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Mimar Aslı ŞENER

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Tez Danışmanı : Prof. Dr. Hülya Yürekli

Diğer Jüri Üyeleri : Prof. Dr. Atilla Yücel

Doç. Dr. Belkıs Uluoğlu

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FOREWORD

I would like to take the chance to offer my special thanks to everybody who have supported me all through this work. I would specially like to thank some specific people; my consultant Prof. Dr. Hülya Yürekli for her patience and kind support, and my family for having been by my side all through my life. I would also like to thank my friends, and everybody who has given me courage during the periods of hard work.

ASLI ŞENER
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SUMMARY

All through the history of architecture building technology has always been one of the major factors which affect the appearance and perception of a building. Especially with the industrialization process that started in the eighteenth century, the introduction of new materials and new building techniques, an obvious change was felt in the architectural scene.

This study is an attempt to investigate the expressive and the creative role of technology in architectural theory and experience, especially in the late ninetieth and twentieth centuries and point out to some remarkable conditions emerging from the changing relations between technology and architectural meaning.

The relationship between technology and architecture is a complex whole, in which many factors affect, determine or change the quality of this relationship. As a result of this complexity the method of this research is chosen as the observation of some concepts deeply related with the use of expressive technology in the architectural course of the twentieth century.

The selection of the observed concepts is done according to the criteria issued by the aims of the study; to observe the impacts of technology in architectural meaning and expression. The selected concepts, apart from a brief view of technology, are: The idea of the machine, transparency, lightness, dematerialization, immateriality, verticality, and utopias concerning technology.

The changing understandings of these concepts through the course of twentieth century are given. Machine has been a metaphor in this century both for the formal and functional aspects. Transparency, lightness and dematerialization are constant qualities in an idea of technological architecture. Immateriality is the consequence of the computer technology and the idea of 'information'. Verticality is a factor that has affected the urban structure. And technological utopias are closely related with the action of creativity in the means of suggesting futuristic views for architecture.

ÖZET

MİMARLIK - TEKNOLOJİ
MİMARİ YAPI BİLİMİ

Antikiteden günümüze, bütün mimarlık tarihi boyunca yapım teknolojisi, mimari eserin oluşturulması ve görüntüsünü etkileyen en önemli etkenlerden biri olmuştur. 18. yüzyılda başlayan endüstrileşme süreci ve yeni yapı malzemelerinin ve bunlara uygun yapım teknolojilerinin geliştirilmesi ile mimarlık alanında önemli bir değişim yaşandı. Aynı dönemlerde oluşan Aydınlanma düşüncesi de geleneksel mimarlık kavramlarının tekrar gözden geçirilmesine ve yeni gerçeklerin aranmasına neden oldu. Yeni yapım teknolojileri ve yeni mimarlık teorilerinin oluşumu ile mimarlık dünyası, daha önce yaşanmamış bir değişime sahne oldu. 18. yüzyılda başlayan rasyonel ve positivist düşünce biçimi, bilim ve teknolojinin ön plana çıkmasına neden oldu. Bu gelişmeler mimarlık alanında, teknolojinin gerek düşüncede gerek uygulamada vurgulanması ile sonuçlandı. Teknolojinin mimarlık ile ilişkilerinin ön plana çıkmasının yarattığı tartışmalar o dönemden günümüze dek sürmektedir.

Bu tez teknolojinin mimari anlam üzerindeki yaratıcı rolünü ortaya çıkarmayı amaçlayan bir denemedir. Özellikle yoğun teknolojik değişimlerin yaşandığı 19. yüzyıl sonu ve 20. yüzyıl ortamında bu rolün nasıl geliştiğini araştırmaktadır. Bunu araştırırken teknoloji ve mimari anlam arasındaki etkileşimin değişimlerinden ortaya çıkan ilgi çekici durumlara dikkat çekmeyi hedeflemektedir.

Mimarlık ile teknoloji arasındaki ilişki, birbiri ile etkileşim içinde olan birçok bileşenden oluşan, karmaşık bir ilişkidir. Bu ilişkinin bir bütün olarak ele alınabilmesinin güçlüğünden dolayı, bu ilişkinin oluşumunda etkili olmuş ve mimarlıkta önemli yeri olan bazı kavramlar ve onların bağlamında bu ilişkinin özellikleri incelenmektedir. Bu kavramların özelinde bütün ile ilgili genel bir fikre ulaşmak amaçlanmaktadır. Bunların yüzyıl içinde teknoloji ve mimari anlama bağlı değişimleri incelenerek, teknoloji ile mimarlık ilişkisinin özelikleri üzerinde fikir edinme olanağı sağlanmaktadır. Bütün bu kavramların incelenmesi, bugünün

mimarlığı ile teknoloji arasındaki ilişkilerin yönünü anlamak için bir zemin oluşturmaktadır.

Ele alınan kavramların seçiminde kriter olarak, tezin hedefi olarak da kabul edilen, teknolojinin mimari anlamdaki yaratıcı rolünü bulmak alınmıştır. Tez boyunca anlatılan kavramlar kendi içlerinde bütünlük oluşturan bölümler halinde ele alınmıştır. Bu bölümlerin sıralanışı da 20. yüzyıl boyunca teknoloji düşüncesinin mimari düşünceye yansıma biçimleri ve gelişimi gözönünde bulundurularak yapılmıştır.

Tezde şu bölümler yer almaktadır:

1. Giriş
2. Teknoloji
3. Makine
4. Saydamlık (Transparency)
5. Hafiflik (Lightness)
6. Dematerializasyon (Dematerialisation)
7. Maddesel olmama durumu (Immateriality),
8. Düşeysellik (Verticality)
9. Ütopyalar

Giriş bölümünde yukarıda da belirtilen tezin konusu ve ilgi alanları, amacı ve ele alınış biçimi ilgili açıklamalar yer almaktadır.

Teknoloji başlığı altında, teknolojinin genel tanımı yapıldıktan sonra teknoloji kavramının zaman içinde, özellikle Endüstri Devrimi sonrası hızlı teknolojik gelişim ortamında ve yirminci yüzyılda değişen anlamsal özelliklerine kısaca değinilmektedir. Teknoloji, yirminci yüzyılın ortalarına kadar Aydınlanma Çağı'ndan itibaren insanlığı etkilemiş pozitivist düşüncenin önemli unsurlarından birini oluşturmuşken, yirminci yüzyılın ikinci yarısındaki savaş sonrası ortamında bir tehlike kaynağı olarak görülmeye başlanmıştır. Bu olumsuz yönde değişimin sebebi, Endüstri Devrimi sonrası başlayan toplumsal değişimlerin, insan gücünden makina kullanımına geçilmesi ve böylelikle güç merkezlerinin el değiştirmesinin teknolojinin kendi içinde insana karşı bir güç olduğu düşüncesine yol açmasıdır. Bazı düşünürlerin bu yöndeki fikirleri belirtildikten sonra teknolojinin tanımlanmasında farklı yaklaşımların sınıflandırılmasına değinilmiştir. Bunlardan teknolojinin enformasyon sistemi olarak tanımlandığı yaklaşımda yer alan 'baskın' ve 'geri planda' fonksiyonlar düşüncesinin mimari teoride kullanımlarından

bahsedilerek, teknolojinin mimari düşüncede benzer biçimde ele alındığı durumlar anlatılmıştır. Bölüm sonunda, mimari teoride teknoloji ile ilgili önemli görüşlere yer verilmiştir.

Makine, teknolojinin değişmez bir aracı olarak endüstrileşmiş toplumun en etkin unsurlarından birini oluşturmuştur. Hem kendi reel benliği ile, hem de mecazi kullanımlarıyla geçen yüzyıldan beri insan yaşantısı ve düşüncesi üzerinde çok etkili olmuş bir düşüncedir. İnsanın kendisinin bir makine olduğu ve dünyanın, içinde bütün alt sistemlerin bir makine düzeni içinde çalıştığı bir dev makine olduğu düşüncesi endüstrileşmiş toplumun önemli inançlarından birini oluşturur. 'Makine Çağı' temellerini bu düşünceden alır. Makinenin bu rolü 19. yüzyıl sonlarından itibaren mimarlıkta da çok etkili olmuştur. 20. yüzyıl başlangıcında ortaya çıkan bütün öncül hareketler, çağa ayak uydurmanın gereğini makinenin sağladığı ilham ve olanakları kullanmak olarak görürler. Bu yüzden makine, bu döneme ait Alman Werkbund Grubu, Fütüristler, Konstrüktivistler, Bauhaus ve De Stijl gibi grupların söylemleri ile Le Corbusier gibi bireysel söylemlerin önemli bir parçasını oluşturur. Ancak, biçimsel anlamda bir makine mimarlığının oluşumu 20. yüzyılın ikinci yarısına rastlar. Bu dönemde oluşturulan gerek bazı ütopik projeler, gerekse de 70'li yıllardan başlayarak inşa edilen bazı binalar biçimsel olarak bir makine benzetmesi içermektedir. 80'li yıllarda ağırlık kazanan 'High-Tech' türü yapılar bunun iyi örneklerini oluşturur. 20. yüzyılın sonuna doğru ise somut biçimsel makine imajı yerini bilgisayar teknolojisinin getirdiği karmaşık enformasyon ağlarının soyut imajına bırakmaktadır.

Saydamlık, hafiflik ve dematerializasyon teknolojiyi ifade biçimi olarak kullanan mimarilerin değişmez özellikleridir. Saydamlık, mimarlığı algılamanın baş gereklerinden olan ışığın iç mekana alınması ile ilgili üstlendiği rol dolayısıyla mimarlık için her zaman önemli bir özellik olmuştur. Endüstri Devrimi'nden sonra saydam yapı malzemelerinin teknolojik olarak geliştirilmesi ve ışıkla en iyi ilişkiyi sağlayan malzeme olan camın olanaklarının geliştirilmesi 20. yüzyılda mimari anlamın dönüşümünde çok önemli bir rol oynamıştır. 19. yüzyıldan başlayarak yapılan çelik-cam yapılar yeni bir mimari dilin öncülüğünü yaparlar. 20. yüzyıl başında cam perde duvar kullanımı ile iç mekan ve dış mekan arasındaki kesin sınırlar ortadan kalkmış ve iki mekan arasında bir görsel süreklilik sağlanmıştır. Yüzyılın devamında bu gerçek (literal) saydamlık, farklı arayışlarla yerini giderek daha karmaşık ve daha zengin bir mimari anlatımı hedefleyen görüngüsel (phenomenal) saydamlığa bırakmıştır (Colin Rowe ve Robert Slutzky'nin

tanımlamaları). Bu yaklaşım günümüz mimarlığında da etkilidir. Bugün, çok çeşitli saydam malzemelerle, elektronik cephelerle ve çeşitli cam cephe sistemleriyle çok farklı saydamlık etkileri elde edilmektedir.

Hafiflik, çağrıştırdığı birçok başka kavramla mimari anlamın çeşitlenmesinde etkili olmuş bir kavramdır. Hafif strüktürler özellikle 19. yüzyıl sonu ve 20. yüzyılda mimari yaklaşımlarda önem kazanarak daha sık kullanılmalarına rağmen, mimarlığın en başından beri var olmuşlardır. 18. yüzyılda Aydınlanma düşüncesinin etkileriyle, yapıların gereksiz ağırlıklardan arındırılarak strüktürün özüne dönmesi fikri ağırlık kazanmıştır. Endüstri Devrimi sonrası yaygınlaşan demir ve çelik kullanımı ile yalın strüktürü kullanan daha hafif yapılar yapılmaya başlanmıştır. 20. yüzyıl başındaki mimari hareketler, hafifliği ulaşılması gereken bir mimari hedef olarak görürler, fakat çoğu uygulamalarında bu hedefe ulaşamamışlardır. Gerçekten hafif, yeni yapım teknolojilerinin oluşturulması yüzyıl ortalarına doğru gerçekleşmiştir. 'Gergi strüktürlerin' gelişimi hafiflik adına önemli bir gelişmedir ve 60'lardan itibaren bu konuda başarılı uygulamalar yapılmıştır. Mimarlıkta hafiflik faktörü ile yeni etkiler elde etmeye çalışan daha güncel bir yaklaşım da 'asılı strüktürler'dir. Bu şekilde hafiflik kavramı yerine görsel bir 'ağırlıksızlık' oluşturulmaya çalışılmaktadır.

Dematerializasyon, yapının malzemeye bağlı algılasal niteliklerinin azaltılarak, binanın bütünleyici homojen bir kabuk altında oluşturulması olarak tanımlanabilir. Bu şekilde maddesel gerçeklik sorgulanarak 'buharlaşma' veya 'çözülme' gibi kavramların mimarlığa yansımaları denenmiştir.

Maddenin yok olması olarak tanımlanabilecek immaterialite (immateriality), enformasyon ağlarının, bilgi akışının giderek maddenin önüne geçmeye başladığı bilgisayar teknolojisi ortamında, bunlardan yararlanarak mimariye yeni anlamlar kazandırmayı denemektedir. Immaterialitenin kullanımı hem mimari düşüncenin oluşturulma sürecinde, hem de sonuç ürünün biçimlenmesinde etkili olmaktadır. Bu şekilde, düşünsel olduğu kadar duyusal etkilere dayalı bir mimari yaklaşım ortaya çıkmaktadır. Bu yaklaşım ancak, insanın organik ilgi odaklarına ve sinir ve duyusal tepkilerinin kökenlerine gönderilmiş yeni bir gerçeklik veya maddesellik olarak anlaşılabilir. Bu anlamda bir maddeselliğin mimarlık üzerinde ilk ve en doğrudan etkisi teknolojinin de olanakları doğrultusunda binanın niteliklerinin bir seri duyumun birleşiminin algılanması gibi düşünüldüğü bir 'yayıncılık fırsatı' olarak tasarlanmasıdır. Bu kendini mimarlığın bazı öğelerinin çevresel etkenlere bağlı olarak sürekli değiştiği ve çevreye cevap verdiği bir biçimde veya programlanabilir

sistemler şeklinde gösterebilir. Elektronik anlatıların bir ışık, hareket ve enformasyon duyarlılığı biçiminde cephede kullanımı güncel bir projelerde rastlanan bir yöntemdir. İmmaterialiteye örnek başka bir yöntem de hareketin bir mimari eleman olarak kullanılmasıdır.

Düşeysellik, teknolojinin şehir ölçeğinde etkilerine örnek oluşturan bir kavramdır. İnsan var olduğundan beri düşeyselliğe ilgi duymuş, yüksek olanı kutsal saymıştır. Mimarlık tarihi boyunca da daha yüksek inşa etme isteği çeşitli dönemlerde kendini gösterir. Endüstri Devrimi ile yaşanan sosyal ve ekonomik değişime kadar düşeysellik sadece dinsel ve politik bir güç ifadesi olarak sembolik bir değer taşırken, kapitalist toplumun oluşumu ile zenginlik, prestij ve güç ifadesi taşıyan ve fonksiyonel olarak kullanılan bir olgu olmaya başlamıştır. Teknolojinin gelişmesi, çeliğin yapım malzemesi olarak kullanılmaya başlanması ve asansörün bir düşeysel taşıma aracı olarak geliştirilmesi ile binalar yükselmeye başlamış ve gökdelen olarak adlandırılan yeni bir yapı türü ortaya çıkmıştır. Bunların sıkça yapılmasıyla gökdelenlerin istila ettiği şehirler oluşmuş ve böylece ütopik bir şehirsel gelişme gerçeklik kazanmıştır..

Mimarlık, sosyal yaşamın somut bir yansıması olarak ütopyaların her zaman önemli bir parçasını oluşturmuştur. 20. yüzyıl başında oluşan Fütürizm ve Konstrüktivizm gibi hareketler ütopya biçiminde ifade edilmiş olsalar da daha çok belli ideolojilerin savunuculuğunu yaparlar. Yüzyıl ortalarına doğru teknolojiyi yeni bir mimarlık için en önemli güç olarak gören ve gelişime inanan ütopik hareketler ortaya çıkmıştır. Bunlar yeni yaşam biçimleri için şehirsel ve bina ölçeğinde tamamen teknolojik imaj kullanan yeni mimari biçimler önerirler. Bu ütopyalarda binaların hareketliliği ve değişimlere kendiliğinden adapte olabilmesi önemli temalardır. Daha güncel ütopyalarda ekolojik kaygılardan kaynaklanan yapay çevre ile doğanın kaynaşması teması göze çarpmaktadır. 20. yüzyıl ütopyaları incelendiğinde teknolojinin hepsinde ortak bir özellik olarak ortaya çıktığı görülmektedir. Teknolojik ütopyalar geleceğe yönelik bakış açıları sunarak mimari yaratıcılığa katkıda bulunurlar.

Sonuç bölümünde tüm bu ele alınan kavramların teknoloji ile ilşkileri bakımından mimari yaratıcılığa olan katkıları özetlenerek, bu kavramlardan ortaya çıkan bazı yeni kavramlar sıralanmıştır. Teknolojinin mimarinin üç boyutta garçekleşebilmesi için değişmez bir faktör olduğu bir kez daha vurgulanarak, bunun hangi dozlarda ve ne biçimde mimari ifadeye yansıdığının, mimarlık - teknoloji ilişkisinin belirleyici bir unsuru olduğu belirtilmiştir.

1. INTRODUCTION

Considering architecture as the 'art of building', building technology; the technique in which a work of architecture is realized, has always been one of the major concerns of architecture all through the history. Since Antiquity, when Vitrivius introduced 'firmitas' as one of the three elements of architecture, this concern has kept its importance with differing degrees of attention drawn to it. Especially after the Industrial Revolution in the end of the 18th century the usage of new building materials and the building technology developed for them caused a deep change in architectural theory and experience. This change led to birth of one of the strongest movements in 20th century architecture; the 'Modern Movement' which still has its influences on the architectural scene even after being announced dead 30 years ago. The moderns were in search of a new architecture that would be an expression of the new world with all the social and technological changes. After modernism, even the reactionary historicist attitudes of postmodernism could not exclude the expressive use of technology and an idea of technology inspired architecture aroused in the 70's again; the so-called 'High-tech' architecture which has its roots in both modernism and the inspiration of the computer age. The to use of latest technology as a manifest character in architecture is a tendency that has not lost its significance in contemporary architectural world. Indeed, it seems to be changing direction towards the search of new effects and new theories in architecture. Consequently, the different aspects of the relation between architecture and technology is still an important argument in the end of the 20th century.

It should be admitted that building technology, apart from its effect on the architectural theory is a very important factor over the end product; the work of architecture: the building. This effect has sometimes played an influential role in giving new meanings and/or getting new results from architecture. Therefore it might be suggested that technology with various kinds of relations on different platforms is an influential factor on architecture and its evolution.

In the introduction of his book 'Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture', Kenneth

Frampton, after stating that the concept of 'space' has been the main emphasis in the architectural theory since modernism and any other concerns have been neglected, explains the theme of his book as such:

"Without wishing to deny the volumetric character of architectural form, this study seeks to mediate and enrich the priority given to space by a reconsideration of constructional and structural modes by which, of necessity, it has to be achieved. Needless to say, I am not alluding to the mere revelation of constructional technique but rather to its expressive potential. Inasmuch as the tectonic amounts to a poetics of construction it is art, but in this respect the artistic dimension is neither figurative nor abstract. It is my contention that the unavoidably earthbound nature of building is as tectonic and tactile in character as it is scenographic and visual, although none of these attributes deny its spatiality." (1)

With the similar intention as Frampton's, this study aims to investigate the expressive and creative role of technology in architectural theory and experience especially in the late nineteenth and twentieth centuries; the period that has witnessed a real technological change. This search will be done in the hope to serve a further aim; to provide a platform to discuss the possibilities of the present situation and form an idea for the future architecture, in the means of technology. However, this discussion is not the subject of this study; in fact this study only aims to point out to some remarkable conditions emerging from the changing relations between technology and architectural meaning.

The relationship between technology and architecture is a complex whole, in which many factors affect, determine or change the quality of this relationship. As a result of this complexity it is not an easy task to explain it as a whole, but it might be helpful to mention some concepts deeply related with the use of expressive technology in the architectural course of the twentieth century.

In 'Machine as Metaphor and Tool', Ryan Johansson explains how 'vague' signs in the natural language reveal creativity. Vague signs, which can mean more than one thing, keep getting combined and recombined in indeterminate, novel ways. Speakers coping with specific environments favour some uses more than others. But in new environments they also combine concepts and create novel meanings. The process of creation and selection drives the evolution of language, therefore of thought. New categories of thought emerge from the domain of vagueness where figures of speech link previously unlinked signs, thus creating new associations, the precise meaning of which is unclear. All of this emphasis on vague signs stems from a comparison between totally logical language (as used in computers) and natural language (used by individuals). The author sees the lack of

vague signs as the reason of the inferiority of logical language to the natural language. Without the evolution of vague signs in the language the formation of creativity is prevented (2).

Similar to this idea of vague signs, the concepts mentioned in this study are not directly equivalent in meaning to the subject discussed; the relationship between technology and architectural meaning. But explaining the relationship in the context of each concept, might help to gain a view of (at least some aspects of) the subject as a whole. These concepts seemingly separate have several relations both internally and as a part of a whole. They are sometimes like intersecting sets, and quite distinct in meaning at other times. And they are only some selected concepts among a wide range of others concerning the whole relationship. This selection is done according to the criteria issued by the aims of the study as mentioned above; to observe the impacts of technology in architectural meaning and expression, especially in the contemporary architecture with an eager for the future.

In his 'Six Memos for the Next Millennium', Italo Calvino described five indispensable qualities for the current state of literature: lightness, quickness, exactitude, visibility, and multiplicity. A sixth quality; consistency, could not be written before his death (3).

With such an inspiration the concepts of transparency, lightness, and dematerialization, which are significant qualities in an architecture that is in close relation with latest technology, are introduced. Richard Rogers' statement on the future of architecture also points out to these qualities: "...Architecture will no longer be a question of mass and volume, but of lightweight structures whose superimposed transparent layers will create form so that constructions will become dematerialized. (4)" Among the other concepts introduced, immateriality is the quality that has increasing effect on architecture with the innovations in computer technology and verticality is the quality that had much influence in the development of the modern city.

The other subjects introduced in this study apart from a brief view of technology, are the idea of machine and the technological utopias in architecture.

One more fact about this study to be stated is that it generally concentrates on the evolution of Western architecture where all the changes discussed in this study found a starting place and influenced the other regions of the world.

2. TECHNOLOGY

The word technology derives from the Greek 'techne', art or craft, and 'technologia' the systematic treatment of art or craft, with 'technic' (Latin; technicus) having now-rare meaning of 'pertaining to an art'. The term technology today is a generalisation, displacing the 'scientific' study of the so-called 'practical arts' by the whole apparatus of specialised production of methods, and their products (1). In its simplest sense, technology may be thought as the application of science especially to industrial or commercial objectives or as the body of knowledge available to a civilisation that is of use in fashioning implements, practising manual arts and skills and extracting or collecting materials. To understand the meaning of technology one should also define 'technique' which is the systematic procedure by which a complex or scientific task is accomplished and 'technic'; the degree of skill or command of fundamentals exhibited in a performance (2).

In a deeper sense, technology may be explained as a complex system of material culture and the scientific knowledge which acts as an input in the formation of it, closely interrelated with all the other systems of society; economy, science, politics, social relations and culture.

In 1934 Lewis Mumford in his 'Technics and Civilization', outlined in broad strokes three great periods of Western technological development: first, the Eotechnic Period, characterized by the technologies of water and wind power, glassworks and wood; then the Industrial or Paleotechnic Period of the dark mines, crowded factories and blackened cities, of giant ironworks and machines, and energy derived from the combustion and pressure of steam and coal; and finally the Neotechnic Period, from the midst of which Mumford himself was then writing, a period whose innovation was to have hitched its 'techne' irreversibly to the precise and minute operations of mathematics and seemingly infinite fecundity of science. This last period delivered alloys, light metals, synthetic compounds, the invisible mysteries of chemical processes and especially electrical energy, but also the reintegration of long neglected 'wet' milieux such as the farm, the vineyard and the physiological laboratory. Mumford, near the end of his book marks the

apprehension of what he calls 'the biotechnic period, already visible over the edge of the horizon'. (3)

As seen from the various definitions of technology and Mumford's history of the technological development, there is a change in the implications of technology with the changing periods in history. Especially after the rapid industrialisation process since the eighteenth century and the increasing acceleration of scientific innovations, the term technology, being closely related with both of these aspects has gained a broader meaning which is associated with production, invention and prowess. The twentieth century as a whole, or certain periods in the twentieth century, as a result of this widening meaning of technology has been named as 'the technology age' and the society as 'a technology society'. Technology has been the source of a belief in the idea of progress. The positivist belief in a science and technology aided rationality and progressivist approach was dominant in the beginning of the twentieth century world until an increasing distrust in technology started in the post-war society about the second half of the century, in accordance with the rapid change in the ideologies and social conditions. The argument on the positive or negative impacts of technology on society through different aspects has continued ever since.

