

**“BRICK AS BRICK, WOOD AS
WOOD, STONE AS STONE”
THE NATURE OF MATERIAL IN
MODERN ARCHITECTURE**

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This trip is for me the end of a much longer journey; one that began in St. Louis in 1965 when as a student I attended the architectural history class of a man named Norris Kelly Smith. Projected on a screen were two images- Thomas Jefferson’s Monticello and Frank Lloyd Wright’s Fallingwater. Dr. Smith, who clearly preferred Monticello, encapsulated in one phrase what was then and remains now the description of the kind of architecture I wanted to make, the idea of an architecture based not on preconceived form, but derived from the properties of its materials.

According to Smith Jefferson’s concept of form was classic- based on idealized, abstract forms that were applied to materials. Wright’s by contrast was romantic, and its forms were derived from the materials themselves. Taking the terminology of Thorlief Boman, Smith stated that whereas the Classic conception of form grew out of the Greek view of the world, the romantic concept was Hebraic, that of the Old Testament. He quoted Wright:

I began to study the nature of materials learning to see them. I now learned how to see brick as brick, to see wood as wood, and to see concrete or glass or metal. See each for itself and all as themselves.¹

Wright called for an architecture that would reject formalism in favor of an architecture growing out of the qualities of materials, and it is widely assumed that we have succeeded in this charge; that in the best that Modernism has to offer this is indeed the case- the form is unique to the material employed, perfectly suited to it, and an expression of its nature. In fact this is seen by some as the essence of Modern architecture, that it would be impossible without the new materials of steel and concrete. But is this really the true? Are the forms of Modernism, even those that seem to be most tightly interlocked with the material of which they are built, really derived from the nature of those materials, or is the phenomenon more complex?

The passage quoted above is from Wright’s 1932 autobiography, and while written in his unmistakable style, it echoes word for word statement written by Gottfried Semper a hundred years earlier:

Let materials speak for themselves and appear undisguised in whatever form and whatever conditions have been shown by experience and knowledge to be best suited to them. Let brick appear as brick, wood as wood, iron as iron, each according to the structural laws that apply to it.²

Semper and Wright of course were talking about very different things, and those architects who spoke of the nature of the material saw the relationship of material characteristics to formal characteristics in very different ways. Was Wright familiar with Semper? Possibly, but it hardly matters as Wright's statement also echoes statement written in 1863 by someone of greater importance to Wright, Viollet-le-Duc:

*The materials employed reveal their function through the form you give them: the stone must clearly look like stone, iron like iron, wood like wood. And while assuming forms appropriate to their nature, the materials must be in harmony with each other.*³

The difficulty of course is that while the words are identical the images they describe could hardly be more diverse- Ancient Greek architecture, twelfth century gothic, and a 1900 Prairie house. This illustrates my dilemma in the study of material- a concept that is the widely accepted, but possessing a diversity of proposed solutions.

While I continue to believe in the concept of a material based architecture, I cannot say that thirty-five years later I am anywhere near discovering its nature or any nearer the end of this search. In fact I must admit that, as in many searches, in not finding what I was looking for I have begun to ask a different question.

My first realization was that the most commonly cited examples of the material/form relationship are negative. They tell us what not to do. Ruskin's 'Lamp of Truth' from *The Seven Lamps of Architecture* is a good example. It represents only a series of proscriptions and is little of help in deciding what should be done.

Of the countless examples of the type of material falsehood described by Ruskin the work of Karl Friedrich Schinkel will serve as example Fig. _ is the vault of Peterborough Cathedral. Fig. _ is the ceiling of Schinkel's Friedrichwerder Church in Berlin. The former is a real stone vault, the latter a plaster imitation, complete with painted-on brick. Figure ___ is a portion of the wall of Schinkel's Nikolai Church in Pottsdam in which the plaster cladding, scored to resemble stone, has peeled away to reveal the brick below. Both are, in Ruskinian terms, falsehoods- one thing pretending to be another.

This 'negative' approach was true of many of those who professed to be working in "the nature of materials." They saw material not as a determinant but simply as restraint, and clearly the forms of their work came from outside purely material considerations. This attitude I will call the decorative mode and Gottfried Semper was perhaps its most conspicuous practitioner, although William Morris or almost any Arts and Crafts architect could serve as well.

My second realization was that those who appeared to transcend the decorative mode, such as Frank Lloyd Wright on closer examination at times seemed to do the opposite. Anyone who has read Wright's series of articles "In the Nature of Materials" will share my disappointment with their content. In most cases they discuss the subject not at all and when they speak of material, emphasize the importance of motif. Wright believed that the nature of material could be found in what he called 'nature pattern.'

