inter-changability of parts, speed of erection, economy, efficiency, and order.

It is often argued that the propagandizing character of this polemic was an acceptable technique given the circumstances of the time. In any case, it is claimed, the subsequent oeuvres of Le Corbusier hardly indicates an urgent desire to dispense with the unique artifact In other words, he was not asking to be taken literally. Yet, however it was meant, the thesis became, and has remained, a powerful influence on architectural discourse and the productive modes of architecture ever since. The rest of this paper traces some of the themes to which these ideas have given rise and looks further at the fluctuations in what it is to which standardization has been applied.

BUILDING SYSTEMS

The industrialization of the building process in the United States has been underway continuously in some form or other since the end of the eighteenth century. Conventional icons of industrialization such as the development of the skyscraper in Chicago that stand out in contrast either to high-style academic architecture or humble vernacular are really only intensification of a much broader, more variegated, complex and even ambiguous phenomenon. There is, however, one period that represents perhaps the only coordinated effort in the history of American architecture on the part of architects, builders, and manufacturers to apply the idea of standardization to building in the comprehensive sense described by Le Corbusier. This came to prominence in the late 1950s and, as a unified movement, faded from the scene in the mid 1970s. Usually it is known as *System Building.*

The two major sectors of the construction economy to which system building was a response were housing and school building. Both programs were sufficiently large that economies of scale could be achieved by rationalizing design procedures and removing as many construction operations as possible from the building site to the factory. Richard Bender, writing in 1973, summed up the various interconnected developments within the building industry that resulted in the housing systems of this period. First, the following changes occurred in *materials and methods*:

1. The introduction of new processes between the source of raw materials and the building.
2. The introduction of new building materials, tools, and products.
3. The transfer of part of the building process from the site to the factory.
4. The introduction of industrially produced components, buildings, and building systems.
5. The use of industrial methods to produce products, components, buildings, and building systems.[10]

Second, significant changes had occurred in the structure of the *building industry*:

1. Building as an assembly operation: mass production techniques supersede traditional craft, small time contractor replaced by large-scale entrepreneur.
2. The role of the manufacturer changed as his product more specifically related to a building.
3. New markets developed as traditional ones change to include new products and services for customers in a new context.
4. A clear framework of standards becomes increasingly important as buildings, materials, and institutions change.
5. The need for research as the basis for standards, goals, and the development of new products.[11]

This detailed inventory shows quite clearly that by the 1960s a significant change had taken place in the modes of production for the housing industry. But what was "the clear framework of standards" to which this change gave rise? In discussing "the necessity for new standards," Bender draws a distinction between ôtraditional approachesö and ôneeded innovations." The former include modular dimensioning,[12] compatible joining systems, and material specifications.

He criticized these approaches as encouraging the setting of standards at the local and regional levels on the basis of *product specification* thus inhibiting the development of elements and systems requiring centralized manufacturing for national or world markets. Instead he suggests that standards for products and the codes that govern their use should be based on performance. This approach to standardization entails four steps: the establishment of performance requirements; the enumeration of performance criteria; the articulation of performance specifications; and the legal incorporation of specifications into performance codes. The focus must shift, he suggests, from "of what is it made?" to "how does it perform?"

The logic of the argument seems clear. However, when we look at its actual implementation we can observe consequences that are counter-productive in terms of the quality of the end product. Though architects and designers continue to make abstract, graphic representations of designs, decisions about the tangible, physical reality of those designs are no longer theirs but those of contractors, sub-contractors, and product manufacturers. The vitally important fact that one choice of materials and construction systems will affect the architectural character of the end product in a way quite different from another is ignored. It assumes that an "*a priori*" architectural idea can exist satisfactorily without being initially grounded in a specific technological context. The notion that performance can be separated in this manner from the physical artifact is simply a sophisticated extension of the urge to superimpose on the act of fabrication, or making, that lies at the root of architecture, the framework of pure science that Perez-Gomez and other commentators have traced from its seventeenth and eighteenth century sources.

Bender concludes his account of the changes that have occurred in modes of housing production in the United States during the mid-twentieth century with the presentation of three possible scenarios for the future of the housing industry. The first of these is "The Housing Factory,"[13] in which he anticipates that the production of houses will eventually mirror the assembly line production of automobiles. This, by implication he has earlier dismissed when he shows just how complex and essentially different the delivery of housing is from the manufacturer of automobiles. The second foresees "the development of a large-scale, systems-oriented life service industry"[14] of which the house is but one small part. Again, by implication, this is seen as unlikely, although desirable, simply because such a systems approach implies too vast an upheaval in existing public and private institutions for society to bear. His "Third Scenario" is clearly the one he regards as the most desirable and the most likely. Cultural changes already at work are bringing about change in technological form and organization that emphasize the individual, "ephemeralization" ("things" becoming less permanent, stable, more open, etc.), and a move from linear to dispersed forms of organization. In terms of the building industry these changes suggest that the emphasis will be on making tools and the pieces of houses rather than on finished houses in order that people can become involved in the creation of their own dwelling. The revival of interest in craft activity and the potential access to "know-how" provided by the personal computer, software packages, video learning cassettes, etc., point in such a direction. What is interesting about Bender's affirmation of man's basic instinct as "homo faber" in this scenario is the way in which it seems to contradict his earlier advocacy of standardization by performance specification.

But can it be argued that "a world of pure science" is an appropriate frame within which building components are produced, and that the house owner's role is that of assembler rather than fabricator? Certainly practical reality would suggest this in the case of housing, particularly if the house is seen as "shelter," setting apart buildings of a public and institutional nature as "architecture." All that might reasonably be said to counter this is that more recent research has indicated the importance of image, symbol and meaning to people in their total built environment and that "open" component systems of factory produced housing seem not to have addressed this end. It would seem reasonable, therefore, that we at least explore the possibilities of coaxing "everyman as assembler" into the richer possibilities of "everyman as designer/fabricator" as one means to this end.