The negative connotations of technology stems from the deep changes in society that started in the 18th century. The Industrial Revolution and the change that occurred as a result of it in all realms concerning human activity in the 19th century made a deep change in the orientation of technology. The transformation from manual labour to the use of machine changed the centre of power which resulted with also a change in the issues that this power was directed towards. Sanford Kwinter says: "Since Renaissance, 'man' has defined himself to be - in his essence - a creative freedom, and this ideology is the source of that liberal humanism only lately maligned and fallen into disrepute, as well as the indomitable and more robust drive to realize this freedom by conquering and subjugating nature through technique...Human technics, until the 19th century, and in the social, political, scientific, industrial and domestic domains, was overwhelmingly oriented towards the mastery of adversity and chance in the external world of nature. Since the turn of the century, however, the will to mastery has been at least partly turned away from the non-human world, and applied to the mastery, knowledge and control of human nature." (3)

Consequently, technology started to be conceived as a power in itself which has control over the society. Such a view of technology has become common among some philosophers in the second half of the 20th century.

In his essay 'Technology and Science as Ideology', Jurgen Habermas exemplifies this attitude by Herbert Marcuse's analysis on technology and rationalization. " ...the very concept of technical reason is perhaps ideological. Not only the application of technology but technology itself is domination (of nature and man) - methodical, scientific, calculated, calculating control. Specific purposes and interests of domination are not foisted upon technology 'subsequently' and from the outside; they enter the very construction of the technical apparatus." Marcuse also states that this domination is legitimized by 'rationalization'; a concept directly linked to the institutionalization of scientific and technical development.(4)

Martin Heidegger is one of the philosophers who responded profoundly to the cultural impact of technology. For Heidegger, the expression of the deep-seated malaise of humanity and of modern societies lies in the split between 'having' and 'being', between 'techne' and 'poiesis', categories that he derived from the exploration of the ancient world (5). To the Greek 'techne' meant bringing-forth, and belonged to 'poiesis', revealing. "The essence of technology is by no means technological," he says, because "technology is a mode of revealing. Technology come to presence in the realm where revealing and unconcealment take place, where 'aletheia', truth happens." A phenomenological approach may give back to technology its true significance, and thus restore architecture as building, in the true sense of the word. Thus Heidegger says: "Only of we are capable of dwelling, only then can we build.(6)" He asserts a fertile and necessary opposition between the 'artifice' of the world and the 'natural' condition of the earth, realizing that the one is symbiotically conditioned by the other and vice versa. His thinking in this regard, have led a number of commentators to see him as a pioneer of 'eco-philosophy'. Technology was disturbing to Heidegger inasmuch as he saw it as being devoid of any respect for the intrinsic nature of things. For him the problem with technology does not reside in the benefits that it affords but in its emergence as a quasi-autonomous force that has 'stamped' the epoch with its Gestalt. It is not primarily the environmentally degrading aspects of industrial technique that concern him, but rather the fact that technology that has tendency to transform everything, even a river, into a 'standing reserve' (7).

Marshall Mc Luhan on the other hand, for the electronic technology, makes his assertion that in a culture which had moved on from the production of objects to the production of messages, the new center of reality lay in communication through images. Thus, in Mc Luhan, the call for pansemiotic conversion became the theoretical support for the production of ephemeral, instantaneaus, and ever-

changing works of architecture that existed purely for the purposes of communication (8). Whereas for Mc Luhan the electronic revolution has definitely utopian aspects, for Baudrillard for example that revolution has effectively made us the helpless victims of a technological determinism that through its unassailable code serves the interests of a hyperreal, meaningless capitalist order (9).

Jon Wagner, makes a survey of the approaches towards the definition of technology in his essay 'Defining Technology: Political Implications of Hardware, Software, Power, and Information' in which he divides these approaches into four categories. The first is the description of technology that refers to hardware; to constructions, machines, and tools of one sort or another; the material culture in all. This approach appears in the works of Ogburn (1964), Mc Luhan (1964,1969), White (1962), Fuller (1969). This 'material culture' was seen as a primary arena for innovation, and technology as a system was considered to be an independent variable, one which in turn affected the rest of the sociocultural matrix. This approach in general points to a 'technological determinism'. The second definition refers to 'energy use' and 'thermodynamics'. Cottrell has presented a rather clear statement of this model ".. the energy available to man limits what he can do and influences what he will do." This model of thermodynamics goes in hand in hand with 'utilitarianism'. A third major conception of technology deals with the 'techniques'. Mumford surveying this approach, expands technological concerns in two directions: An identification of the cultural context of technology (including the variables such as taste, style, values, beliefs and political conditions) and the consideration of organic and social forms of 'technological' inventions (social organization systems as machines). These three models of technology; 'hardware', 'power' and 'software' have theoretical weaknesses as well as strengths. A fourth conception of technology which attempts to embrace all the other three models is the treatment of technology as information system. Dupree suggests that technology as an information system connect people with the environment. The human individual taking the information through his senses, processes it, and makes a behaviour adapted to the environment and this system forms the closest analogue to technology. This may also be suggested in a larger scale that culture provides a kind of memory unit which processes information flowing from the environment and stress it for the future. Here technology is the system in operation as a creation and definition of our relationship to the environment. The most crucial application of the information system includes what is called 'ecological analysis' a

process in which 'everything is related to everything.' The elegance of the system is that it begins with assumptions about connectedness within the system, while allowing for refined distinctions to be made between systems. There is a nondeterministic nature of relationship between the elements of the system. All elements exist together, and they are defined only in terms of each other (10).

The idea of the information system shows resemblance to Prigogine's theory of chaos described in his book named "Order Out of Chaos". The changing attitudes towards scientific methods is summarised in Alvin Toffler's foreword to the book:

"The body of ideas that came together in the seventeenth and eighteenth centuries under the heading of "classical science" or "Newtonianism" pictured a world in which every event was determined by precise initial conditions. It was a world in which chance played no part, in which all the pieces came together like cogs in a cosmic machine...

Today, however, the Age of the Machine is screeching to a halt...And the decline of the industrial age forces us to confront the painful limitations of the machine model of reality...

The traditional science in the Age of the Machine tended to emphasise stability, order, uniformity, and equilibrium. It concerned itself mostly with closed systems and linear relationships in which small inputs yield small results. With the transition from an industrial society based on heavy inputs of energy, capital, and labour to a high-technology society in which information and innovation are critical resources, new scientific world models should appear.

Prigogine, in his "Order Out of Chaos" describes this new scientific model as an open system which is, on the contrary of traditional science seething and bubbling with change, disorder, and process. According to Prigogine, all systems contain subsystems, which are continually 'fluctuating' and out of this disorder and chaos an order and organisation can arise spontaneously through a process of self organisation. In this new model the concept of 'time' is introduced which was never thoroughly considered in traditional science (11).

The attempt to define technology in the means of an information system, therefore, fits into this new scientific model and serves better to understand a complex system.

Wagner, later in his essay introduces Robert Merton's concept of 'latent' and 'manifest' functions, as a step towards latent and manifest elements of an information system to provide the means for respecting the particulars of different social systems while addressing issues of their general comparability. The manifest-latent distinction allows describing social systems in terms of their members. A traditional concern of social scientists has been the examination of 'instrumental' and 'expressive' activity, a distinction which has persisted in spite of

its analytical ambiguity. The dichotomy of 'instrumental' and 'expressive' also provides a framework for other variables such as 'aesthetic' and 'technical'. With the latent and manifest distinctions there is no need to make final determinations of these ambiguities (12).

Similar dichotomies appear in many texts which concern the relationship between technology and architecture. In Alain Colquhoun's 1962 essay, 'The Symbolic and Literal Aspects of Technology', the relative expressivity of symbolic and literal aspects are observed in the means of modern architecture. According to Colquhoun "the rationalization of the building science and construction, even if they are crucial factors internally, remain only directly in the literal function world. Architecture only comes into being when the architect seizes and conceives this world, and rearranges it in the logic of symbolic forms" (13).

Relevant to the 'symbolic and literal' dichotomy, Kenneth Frampton proposes a distinction between the 'representational' and 'ontological' aspects of the tectonic form, basing his argument on the distinction Semper draws between the symbolic and technical aspects of construction. He states that the difference between the skin that re-presents the composite character of the construction and the core of a building that is simultaneously both its fundamental structure and its substance finds a more articulated reflection in the distinction that Semper draws between the ontological (constructional) nature of the earthwork, frame and roof and the more representational (symbolic) nature of the hearth and the infill wall (14). Frampton adds that this dichotomy must be constantly rearticulated in the creation of architectural form, since each building type, technique, topography, and temporal circumstance brings about a different cultural condition (15).

Both articles point out to a distinction between the symbolic expressivity of the construction and the merely functional character of it. Before the evolution of the idea of structural rationality, the symbolic aspects of a building were generally thought to be in the means of its form, its order, its ornaments and its position in the tradition, which formed the manifest elements of the building. With the emphasis on structure, the technique within which it is constructed loses its traditional latent function and becomes manifest. This transformation of the latent and manifest elements changed the usual perception of architecture as an inner structure wrapped by a series of elements that form the building's symbolic character. The structure could then possess both functional and symbolic qualities, which added a new value to the technologies used in its construction. As a result

the symbolisation of technique combined with other theoretical concerns such as seizing the spirit of the age appeared as a new way of expressivity in architecture. This led to the arguments on the legitimacy of such an approach.

In an essay named "High-tech; Functionalism or Rhetoric" Ignasi De Sola-Morales argues the same question for a certain tendency in architecture that makes much use of high technology, that whether the use of technology in high-tech is functional or rhetorical. He comes to a conclusion that high-tech is a rhetorical glorification of technology as an instrument of personal and social pacification and adds:

"This represents the fulfilment of the constant vocation of technological rhetoric, in the positive sense that we have proposed in this text: the art of eloquence by which a message - this case one of integration- is adapted by its author to the forms of architecture.

This rhetoric, once again, possesses the characteristics that we have identified right from the outset of this aporia of modernity. A rhetoric that can be literal or mediated, a direct translation of technological icons accumulated as a redundant appeal to its legitimation, or elaborate architecture in which the repertoires that technology offers are the fruit of a mediation of rules, protocols, and codifications that end up by constructing an elaborate system of communication through architecture."

He ends up his essay as:

"Banishing anxiety, as in the famous opening words of Manfredo Tafuri's book 'Progetto e utopia', or, as Le Corbusier put it in 1923, revolution or architecture, may have been, right from the beginning, the true purpose of the appropriation of technology through architecture." (16)

This point of view is not very distant from the general belief against technology which is formed by the reaction to the use of technology and science as the means of institutionalization of an ideology. Habermas describes the ways in which the ideology of 'capitalism' is propagated by the use of science and technology, and the change in the ideology in accordance with the critical developments in them (17).

The architects of the so-called high-tech movement, however, denying such an ideological viewpoint, and even as if 'in an intentional ideological critical silence', state that they see technology not as an end in itself, but as a tool that provides possibilities to the architect.

Richard Rogers says that new technologies, if they are used in their proper sense remove limits and provide possibilities. He relates this point of view in his statements on technology, although their reflection in his practice is a matter of discussion:

"Technology is a tool which architects ignore to their loss. It is not that there exists a linearity in the progress of technology but there is and has always been a consistent and constant relationship between the ambitions of the architect and the possibilities provided by technology...Technology widens the possibilities of the architect's imagination, it serves man, it is not an end in itself... Technology is nothing but an enabler, a catalyst for cultural activity." (18)

Norman Foster described his feelings about technology in 1981 as follows:

"For me the history of gliders is exemplary: over the course of time they have become faster, safer, more comfortable, and much more beautiful; they can cover ever grater distances, use less and less energy... keep up with the most advanced technologies, and give the pilot ever greater pleasure."

'In this can be heard echoes that range from the 19th century myth of technological and scientific progree to what might be called New Age aspirations: aspirations to a world reconciled by the pleasure principle', says Alessandro Rocca (19).

And Kenneth Frampton giving Peter Rice's comments on technology, in which he says a poetic formal dimension is capable of transcending instrumentality as an end in itself, declares that 'technological devise is a cultural choice and not simply a matter of reductive logic.'

"...This brings to mind another myth about technology. The feeling that technological choice is the result of a predetermined logic. The feeling that there is a correct solution to a technological question is very common. But a technical solution like any other decision is a moment in time. It is not definitive. The decision is the result of a complex process where a lot of information is analyzed and examined and choices made on the evidence. It is a moment in time and place where people, their background and their talent is paramount. What is often missing is the evidence of human intervention, the black box syndrome. So by looking at new materials, or at old materials in a new way we change the rules. People become visible again." (20)

Here Peter Rice also gives an idea on how the choice of technology is made, that it is decided after a long process of analysis and that the use of the new materials or old materials in a new way are the means for changing rules.

Whereas the contemporary architects mention technology as not an end in itself, Mies van der Rohe in 1950 admits the cultural import and power of technology: "Technology is rooted in the past. It dominates the present and tends into the future. It is a real historical movement - one of the great movements which shape and represent their epoch.

It can be compared only with the classic discovery of man as a person, the Roman will to power, and the religious movement of the Middle Ages.

Technology is far more than a method, it is a world in itself. As a method it is superior in almost every respect. But only where it is left to itself, as in gigantic structures of engineering, there technology reveals its true nature...Whenever technology reaches its real fulfilment, it transcends into architecture. It is true that architecture depends on facts, but its real field of activity is in the realm of significance." (21)

3. MACHINE

As a constant component of the idea of technology, the machine has been one of the most influential features of the industrialized society. The machine both as a thing in itself and as a metaphor has been the source of remarkable changes in the evolution of man's position in the world, as well as the material change of the world.

Machine or mechanisms have always interested man and has formed a part of his creativity directed towards future in the means of invention. The drawings of machine designs of Da Vinci show that an interest in mechanisation existed even in Renaissance period, although this is limited with the imaginations of the great artists of the time (1). But the impact of the machine on human life after the Industrial Revolution is of greater significance due to the change in all realms of social life that happened as a result of the transformation of man's power to a mechanical power. This transformation resulted with deep change in the ideologies, social organisations and even the total conception of the world. In his section on 'Mechanism' in 'The Architecture of Good Intentions', Colin Rowe states that since Julien Offroy de la Mettrie, the French populariser and philosopher published his polemic 'L'Homme machine' in 1752, man/society as a machine has remained as one of the critical themes (2). The conception of human being as a machine himself and the world as a giant machine in which all organisational systems work in a machine like order has been a part of the belief of the industrial society.

When this metaphorical belief in machine was added to the enthusiasm of the new order of the world operated by machines, the idea of the 'Machine Age' was formed. As early as the first half of the 19th century there were implications of a machine age. Thomas Carlyle in 'Signs of the Times', in 1829, has written:

"Were we required to characterise this age of ours by a single epithet, we should be tempted to call it, not an Heroical, Devotional, Philosophical or Moral Age, but, above all other, the Mechanical Age. It is the Age of Machinery, in every outward and inward sense of that word." (3)

The will to design a new world that would be in accordance with the conditions of the machine age was a further concern. All of the avant-garde

movements in the beginning of the 20th century mentioned the need to adapt to the machine age by the inspiration and the resources provided by the machines.

In Germany, the Deutscher Werkbund group founded by Muthesius in 1907 saw the potential of power and quality in the use of industrial machines for mass-production and described the role of the artist as a mediator formal invention and standardisation, between personal style and the appropriate form for the "Zeitgeist" (the spirit of the times). Peter Behrens, also related with the Werkbund described the nature of the new 'German spirit' in 1907 as:

"From now on the tendency of our age should be followed in a manner of design established appropriate to machine production. This will not be achieved through the imitation of handcraftmanship, of other materials and of historical styles." (4)

Walter Gropius after working with Behrens for some time received his own commission to redesign the Fagus shoe-last factory at Alfred in 1911. The building he designed for the factory with Adolf Meyer is significant in the creation of an industrial style and in the formation of a "factory aesthetic".

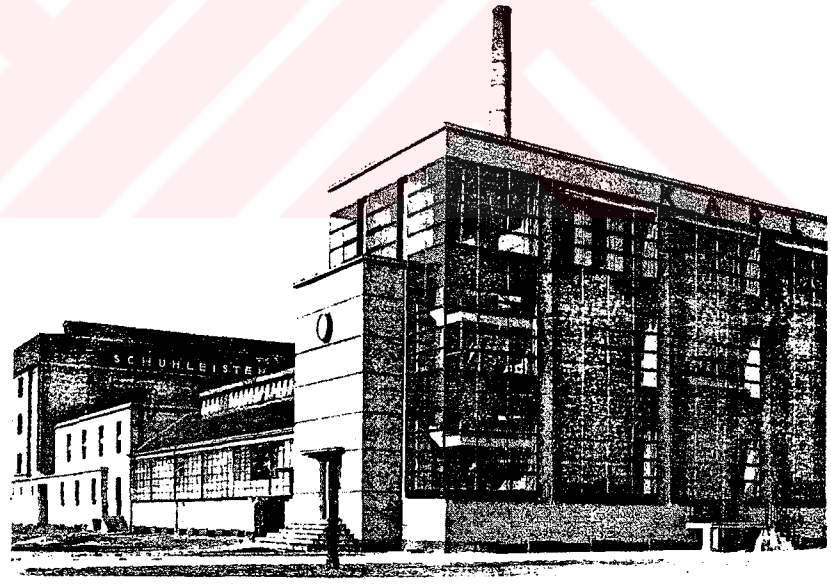


Fig.3.1. Walter Gropius and Adolf Meyer, Fagus shoe-last factory, 1911

Around the same years with Werkbund, a futuristic ideology had evolved in Italy. Futurism in general covered the progressivist attitudes, anti-traditional positions and tendencies towards abstract form with the celebration of modern materials, and an indulgence in mechanical analogies. The Foundation Manifesto of Futurism declared in 1909 expressed this idea as:

"We declare that the splendour of the world has been enriched by a new beauty- the beauty of speed. A racing car with its bonnet draped with exhaust pipes, like fire-breathing serpents- a roaring

racing car, rattling along like a machine gun, is more beautiful than the winged Victory of Samothrace."

In the limited sense there was a Futurist Manifesto of architecture in 1914 and Sant' Elia's drawings attempted to translate Futurist ideals into a new urban imagery-'La Citta Nuova' ('The New City') in which the modern city is like an immense and tumultuous shipyard and the modern building is like a gigantic machine. Futurists and the Deutscher Werkbund both rested on the central assumption that the spirit of the times was inevitably tied to the evolution of mechanisation, and that an authentic modern architecture must take this into account in its functions, its methods of construction, its aesthetics and its symbolic forms (5). The Italian futurists intended to conjure an aesthetic out of machinery and engineering while the Germans hoped to conjure some aesthetic into them (6).

These were some of the movements before the world was intruded into a war. After the First World War which started in 1914 and ended in 1918, the formation of modernism became even more clear. In Germany, after the defeat of the German army in the war, and the collapse of the imperial order an economic chaos and political polarisation had started. Gropius, catching the ambivalent mood of the period formed the Bauhaus as an ideal centre that would embody new social and spiritual integration in which artists and craftsmen would unite to create a sort of collective symbolic building of the future. Their first manifesto (1919) stressed the craftsmanship as an ideal. In their second manifesto in 1923, however, the new orientation of Bauhaus is announced as:

"The Bauhaus believes the machine to be our modern medium of design and seeks to come to terms with it."

"... we want an architecture adapted to our world of machines, radios, and fast cars,... with the increasing strength of the new materials- steel, concrete, glass- and with the new audacity of engineering, the ponderousness of the old methods of building is giving way to a new lightness and airiness." (7)

In 1928 Gropius left Bauhaus and handed over the reins to Hannes Meyer whose philosophy differed considerably from his. Demanding a complete break with the past, Meyer preached an uncompromising functionalism (1926):

"Building is a technical, not an aesthetic process, and time and again the artistic composition of a house has contradicted its practical function. Planned in ideal and basic terms, our house will become a piece of machinery." (8)

The Dutch De Stijl movement that was centred about the work of three men: the painters Piet Mondrian, Theo van Doesburg and the architect Gerrit Rietveld had its original formation in 1917 and lasted about fourteen years (9). Sharing the

Futurist excitement of a vision of the new and pure world, they had a common interest in the machine. Almost inevitably, mechanization figures largely in this vision, but not as something worth having for its own sake, or simply because it was new, as the Futurists saw it. For De Stijl, machinery, in separating Man from Nature hastened the spiritualization of life. Van Doesburg wrote more than once:

"The machine is, par excellence, a phenomenon of spiritual discipline. Materialism as a way of life and art took handicraft as its direct physiological expression. The new spiritual artistic sensibility of the 20th century has not only felt the beauty of the machine, but has also taken cognisance of its unlimited expressive possibilities of the arts... Under the supremacy of materialism, handicraft reduced men to the level of machines; the proper tendency for the machine (in the sense of cultural development) is as unique medium of the very opposite, social liberation."

and again :

"Every machine is the spiritualization of an organism." (10)

This substantial reversal of both Rationalist materialism and Futurist mechanolatry is extended by Mondrian's views on the Modern city and the implied equation between abstract art and machinery receives support from the fact that both were also seen as instruments of the depersonalisation of art. The analogy of the machine to the work of art expressed in De Stijl, shows the transformation of attitude to machinery before and after the war. The pre-war Futurist attitude to machinery as the agent of private, romantic, anti-classical disorder is transformed with De Stijl to the post-war 'machine aesthetics' that saw machinery as the agent of collective discipline and an order that drew nearer to the canons of classical aesthetics. By this transformation the theorists of De Stijl may be accepted as the true founder of the enlightened 'machine aesthetics' that inspired the best work of the 20s (11).

Another movement closely related with the idea of the machine is the Russian Constructivist movement which evolved in post-revolutionary Russia in the period after 1917. Influenced by the Futurist ideas, the Russian Constructivists chose machine as their metaphor to express the dynamism of the revolution, as well as the connotations of technology with the ideas of newness and progress. Machine worship became a tenet of faith, as if mechanization could be thought of as identical with the social and historical path of progress. Tatlin's paper project for a Monument to the Third International of 1920, reveals some sense of this orientation. The Pravda building scheme designed by the Vesnin brothers in 1924 shows a more successful fusion of the devices of abstract art with the articulation of function and mechanistic moving parts (12).

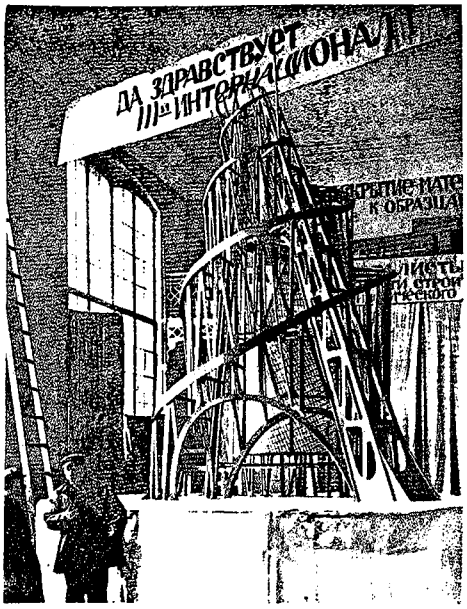


Fig. 3.2. Model of Monument to the Third International, Tatlin, 1920

Starting from 1922 new members from Russia and Germany joined De Stijl and that gave an international character to the movement. Among these new members the Russian El Lissitsky was of special importance, because he had introduced Russian Constructivism to the Western Europe. In 1922 Theo van Doesburg signed the foundation Manifesto of the Constructivist International which stated:

"This International is not the result of some humanitarian, idealistic or political sentiment, but of that amoral and elementary principle on which science and technology are based."

And about the machine aesthetics van Doesburg says:

"Since it is correct to say that culture in its widest sense means independence of Nature, then we must not wonder that the machine stands in the forefront of our cultural will- to- style... Consequently, the spiritual and practical needs of our time are realized in constructive sensibility. The new possibilities of the machine have created an aesthetic expressive of our time, that I once called 'the Mechanical Aesthetic'."

The conjunction of the 'mechanical aesthetic with 'constructive sensibility' here points out to a growing feeling, which has much later been codified as a definitive credo, that the art proper to a mechanical age is Russian Constructivism (13).

Meanwhile, in France Le Corbusier was already expressing his outstanding view of the new spirit of architecture in L'Esprit Nouveau (1920).

"Nobody today can deny the aesthetic which is disengaging itself from the creations of modern industry. More and more buildings and machines are growing up, in which the proportions, the play of their masses and the materials used are of such a kind that many of them are real works of art, for they are based on 'number' that is to say an order." (14)

And later in his 'Vers Une Architecture' he introduces his famous analogy of the house as a machine (1923).