This could take the form, as it does in early works such as the Dana house of 1903 specific plants- Sumac and Wisteria- that are abstracted in to decorative patterns in the windows, lamps, wall friezes and, according to Wright, the plan and elevation. This methodology is subtle in his later work but still present and explains some of the decorative eccentricities of otherwise abstract designs such as the Pope and Smith houses of the 1930s. The results of this technique are some of Wright's his most powerful but also some of his most decorative designs, and in a material sense, most superficial. In much of his work, rather than growing out of the material, the motifs are the opposite- abstract patterns imposed on a material that is indifferent to its structural qualities. The motival impulse occurs in less obvious ways in the hexagonal plan of the Hanna house, which was, as Wright stated, derived form crystalline structures in nature but the hexagon is hardly in the nature of the material wood and the numerous problems of building and maintaining the 60° and 120° corners shows a direct conflict between abstract form and material reality.

The third discovery was a group of Wright's contemporaries who seemed to have escaped the decorative mode. They are exemplified by Otto Wagner, who wrote "New constructions must out of necessity create new forms."⁴ and while Wagner was completely sincere in this thought, he has also been completely misunderstood, for he did not seek a wholesale break with the past or even an abandonment of traditional forms, but rather an evolutionary transformation brought about by building the old forms out of the new materials.

This process could be called the transformational, and it is the familiar pattern of architectural development when a new material is introduced- the new material replaces an old one and old forms are simply built of the new material. Much of the appeal of Henry Mercer's house in Doylestown, an early concrete work in America, is the oblivious inappropriateness of concrete to the way it is used for every element of the building- sloped roofs, window mullions, chimneys and birdhouses.

The work of Auguste Perret is a more sophisticated example of the transformation of form via material at work. The classic Doric order is built of concrete, but the form is altered to meet the structural characteristics of the new material. The taper of the column is reversed from top to bottom since the concrete, unlike its stone precedent, forms a rigid frame, placing the greatest stress at the top and not the bottom of the column, and the capital is transformed to indicate the continuity rather than the discontinuity

Wagner's work also transforms the Classical order but in a multi-layered rather than monolithic and mono-material way. The cornice is no longer stone but concrete or steel clad with aluminum or copper. The column shafts and other ornaments evolve into a kind of two-dimensional relief.

History has judged Wagner to be progressive and judged his contemporaries such as McKim, Mead & White to be reactionary and traditional, but whereas the dome of Wagner's St. Leopolds church is a stone form executed in metal- Stanford White's Madison Square church is true masonry, built of Guastavino tile, and by Ruskinian standards of material, the superior work.

My forth discovery were those architects who took what I call the engineered approach, who looked at the structural capacities of a material to see what structural forms and thus what spaces were appropriate if not inherent in its use. It begins with Viollet-le-Duc who formulated what I call the doctrine of material efficiency, based on his not entirely accurate analysis of twelfth century cathedrals such as Amiens. He wrote:

Today we have got into the habit of using hulking, enormous masses of stone in constructions that are themselves of minor importance; we have gotten into the habit, in other words, of putting in place structures with ten times the resistance that is necessary. . . We would expend fabulous sums in order to equal what in the twelfth century builders were able to accomplish with comparatively minimal resources.⁵

Antoni Gaudí, a great admirer of Viollet-le-Duc, took the concept beyond its Gothic origins in his catenary vaults in tile and stone, but material efficiency found its true expression in nineteenth century works of engineering. The suspension bridge, the Brooklyn bridge in particular, and its architectural progeny are the best examples. Doubtless our admiration for the suspension bridge is based in part on its efficiency- its use of the minimum quantity of steel to span the maximum distance,

However, it is the educational program of the Bauhaus rather than Viollet-le-Duc or Roebing that codified this doctrine. The preliminary course, required of designers in all fields, included an intense exploration of materials. Under Johannes Itten this exploration was largely sculptural and tactile, but under Laszlo Moholy-Nagy and Josef Albers the charge became to configure materials in way the increased their structural capacities. While the material might be paper or sheet metal, the architectural implications were clear.

Santiago Calatrava is the heir to this school of 'materialism' but, although his best work is usually informed by concepts of material efficiency, it also draws heavily organic structural metaphors.