An extension of this line of thinking about the future shape of housing involves the distinction that might be made in medium and high density situations between what is fixed and what is *flexible*. Nicholas Habraken was perhaps the first to suggest an intermediate situation lying between the polar extremes of Aldo Rossi's "building as autonomous monument" and Cedric Price's totally adaptable and demountable "building as tinkertoy" (e.g., his "Fun Palace" project).

As this concept has developed, situations have emerged in which three different priorities can be seen to have governed proposals: separation by building systems (e.g., fixed structure / variable cladding - both factory made); separation by the degree of sophistication in the processes of production involved (e.g., fixed masonry or poured concrete infrastructure/flexible steel, aluminum or plastic dwelling components); and separation by the process of social organization (fixed infrastructure, owned and controlled by institutions / flexible dwelling, owned and controlled by private individuals).

The third of these is Harbraken's own proposition as first described in Supports. Housing is more than the delivery of physical artifacts (houses). It involves equally land ownership, financing, utilities, and the complex social, economic and institutional structures that control them. A basic physical separation could therefore be made between the privately-controlled individual dwelling and the publicly-owned support infrastructure (building structure and utilities).

It is fairly clear how this interpretation of the fixed / flexible equation might facilitate the involvement of "everyman as designer / fabricator." What is also implied in this scenario is the re-introduction of a dialogue between standards as "fixed measure" and "standards as approximate measure." Hard-and-fast code restraints for instance (structural loading limits, fire resistance, means of escape, etc.) would appropriately relate to fixed infrastructure, while normative standards common in the past to craftsmanship (joints, details, expressive vocabulary) might naturally develop in relation to the flexible infill.

SUMMARY

To sum up, history shows that the object of standardization has not remained constant and that change in modes of production is a critical factor in such fluctuation. It also indicates that normative standards have steadily been overtaken by strict standards. These are now present in the design / construction enterprise in a multitude of guises. There is even need of a special section of the National Bureau of Standards to formulate and codify, so numerous and pervasive have they become — not to mention the plethora of agencies charged with their enforcement. This is, however, not necessarily a cause in itself for regret. As in other spheres such as politics and business, society is willing to trade the restrictive aspects of strict standards for compensating freedoms. For example, fire escape codes place severe restrictions on the architect's freedom to manipulate the form, space and circulation system of a theatre to hold 2000 people. In return, society receives certain "health, safety, and welfare" guarantees in their use of the building. In such matters, it is indisputably necessary to construct fixed models—standards—with which to compare specific situations. Building codes cannot constantly be subject to differences of opinion and value.

Nevertheless, there does appear to be a need today for normative standards however precarious their existence may seem. Within the internal subculture of architecture this need expresses itself constantly. "Post modernism" and its various sub-categorizations were attempts to construct approximate or normative conditions as guidelines for professional action. What is much less easy to achieve is tacit agreement in sufficient numbers on architectural issues in the wider realm of building technology and the public and business institutions linked to the design / construction enterprise. Only in this way will normative standards of broad cultural significance emerge.

NOTES

1 Alberto Perez-Gomez, *Architecture and the Crisis of Modern Science*, (Cambridge, Mass., 1983) p. 19.

2 Achsak Nesmith, "A Long Arduous March towards Standardization"ö *Smithsonian*,Vol 15, No. 12, (March 1985), p. 191.

3 Carl W. Condit, *American Building: Materials and Techniques from the First Colonial Settlements to the Present*, (Chicago: The University of Chicago Press, 1982), p. 10.

4 *The Rules of Work of the Carpenters' Company of the City and County of Philadelphia, 1786*, ed. Chas. E. Peterson (Philadelphia: Bell Publishing Co., 1971), p. vii.

5 Condit, p. 76.

6 Andrew Jackson Downing, *The Fruit and Fruit Trees of America* (9th ed., 1849), p. 148.

7 Siegfried, Giedion, *Mechanization Takes Command*, (New York: W.W. Norton & Co., 1969), pp. 214-246.

8 Spiro Kostoff, *The Architect: Chapters in the History of the Profession*, (New York: Oxford University Press, 1977), p. 215.

9 Le Corbusier, *Vers une Architecture*, (Paris: Editions Vincent, Freal et cie, 1925), p. 8.

10 Richard Bender, *A Crack in the Rear-View Mirror: A View of Industrialized Building*, (New York: Van Nostrand Reinhold Co., 1973), p. 22.

11 Ibid., p. 105.

12 Modular dimensioning systems, or dimensional coordination, provide a discipline within which building elements of standard size can be inter-related in a variety of ways without necessitating on-site cutting of elements or additional non-standard make up pieces. Le Corbusier's Modular system of the 1940s was intended not only as a formal design tool that would make "the bad difficult and the good possible," but also as a practical discipline of this sort. However its inherent complexity and the resistance of the French building industry to change limited its use to the control of visual proportion in the hands of architects. The much simpler system devised by Albert Bemis at about the same time in the United States fared better. Based on a 4""/ 100cm basic module with dimensions measured from the face rather than the center lines of elements, this found favor particularly in Europe as a controlling basis for housing, schools and hospital building systems. In the United States it was introduced by Ezra Ehrenkrantz in the SCSD schools systems, was used in subsequent systems such as URBS and certain Operation Breakthrough housing projects, but has barely affected orthodox architectural practice.

13 Bender, p. 131.

14 Ibid., p. 143.