"The airplane is the product of close selection. The lesson of the airplane lies in the logic which governed the statement of the problem and its realization. The problem of the house has not yet been stated. Nevertheless there do exist standards for the dwelling-house. Machinery contains in itself the factor of economy, which makes for selection. The house is a machine for living in." (15)

"A great epoch has begun. There exists a new spirit. Industry, overwhelming us like a flood which rolls on towards its destined ends, has furnished us with new tools adapted to this new epoch, animated by the new spirit... If we eliminate from our hearts and minds all dead concepts in regard to the house, and look at the question from a critical and objective point of view, we shall arrive at the 'House - Machine,' the mass-production house, healthy (and morally so too) and beautiful in the same way that the working tools and instruments which accompany our existence are beautiful. Beautiful also with all animation that the artist's sensibility can add to severe and pure functioning elements." (16)

All of these architectural theories belonging to the first quarter of the 20th century shared the common excitement in the new spirit of the new epoch and the will to construct the world anew. In the machine they found the inspiration they acquired; an expression of this new epoch. The ideas of motion, speed, power and progress that could provide the world with a totally new way of life was intrinsic in the nature of the machine. Therefore it constituted the perfect symbol for a new architecture.

Another important factor in this interest in the machine was the fascination created by the machines of perfection; the motor-car, the ship and the aeroplane. This fascination was not only due to their perfection as mobile objects, but as models of industrial production. From the beginning of this century the example of the abundant success of the motor-car's reproductive system was everywhere cited by Modern architects as a model to be emulated. Banham described it as the cause of a 'psychological revolution' because of the power it gave to the 'ordinary individual'; 'Man Multiplied by the Motor' in Marinetti's phrase (17). The impacts of the motor-car is obvious in the Futurist Manifesto as the appraisal of the racing car, or in Le Corbusier's 'Vers Une Architecture' in which the attraction of the motor-car, the liner and the aeroplane is told in separate chapters. In the thirties Walter Gropius did even design a series of closely related bodies for Adler cars.

Nevertheless, the reflection of the idea of machine to the formal aspects of architecture remained as only a metaphor for the early modernists except for the Futurists and Constructivist, whose relatively utopian projects were never actually realized. Le Corbusier's 'house - machine' did not resemble a machine at all. In

fact, it was a purified white form of a reductionist stereometry and in this way a return to the fundamentals, the ultimate origins of architecture in primary forms. According to Banham modern architects "produced machine age architecture only in the sense that its monuments were built in a machine age" (18).

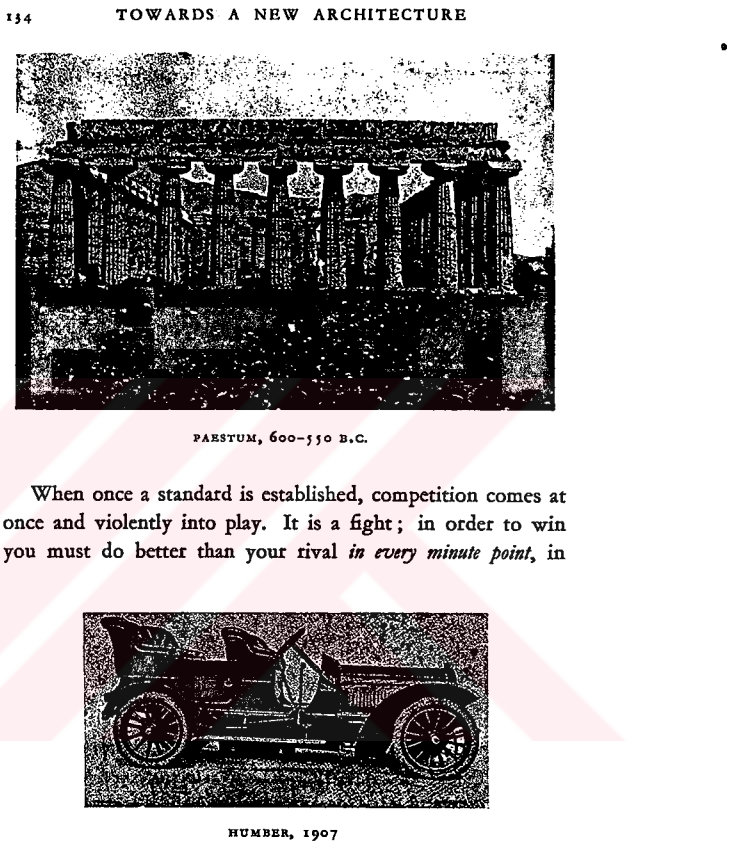


Fig. 3.3. A page from Corbusier's 'Vers une architecture', 1923

The machine image did not loose its impact on the next generations of architecture even after the enthusiasm raised by modernism in the beginning of the 20th century was lost. Therefore the task of designing buildings that really looked like machines was left to the coming generations.

One exception to the relation of modernism and the machine is the American avant-garde architect Bucksminster Fuller. The Dymaxion House designed by Fuller in 1927 possessed the qualities of a living-machine, although it did not exactly resemble a machine in appearance. This was a lightweight building designed for mass-production with a hexagonal ring of dwelling space, walled in double skins of plastic in different transparencies according to lighting needs, and

hung by wires from the apex of a central duralumin mast which also housed all the mechanical services. The formal qualities of this design are not remarkable, except in combination with the structural and planning methods involved (19). According to Fuller, the house is to be conceived of scientifically as man's initial advantage relative to forces of the environment. Later in 1940 Fuller designed the 'Mechanical Wing'; a capsule containing a fully fitted kitchen, bathroom and generator, that could be towed behind a car and plugged into a remote tent or cabin. His later projects, the DDU (Dymaxion Deployment Unit), the Wichita House served the principles of mass-production and mechanical emphasis (20).

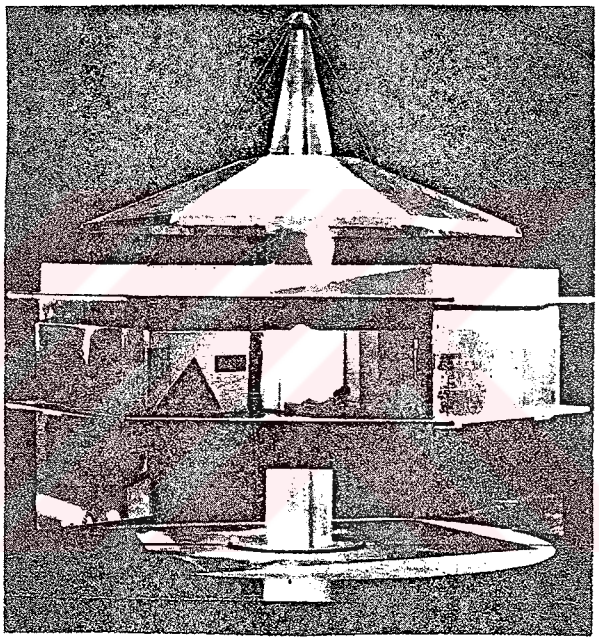


Fig.3.4. Dymaxion House, Bucksminster Fuller, 1929

There are some important buildings built between the 30s and 60s that helped the formation of a new machine aesthetic, that was rather different than the machine aesthetic of modernism. Chareau's Maison de Verre in Paris (1931), Owen Williams' Boots factory in Beeston (1932), Jean Prouve's Maison du Peuple in Clichy (1939), Charles Eames' house in California (1949), Wachsmann's space-frame structures (1950-53) have been influential on the machine aesthetic later presented by the high-tech architects (21).

However, the direct formal reference to the machine in architecture was made by the London architectural team known as Archigram founded in 1960. In the utopian projects of Archigram the building, for the first time became a real machine in appearance. Mike Webb's early project for the Furniture Manufacturer's

Association Building for High Wycombe (1957) was a reminiscent of an automobile engine. Ron Herron's and Warren Chalk's Interchange project (1963), Peter Cook's Plug-in City project (1964), Ron Herron's Walking City project (1964), Cedric Price's Fun Palace project (1961), Archigram's Control and Choice project (1967) and many similar projects with a world of lattice frames, tubes, capsules, cells, spheres expressed in the means of Pop Art show direct formal use of machine imagery. Archigram made the machine and its qualities worthy of artistic and architectural representation, without interposing the sort of aestheticizing sublimation that Le Corbusier had employed (22).

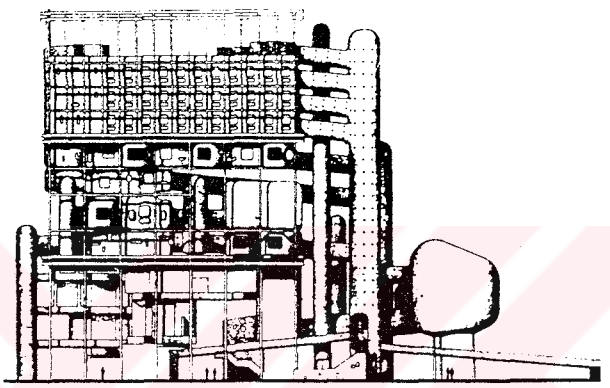


Fig.3.5. Furniture Manufacturer's Association Building for High Wycombe, Mike Webb, 1957

Apart from this utopian view, the machine aesthetic was developing in the realm of actual construction. Leicester Engineering building by James Stirling and James Gowan (1959), the Olivetti training school at Haslemere (1969-72) by again Stirling and Wilford, the early works of Norman Foster and Richard Rogers and their work together as Team 4 among which The Reliance Controls factory (1967) is one of the most outstanding, are early examples for this machine aesthetic. But this approach found its true paradigm in the Centre Pompidou designed by Richard Rogers in corporation with Renzo Piano. The building completed in 1977, in Paris is obviously a realisation of the technological and infrastructural rhetoric of Archigram; a vast, serviceable hangar supported by megastructural steel-tubed frame. The floor slabs were made to span adjustable interior spaces, and the elevations were entirely glazed. An appropriate ornament was provided by festoons of mechanical tubes, including a long glass canister enclosing a moving staircase up the main facade.(23) In contrast to the reactions to it, in the beginning of the project, the building became very popular. The Centre Pompidou was like a giant machine in the heart of Paris.

Fig. 3.6. Leicester Engineering Building, Stirling & Gowan, 1959-63

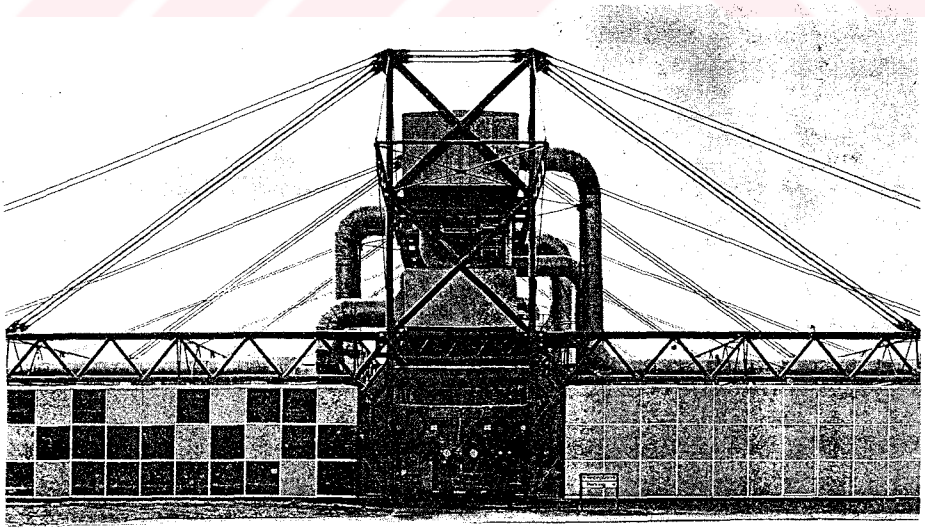


Fig. 3.7. Inmos Factory , Richard Rogers, 1982

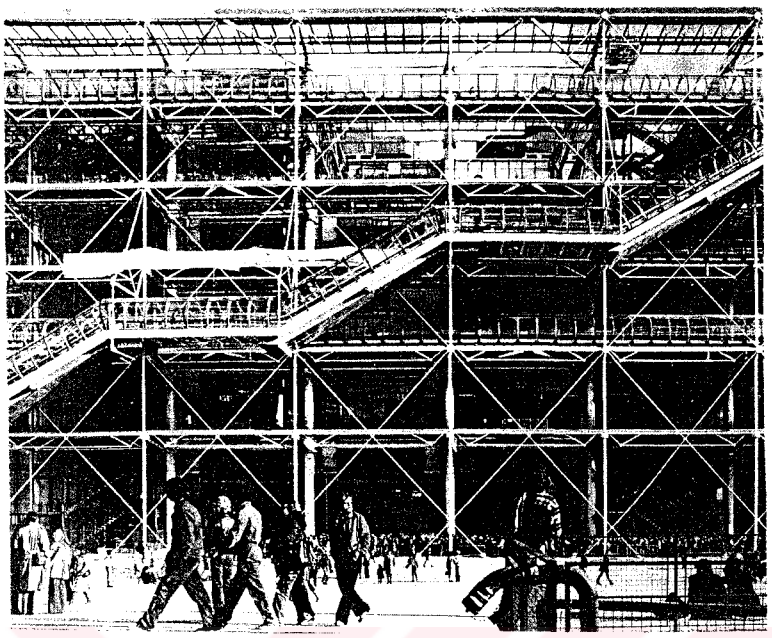


Fig.3.8 Centre Pompidou, Richard Rogers and Renzo Piano, 1977

Many projects that could be suggested to have such an aesthetic quality were erected in the 80s and were labelled as high-tech buildings, including the well known examples, the Hongkong Bank Headquarters by Norman Foster and the Lloyd's of London by Richard Rogers completed in the same year, in 1986. Especially Richard Rogers designed many industrial buildings in the 80s that exhibited an obvious machine aesthetic, with all the mechanical services are placed on the outside of the buildings connected to the structural system, such as the PA Technology Laboratories and Corporate Facility in Princeton (1982) and the INMOS Microprocessor Factory in Newport (1982). Many other buildings of the same manner were designed and built by Nicholas Grimshaw, like the Rank Xerox Research Center (1988) and his Igus Factory Headquarters (1993). Similar aesthetic qualities were obtained by Michael Hopkins, Ian Ritchie with Rogers, Foster and Grimshaw on the British wing, Renzo Piano from Italy and other architects following similar attitudes in France. These were achieved by the close corporation of some structural engineers among which the most well known is Peter Rice. The engineer's contribution to the building process in high-tech is indisputable.

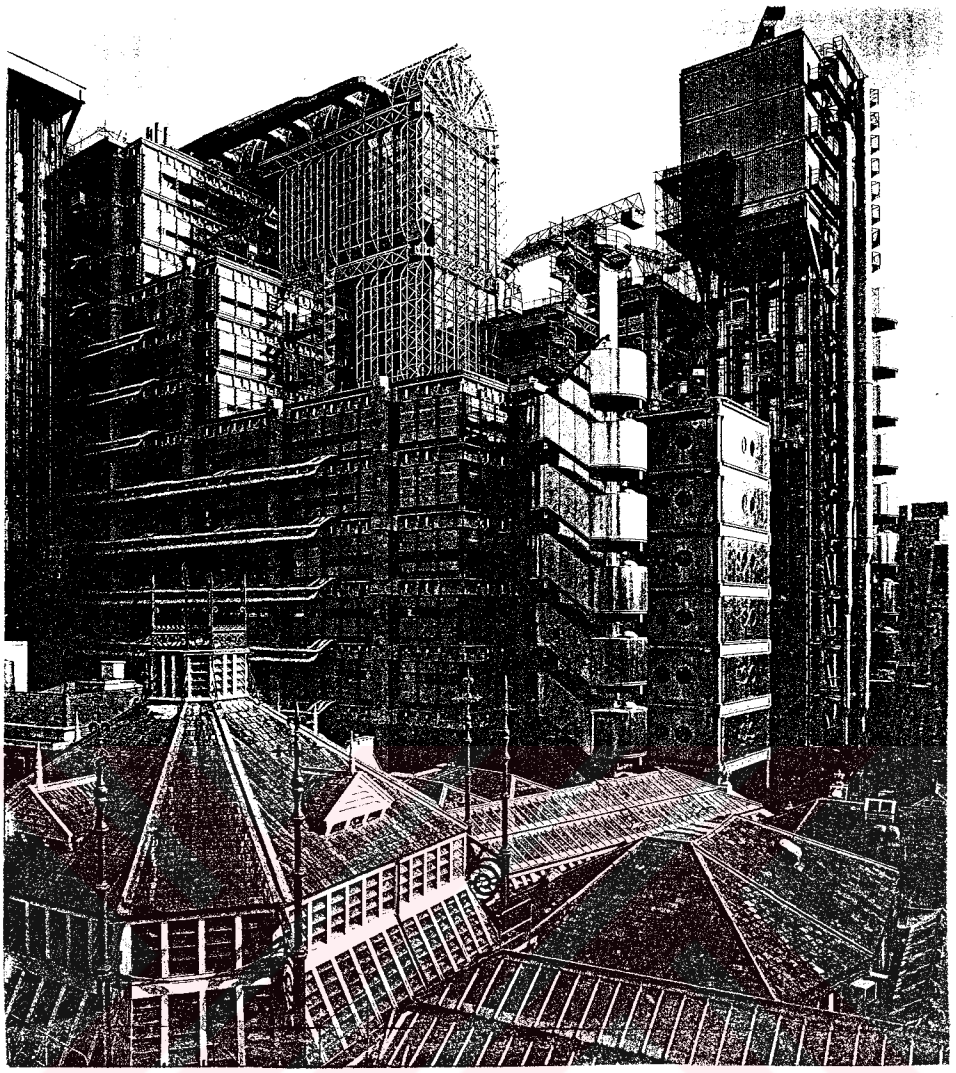


Fig.3.9. Lloyd's of London, Richard Rogers, 1986

Towards the end of twentieth century, the machine image has lost the remarkable attractivity it had in the beginning of the century. The transformation from a technology dominated by machines to a technology dominated by computers and microchips changed the general image of the world through the machine metaphor. At the heart of this modern metaphor stands the computer. The simple and visual has been replaced by a complex micro-world, where the parts are too small to be seen and the interconnections too complex to be grasped (24). The early machine image has shifted to another image of a complex information network. The results of this shift is seen in architecture as a whole body of intelligent buildings and the use of immateriality. This has partly changed the idea of the building machine as a formal analogy to an idea of the building controlled by a complex system of invisible mechanisms independent of any formal aspiration.

4. TRANSPARENCY

Transparency is the capability of an object to transmit light so that it enables the vision of the objects behind it. Transparency, in architecture is the quality that moves away the heavy borders between the outside and the inside and still acts as a border, enabling the visual communication. By this characteristic transparency has been one of the critical features in shifting the architectural meaning in the 19th century. Transparency, due to these qualities, is also one of the major characteristics in an idea of architecture that is in close relation with technical innovation.

Two important elements that are essential in the formation of transparency is light and the transparent material, generally glass in the architectural practise that is the oldest man-made transparent material. Glass is a beautiful chaotic solid, whose ubiquity is a witness to its material versatility. It is a material based on silica, seeded with metal oxides which can render it transparent and opaque, black and white or virtually any degree between either of these limits.

In architecture, glass has for a thousand years been the medium through which light has entered building revealing the spatial art of architecture, while completing the protective enclosure of walls and roof against the elements while allowing visual contact to be maintained with the outside world (1).

The role of glass used in architecture changes through the history according to the innovations in glass making technology. This change also plays a determining role in the sudden and deep shift in architectural meaning in the 20th century.

Ian Ritchie classifies the glass making process through the history in five stages, two by hand and so far three by machine: the working of molten glass as it cools and becomes more viscous and the blowing of molten glass to produce thin walled vessels and the first 'flat' glass; the machine production of vessels (mid 19th century), the production of large flat sheets by the 'float' process in the 50s (revolutionising our built environment), and more recently the production of glass

fibres (revolutionising the quantity and speed of our communication) which is in woven form has also helped to create a new architectural material (2).

Before the first flat glass production during the Industrial Revolution; glass appears as a complementary material of the 'window' which, next to the 'wall' forms one of the major elements of the architectural composition. In that case glass was not the determining material, earlier other materials could be used in the place of glass such as very thin leather, semi-transparent marble or treated paper as in Japan architecture (3). But still as a material of perfect transparency, having the best interaction with light it was always a part of man's fascination and belief in the future.

Man's desire towards totally transparent buildings, his fascination with a glass architecture comes from many centuries ago and is evident in Jewish, Arabic, and European literature and mythology. The "glass dream" which inspired these cultures has ancient roots. The glass dream was sustained through the Mozarabic culture of mediaeval Spain, principally in literary form, but it also found built expression in small metaphorical structures such as garden pavilions. In the Gothic period, the glass dream found greater expression in built form, soaring cathedrals with their expansive walls of coloured glass, as well as in literary sources. The association between the image of a crystal or jewel and glass architecture is enduring (4). There are many examples to the crystal image in architectural history.

This literary and architectural motive continued through the Renaissance, emerging as a central theme of Francesco Colonna's widely read 'Hypneotomachia Poliphili' of 1499. An expression of the romantic aspect of the Renaissance fascination with the ruins of classical antiquity, it invokes images of structures with transparent alabaster walls and floors of highly polished obsidian, so mirrorlike that viewers thought they were walking through the reflected sky. After the Renaissance the Enlightenment was characterized by a fascination with light and the scientific investigations of optics, its architectural expressions were not as poetic (5). With the Industrial Revolution in the 18th century, the innovations in technology and industry enabled the production of new building materials; wrought and cast iron. Towards the beginning of 19th century, by the improvements in the production of thin flat glass, common use of the material in architecture became possible. The use of iron frame with glass established a new architectural language. The glass houses built in this period made man's long glass dream partly come true. One of the first glass houses was built by a gardener JC Loudon at Bretton Hall, Yorkshire

in 1827. This building had a dome spanning 30 metres and depended on the interaction of metal and glass for its rigidity, one of the first to do so (6). The glass houses usually served as greenhouses for plants or conservatories; both functions directly related with much light. The first of the greenhouse structures to draw significant public attention was Sir Joseph Paxton's Great Conservatory at Chatsworth, Derbyshire (1837-40) (7).

At about the same time there was a tradition of holding regular exhibitions displaying national industries at regular intervals, especially in France. The erection of the famous Crystal Palace in London (1851) by Paxton was for the similar purpose. By Crystal Palace, all of the evolutionary issues of its time came together into one clear and coherent architectural statement (8). The Crystal Palace, as a transparent structure of that size (its total envelope 93000 square metres of glass) is thought to be a revolution in architecture. It was also a reply to the long interest of man towards the glass (or crystal in metaphorical sense) palace. Hilberseimer describes the light qualities of the structure as " It obliterated the old opposition of light and shadow, which had formed the proportions of past architecture. It made space of evenly distributed brightness; it created a room of shadowless light." (9). Glass architecture was continued with other Exhibition Buildings built in the following years of the 19th century.

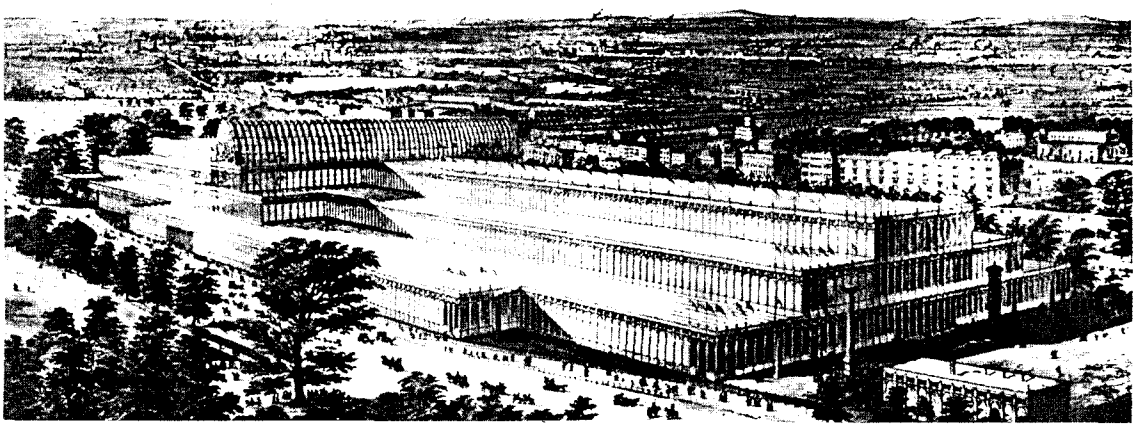


Fig.4.1. Joseph Paxton's Crystal Palace, 1851

Modern architecture in the beginning of the 20th century did not directly deal with transparency as a part of its concept, although it used the materialistic properties of glass to manifest its idea of a new architecture. One of the first

modern buildings (actually the first modern building *according to Banham*) to achieve a manipulated sense of transparency is Walter Gropius' Fagus shoe-last factory at Alfred built in 1911. A separation between the diaphanous glass skin and the upright structure is achieved in the building by bringing the plane of the glass forward in relation to the piers. This results with a sense of transparency and creates a dematerialization of the structure (10). In his later work, the Werkbund Pavilion in Cologne (1914) the glazed wrapping to the rear and the transparent, streamlined stair-towers (with the spiral stairs visible inside them) that created a sense of weightlessness and space (11).