The material efficiency or structural approach has produced some of Modernism's finest buildings but also some of its most problematic. The difficulty with this concept is that economy of material does not automatically yield economy of labor, economy of capital, or even appropriate architectural form. The work of the current High Tech architects exemplifies this clearly. Their buildings undoubtedly have the 'style' that material economy was meant to generate, but they are at times structurally overdesigned with spans far in excess of their programmatic requirements and are often far more expensive than their less "economical" but more mundane counterparts. When the form of the suspension bridge and its architectural principles are applied at the smaller scale the results evoke an entirely different reaction- a kind of miniature technical charm in the case of the Buckminster Fuller's Dymaxion house, but in a buildings like Richard Roger's PAT Center, the sense of a tool vastly overlarge, over expensive, and overdesigned for the job at hand.

Another school of material, related to the structural, might be called the organic. The organic concept has produced buildings which have not fallen so easily into the trap of the motif, inspired by natural and vernacular marriages such as Canyon de Chelly or Mesa Verde it also borrows forms fairly literally from nature, sometimes metaphorically as in Gaudi's vaults, and sometimes literally, as in the columns of the Colonia Guell chapel- basalt shapes fractured hexagonally and used in their natural form. Like some natural elements-soap bubbles, radiolaria, etc., they often have the characteristics of material efficiency but they can in their more literal manifestations have the opposite qualities. Consider the furniture of George Nakashima for example.

Calatrava could be included in both the engineered and organic schools and whereas his large span work bridges in particular, is informed by a concept of efficiency, his smaller scale work is heavily organic often with the same result, an excess of material as in the Toronto Arcade.

The sixth realization was that while one form may be appropriate to one material the relationship is hardly unique. Eliel Saarinen was criticized for using concrete vaults at the Helsinki Train station- the vault being at least in the eyes of his critics- appropriate to stone. But to many architects and to many engineers a vault is a logical choice for concrete. Louis Kahn faced a similar criticism for the Kimbell Museum. What is the correct form for concrete- post and beam or plate and vault? If, as Louis Kahn believed, the folded plate is an appropriate form for concrete can it also be for plywood and steel? To the engineer some forms, such as the vault, may be appropriate in several materials.

Even Fallingwater the paradigm of material based form is not a unique one. The concrete and stone building of 1937 follows that of the wood and stucco Gale house of 1909.

The phenomenon of translation introduces another question, one of representation or what might be called the sculptural school of material appropriateness. Consider the sculptural panel shown on the title page of this article from the Orsanmichele in Florence. What does it portray? A man carving a statue of a putti or a man attacking a baby with a chisel? How do we know it is the former? In all the other figures the marble represents flesh, clothing, or wood, but in the case of the statue, it represents itself. The appeal of the capitals of Southwell Chapter house is that they use a brittle and massive material stone to suggest a light and flexible one- foliage.

The problem is a kind of violation of the rule of representation. How do materials speak to us? One might say that this is the sculptural interpretation of material.

This is sculpture not architecture, but there are undoubtedly architectural elements that we interpret in a sculptural way- the wood gothic ribs of A J Davis' Lyndhurst, the wood quoins of Jefferson's Edgemont. We know that these are not really stone, and they are not falsehoods per se.

We may view the vaults of Amiens as the expression of material efficiency at work, but this idea is of little use in explaining the myriad of small columns, brackets and canopies of the façade which although they are filled with structural associations are in this context performing an ambiguous structural role or are performing no structural role at all.

The fifth realization was that if material is configured in its most efficient form- that in which the least material resist the most load- the result is often a form that evokes in an aesthetic sense qualities it does not possess. What is the appropriate expression of stone- a lightweight Gothic vault or the Great Pyramid?

This phenomenon- that of informing of one material with a concept derived from another, which I call translation- might be seen as a more accurate description of the role of materials in Modernism. It is difficult to conceive of a form that is wholly original and completely dependent on the development of new material. Even the suspension bridge has precedent in rope construction.

There are material translations that are deplorable- stone cornices built of lightweight foam plastic or fiberglass; brick patterned concrete form liners. There are others whose translation imports a heightening of symbolic qualities at the expense of tectonic ones- the creation of a stone Doric order out of wood or Semper's application of textile motifs to stone. But there are other translations in which structural concepts remain intact and in which form retains its structural validity.