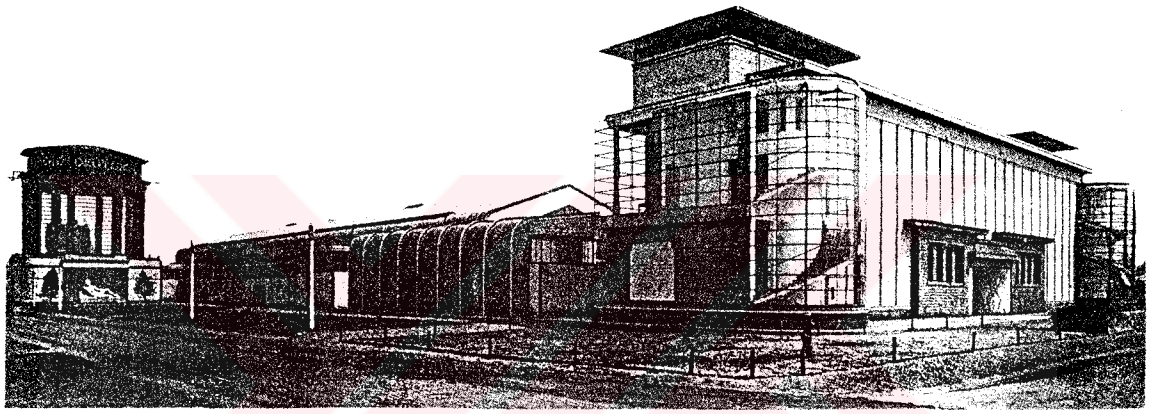


Fig. 4.2. Werkbund Exhibition Pavilion, Gropius & Meyer, 1914

In a more direct way, glass architecture was pictured through the writings of Paul Scheerbart, a utopian and a poet who saw glass as the material of the future. He expressed his fantastic ideas in his 'Glass Architecture' in 1914 which consisted of 111 sections:

"We live for the most part in closed rooms. These form the environment from which our culture grows. Our culture is to a certain extent the product of our architecture. If we want our culture to rise to a higher level, we are obliged, for better or for worse, to change our architecture. And this only becomes possible if we take away the closed character from the rooms in which we live. We can only do that by introducing glass architecture, which lets in the light of the sun, the moon and the stars, not merely through a few windows, but through every possible wall, which will be made entirely of glass- of coloured glass. The new environment which we thus create must bring us a new culture." (12)

Inspired by Scheerbart's image of a glass architecture, Bruno Taut , on the expressionist wing of the Deuthcher Werkbund Group of the early 20th century designed his 'Glass Pavilion' (1914). The pavilion was in the form of a geodesic

dome of different coloured glass. The expressionist movement in the 20th century added to the spirituality, fantasy, transformation, and utopianism with which glass architecture had historically been identified (13).

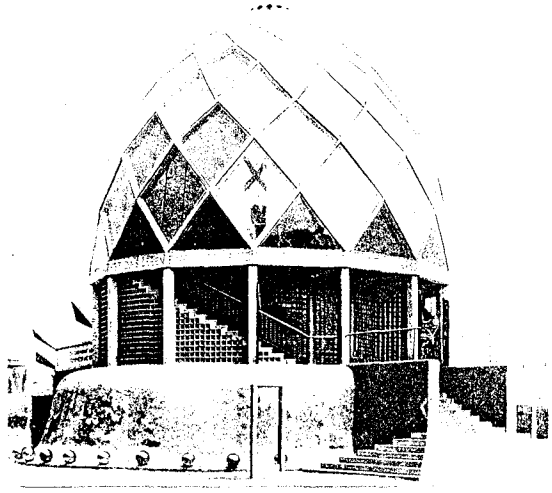


Fig. 4.3. Glass Pavilion, Taut, 1914

The visual objectivity embraced by the early modernists has been a reference to the contemporary architecture. Ludwig Hilberseimer's 1929 essay 'Glasarchitektur' represents that rationalist outlook and serves as a historical antipode to contemporary attitudes. For him the use of glass in architecture furthers hygienic and economic goals; he discusses its formal properties only insofar as they enable the architect more clearly to express the structural system. Aesthetic concerns are essentially negated. He states that in the modern use of glass, it is often combined with the load bearing structure in such a way that glass's characteristic effects of lightness and transparency become completely lost (14).

A distinction to Hilberheimer's statement, Mies van der Rohe may be called as the architect who gave a new, significant meaning to glass in the early 20th century. His 'Glass Skyscraper' project designed for a competition in 1921 may be read as a minimalist and rational solution which attempted to strip a tall framed building down to its essential structure wrapped by a glass curtain. In this project, glass is far more than a building material; it is the main architectural element that defines the whole building. The Barcelona Pavilion built in 1929, is one of the most important buildings in this context. The use of glass, in the Barcelona Pavilion substitutes wall's place and eliminates its traditional meaning. In this way it is not only the wall that is eliminated but the window, whose existence is directly linked to the existence of the wall. In other words, the wall is transformed into window and

the window into wall. The wall should no longer be considered as the major element of the architectural composition (15). Mies saw glass as embodying a new challenge, to the fundamental tectonic elements of the wall, the floor, and the ceiling. In 1933 he stressed the symbiotic impact of glass on modern form as:

"What would concrete be, what steel without plate glass? The ability of both to transform space would be limited, even lost altogether, it would remain only a vague promise. Only a glass skin and glass walls can reveal the simple structural form of the skeletal frame and ensure its architectonic possibilities..." (16)

The spatial continuity and the experience implied by the nonmaterial surfaces of the pavillion is also seen in Mies' Tugendhat House built in 1930 in which he employed the simplest kind of skin to achieve the greatest transparency. The use of large glass sheets to attain a dematerializing effect is characteristic to most of his later buildings.

Fig.4.4. Farnsworth House, Mies van der Rohe, 1946-51

Another building built about the same years, Pierre Chareau's 1932 Maison de Verre ran completely against the grain of modern rationalist thought. The employment of atypical materials; the glass brick and thin steel struts elegantly composed into a linear aesthetic in this building made it an outrageous building among the functionalist examples of the time (17). Maison de Verre is accepted as an early example of the later high technology buildings due to its choice of materials, all industrial products as glass, steel, plastic and the way these materials are assembled together. Another important factor about the building is the quality of transparency achieved. The building is sheathed in layers of transparent and translucent materials, which alternately obscured and revealed a sequence of views -'ambiguous characteristics' (18).

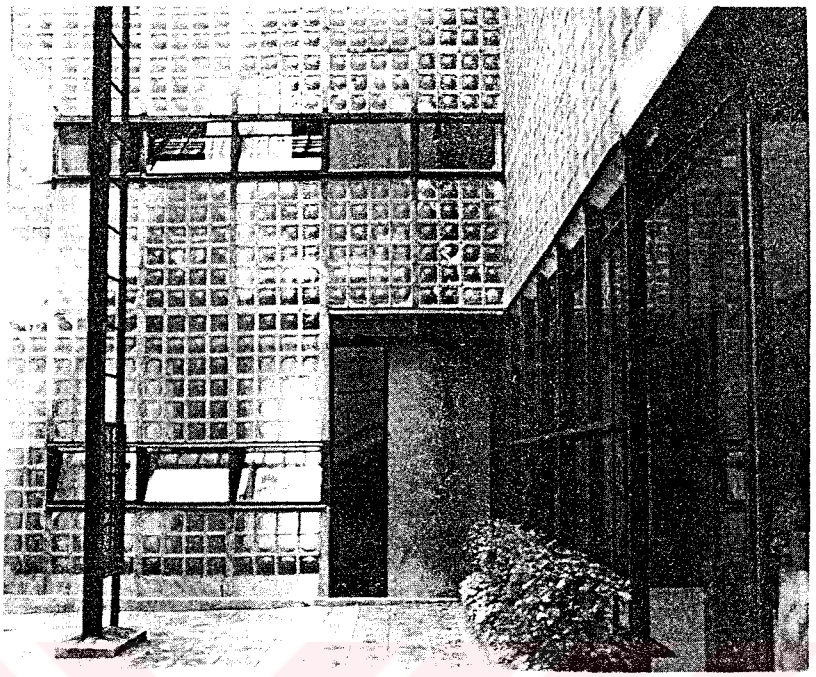


Fig.4.5. Maison de Verre, Pierre Chareau, 1932

These and some other examples of the modern movement searched for new architectural meanings by the means of transparency, using glass as a part of a new architectural vocabulary. However towards the mid 20th century, by the spread of international style, the idea of glass boxes became popular and the banality in the extensive use of glass in many of the buildings of the period has led to negative connotations and a reaction against glass surfaces. Therefore the historicism tendencies in postmodernist architecture preferred to return to the traditional facade, with the window- wall and proportion systems.

Those years provided fertile ground for critics of the modern rationalists and their followers. An essay written in 1955-56 on transparency by architectural historian Colin Rowe and painter Robert Slutzky, 'Transparency: Literal and Phenomenal' was widely read in the 1960s, became a basic text serving to dispel the positivist aura still clinging to 'space-time' modernism and widely establishing the authors' distinction between literal and phenomenal transparency (19). Phenomenal transparency is proposed as an abstract, theoretical sense of transparency derived from the skilful formal manipulation of the architectural facade, viewed frontally, as opposed to the more straightforward literal transparency of the glass curtain wall. Rowe and Slutzky equated the literal transparency of glass structures with materiality and the phenomenal transparency

with the higher functions of intellectual abstraction: "A basic distinction must perhaps be established. Transparency may be an inherent quality of substance - as in a wire mesh or glass curtain wall, or it may be an inherent quality of organization... a phenomenal or seeming transparency. (20)" Phenomenal transparency is the process in which the eye is led through overlapping planes, the play of light and shadow gives the impression of transparency (21).

This distinction was in a certain sense parallel to the distinction Alain Colquhoun drew between literal and symbolic in the technical aspects of modern architecture in an article published in 1962. Although in relation to different problems the authors established the difference between an immediate, obvious, evident meaning and a meaning that is comprehensible only in terms of the assumption that the technological factor or transparency were such only as an expression or manifestation of an intention or purpose (22).

Transparency is one of the important qualities of the buildings succeeding the progressivism and the rationality of the early modern movement, in the second half of the 20th century, among which the architecture known as high-tech plays an important role. High-tech architecture, in search for a new understanding between the use of technology and architecture found its expression through the effect of lightness and transparency, that is obtained by the use of highly industrialized materials. This transparency, however, was quite different from the direct transparency of the Miesian glass box which is categorized as 'literal' according to Slutzky and Rowe's distinction.

This difference partly stems from the different attitudes towards the architectural facade. In modern architecture the presence of an autonomous element, expressing and summing up the peculiar characteristics of the building, had been superseded by the idea of the building's integrity and of the correspondence between interior and exterior. After modernism, with the postmodernist attitudes the idea of the building as a unitary phenomenon was abandoned and the facade took on a preponderant value. The facade as an independent element has been a characteristic of postmodern architecture (23). This independency is not only particular to the historicist or metaphorical trends in postmodern architecture, but to other approaches that are seen as a continuation of modernism. The facade of the building in many cases become a skin that is wrapped around a number of other volumes which make up the interior of the building. The facade or skin, being regarded as something independent of the rest

of the building is endowed with a life of its own and with an independent structure of its own. The skin as an independent element is also a characteristic of the architectural tendencies that use high technology (24).

Norman Foster's Willis, Faber and Dumas building in Ipswich, England (1974), one of the early examples of this tendency exhibits such a character, with an entirely continuous volume wrapped by a undulated reflective glass skin which was clipped on without any intervening struts or mullions. It evokes Mies' glass skyscraper proposals of the 1920s, with a seeming frameless glass technique employed, glass sheets hung from the roof, connected by weatherproof neoprene joints (25). "The building proffers a range of constantly changing kinaesthetic sensations, opaque and scintillating in overcast light, reflective in the sun, transparent at night (26)." The Willis, Faber and Dumas building is actually an anticipation of Foster's earlier transparent buildings such as the IBM Head Office at Hampshire completed in 1971, which is one of the many variations of the glass pavilion.

Fig. 4.6. Willis, Faber and Dumas Building, Norman Foster, 1974

To 'eliminate'; to make the structure that supported the glass sheets 'invisible', so as to obtain a clear glass plane and an undisturbed transparency was a concern starting with Mies that was realized in the 80s. The very particular technical innovation that contributed so much to the successful realisation of the concept of transparency was in the smallest of all the components, the glass suspension assembly which transfers, under normal conditions, the accumulated load of four glass panels to the primary structure. These assemblies were used in the Cité des Sciences et Industrie at La Villette in Paris (1981), designed and built

by the group of Peter Rice, Michael Francis and Ian Ritchie. Here, Ian Ritchie states that the concept developed was to create transparency so as to make the bioclimatic facades as windows to the park as well as windows into the museum. To achieve this they aimed to develop a structure that seemed to hold nothing apart from itself where the glass surface would be invisible (27).

A step further in the independent skin system is when the skin becomes a space of transition, a threshold between interior and exterior which represents itself. This space of transition is formed by layers of transparency; different layers of alternating elements that lead to the facade becoming an element of expression in itself, through the materials used. The technical and material qualities of these materials are displayed, as well as the construction process adopted, the way it is made, the actual structure of the wall (28). The wide range of materials used in these facades are usually of technological choice such as semitransparent glazing materials (such as frosted or mottled glass), translucent plastic sheathings, double layers of glass, and an apparently infinite number of perforated materials. As a result the facade becomes an interposed veil, triggering a subjective relationship by distancing the viewer of the building from the space or forms within and isolating the viewer within from the outside world. This veil results with a mediated relationship between the viewer and the distanced space which indicates a departure from the early modernist attitudes of 'literal' transparency (29). Such idea of transparency is of the 'phenomenal' character in Rowe and Slutzky's distinction.

The theme of layers of transparency is successfully manipulated in a contemporary example, Jean Nouvel's Cartier Foundation Building in Paris completed in 1994. The building is sited in a magnificent garden, which is made evident from the street by shifting of glass planes of the facade. Here the architectural play consists of blurring the edges of the building and impeding an immediate reading of a solid volume. The trees are taken inside the building by placing them between sheets of glass. The steel or polished aluminium facades overflow the building as such. On other facades roller blinds made of more or less dense tulle-like cloth filters are used. The building ends up as a series of overlapped images of the sky, the trees and their reflection, and achieves extreme visual complexity. Here the idea of transparency is present deep within the structures; one seems to be suspended within multiple layers of transparency (30).

A building where a different sense of phenomenal transparency is achieved is the Goetz Collection by Jacques Herzog and Pierre de Meuron in Munich (1992).

The architects say that in this building they wanted to create transparency, to give an idea of what is behind. The gallery opens and closes, it is both solid and transparent. It shows an ambiguous nature and the inner structure is not easily understood. This ambiguity is emphasized by the use of frosted glass sheathings. "We want to put forward concepts that are more open to the imagination, to changes in light and in season. It is possible to create spaces that have the quality of being both one thing and another, enigmatic constructions. Like this gallery: a box of light carried by light.", say the architects. The idea of phenomenal transparency is seen in many of Herzog & de Meuron buildings. In their Ricola building at Mulhouse a mediation between transparency and solidity is achieved by the use of screen-printed sheets on the inner face of the skin of the frontal facades. This creates an unexpected, textile-like effect. The building aims to go beyond the dialectical separation of solid and void and draw these states together (31). The extension and alteration of the Suva Building in Basel in which a glass frame of different degrees of transparency is constructed as a new skin to the existing building, or the apartment at Bale with a facade of heavy cast iron shutters with sinusoidal geometry are all good examples for such an understanding of transparency.

The ACOM Office Building by Ben van Berkel and C. Bos show a similar character. Again as a transformation of a small building dating from the 60s, the existing frontage of the building was wrapped in isolating polystyrene and a flat, transparent surface of toughened glass was in front of that. The volume-denying flatness and transparency of the glass surface is relieved by large sunscreens, which consists of long wooden slats placed at different angles. Instead of actually being removed, the original facades become removed: present but distanced from the immediate visual grasp implied by the modernist architectural language they express (32).

The tradition of glass pavilions are carried on by contemporary architects. The Sculpture Pavilion in Arnhem, the Netherlands by Benthem Crouwel is a realization of the modern ideal of all-glass box. All of the structure including the walls as well as the roof are entirely unframed butt-jointed glass without a floor. It is so transparent as to be barely there, the sloping ground passing through without an interruption other than a carpet of woodshavings (33).

Another glass pavilion, the Glass Video Gallery by Bernard Tschumi in Groningen, the Netherlands (1990) with its transparent surfaces, flickering video screens, and tilted volume counteract the ability of a structural grid and perspective

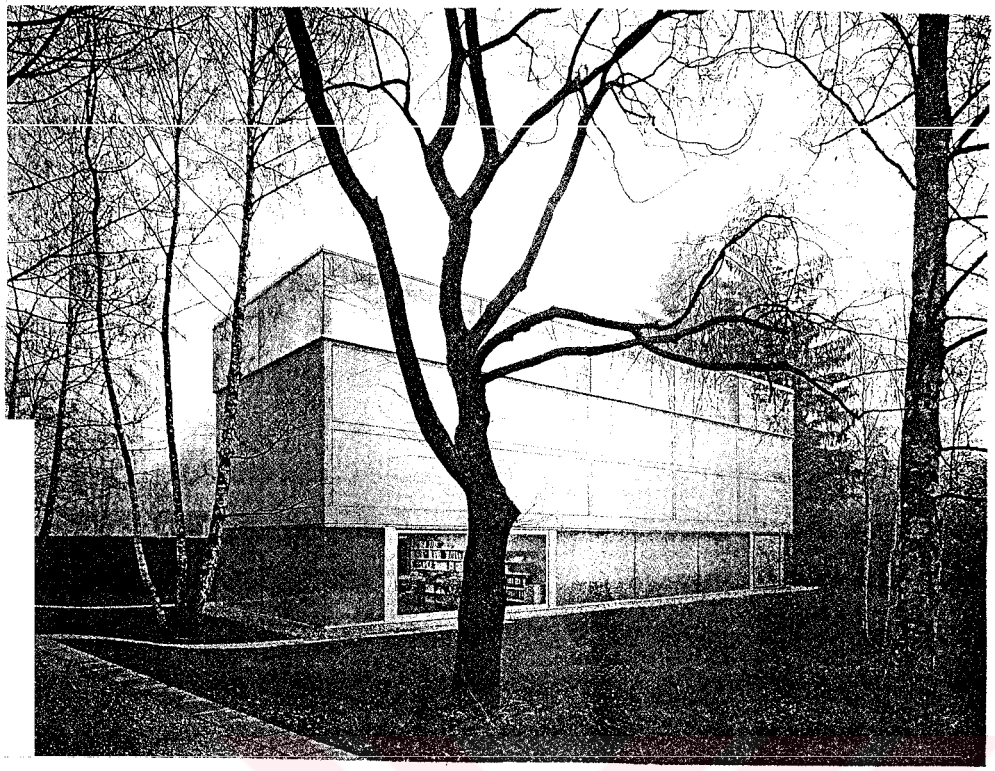


Fig. 4.7. Goetz Collection,
Herzog & de Meuron, 1992

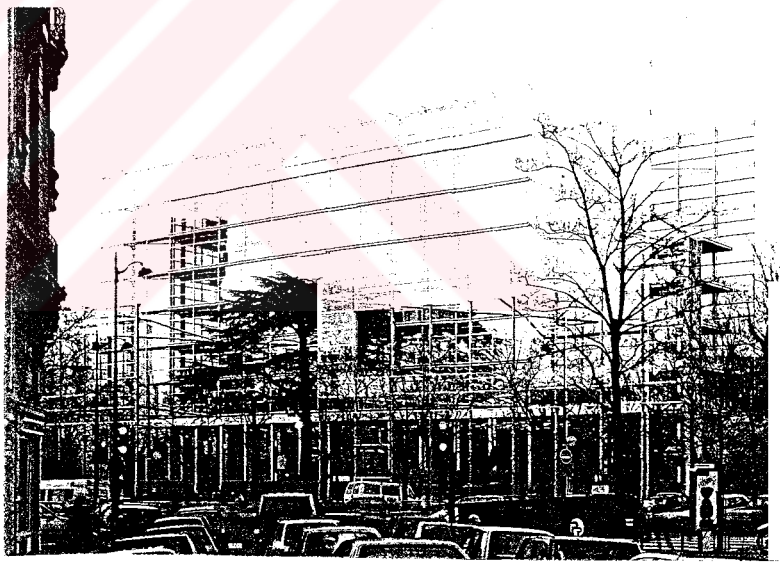


Fig. 4.8. Cartier Building, Jean Nouvel, 1994

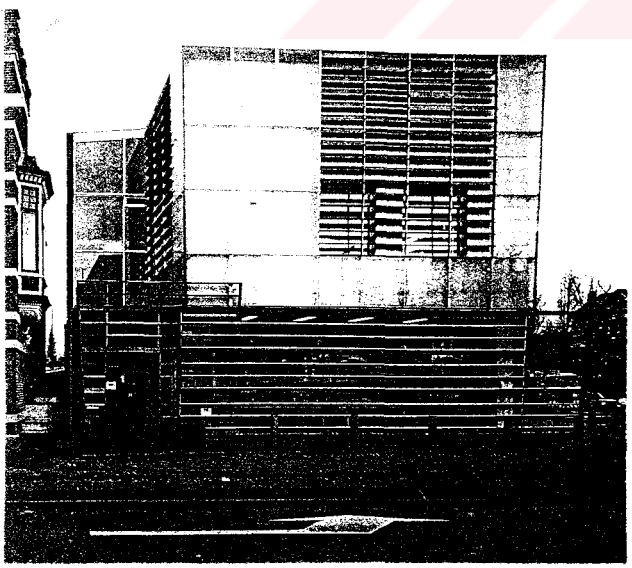


Fig. 4.9. ACOM Building, Van Berkel & Bos, 1993

vision to determine the overall image of architecture. Here the boundary between support and surface is virtually erased; making no material distinction between the glass ribs that give the pavilion stability and the glass sheathing that encloses the space (34).

Speaking of glass structures one has to mention I.M. Pei's Glass Pyramid in Musee de Louvre, in Paris. An entirely glass structure with a form so symbolic as a pyramid designed as the entrance of the new extension to the museum stands as a realization of man's long glass dream.

Apart from a wide range of glazing materials used in construction industry such as transparent, semitransparent, colored, textured, double layered variations of glass, and plastic based transparent 'mutant materials' that have been strengthened to compete with the qualities of glass, new glazing systems are being developed. The innovations in technology concerning glass production have enabled the use of high performance glazing materials that possess better insulation properties than many thermally efficient opaque materials. New glazing materials like glass with various coatings and gas-filled cavities are on the edge of wide use. New 'smart' glazings which react to changing conditions are being developed. These include photochromic glass, that reversibly changes optical density when exposed to light, and thermochromic glazings that become translucent when a preset thermal threshold is reached. A third type of smart glazings , called electrochromic, consists of multilayer assemblies through which a low voltage electric current can be passed, causing ions to move to the outer layer where they may reflect heat-producing ultraviolet light but transmit visible wavelenghts (35).

Such an intelligent facade is practised in Nouvel's Institut du Monde Arabe in Paris (completed in 1987). The mechanism for controlling light on one facade of the building acts as an environmental filter between the inside and the outside. By this mechanism changing motifs according to the degree of light are gained, the facade becomes an opaque body whose job is no longer to reveal, but to veil. In this particular building the technological character of this mechanism which forms the facade is smartly combined with the symbolic aspects of the institution.

A similar glazing system is developed by Renzo Piano for the renovation of an old factory for the Fiat company in the Lingotto area (1985-86). He developed a new frame for the window module, so as to give the gloomy factory a completely new appearance. This new frame is a full-fledged light-filtering machine, calibrated

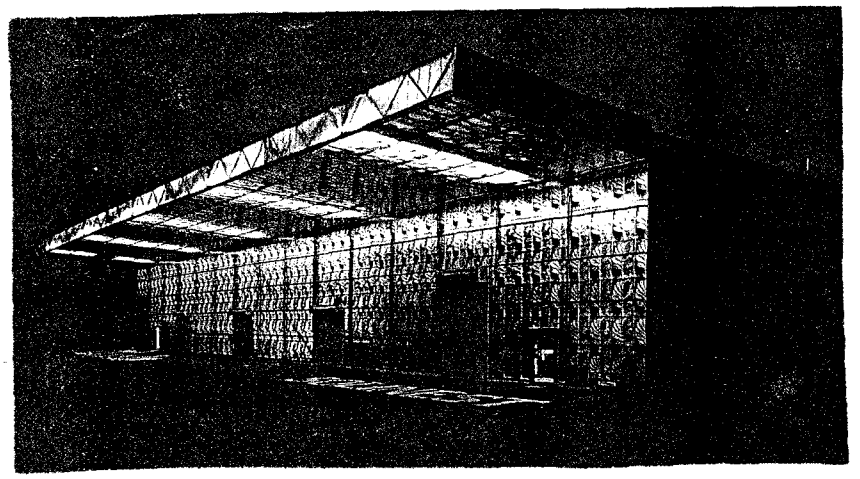


Fig. 4.10. Ricola building, Herzog & de Meuron, 1993

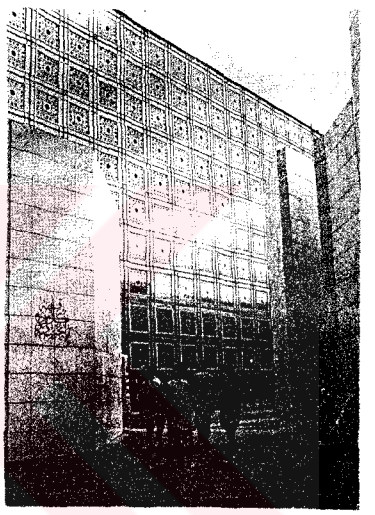


Fig. 4.11. Institut du Monde Arabe, Jean Nouvel, 1987

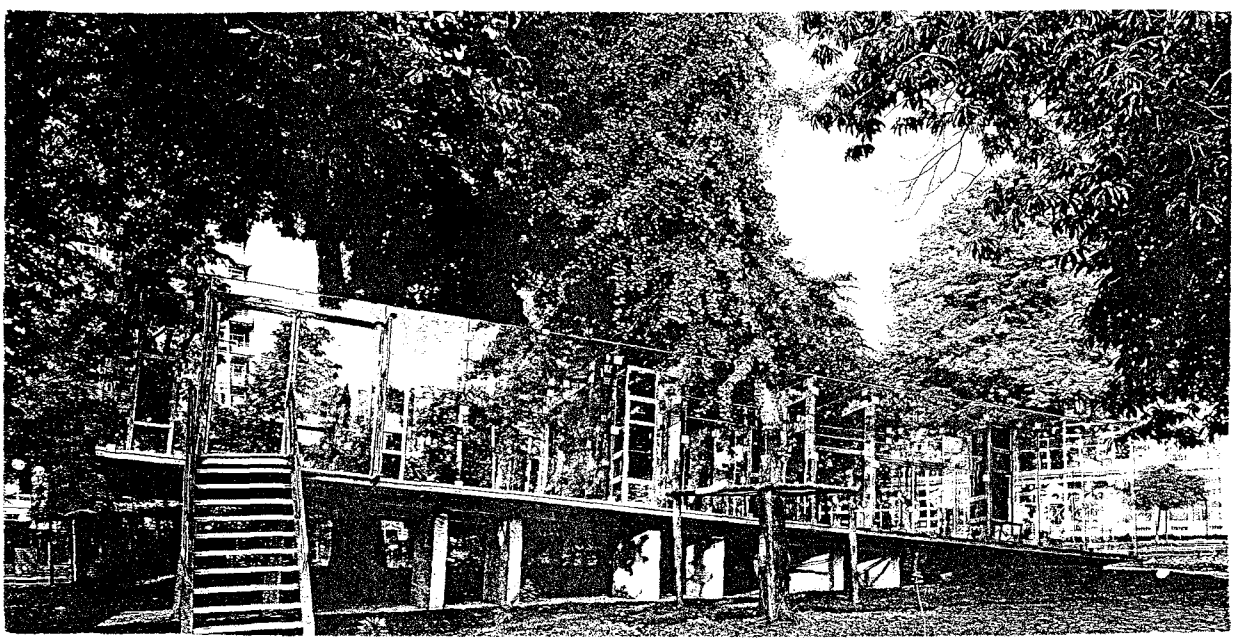


Fig. 4.12. Glass Video Gallery, Bernard Tschumi, 1990

according to the intensity of sun-light. The passage of a cloud will be sufficient to provoke a reaction in all of the windows, one after another, as they adjust to the varying intensity of the sunlight (36).

All of these contemporary examples point out to a different attitude than the examples of the early 20th century, which may be explained with the distinction between the literal and phenomenal transparency, as stated before. The significance of this difference lies in the deepness and effectiveness brought to the facade as an independent architectural element, that acts as a mediator between the interior and exterior, supported by the facilities of the latest technologies.

Fig. 4.13. Sculpture Pavilion, Benthem Crouwel, 1986

5. LIGHTNESS

In English the word lightness corresponds to two seemingly separate meanings which point out to two associated concepts in architecture. The first meaning of lightness is certainly related with light and both the quality and the quantity of it. The second meaning related with weight, is the quality of having or being lightweight. In architecture the effect of lightness sometimes implies both meanings, partly because of the capability of light to obtain an effect of weightlessness, being a weightless material itself, and partly because of the long tradition of using light and glass as inevitable elements of lightweight structures. Hence, lightness is also in close relation with the concept of transparency, as well as agility .

The history of architecture shows that the lightweight structure is almost as old as man's need of dwelling. The prehistoric examples of lightweight structures; the archetypal tent, the primordial hut, the primitive wooden houses and several types of lightweight outdoor structures belonging to later periods in history point out to the fact that the need or interest for lightweight structure is not something new. Indeed, these primitive structures formed a restarting point for the architectural theory in the 18th century.

The 18th century, the Age of Enlightenment made a deep change in scientific and cultural realms. The foundation of modern science had established analytical and experimental knowledge as a substitute for the blind faith in the classics. The objective view of history as a characteristic of the Enlightenment brought a different questioning of time and the past. By the mid 18th century the confident sway of classicism was no longer unquestioned and it was accepted as not the only, but one of the permissible sources of contemporary architecture. The secularisation of Enlightenment thought with the reaction to the styles of the day compelled the architects of the 18th century to search for the fundamental truths, a universality more encompassing than that of Greece and Rome (1,2). At the same time with the changing social and cultural conditions brought by the Enlightenment, the technological changes led to a new infrastructure and the exploitation of an increased productive capacity (3).

The new research of history, objectivity, the will to return to real Greece that is different from the dictum of the Renaissance led to the evolution of a new understanding of classicism. Towards the mid-eighteenth century a theoretical position is established in western Europe for a rigorist, functional architecture (4).

In architectural theory the questioning of Vitruvian proportions was already done in late 17th century by Claude Perrault in his thesis of 'positive' beauty and 'arbitrary' beauty. This challenge to Vitruvian orthodoxy was codified by Abbe de Cordemoy in his 'Nouveau Traite de toute l'architecture' in 1706 where he replaces the principles utilitas, firmitas and venustas by his own trinity of ordonnance, distrubution and bienseance (5). Cordemoy insisted on the hierarchical principles of propriety in architecture, arguing that all utilitarian structures should be left entirely devoid of ornament, thereby serving to express the difference in cultural stature between everyday building and works of institutional and symbolic import (6).

Fig. 5.1. The Primitive Hut, Abbé Laugier, Essai sur L'Architecture, 1755

Cordemoy's ideas anticipated new theoreticians who believed that the 'primitive hut' from which Vitrivius had said all architecture takes its start should be uncovered. This would help to shed all inessential elaboration and attain an honest architecture once again. The advocates of this approach were called 'Rigorists', among which the most influential names were Carlo Lodoli (1690-1761) and Abbe Laugier (1713-69). In his 'Essai sur l'architecture' (1753), Laugier pictured the primordial primitive hut consisting of four tree trunks supporting a rustic pitched roof, to posit a universal 'natural' architecture (7). He regarded the elements of this hut as natural, rational and functional. He believed in an absolute, 'essential' beauty independent of custom and convention and that the structural logic dictated the form of the building (8). The rigorists made the basis for a 'structural classicism' in the neo-classical period.

These developments in the architectural theory formed the basis of an idea of architecture in which the structure freed itself from all the inessential loads and elaboration. In about the same period, as a result of the Industrial Revolution changes in materials, their production processes and construction technologies enabled a parallel transformation towards a lighter architecture in practice.

Iron was one of these materials. Iron was used for fastening and as small pieces even in the prehistoric ages, but the difficulty of obtaining and shaping it prevented its use until the right technologies were developed for it. The first use of cast iron structural members in an architectural sense was in 1714, in the House of Commons. In 1752, iron provided a direct contribution to the structure of a building. While the use of iron was becoming more common, integrating the slender iron shaft into the traditional proportions became a problem and the question of new forms for new materials arose. The use of iron became more popular due to the improvements in its production (9).

The new general situation created by the industrial and social revolutions provided a multitude of new building tasks. The church and the palace lost their importance as leading powers and during the 19th century the monument, the museum, the dwelling, the theatre, the exhibition hall, the factory and the office building in turn took over their roles (10). The new building tasks brought new functional and structural necessities. The greenhouses brought the need for light, the colossal exhibition halls brought the need for prefabrication that would enable the rapid erection, the railway stations brought the need to cross wider spans. All of

these necessities were overcome by the facilities of iron construction with glass as its companion, and the result was lightweight structures of iron skeleton.

Among these new buildings the exhibition halls were of particular significance. These huge prefabricated iron-glass structures designed for rapid erection and dismantling were experimental for the new construction technologies. The prototype of these was Rouhault's Greenhouses in Paris, built in 1833. It anticipated Paxton's famous Crystal Palace, in London (1851). The temporality and lightness of the structure played an important role in the choice of Paxton's project, because such a great massive building in Hyde Park was thought to be a disaster (11). The iron frame structures built for the international exhibitions in Paris in 1855 and the following years, the Hall of Machines in Paris (1867) were specific examples of the new aesthetics created by the new materials and new technologies.

In the realm of architectural theory, in the middle of the 19th century the line of Cordemoy, Laugier and Soufflot was succeeded by the Structural Classicism of Henri Labrouste which tended to emphasize the structure (12). The Bibliotheque Sainte-Geneviéve built between 1838-50, by Henri Labrouste (1801-75) was the first time cast and wrought iron was used from foundations to the roof in an important public building. The Bibliothéque Nationale, his masterpiece was built in Paris between 1858 -1868. The importance of Labrouste lies in the principal distinction he drew between basic structure and exterior decoration, seeing the latter as determined by construction and material (13).

The theory of Structural Classicism was continued by other professionals in Europe meanwhile. The German architect Gottfried Semper (1803-79), with departure from Vitrivius' three elements 'firmitas-utilitas-venustas', wrote the 'Four Elements of Architecture' (1851) indirectly challenging the neoclassical primitive hut of Laugier, in which he introduced the basic elements of his primordial dwelling as: the earthwork, the hearth, the framework/roof and the lightweight enclosing membrane. On the basis of this taxonomy Semper would classify the building crafts into two fundamental procedures: the tectonics of the frame, in which lightweight, linear components are assembled so as to encompass a spatial matrix, and the stereotomics of the earthwork, wherein mass and volume are conjointly formed through the repetitious piling up of heavyweight elements (14). The lightweight enclosing membrane was of special importance to Semper who maintained that the earliest basic structural artifact was the 'knot', from which follows the primary

nomadic building culture of the tent and its textile fabric. The knot, resembled to the joint, is accepted as the oldest tectonic symbol. Semper's theory is of particular significance for the idea of lightness in architecture for his classification of the basic building elements points out to a distinction between light and heavy elements in the means of building materials, which is expressed so accurately for the first time. Furthermore, it is important because it became a mode for the progressive dematerialization of architecture, liberating the mind from the stereotomic obtuseness of matter and focusing it instead on a reticulation of surface and thus on a dematerialization that, as in the Crystal Palace, aspired to the dissolution of form into light (15). This idea of dematerialization and reticulation of surface forms a basis for the certain tendencies in contemporary architecture.

Fig. 5.2. Post Office Savings Bank, Otto Wagner, 1905

The technical and tectonic consequences of Semper's theoretical corpus, with the legacy of his scientific, architectural realism was pursued by the next generation. Of the many who followed him in this regard Otto Wagner reserves special attention whose work came closest to demonstrating a precise relationship between an articulated skin and the development of a building in depth (16). His Post Office Savings Bank built in Vienna (1905) shows a clear distinction between the expressed structure and the unadorned and well-disciplined glazing. On the outside of the building the use of thin sheets of stone as a veneer cladding is honestly demonstrated by the expressed aluminium fixings (17). The Post Office

Savings Bank is one of the earliest examples of a tectonic that will attain its apotheosis in the Produktform of the so-called High-Tech architects of the 1970s (18).

The avant-garde movements of modern architecture in the beginning of the 20th century that were in search of a new architecture for the new means of the changing life conditions where dynamism, speed and technology played an important role, mentioned lightness as a major objective. This is probably due to the close relation in meaning between lightness and motion, and the controversial character of lightness to the heavy monumentalism of the traditional. This is expressed in the Futurists manifesto by Sant' Elia in 1914 as "We have lost the sense of the monumental, the massive, the static, and we have enriched our sensibilities with a taste for the light and practical... the new architecture is the architecture of cold calculation, temerious boldness and simplicity; the architecture of reinforced concrete, iron, glass, textile fibres and all those replacements for wood, stone and brick that make for the attainment in maximum elasticity and lightness." (19)

The Russian Constructivists about the same periods manifested in the Consructivist Manifesto by Naum Gabo and Antoine Pevsner (1920) their refusal to the closed mass as the only element in the formation of three dimensional and architectonic matter in space and their wish to produce plastical matter stereometrically (20). While Constructivism remained in some cases in an aesthetic 'machine art' expressing the spirit of progress, it was in others a very real means of transforming architecture into pure construction (21).

Of all the early modernists of the beginning of the century Mies van der Rohe in his dematerialized glass houses contributed much to the idea of lightness. The tradition of structural clarity coming from the late 18th century found its realizations in the works of masters of the early 20th century, however the choice of traditional materials and traditional building methods prevented the achievement of lightness as an ideal of the modern architecture.

Later in the 20th century there have been some creative personalities in the architectural field who have produced new and innovative ideas, particularly directed at the development of lightweight building systems using new technologies. Buckminster Fuller, among these personalities is the one who directed his attention mainly to the weight problem in building construction. Fuller's work can be defined quite simply into two concerns: the desire to introduce new methods of producing affordable housing, and the relevance of weight as a design component in building. Fuller was interested in the actual weight of the building

rather than the weight as a perception, or lightness as an effect. "We have now actually met the original theoretical requirements of the physical problem. We have gotten down to the proper weight. We are down, not including the bathroom and the partitions, to 5400 pounds. The copper bathroom now in the house weighs 430 pounds- but in a aluminium with plastic finish, as we are going to manufacture it, the bathroom will weigh around 250 pounds..." This is part of a speech Fuller . Having worked for the US Navy for two years, Fuller was inspired for the possibilities of technological transfers into building industry. His Dymaxion House project which was patented in 1928 shows a futuristic vision described as "air-deliverable, mass-producable, world- around, new human life protecting and nurturing scientific dwelling service industry as means of transferring high scientific capability from a weaponry to livingry focus" by himself. The Wichita House, 1946, is a further step in his mass-production, transportable housing systems. Made of duralumin, a lightweight alloy the aircraft industry used, it was a remarkable re-invention of the dwelling; designed as separate units to be assembled of which no unit weighed more than 5 kilograms. Fuller's later interest in the development of the geodesic dome made his name synonymous with its form. The American pavilion at Expo '67 in Montreal was the culmination of his built domes. Fuller's theory, his ideas on the use of new technologies in construction industry had serious influence on the next generation who carried on with the architectural heritage of modernism (22).

Fig. 5.3. American pavilion at Expo '67, Buckminster Fuller

Another personality similarly interested in industrial technology as Fuller, Konrad Wachsmann starting from the 1940s worked on a series of conceptually pure building systems in wood, metal and tubular steel. Especially focused on the joint or point of structural coupling and the reduction of the constructional repertory to the fewest possible elements, Wachsmann's designs gave primacy to universal connectors and flexible components capable of being recombined in a maximum number of ways. Related with his concern for the joint Wachsmann accepts lightness as a characteristic of the day and the future. "Surface articulation will as good as disappear shortly; smooth surfaces will dominate. We are approaching a period in which people will again be able to recognize the play of lines created by joints and surface areas. Such weightless, massless planes will govern structures. More than ever before, lightness will be a characteristic. Forces and weight will be suspended. One of the central ideas of the future architecture will be the differentiation and separation of each object and each function, in detail and as a whole. (23)" His space frame structure developed as a hangar for the US Air Force in 1959 spans 120 feet on four supports, cantilevering on all sides approximately 20 meters and thus creating a sense of lightness.

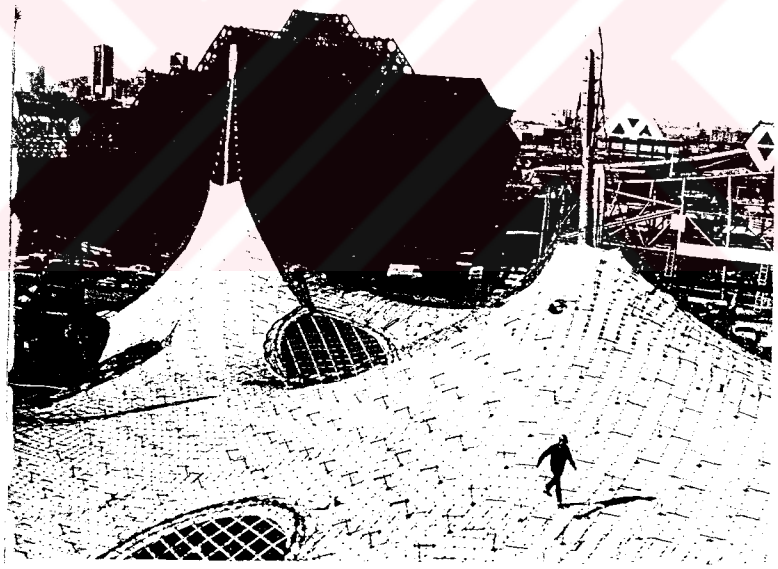


Fig. 5.4. German Pavilion at Montreal Expo' 67, Frei Otto

The advent of tensile structures (in especially the second half of the 20th) century has given rise to the definition of a new, modern building tradition: that of lightweight constructions, in which the rapport between the weight of the supporting structure and supported weight is inferior to the whole (24). This was actually an interpretation of a long tradition; the tradition of the primitive tent, enriched by the possibilities of new construction technologies and materials. Transforming the potential properties of the nomadic tent; portability, lightness and flexibility into new

structures by the aid of new construction technologies and materials, the tensile structures formed a dynamic example for the new architecture of the century. This potential was recognized by Frei Otto who produced several delicate structures of the kind; freely suspended forms that seem to touch the earth gently and reluctantly, held aloft by the thinnest of compression members and tension cables. Among these the German Pavilion at Montreal Expo' 67 and his structure for the Munich Olympic Games (1980) are highly recognized.

Similar structures were built later in the 80s by other architects. Michael Hopkins' Schlumberger Cambridge Research Centre completed in 1985 is a well known example of the tensile buildings with art tent technology brilliantly adapted to a function with which it would not normally be associated, giving the building the sense of inevitability. By fully utilising the translucency of teflon-coated fibreglass fabric Hopkins creates an expressive High-Tech building sensitive to its setting. Hopkins goes a bit further in expressing the idea of thinness here, using trusses and cables in a way that make a fabric with a tensile strength akin to steel seem like skin, and the structure looks like a exoskeleton beneath it (25). His Mound Stand, Lord's Cricket Ground in London (1987), built on a restored 19th century brick arcade uses a similar tent structure made up of the same membrane technology; teflon coated fibreglass due to its translucence, lightness and flexibility (26).

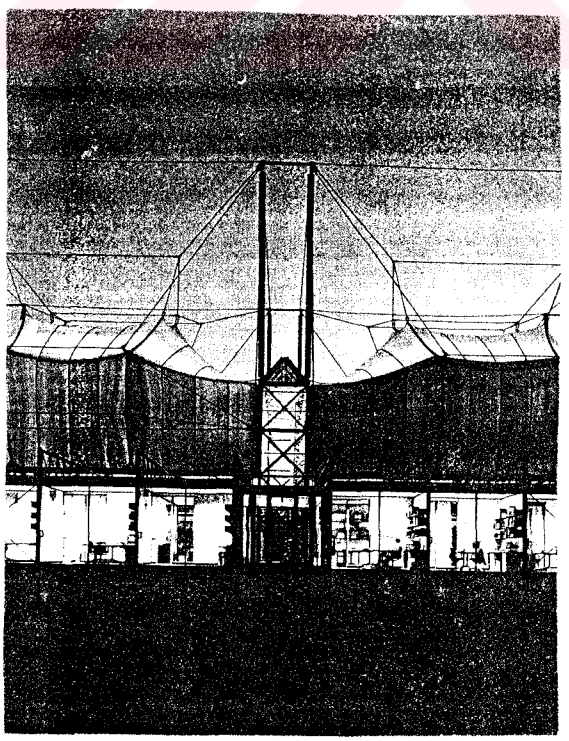


Fig. 5.5 Schlumberger Cambridge Research Centre, Michael Hopkins, 1985

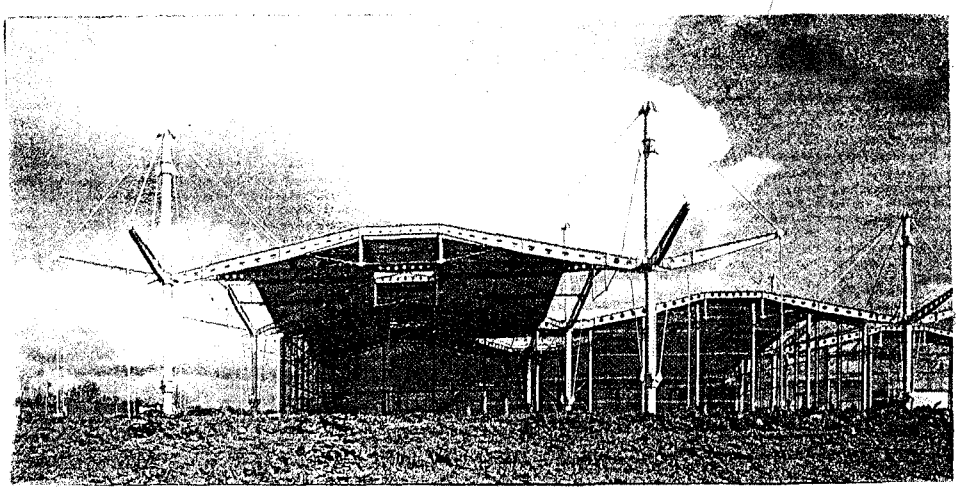


Fig. 5.6. Renault Center, Norman Foster, 1983

The tensile structure started to be mentioned as a formal characteristic of the so called High Tech style in the 80s (Charles Jencks suggests 'a lightweight filigree of tensile members' as one of the rules of the High Tech maniera) (16). Richard Rogers designed many buildings of the kind in those years; among which the PA Technology Laboratories and Corporate Facility in Princeton (1982), the Fleetguard Manufacturing and Distribution Centre in France (1981), the INMOS Microprocessor Factory in Newport (1982) are well known. All of these buildings apart from having similar functions as laboratories and factory buildings had similar structural character; a single-storey suspended steel structure with tensile elements like tension cables and minimum number of columns to which these cables are tied, to achieve maximum flexibility. Norman Foster's Renault Center in Swindon (1983) is one of the most famous buildings of these tensile systems with its high tubular steel poles poking up through the roof to carry the tension rods from which hang the undulating internal structure of the roof, all painted in yellow (27).

Another type of structure whose development goes parallel to the tensile structures, and has a similar effect in the means lightness, is the 'suspended structure'. The Dutch architect Ben van Berkel describes the suspended structure as fascinating:

"From the architectural point of view, the fascination of the suspended structure lies not in its deceptive lightness, in its seemingly free-floating weightlessness against a background of 'zero gravity', but in the construction that holds it up. What fascinates are the many different ways in which the suspended structure can be carried aloft by an underlying solid body that enables the levity above.

Architecturally, weightlessness and immateriality themselves are not the most interesting aspects of the suspended structure, since, as in stage magic, the real performance is going on elsewhere, unobserved and undisturbed.

The construction of space suspended slightly above ground level could be termed a classical-modernist device, with Mies' glass house as its prime example. As a structural type it owes its existence to the exploitation of new materials and techniques. Its main contribution from the user perspective is that it provides a new relation between the inside and the outside. Actually it introduces an element of artifice in this relation; as the elevated construction tilts its users above their surroundings, the presence of the outside is tamed and framed. The exterior is subordinated to the interior. It introduces a manipulated view, a contrived setting. Not for nothing did Mies, during the lawsuit concerning the glass house, describe the house as a showcase, made to set off to the best effect to the client's extraverted lifestyle.

However, the manipulation of effects is preceded by the manipulation of the structure... The essence of the suspended structure is that it introduces a stillness, a type of static, where normally a dynamic tension could be expected. The stillness of that moment when all forces are temporarily suspended, is one of the fascinating aspects of structuring...