Do Gehry's metal skinned walls at Bilbao say something about the nature of metal or is their appeal that they suggest something else, such as paper or fabric? There is a great deal of Modernism which draws its

power form the exploitation of the nature of material and the nature of form but there is a great deal of Modernism whose power comes form the contradiction of that relationship as in Meret Oppenheim's fur lined teacup. (1936)

The numerous histories of Modernism demonstrate a steady decline in the importance assigned to material in the development of Modern Architecture. To Sigfried Gideon it was essential. To Reynar Banham it was present but the lesson learned were superficial. To Colin Rowe the whole theory was an expedient excuse for a purely aesthetic movement. Kenneth Frampton is fairly isolated in his attempt to give it importance among contemporary critics.

I of course agree. Could the Villa Savoye be built without concrete? Could the Farnsworth house be built without steel? Yes and no. It is clear that the structural capacities of modern materials inspired these forms, but any number of examples from the last fifty years of American domestic architecture will demonstrate the opposite. Could Breuer's first all wood house for himself in New Canaan exist without the Villa Savoye? Could Philip Johnson's all wood Wiley house have been designed without the Farnsworth house? Stated more precisely, one might say that the new materials demonstrated new concepts of form and structure, concepts that once demonstrated, could then be applied to traditional materials.

Le Corbusier's interest in vaults, for example, began with the Maisons Monol- planned to be built of thin-shelled concrete structures borrowed from Auguste Perret. This was finally built in the house in St. Cloud, but in his later work the vaults were executed in masonry after he became aware of Catalan vaulting through the work of Gaudi. These same shallow-vaulted forms were then copied in plywood by American architects such as Paul Rudolph. A large part of the appeal of Paul Rudolph's plywood canopy structures in Florida in the 1950s is our recollection of it more massive masonry and concrete ancestors. All of these forms were structurally appropriate to the material, but none was inspired by that material. All of these translations exhibit other phenomenon. They are both structural and sculptural in their appeal. Eero Saarinen's work shows similar transformations. Le Corbusier's steel Palace of the Soviets project is executed in wood at his Tanglewood Music Center. Saarinen's own thin steel shell dome at the GM tech center is copied in concrete at his Kresge auditorium at MIT.

Likewise Saarinen's work in steel became by means of a similar transformation, the inspiration for he work of Louis Kahn. The Yale Art Museum is Saarinen's steel space frame for the GM Tech center built in concrete The thin steel tube structure for Saarinen's St. Louis arch, similar in concept to Kahn's entry in that same competition, became the basis for Kahn's heavier, hollow tube structures of masonry and concrete, as in the Hurva Synagogue. Many other Kahn structures follow similar paths, the veerendeil precast posttensioned concrete girders of the Richards building have their origin n his steel parasol house of

1944, and a large part of the appeal of Kahn's concrete work is our recollection of its lightweight steel precedents.

I will close with a transformation that I consider one of the more effective and poetic. Fig is a aboriginal Australian hut made of sheets of bark stretched over a frame of wood poles Figure _ is Glenn Murcutt's Magney house a corrugated zincaluminum skin on a framework of round steel pipes. Both answer to the order of material, both answer to the order of structure and both respond to the sun and climate in the same way.

In almost every case the reality of material-based architecture can be seen as neither revolutionary nor evolutionary but transformational. The most productive aspect of this exploration has been the transfer of form from one material to another and the results have not been so irrational as the rhetoric of Modernism would have us believe.

We have come to conveniently divide our response to traditional architecture into the sculptural and the architectural.

Likewise, while there is a strong case to be made for the dependency of Modernism on the structural capacities of new materials, it is equally true that the forms thus generated have been applied with great success to traditional materials, and again with results that confirm rather than deny the form-material relationship.

I have come to see the form-material relationship in a way quite different that that proposed by Wright and Viollet-le-Duc. While the structural nature and limitation of material must be our guide in the determination of form, we should perhaps recognize that this has rarely occurred in a way that makes no reference to precedent and that the most useful precedents have proven to be those taken from other materials and then translated into the new.

1. *Frank Lloyd Wright, An Autobiography*, quoted in N.K. Smith, *Frank Lloyd Wright: A Study in Architectural Content*, p. 39.

2. Gottfried Semper, quoted in Hanno-Walter Kruft, *A History of Architectural Theory*, p. 311.

3. E. E. Viollet-le Duc, *Entretiens sur L'Architecture*, *ibid.* p. 285.

4. Otto Wagner, *Modern Architecture*, quoted in *9H*, no. 6 (1983), p. 76.

5. E. E. Viollet-le-Duc, *The Foundations of Architecture; Selections from the Dictionnaire*, ed. by Barry Bergdoll, p. 176.