There is a remarkable correspondence between the psychology of fascination and the architecture of suspension. Both are characterized by an artificial timelessness, by the unreality of the present moment, by a sense of floating, and of being disconnected. Both are deep. Both penetrate the ever shifting layers of consciousness which obscure the genealogy of the object, to unveil its hidden core of inflexibility; its final stratum of stillness. Suspension can take many different forms, just as fascination converge on many objects." (28)

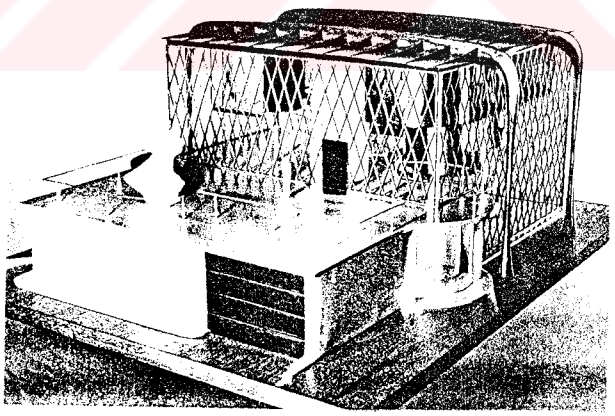


Fig. 5.7. Suspended House, Paul Nelson, 1938

Van Berkel's ideas on 'suspended structures' find their concrete realizations in some contemporary projects and buildings, including some of his own designs, and sometimes even as a further phase like 'suspended volumes'. An early example of this 'suspension' concept was Paul Nelson's Suspended House project (1938),a glazed volume with free-floating forms suspended within, which provided a model for a number of contemporary projects. Fuhimiko Maki's Congress Center

proposal for Salzburg (1992) shows a similar character, achieving a great sense of lightness with the floating volumes within one main volume that is bounded from the outside by wide variety of light and transparent perforated materials. A realized project of the same idea is the Saishunkan Seiyaku Women's Dormitory by Kazuyo Sejima (Japan, 1991). A parallel approach is seen in some of Rem Koolhaas' projects, especially in his competition proposal for Bibliotheque Nationale de France (1989) which is described as: " a solid, not as void, with the interior volumes carved out of crystalline block so as to float within it, in amoebic suspension. These are then represented on the surface of the cube as shadowy presences, their three-dimentionality displayed ambiguously and flattened, superimposed on one another in a play of amorphous densities...The subject is suspended in a difficult moment between knowledge and blockage." by the architectural historian Anthony Vidler (29).

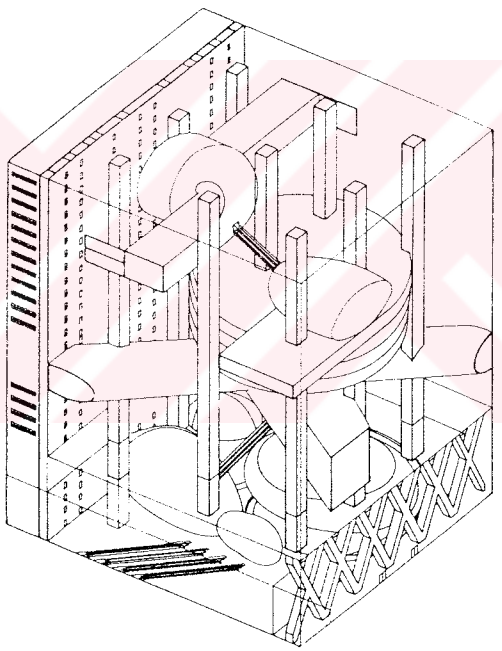


Fig. 5.8. Competition proposal for Bibliotheque Nationale de France, Rem Koolhaas, O.M.A., 1989

These contemporary projects of 'suspended structures' or 'tensile structures' imply a distinct expression of lightness from the earlier conceptions of lightweight architecture; a seeming weightlessness rather than a calculation of relative weight.

In his essay named 'Lightness' Italo Calvino explains the change in the idea of lightness comparing it to the scientific change:

"...I look to science to nourish my visions in which all heaviness disappears. Today every branch of science seems intent on demonstrating that the world is supported by the most minute

entities, such as the messages of DNA, the impulses of neurons, and quarks, and neutrinos wandering throughspace since the beginning of time...

Then we have computer science. It is true that software cannot exercise its powers of lightness except through the weight of hardware. but it is software that gives the orders, acting on the outside world and on machines that exist only as functions of software and evolve so that they can work out ever more complex programs. The second industrial revolution, unlike the first, does not present us with such crushing images of rolling mills and molten steel, but with 'bits' in a flow of information of travelling along circuits in the form of electronic impulses. The iron machines still exist, but they obey the orders of weightless bits." (30)

Towards the end of the 20th century the idea of 'lightweightness' has a tendency to change into an idea of 'weightlessness', with the deep influence and effects of the computer technology.

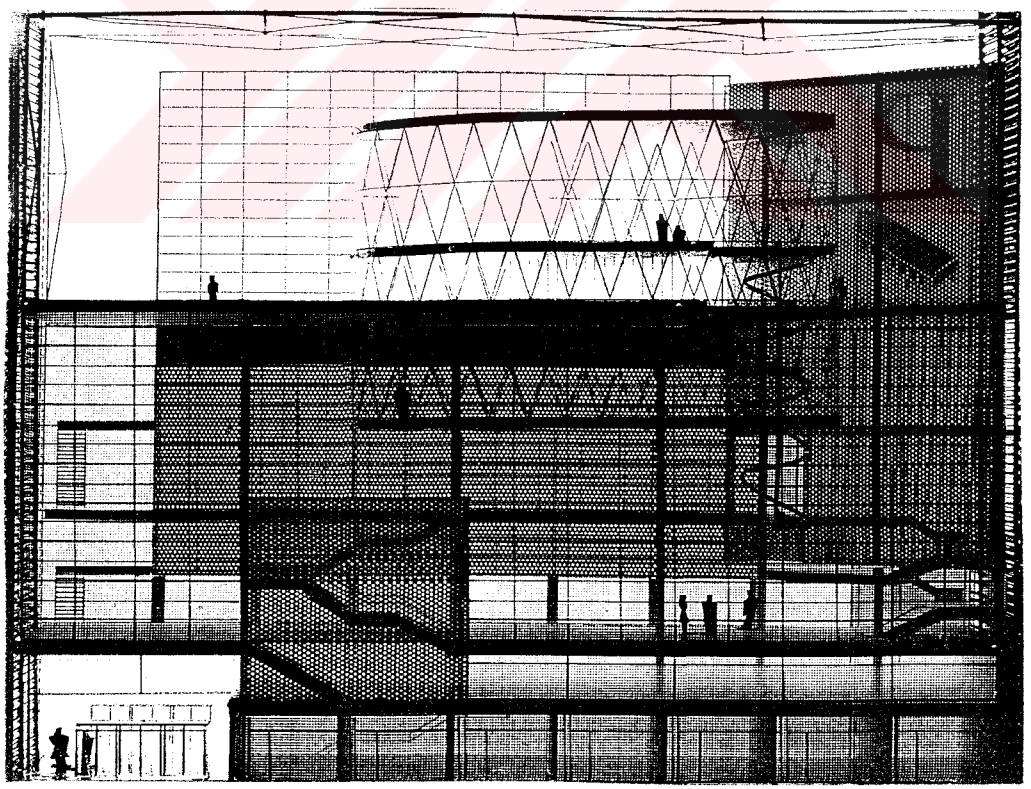


Fig. 5.9. Competition proposal for Salzburg Congress Center, Fuhimiko Maki, 1992

6. DEMATERIALIZATION

The term 'dematerialization' appears in many texts which concern the tendency to use new building technologies and materials as a part of the architectural design process and its end products. The use of the term not always points out to exactly the same meaning, but relevant understandings can be gained from these uses.

In general dematerialization is mentioned as the disappearance of the material, or its materialistic qualities, which make the material easily perceptible. The use of large glass surfaces starting with the Industrial Revolution formed the beginning of such a concept in architecture, due to the seemingly non-materialistic character of glass as a building material. The Crystal Palace, the symbolic structure of the period is considered as a reference to the contemporary uses of technology in architecture not only because it was a prototype for the prefabrication industry, but because it indicates a number of aesthetic principles fundamental to high-tech and related tendencies in architecture: transparency, lightness, dematerialization (1).

Pierre von Meiss in his 'Elements of Architecture' defines dematerialization as a design process whereby the sculptural play of the geometry of spaces, forms and surfaces dominates to the extent that the different materials with which they are created must be made homogeneous under a unified facing. He further states that: "With an architecture of facing to which our thermal demands are leading such a tendency acquires a justification. Moreover, some buildings would gain by being covered with a unifying layer rather than 'honestly' displaying their heterogeneous range of materials. Dematerialization has therefore become today one of the legitimate approaches and a potential for contemporary architecture."(2)

A relevant understanding to von Meiss' definition of the term is seen in Kenneth Frampton. He points out the dematerializing effect in Mies' several works. In the Exposition de la Mode (1927), Mies used silk as semitransparent screens that yielded a dematerialized aesthetic, making a literal reference to the Semperian textile wall hanging, as the symbolic representational form of built enclosure. The columns of the Barcelona Pavilion (1929) are described as dematerialized

cruciform point supports; the steel cruciform column encased in polished chromium steel (3). The effect gained here by dematerialization is a sense of purity, lightness and refinement. Dematerialization is a characteristic for Mies' works, especially his works in America after 1930. Rem Koolhaas poetically says that Mies "invented the tectonics of disappearance, dissolution, floating, with which he made history".

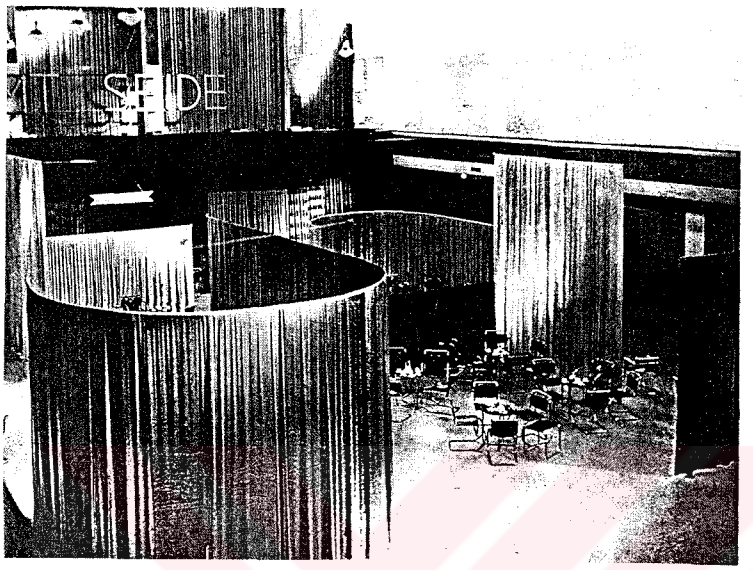


Fig. 6.1. Exposition de la Mode, Mies van der Rohe, 1927

Fig. 6.2. Barcelona Pavilion, Mies van der Rohe, 1929

The idea of dematerialization may indeed seem quite contrary from the direct exposition of the structure and the services on the exterior as a form of ornament in some of the high-tech works, such as in the Centre Pompidou by

Richard Rogers and Renzo Piano, but the complex skin systems or the encasement of the structure by a membrane of glass or other lightweight materials in other examples of the same tendency certainly show a dematerializing character.

Kenneth Frampton describes the two dematerializing factors in Norman Foster's Sainsbury Centre for the Visual Arts in England (1977) as: "the spatially generative structure, be it a clear span or a repetitive framework and the production of a hermetic membrane that encases the structure in a gasketed skin . " (5)

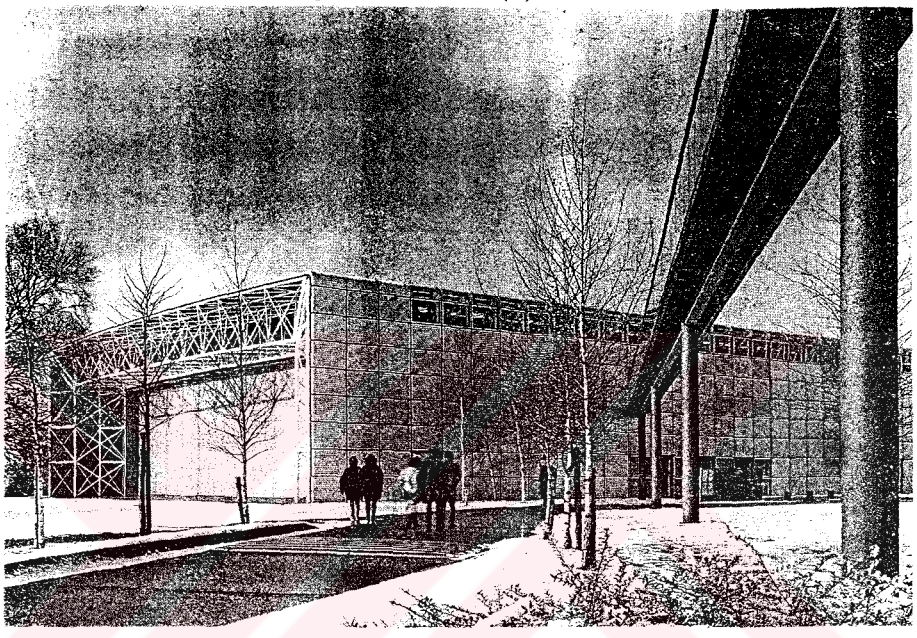


Fig. 6.3. Sainsbury Centre, Norman Foster, 1977

A contemporary outstanding example of dematerialization is Jean Nouvel's 'Tour Sans Fin' project to be erected near the Grande Arche in La Défense, Paris. In this project the effect of dematerialization is defined as the reduction of the material density with the objective to obtain a visual nihility, and is expressed in the tower as a change in the material quality all through the length of it. The tower lightens as it rises up; the dark colored rough granite is replaced by polished granite which gives way to grey stone and then glass panels embroided by silver motifs which gradually turn into glazed panels follow. The will to obtain a feeling of infinity is evident in the project and this will is realized through dematerialization (6).

Dematerialization, is an attitude to obtain different effects or to achieve different goals in architecture, but the common factor in the use of it today is that it usually appears with the use of technological materials and systems, and results with highly refined end products .

7. IMMATERIALITY

The concept of immateriality has recently been a significant idea in architecture which may suggest some related understandings. It is sometimes referred as in close meaning to the idea of dematerialization; as an understanding of a seemingly non-material character. However, towards the next millennium the state of actual immateriality has been a part of both the architectural theory and architectural practice, and is used as a tool to enrich its effects and meaning, as well as an aid in the design process.

Towards the end of it there is a common opinion that the 20th century did not witness the invention of many new types of machines apart from the development in the electronics. Paolo Portoghesi expresses this fact as: "We are living in a time in which technological advances have lost the spectacular and tangible nature characteristic of the initial stages of the Industrial Revolution. For fifty years we have not seen the appearance of any new types of machines: after aeroplane, television and the computer, it seems as if the cycle of mechanical invention is complete and that great transformations no longer add to the number of players on the technological scenario, but instead expand the repertoire of those already extant, extending the capacity of archetypes by now consolidated to radically modify the 'human condition' (1)." A more cynical epitaph of our century is made by Martin Pawley: "...if we observe the historians' convention of running the 19th century from the defeat of Napoleon in 1815 to the outbreak of the Great War in 1914, the virtually every significant element of modern life, from antiseptis to railways, from electricity to turbines, the aeroplane, the motor car, the radio, the telephone and even the fax machine and the computer, were properly speaking 19th century inventions. With the exception of electronics, our own century has made only developmental contribution; and our process of development has slowed to a crawl (2)."

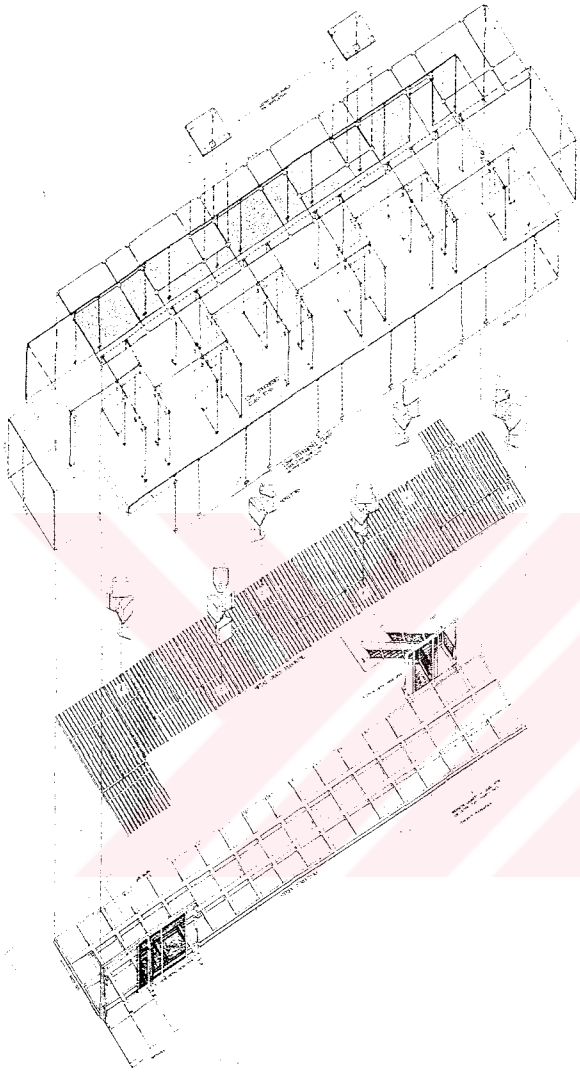
As suggested in these statements, above everything else the scientific and technological developments in the realm of electronics has been a particular characteristic of the 20th century, especially in the second half. With the entrance of electronics and the computer technology into every area related with human life, the input and the outcome of them; 'information' has gained a real significance. "A word that, until a few decades ago was considered of little account, devoid of philosophical implications- the word 'information'- has acquired a disquieting leading role. Having become a measurable quantity as well as object of reflection, it has caused the most widely diverging disciplines to reconsider themselves fundamentally, modifying their methods and basic principles. In addition to the assault of computer science, it has contributed to the increase in the insubstantial, the advent of

laser beams, magnetic resonance and the incredible development of electronic sensing processes and the numberless methods of recording and storage that make 'artificial memory an ever growing depository." (3)

The change brought by the computer sciences showed itself as fundamental 'biotechnic' transformations in the built environment: First, processes of unprecedented organic integration of machines and infrastructural systems are taking place at a variety of scales - the integration of sound-, text-, image- and raw-data flows into single, blended, sensory environment of multimedia; the integration of such micro-environments or 'stations' into permanently activated macro-systems or global systems through digital telephone, cable, or fibre-optic networks; and, perhaps most important of all, the phenomenological integration of the human nervous system into these multi-level, multi-scaled networks and environments through the development of so-called 'natural' or 'fluid' interactive interfaces that use voice, gesture and touch. These architectures can be understood only in terms of a new type of concreteness or materiality, one that addresses itself to our organic 'modes of attention' and the substratum of human nervous and sensory response. But this active, informational penetration of matter goes farther still: First the progressive saturation of our concrete and mechanical milieux by the microchip, which now threatens to leave nearly every aspect of our inherited material environment at once apparently intact and yet also computerized, software-driven, servo-controlled, real-time responsive, and interlinked. Second, as materials science delivers its bewildering panoply of active, sensitive or programmable materials such as shape-memory alloys, glasses, ceramics and polymers, new hybrid materials with integrated piezoelectric crystals and organic molecules - all are capable of changing structure and appearance in response to an array of environmental cues - the very idea of architecture as merely 'frozen' music has become literally, and not just ideologically, obsolete. The remarkable prestige earned by the once purely theoretical speculations of nanotechnonoly engineers, are equally signs of a fundamental shift away from a classical mechanical paradigm (4).

The frontier of the immaterial seems to suggest an approach that may be called 'conceptual', from which derives a renewed enthusiasm for the 'cerebral' aspects of architecture. This approach leads to a decreased understanding towards objective concreteness, instead entering the brains in the form of nervous impulses and stored images. The impacts of such an approach in architecture is

seen first in the architectural theory and design, in the formation of new design philosophies that suggest thoroughly new conceptual frameworks.



A new organic, thermodynamic, informational view of architecture form has already begun to emerge. Noteworthy examples are Peter Eisenman's recent move towards the use of drifting, pulsuating of forms, self-regulating systems and 'continuous', as opposed to discrete, mappings and transformations, Bernard Tschumi's use of multi-level reaction-diffusion systems in which points, lines and surfaces are transformed, like printed directions on a musical score, into 'activities' of intensification, relay and diffusion and Rem Koolhaas's embrace of fluctuations, instabilities, interference and continuous self-updating systems, and his insight that it is 'soft' form, not hard, that bears the maximum of 'active' structure (5).

Fig. 7.1 Bernard Tschumi, Glass Video Gallery
Exploded axonometric diagram, 1990

Other impacts of the idea of immateriality is seen as a reflection on the end-product; the actual architectural structure. The first and most direct consequence of the emphasis on the immaterial aspects of architecture made possible by new technologies is to design a building as a broadcasting facility, considering the perception of its qualities architecturally as a combination of a series of sensations. This might show itself as a tendency to connect architecture and the environment through a continually metamorphosing symbolic system that is influenced by the

conditions that surround it and its capability to modify its responses to these conditions. Such cybernetic structures contain, along with invariant elements, a series of variables that are in some cases completely programmed (6). These may be systems which react to meteorological conditions or the changing scenes on a big video screen which also forms the facade of the building.

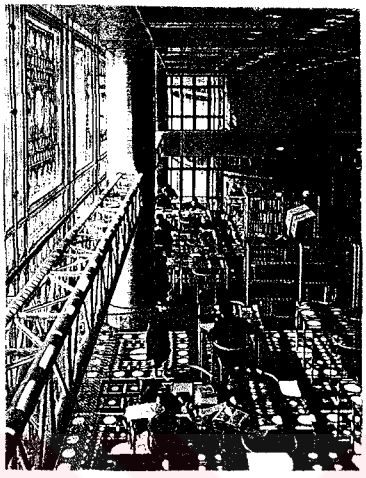


Fig. 7.2 Institut du Monde Arabe, Jean Nouvel, 1987

The continuous change provided by the diaphragm system which reacts to the degree of light, used on one facade of Jean Nouvel's Institut du Monde Arabe in Paris brings variation as an immaterial quality to the building.

The use of electronic imagery finds its way into architecture through the culture of film, television, video and computer screens which represent a unique sensibility of light, movement, and information (7). The facade of the building used as a support for images or inscriptions, with the aid of the developments in biotechnology is common in many recent projects and buildings (8).

Rem Koolhaas's competition design for the Center for Art and Media Technology in Karlsruhe, Germany (1989-92) is one of the most remarkable examples of the configuration of the electronic screen and the architectural facade. The program that contains several facilities concerning media has almost made it impossible not to use an electronic media imagery explicitly.

In Jean Nouvel's projects for the Galleries La Fayette in Berlin (1990) and DuMont Schanberg in Köln (1990) the facade is used as a support for images, with large video screens and advertizing facilities. In Bernard Tcshumi's Glass Video Pavilion, where a series of video screens are placed inside a prismatic volume with a glass envelope, architectural stability itself is replaced with the immaterial essence of the electronic image.

The transformation of the facade into a backing for images, or for electronic signs, is the next step. Toyo Ito's 'Egg of the Winds' (Tokyo, 1991), a rotating oval 'egg' 16 metres long and eight metres wide, floats four metres above ground on the

entrance of a car park. It is dim silver during the day, but in the evening the in-built projection unit and lighting system star to operate, and silently transform the 'Egg of the Winds' into a visual display unit. The projected picture is computer controlled. The projectors enable the structure to present information and images which display a new kind of advertising space. Another structure of electronic signs by the same architect is the 'Tower of the Winds' built and dismantled in Yokohama in 1986 is a 21 metre high tower covered in synthetic mirrored plates and encased in an oval aluminium cylinder. Foodlightings positioned within these two layers, when lit, give the tower the appearance of a giant kaleidoscope. The reflective properties of the aluminium panels emphasize the tower's simple metallic form during the day. At night the' kaleidoscope' is switched on, presenting a brilliant display of reflection upon reflection (9).

Toyo Ito is an architect especially interested in the electronics. The world of microchip is both a symbol and a concrete challenge for him. All that applies to mechanical objects, the relationship between form and function, no longer applies here. The enormous capacity of a computer to store or add vast amounts of information does not necessarily lead to formal articulation. One imagines the microchips in a manner linked to a space through which invisible objects are flowing spurred on by electronically packaged information. An ever-changing flux is implied in this imagined space, full of constantly flowing matter. Ito regards it as a never-ending flowing; a flowing of people, cars, winds, plants, topography and the sounds between buildings. 'I believe that an architect should implant a type of filter, in order to make these various streams visible - architecture as medium. He says we should 'build fictional and ephemeral architecture as a permanent entity'. He suggests using fleeting forms such as light or video for this purpose as with the Tower of Winds or the Egg of Winds. He tries to create scenes that flow easily into one another as in the cinema. These scenes are therefore characterized by regular change and are fictions created by technology (10).

Another approach to immaterialism, less tied to innovative technologies but still full of possibilities, is absed on the utilization of the motility of certain architectural elements; based on the internal contrast between stable materials and changeable ones. In the simplest sense these changeable elements may be movable parts of the building like elevators. The utilization of water, not as a decorative element but structural, in the sense of an insertion into the architectural image of progressive rarefactions of matter, or of an intertwining between

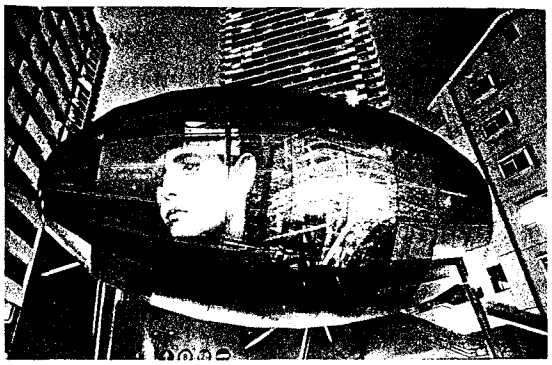


Fig. 7.3 Egg of the Winds, Toyo Ito, 1991

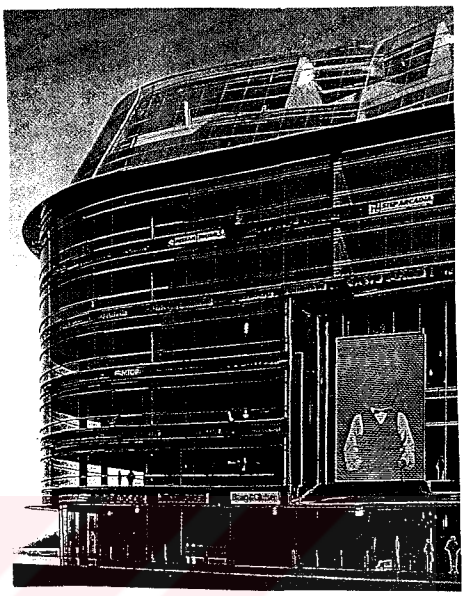


Fig. 7.4 Galleries La Fayette Berlin,
Jean Nouvel, 1990

Fig. 7.5 Tower of the Winds, Toyo Ito, 1986

volumetric immutability and spatial fluidity is one example. Another is the creative use of light, which can take the form of an incisive flux, capable of literally breaking up space and volumes with its force, or the more subtle form of a reflected flow, bounced from surface to surface with a proven dematerializing effect (11).

Grimshaw's British Pavilion at the Seville Expo (1992), uses water in such a way. The Pavilion is impressive with the wall of water-fall and the roof sails of integrated solar cells, and by the use of these factors shows an ecological responsibility for energy. The east facade of the building exhibits a water-wall on which 300000 litres of water are kept in motion to reduce the temperature inside the building. The building's highly technological character is combined with the utilization of water as a functional element.

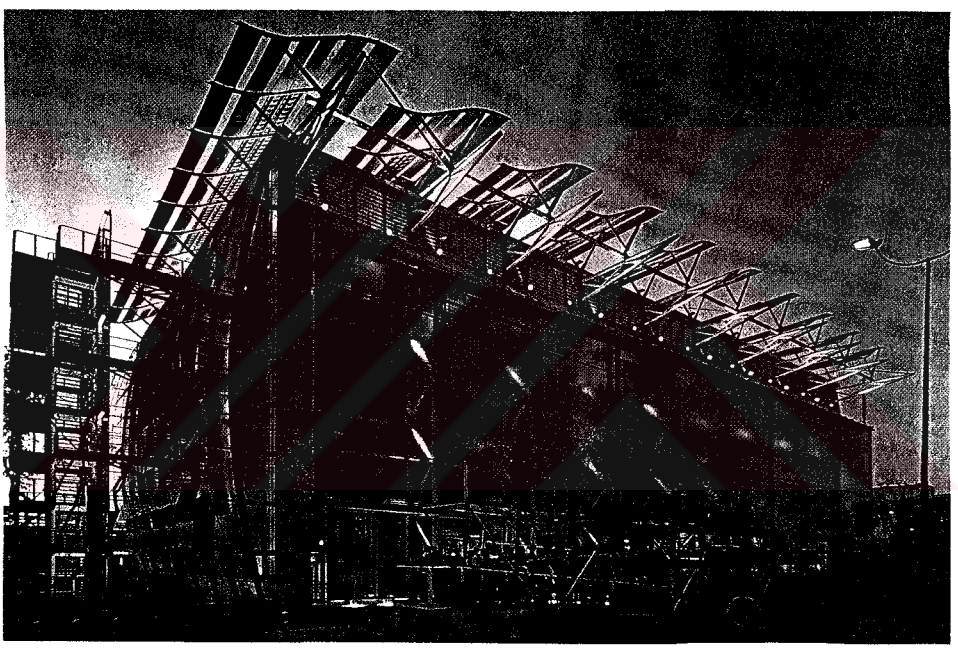


Fig. 7.6 British Pavilion at the Seville Expo 92, Nicholas Grimshaw

Steven Holl's D.E. Shaw and Company Offices in Manhattan show an extraordinary use of light. The office is sited at the two top floors of a skyscraper. At the cube shaped space in the entry, the walls are carved and notched to create gaps and fissures. Color has been applied to the back or bottom surfaces of these notches, and is projected into space by daylight and electric light. Only the projected color is seen, the actual colored surface remains invisible to the viewer within the space. Several openings are left without color, and reflect only the actual color of daylight. As the phenomenon of reflection greatly reduces the intensity of the color being reflected, a range of intense fluorescent colors were utilized on the unseen surfaces (12).

Fig. 7.7. D.E. Shaw and Company Offices, Steven Holl, New York

The concept of immateriality, as exemplified by the works above and in may be different forms that are yet unknown, seems to hold a great potential in the means of making deep changes in architectural meaning in the 21st century.

8. VERTICALITY

In 'Existence, Space & Architecture', Christian Norberg-Schulz describes the meaning of verticality for human existence, giving several philosopher's ideas on the subject:

"Aristotle recognized the qualitative distinctions above and below, in front of and behind, and right and left, distinctions which are rooted in a man's constitution and his relationship to the gravitational field. The vertical direction expresses a rising up or falling down, and has since remote times been endowed with a particular meaning. Erich Kastner says:

'The climbing of a mountain reflects redemption. That is due to the force of the word 'above', and the power of the word 'up'. Even those who have long ceased to believe in Heaven and Hell, cannot exchange the words 'above' and 'below'.'

The vertical, therefore, has always been considered as the sacred dimension of space. It represents a path towards a reality which may be higher or lower than daily life, a reality which conquers gravity, that is earthly existence, or succumbs to it...

The vertical direction, however, also has a more concrete meaning. In connection with the home it expresses the very process of 'building', that is, man's ability to 'conquer nature'. In Ibsen's play 'The Master Builder' the tower becomes the symbol of victory and defeat, and Serlio already interpreted the vertical column as an expression of Man's power of creation. Gaston Bachelard defines the basic properties of the house as 'verticality' and 'concentration', and he discusses the cellar and the attic as particularly meaningful places. Quoting Joe Bosquet he also characterizes modern man as 'having one storey only'." (1)

As explained by Schulz, verticality has always been of great significance for man's existence. The sacred dimension of verticality was emphasized through architecture, in the Medieval Ages. Especially in the Gothic architecture the yearn of man towards the sky where symbolically both God and Heaven exist resulted with a search of verticality. This brought out the problem of structure and building techniques and forced the professionals to find new solutions to achieve new scales. New forms and new elements of architecture were introduced to overcome the difficulties of construction to achieve the goal of verticality. The symbols of Gothic architecture; the ribbed vault and flying buttresses are the results of such a problem. The structures were built by experimentation at that period. By time more slender structures could be built. The architects of the period who generally acted as leading craftsmen in a team, employed the new engineering knowledge to express the aims and emotions of their age and reach unprecedented heights. One

of the most famous examples of Gothic 'Notre Dame de Paris' (1163 AD) reaches to a height of 33m in the interior (2).

Until the advent of Industrial Revolution, verticality was a way of expressing religious or political power, with the construction of high buildings that would form landmarks for the cities. Until then private structures were not allowed to overwhelm the collective symbols of the city. There was a hierarchy in the cityscape following the traditional order of social structure.

With the Industrial Revolution the deep change in the social structure affected the urbanization of the cities. Until then height was not particularly useful except in a symbolic sense. With the formation of capitalist society the use of land became important and height became a symbol for wealth, prestige and vigour. As industry and trade gained an extra role in the social structure, the cities were invaded by business centers. Near the end of the 19th century in America a new building type; the skyscraper emerged, as a result of these social changes as well as the facilities provided by the new technologies and new materials like iron and steel. The verticality of the skyscraper was used for different purposes when compared to the traditional verticality of religious or institutional buildings. First of all it was not used as public place anymore, but it was the product of private enterprise, however it might have come to dominate visually the image of the city, and to stand as the very embodiment of its public realm. Apart from this functional role, its symbolism was an extra factor, shaped by its height and figure.

The steel framed skyscraper began in Chicago, as a consequence of the renovation facilities after the disastrous fire in 1871. The first completely steel framed building was designed by Le Baron Jenney in 1885. This was the twelve storey Home Insurance Building. The architect Louis Sullivan made a considerable contribution to the development of the skyscraper. Sullivan recognized that a new form of architectural expression would come out of the new technology, that these buildings would express a spirit of height, and that this expression would be without historical reference. The emphasis on verticality is the essence of the Wainwright Building, St. Louis, 1891, designed by Adler and Sullivan. It expresses Sullivan's aspiration that the skyscraper:

"...must be tall, every inch of it tall. The force and power of altitude must be in it, the glory and pride of exultation must be in it. It must be every inch a proud and soaring thing, rising in sheer exaltation that from bottom to top it is a unit without a single dissenting line." (3)

In the 15-storey skeleton frame Reliance Building of 1894 in Chicago by Burnham and Company the steel frame allows the enclosing walls to become a lightweight open lattice of glass and terra cotta.

An important factor in the development of skyscrapers is the development of vertical transportation, the invention of the elevator. After the steel framed structural system was developed the limiting factor for the height of buildings had not been the strength of the structure, but the amount of stair-climbing which people were prepared to accept. The lift removed this limitation and Chicago buildings grew in height. The prototype of the contemporary elevator was developed by Elisha Graves Otis as a safety device which prevented the platform from falling during vertical transportation, and was demonstrated to the public at the Crystal Palace Exhibition in New York in 1854. The safety lift was immediately adopted in the USA for goods, but its acceptance for passenger transport was initially slow. Only one passenger lift was built in the next 13 years; it was belt driven at a speed of 0,2 m/s. However by 1870 more than two thousand lifts were in service in America, and all the major buildings erected in Chicago after the Great Fire of 1871 had lifts. The speed and efficiency of lifts also increased rapidly. Hydraulic lifts were invented in 1878, electric lifts were invented in 1889 and gearless traction in 1903. These developments continued with the automatic control and then electronical control of the elevators (4).

Towards the end of 19th century height had become an important factor for some cities as a landmark and symbol, and high structures were being designed or built. The facilities of the steel structures were tried before in the erection of bridges and these were transformed to the use of monumental high structures for special events, like the Centennial Tower project designed by Clark, Reeves and Company for the Philadelphia Centennial Exposition 1876. The most famous among those is the Eiffel Tower built in Paris in 1889 for the Paris Exposition which became a representative of a century of technological progress.

The Germans in the beginning of the 20th century were in the search of a structure that would be a symbol for communal life as a continuation of their work on the 'Stadkrone', the crown of the modern city. This building would arise above the level among the other buildings and would dominate the other buildings, as described by Martin Wagner. In Bruno Taut's 'Alpine Architektur' great cathedrals of crystal were cascaded. But for utopian expressionists, the American skyscraper was not an acceptable urban symbol, because it was a monument of self-interest

and the aggressive competitiveness of capitalism and would not suit their socialist ideals (5).

In America meanwhile cities were being invaded by skyscrapers. On purely aesthetic level, the architectural critic Montgomery Schuyler found the new urban prospect chaotic: "New York has no skyline at all," he wrote in 1899. "It is all interruptions, of various heights and shapes and sizes... scattered or huddled towers which have nothing to do with each other or with what is below." (6)

The skyscraper was a paradoxical building. It was at once highly materialistic and redolent of poetry, hardnosed in terms of urban economics and arbitrary. to the first clients of Chicago skyscrapers, it was a vehicle to maximize profits on their plot of land. But at the same time the tall building began to behave in ways that were not keeping with this insistence on a commonsensical business proposition. Ornament appeared to grace the frame immediately. A competitive craze over height for its own sake seized the makers of the tall buildings (7). The density of skyscrapers in American cities were forced in a fairly restricted area of the city center. The towers joined an increasingly specialized center-city, which emptied of its working crowds at the end of the day. In such a density of tall buildings, the height lost its quality of being a landmark and being perceived from distant places like the earlier high buildings.

Many famous skyscrapers were built between the two wars in America. The Chrysler Building in New York by William Van Allen (1928-30), the McGraw-Hill building (1928-30) and the Rockefeller Center (1931-40) in New York by Raymond Hood are among the best known of these.

The early modernists in Europe saw skyscrapers as a controversial to traditional buildings and added it in their image of the new urban environment. The Futurists were first to mention the 'multilevel, apocalyptic skyscraper city' (8). The tall buildings were a part of Sant' Elia's Citta Nuova.

Le Corbusier approving of the concentration of a high-rise business district, does not accept skyscraper as the definer of public spaces. In his 'City of Tomorrow' (1924) he describes in detail a 'Contemporary City Of Three Million Inhabitants' consisting of all alike twenty-four skyscrapers. They are standing, not in the thick of an old city, but in vast open parks. They are experienced from fast-speed motorways. And they are made up of glass. He relates this image as:

"...Suppose we are entering the city by the way of the Great Park. Our fast car takes the special elevated motor track between the majestic sky-scrapers: as we approach nearer there is seen

the repetition against the sky of the twenty-four sky-scrapers; the municipal and administrative buildings; and enclosing the space are the museums and university buildings.

Then suddenly we find ourselves at the feet of the first sky-scrapers. But here we have, not the meagre shaft of sunlight which so faintly illuminates the dismal streets of New York, but an immensity of space. The whole city is a Park. The terraces stretch out over lawns and into groves. Low buildings of a horizontal kind lead the eye to the foliage of the trees. Where are now the trivial Procuracies? Here is the CITY with its crowds living in peace and pure air, where noise is smothered under the foliage of green trees. The chaos of New York is overcome. Here bathed in light, stands the modern city." (9)

These negative qualities Le Corbusier sees in New York are indeed a part of the image of that specific city. The quality of light that faintly illuminates the streets give the city a characteristic in the means of perception. New York continues to be both a scary and a fascinating city. It looks as the realization of a futuristic dream. Indeed, it looks like the concrete realization of the 'City of the Future' in Fritz Lang's 1926 dated film 'Metropolis' (10). Rem Koolhaas describes this quality of the city in the introduction of his book 'Delirious New York' as 'a mountain range of evidence without manifesto' and says:

" Especially between 1890 and 1940 a new culture (the Machine Age?) sselected Manhattan as laboratory: a mythical island where the invention and testing of a metropolitan lifestyle and its attendant culture could be pursued as a collective experiment in which the entire city became a factory of man-made experience, where the real and the natural ceased to exist."

And he suggests Manhattanism as the unformulated theory for Manhattan 'whose program - to exist in a world totally fabricated by man, I.e. , to live inside a fantasy - was so ambitious that to be realized, it could never be openly stated' (11). Manhattan is the perfect symbol for seeing the extents to which verticality may play a dominant role in the development of a city.

Tall buildings have been erected in all over the world since Corbusier. City centers with skyscrapers became common in many cities in Europe, like the Defense district or Montparnasse Tower (1969) in Paris, or London with the Portland House (1960) and National Westminster Bank Headquarters (1981) (12).

Many well known skyscrapers are erected in different districts of the world. In Hong Kong skyline for example Norman Foster's Hongkong and Shanghai Bank stands next to Pei's more recent Bank of China Building.

In the example of the skyscrapers it is possible to see the change brought to the architecture of the city in the means of verticality, by the facilities of the developments in building technology.

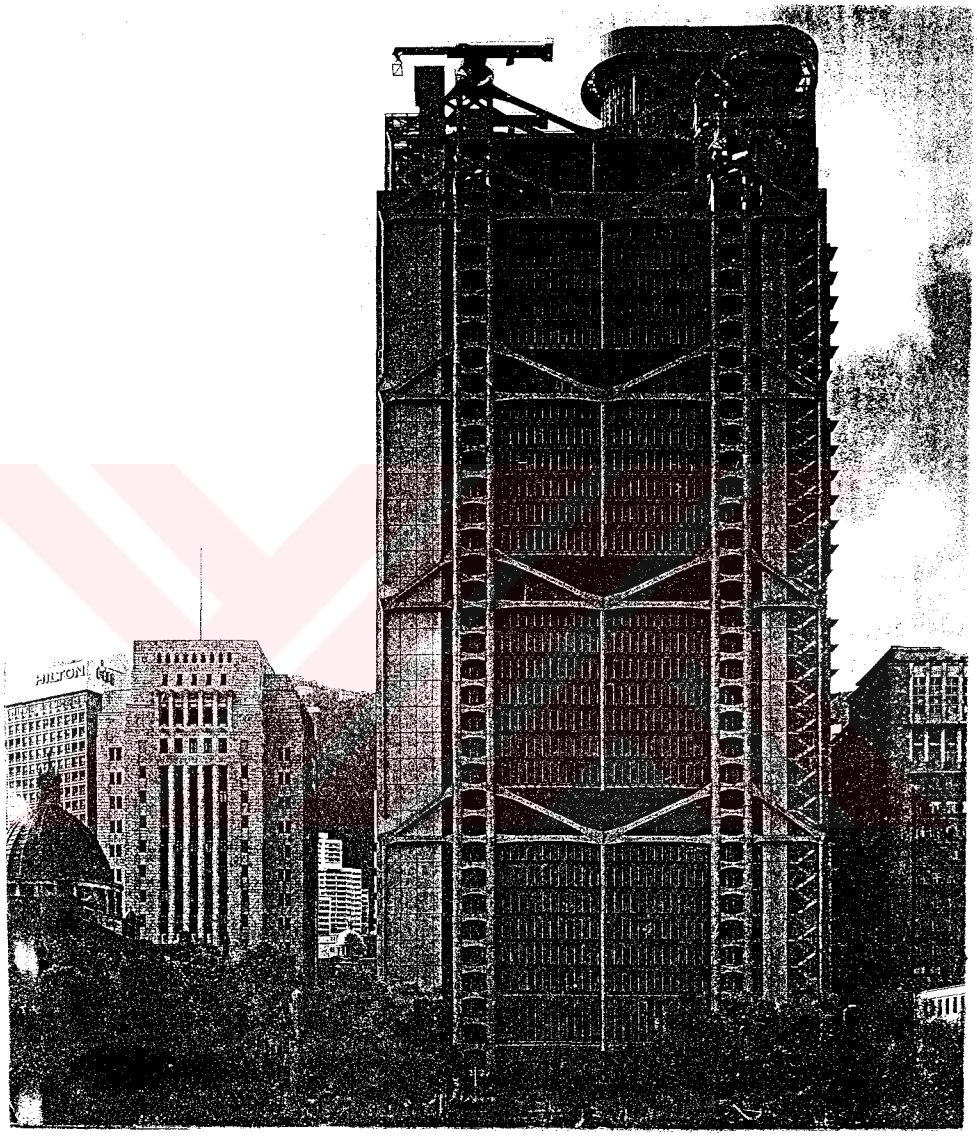


Fig. 8.1. Hongkong and Shanghai Bank, Norman Foster, 1986

8. UTOPIA

Since Thomas More's description of the imagery island of ideal perfection named 'Utopia' (1516), architecture, as the concrete reflection of the social life has been one of the most important components of utopian projects. As projections of idealized social structures, utopias gain an acceleration in the periods of deep social changes. The Enlightenment is one of these periods when a radical transformation in the relationship between man and nature occurred. At the same time with the changing social and cultural conditions brought by the Enlightenment, the technological changes led to a new infrastructure and the exploitation of an increased productive capacity.

The supposedly utopian projects of the Enlightenment developed for the new conditions of bourgeois ideology and economic liberalism, however, did not possess that much utopian qualities according to Manfredo Tafuri. Describing the period in his 'Architecture and Utopia', he says:

"As a political agent the architect had to assume the task of continual invention of advanced solutions, at the most generally applicable level. In the acceptance of this task, the architect's role as idealist became prominent.

The truth is that the architectural proposals of 18th century Europe have nothing unrealizable about them. Nor is it accidental that all the vast theorization of the philosophes of architecture contains no social utopia to support the urban reformism proclaimes at a purely formal level." (1)

He sees the gigantic architectural dreams of Boullée as not so much unrealizable dreams, but rather as experimental models of a new method of architectural creation. Tafuri later makes a comparison between the 19th century utopias and early 20th century utopias:

"The unproductiveness of intellectual work was the crime that weighed upon the conscience of the cultural world of the 19th century, and which advanced ideologies to overcome. To turn ideology into utopia thus became imperative. In order to survive, ideology had to negate itself as such, break its own crystallized forms, and throw itself entirely into the 'construction of the future'. This revision of ideology was thus a project for establishing the dominion of a realized ideology over the forms of development." (2)

Taking his criticism on the Enlightenment utopias into account, one may suggest that the utopian idea should have an unrealizable, futuristic character, as an addition to the ideology that supports it. As Peter Cook suggests a utopia

should possess anticipatory qualities: "The combination of anticipatory statement with anticipatory organizations and anticipatory physical symbols is understandably termed 'utopian' (3)." In order to give this anticipatory character to the project, a view of technology that proposes imaginary future technologies unrealizable at that certain period of time have been helpful.

According to Tafuri's statement the avant-garde movements of the early 20th century may be regarded as ideologies turned into utopias. Futurism is one of these movements with an ideology of creating a totally new world that carries the spirit of the age. Reyner Banham agrees with its ideological nature:

"The qualities which made Futurism a turning-point in the development of Modern theories of design were primarily ideological, and concerned with attitudes of mind, rather than formal or technical methods - though these attitudes of mind were often influential as vehicles in the transmission of formal and technical methods which were not, in the first place, of Futurist invention (4)."

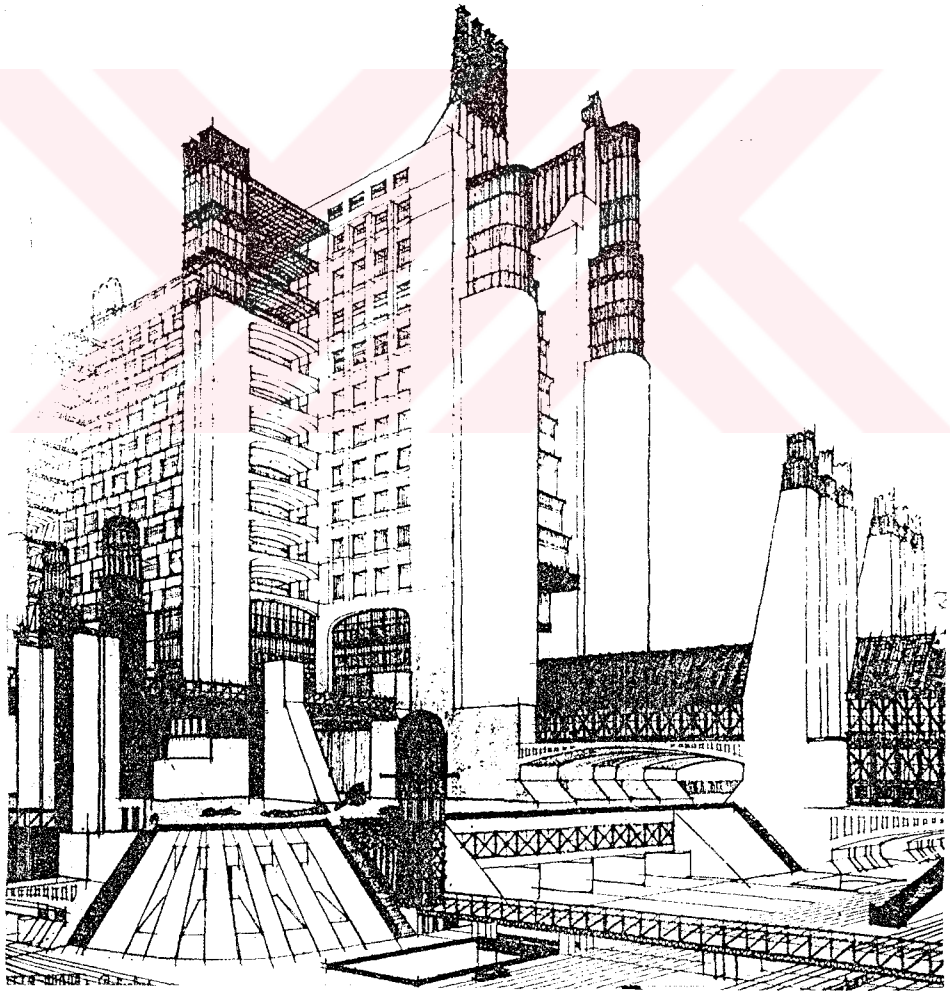


Fig. 9.1. Sant' Elia casa a gradinata for the Citta Nuova, 1914

The Foundation Manifesto of Futurism was published in 1909 and was a creation of the poet Tommaso Filippo Marinetti. The Manifesto was a lively attack on traditionalism in culture, and championed an expression nourished by

contemporary forces and the poetic sensations released by new industrial environment. Anarchist in inspiration, the Futurist outlook had no particular political affiliation, but was in favor of revolutionary change, speed, dynamism of all sorts and an adulation of the machine (5). The architectural view of futurism was introduced by Sant' Elia in his 'Messagio' where he declared the refusal against everything traditional, monumental, heavy and static. His designs to picture these ideas were exhibited under the name 'Citta Nuova' in 1914. However, Frampton says that these sketches are not entirely consistent with his precepts in Messagio. His drawings are replete with monumental images. "In retrospect it seems but a step from Sommaruga's Facconi Mausaleum to the soaring, massive and often symmetrical power-houses and tall blocks that rise like mirages out of the scenographic landscape of the Citta Nuova (6)."

In the post-revolutionary Russia, meanwhile, because of the economical conditions and the impossibility of construction led to a frenzied visual experimentation on paper and encouraged a heady and impractical utopianism. The need to destroy all links with the reactionary past brought the architect seeking a visual language of expression appropriate to new ideals. The new architectural vocabulary of the Russian constructivists was formed partly by the effect of the futurist ideas mated with the Marxist ideals in the quest for suitable metaphors to express the supposed inner dynamism of the revolutionary process. As a result mechanisation became the symbol of this new vocabulary (7).

It would not be right to accept the Futurist and the Constructivist movements as exact utopias. They were rather revolutionary ideologies shaped into a form of utopia, as Tafuri suggests. On one hand Futurism was a revolutionary ideology expressed in a utopian way. On the other hand Constructivism was the search of a formal expression for a revolution that happened, and found its symbol in the machine.

The utopian movements around the second half of the 20th century, however, could not be accepted as the direct results of such ideological positions, but a belief in progress provided by technology; or the belief in construction as Klotz suggests:

"The discovery of new construction techniques spawned the all too familiar human desire to stretch new-found knowledge to the full and try to construct a world anew, to universalize the new technical discoveries and replace the historically and culturally worn fabric of the earth with a second culture of space frames, pipes, capsules, tyres, domes, masts and superstructures. Belief in progress was belief in construction, the future was construction and architecture was construction, just as utopia was a technical construction." (8)

A very strong thread running through architecture especially near the mid century is that the material itself has provided an incentive for the discovery of new things. Another most frequent aspiration that has been overlaid is looking towards technology as a great force for a new architecture (9).

In the 60s the London architectural team known as Archigram, which compromised Peter Cook, Warren Chalk, Dennis Crompton, David Greene, Ron Herron and Mike Webb from a seemingly inexhaustible wealth of imaginative ideas, created rapturous utopian visions of a world of lattice frames, tubes, capsules, cells, spheres, balloons, robots, space units, submarines, plastic - of a society oriented toward high-technology recreation and leisure (10).

Peter Cook's 'Plug-in City' (1964) is a basic extendible structure serviced by railways, helicopters and hovercrafts. All the plug-in units are easily clipped into place and can be dissected and discarded when obsolete (11). The 'Control and Choice' project by Archigram (1967) proposes an environment of responsive systems such as extendable structures, movable pneumatic skins, adjustable walls and floors, service robots and even collapsible electric cars which turn into bedrooms (12).

Perhaps the most poetic (and ludicrous) of Archigram's projects was the Ron Herron's 'Walking City' (1963), with which he proposed insect-like legged buildings that would be able to crawl across the landscape. Here was a technological utopia that no longer had anything in common with technology's sober rationalism. Herron combined modern and atavistic concepts to produce a vision of strange and primitive force, and he quoted from Arthur C. Clarke's novel '2001': "High technology is high technology only when it is magical." Thus, the rationality of technology was to give way to magic of technology, which could be manifested only through artistic fiction (13).

Through the medium of technology and the machine, Archigram began to tell architectural fables of a kind that had hardly been seen before in the twentieth century. From Webb's 'Sin Centre' to Herron's 'Instant City' (1969), Archigram produced a series of urban fictions that left the geometry of modernism and the muteness of functionalism far behind. The decisive thing was what Archigram was talking about: the great myth of modernism, the great myth of technology. Thus, Archigram remained in a one-dimensional zone of technological utopianism, without being able to re-establish coherence between the past, the present, and

the future. Although they adopted a few of Pop's stylistic features, its main interest lay in appropriation and glamorizing of technology (14).

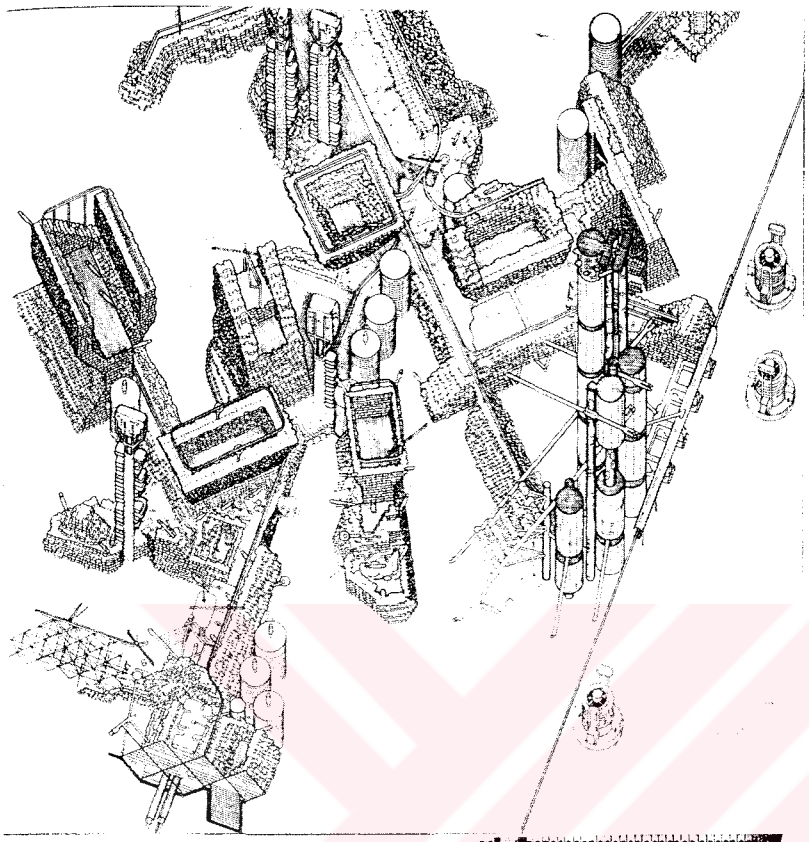


Fig. 9.2. Plug-in-City, Peter Cook,

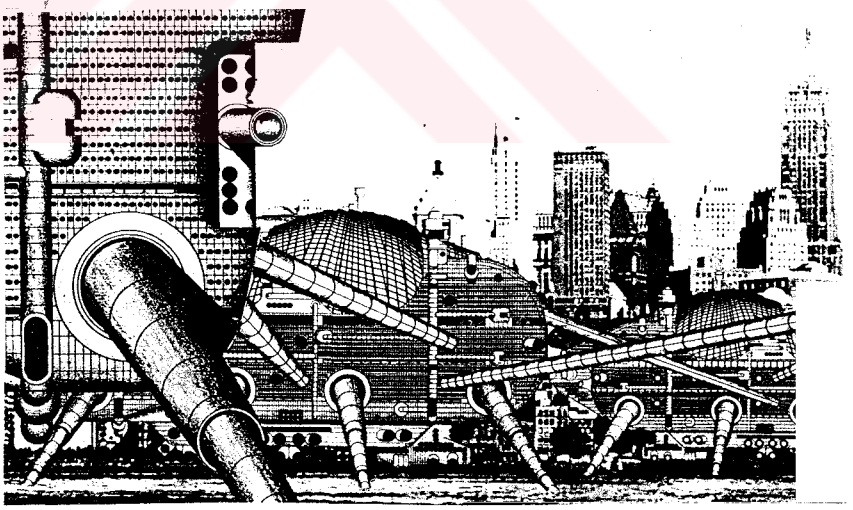


Fig. 9.3. Walking City, Ron Herron, 1963

The French 'Utopie' group has translated the ideas of expandability and social utility into a very striking kind of architecture based on pneumatic structures (1967).They have designed pneumatic projects where everything is inflatable and disposable including the walls, floor, furniture, joints, structure, skin and even mechanical equipment. Physically the results resembled, the Michelin Man, with his

body made up of bulbous tires. Functionally the concept is very responsive as it allows easy transport, quick erection and sudden disposability at the prick of a needle. And socially, the 'Utopie' group has shown that pneumatic structures are as responsive as clothing, they can be altered to suit the situation as fast as it changes, and thus avoid the continual irrelevance of more permanent structures (15).

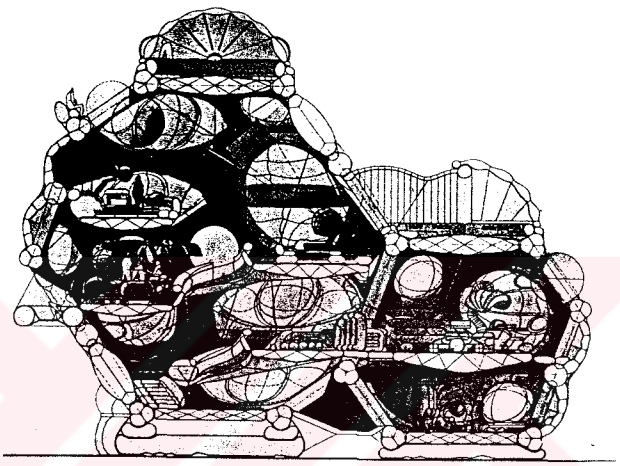


Fig. 9.4. Experimental pneumatic house project, Jean-Paul Jungmann, 1967

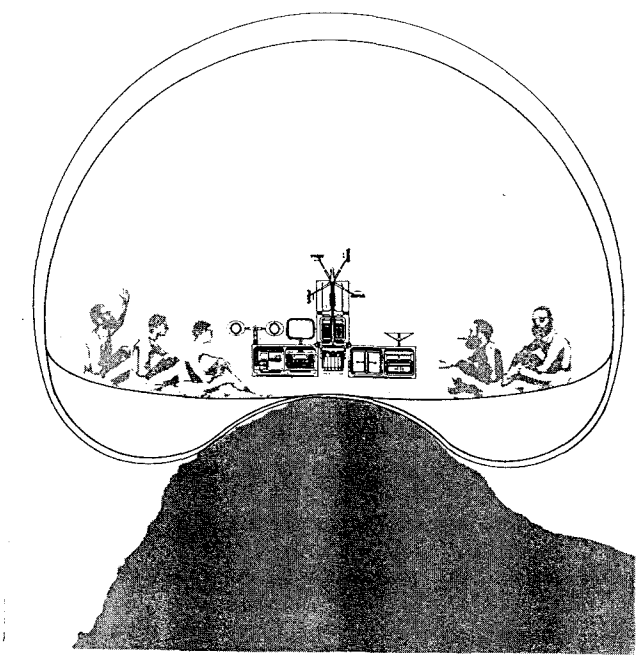


Fig. 9.5. Environmental bubble, Dallagret & Banham, 1965

An earlier example of inflatable structures was proposed in 1965 by Reyner Banham with François Dallagret, the 'Un-house'; the ultimate in throwaway living where all products including clothing are dispensed with and the artifacts come through the electric media incorporated under an inflatable dome. The two ideas behind this are to give everyone a 'standard-of-living package' containing all the necessities of modern life (shelter, food, energy, television) and to do away with all the permanent structures of building, so that nature would remain untouched and men would not be constrained by past settlement (16).

The dream to create a controlled microcosmos appeared at different scales. As new materials have become available and a more transient attitude to certain pieces of architectural hardware has developed, the idea of the skin that can act as an umbrella to a whole series of secondary operations has emerged very strongly. The famous two-mile wide dome which Bucksminster Fuller suggests for New York (1960) implies that the buildings within would not have to cope with exterior weather conditions (17).

In his article 'High-Tech' Peter Buchanan mentions two further extreme myths of high-tech architecture: At one extreme there is the idea of an infinitely flexible framework. At the other extreme there is a complete environmental control in which the building evaporates completely but protects the occupants from wind, rain and other natural events (18).

Creating the perfect building skin that is totally adaptable to the climatic and environmental conditions is seen as a future goal for architecture. The best ways to optimise the climatic benefits is to have a building envelope that positively interacts with its environment. An intelligent and adaptable building skin would regulate the energy flow through itself. It would no longer be a barrier between inside and outside, but would become an interface between two energy sinks. Such a skin should be able to tune itself to provide the ideal thermal response to any given set of external climatic conditions, occupancy requirements, orientation and building type (19). The technology already exists to develop an intelligent monolithic building envelope. The enclosure could, in effect, be a multi-functional 'skin' that would build and maintain itself, and respond to climatic changes such as wind, sun, rain and temperature, whilst creating a building which would be self-sufficient in energy demands. This kind of a development in the building skin will be of great significance both for architecture and the future of the energy resources of the earth (20).

Ecological concerns have gained an emphasis in the highly technological society of the late 20th century. To recover the disturbed relationship between nature and the built environment has been subject to some architects producing utopian ecological projects. One of these architects of highly poetic vision is Emilio Ambasz who is described by Ryuichi Sakamoto as "an architect who does not merely think in terms of just one building but, rather, always bears in mind an entire culture, who thinks of his buildings in the context of an entire planet still possessing many areas to be explored" (21). One of his most well-known projects, the Fukuoka Prefectural International Hall project proposes a powerful new solution to reconcile the public need of open green space with the developer's desire for profitable use of a site. This is an elegant symbiosis of the green, water and the urban fabric. What is noteworthy about Ambasz's projects is that he uses technology to achieve this symbiosis between nature and the built environment.

The World Ecology Pavilion project by the Site group is of a similar nature. Ecology is a consistent theme for Site in their 'de-architecture', which provides commentary ranging from the serious and lyrical to the ironic about the place of built additions to the environment.

The idea of 'mobility' is another concern for the futuristic architectural approaches. The development of transportation devices in the 20th century, including even the space-ship has made the idea of motion an inspiration for architecture, in addition to the formal influence provided by these devices.

The London-based architectural practice, Future Systems, consisting of David Nixon and Jan Kaplicky borrow imagery from the transportation industries and their work supports the idea that the journey itself, rather than the destination, can be the objective for ephemeral architectural projects. The image of their practice is a an experimental studio concerned with utilizing all that technology has to offer in the creation of architecture. Their projects start in 1975 by series of small, cabin-like, mobile living units explore the notion of pre-manufactured and self-sustaining object settling into a wild and natural environment. the collages used to illustrate these projects accentuate the technological aestheticism of the 'building' as a foil to the organic nature of their sites. The latest of these is the 'Peanut House' (1984) which consists of a small pod dwelling, this time attached to the end of a hydraulic arm. This structure is located at the edge of a lake and its arm moves from its surface to the land, or to an elevated position, dependent on the whim of its occupier. The logistical siting of the house is therefore only

established in general terms and its has a finite relationship with its site (22). Jan Kaplicky explains his view on the future as:

"The future is here and it is our responsibility to use it. But a leap in faith, vision and imagination is needed if we are to exploit both the advantages of natural resources and state-of-the-art technology.

Buildings no longer need to be static machine-controlled environments but rather dynamic responsive enclosures to interact with the climate to meet individual needs.

The symbiotic relationship between nature and technology is a driving force that creates an architecture of its own; of free-form lightweight enclosures, of ever-changing organic surfaces, of a complexity of layers, of fluid seamless self-regulating skins.

Maybe it is now time for a new profession to emerge; not one led by the architect, but a truly creative, interactive partnership between many different disciplines." (23)

A contemporary utopian, whose aim is the creation of a suitable architecture to accentuate the freedom of the individual is Lebbeus Woods. His design principles are based on his belief that all architecture should be created for the individual and that any restrictions applied for the group are artificial and undesirable. This architecture based on individualistic concepts, is characterized by its indeterminate nature, often seen as a foil to the existing pattern of historic cities. The construction and materials of Woods' designs seem to be an intrinsic component in the message, their part-completed appearance of an assembly of mechanized, industrial components enhance the appearance of indeterminacy which is an intrinsic part of the desired image. Although Woods' designs show a utilization of contemporary and futuristic technology, he does not believe it can really provide a solution without a revolution in the way architects approach its use:

"In the present technological society, innovation has already begun to race ahead of tradition. Technology cannot become a tradition. New knowledge, new conditions of living are developing faster than can be thoroughly assessed and tested, or their effects controlled. These conditions force changes in thinking and society, from which a new type of coherence must come... Most architects today seem confused when they confront new technology, knowledge and conditions of living, preferring either to ignore them or fall back on stereotypes. Their confusion will end only when architects accept that the mandate for practising architecture today is not the control of change, but its 'invention'." (24)

A more realistic view of future architecture comes from Richard Rogers:

"I am searching for an architecture that will express and celebrate the ever-quickening speed of social , technical, political and economic change; an *architecture of permanence* and transformation where urban vitality and economic dynamics can take place, reflecting the changing and overlapping of functions; buildings as a form of controlled randomness that can respond to complex situations and relationships. Such architecture can be partially achieved by the zoning of buildings into long-life served and short-life servant activities.

The creation of an architecture that incorporates the new technologies entails breaking away from the Platonic idea of a static world, expressed by the perfect finite object to which nothing can be added or taken away, a concept that has dominated architecture since its beginning.

Instead of Schelling's description of architecture as frozen music, we are looking for an architecture more like some modern music, jazz or poetry, where improvization plays a part: an indeterminate architecture containing both permanence and transformation.

The best buildings of the future will interact dynamically with the climate in order to meet users' needs better and make optimum use of energy. More like robots than temples, these apparitions, with their chameleon-like surfaces, insist that we rethink the art of building. Architecture will no longer be a question of mass and volume, but of lightweight structures whose superimposed transparent layers will create form so that constructions will become dematerialized." (25)

The relation between the utopian idea or project and technology in architecture seems to be a double-sided matter. On one side, the utopia; the idealized way of life for a new world is physically shaped through architecture in which anticipatory technologies of construction are proposed so as to symbolize an unrealizable theory with an unrealizable physical structure. On the other side, technology shows a paradoxical character to utopia, because the innovation and invention provided through technology might enable the construction of an 'early' unrealizable structure and therefore one might hesitate to call such projects as utopia, knowing that they may become realized in a future that is not so far away. However the latter might be suggested largely for the physical aspects of the utopia, and not for the social aspects which are more complex and harder to achieve.

Peter Cook, after defining utopian as the combination of anticipatory statement with anticipatory organizations and anticipatory physical symbols describes its qualities as: "It presumes that there is a direct relationship between all forms of anticipation, denying the right of a project to innovate only in some areas at one time. It presumes that a project is in a special category, a gimmick, a parable or a will of the wisp (26)." If we examine the architectural projects and theories subjected in this section according to this definition of utopia, it is hard to state that they are all exact utopias. But it may be appropriate to say that they all have utopian characteristics due to the anticipatory, experimental, or predictive characteristics they possess. And they also point out to the fact that whatever they should be called; utopia, prediction or experimental project, the futuristic dreams in the 20th century have been in general closely related with high technology.

CONCLUSION

Before making a general analysis on the concepts introduced in this study, it might be necessary to make some comments on the changes that affected architecture in the twentieth century.

It is true that the building tradition has gone through several changes during the whole course of architectural history. But the changes that happened especially in the last century was directly associated with the shifting of architectural meaning. The architects in the beginning of the 20th century searched for the appropriate form for the industrialized society. With this dream they created the means for a totally new architectural language. Even if modernism is conceived as unsuccessful in realizing the principles it has claimed, it should be admitted that it formed the basis for an architecture of a 'new' understanding. One of the leading roles in the formation of this new understanding was either ideologically or naturally given to technology. Therefore technology became the agent for the new architecture of the new epoch. Although reactions were raised against modernism and its qualities in the second half of the century, the influences of technology in the social life never ended, and the pace of technological development continued in an increasing speed. As a result technology, whether a threatening power over the society or a beneficial tool in the service of it became an inevitable part of human life, and the impacts of it on architecture was also inevitable.

As for the creative and expressive impacts of technology on architecture, a brief survey of the concepts mentioned in the earlier chapters will be helpful. Creativity is directly linked with the idea of the new. It is the search of new relations, new forms, new effects, new directions. As described in the introduction, creativity in the language stems from the new associations of 'vague signs' (figures of speech such as metaphors) in new environments. When compared to the architecture of the twentieth century there is a quite similarity. In the perfectly creative medium of the early twentieth century, the search for new inspirations, new associations in architecture in the new industrialized society is influential. These inspirations were found in both the idea of industrialisation and mechanisation, and the resources offered by it, such as new materials or new

building techniques. Therefore the machine metaphor in the modernists gains an extra significance in changing the ways of expression in architecture. And towards the end of the century this machine metaphor is replaced by the non-material existence of information which is the direct outcome of the computer technology.

New qualities and concepts derived from this new condition. These qualities may be accepted as metaphors because of their prolific characteristics, which lead to their perception in several ways and they enable the formation of new associated concepts in their being. Transparency is one of these qualities which changed the traditional relationship between the interior and exterior in architecture. It enabled a continuity of space and the dissolution of the material. This led to the questioning of borders; a common theme in contemporary architecture. The concept of transparency evolved through the century, from a direct, 'literal' transparency to a mediated, 'phenomenal' transparency. From phenomenal transparency new themes such as 'veiling' and 'delay in layers' evolved.

Lightness, with the close relation with transparency, first enabled the transformation from the traditional heaviness to a new light and dynamic architecture. And then it gave rise to the concepts like 'floating', 'suspension', or 'tension'. These all resulted with totally new effects in architecture.

Dematerialization caused the questioning of material reality in the means of effectuality and led to concepts like 'evaporation' or 'dissolution'. Immateriality, directed architecture to totally new horizons with the use of informational systems. The use of light (natural and artificial), electronics, self-responsive systems led to the formation of concepts like 'ephemerality', 'fluidity' or the concepts manipulated by some specific architects such as 'fluctuation' or 'pulsuation'.

The creative process here is seen in the formation of new concepts through new associations of the former ones. As for the case of utopia, there is a direct relation between utopian ideas and creativity, and that stems from the fact that utopia cannot exist without creation, but on the other hand the predictive, experimental idea is also very important for creativity.

The role of technology in the creation and evolution of these concepts have been mentioned through the earlier chapters of the study. This role has both been played through the symbolization of technology for a new architecture and the direct impacts of technology on architecture, such as the facilities provided by the new materials and new building techniques. With the symbolization of technique a

new formal context for architecture has formed and this context changed the overall image of architecture, from a heavy and static to a light and dynamic image. Some qualities and concepts like lightness or transparency gained extra significance for this new image. Without the existence of appropriate technologies the realization of these concepts would have never occurred. Technology is an invariable in transforming new concepts into real three-dimensional spaces. On the other hand, new materials and new techniques have always been a source of inspiration. And the capability of practising certain techniques have led to the formation of further ideals.

Technology is a constant factor in building construction. But the way and the degree to which it is expressed in the building's appearance may vary. The discussions on the technological image generally stem from these factors. The reactions raised against the real living machines of the 70s and the 80s is a result of their use of technology in the most manifest way. In these buildings the choice between the symbolical and merely functional use of technology, seems to be made rather for the symbolic. However, the contemporary architects (at least some of them) who prefer to use technological material, seem to achieve in making it a device for gaining further effects and forming further concepts.

Many of the concepts derived from the former concepts, as the examples given above, are related with such a use of technology. The early inspiration found in the machine, is now found in the idea of information. And from this inspiration new interactions between technology and architecture seems to be emerging.

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CURRICULUM VITAE

Aslı Şener was born in Samsun, in 1971. She received her high-school degree from Beyoğlu Anadolu Lisesi in 1989 and started her university education at İstanbul Technical University, Faculty of Architecture. She received her Bachelor of Science degree in Architecture in 1993 and started her post-graduate studies the same year.

She started her professional career in Turgut Cansever's office in 1993. Then she worked with architect Gökhan Avcıoğlu between August 1994 and March 1996.