High Tech Architecture

by Colin Davies

1. A tentative definition

High Tech architects all agree on at least one thing: they hate the term "High Tech". Apart from a natural human unwillingness to be pigeonholed, there seem to be three main reasons for this.

The first is that in the early 1970s "High Tech" was often used as a term of abuse by architects who had taken up the fashionable cause of "alternative technology". As the term passed into more general use it lost its negative connotations, but High Tech architects themselves still prefer to use some such phrase as "appropriate technology". Second, it is an ambiguous term. High Tech in architecture means something different from High Tech in industry. In industry, it means electronics, computers, silicon chips, robots, and the like; in architecture it now means a particular style of building.

But as soon as we use the word style we come up against the third objection. British High Tech architects hate the word style even more than they hate the words High Tech. In the USA the term High Tech does refer mainly to a style, but in Britain it means something much more rigorous. It is High Tech in the British sense that this book sets out to analyse and illustrate. It is too late now to invent a new name. Most people interested in contemporary architecture know what High Tech means, at least in general terms. And if High Tech has nothing to do with high technology, well neither has Gothic anything to do with Goths.

So exactly what does it mean? The physical and ideological features of High Tech are analysed in some detail in the pages that follow. For now we can simply say that its characteristic materials are metal and glass, that it purports to adhere to a strict code of honesty of expression, that it usually embodies ideas about industrial production, that it uses industries other than the building industry as sources both of technology and of imagery, and that it puts a high priority on flexibility of use.

It could, alternatively, be defined in purely personal and historical terms as the label we apply to almost any building designed in the last twenty years by Richard Rogers, Norman Foster, Nicholas Grimshaw, or Michael Hopkins. There are other exponents of High Tech, and not all of them are British, but these four are the leaders of the movement. And it is, in a sense, a movement. It holds no conferences and issues no manifestos, but most of its members share the same educational background and are known personally to one another. They have worked in each other's offices, and exchange ideas, sometimes collaborating, sometimes competing.

A number of theories have been put forward as to why this style of building should have developed in Britain rather than, say, Germany, America, or Japan. Perhaps it is nostalgia for the great days when the Empire was serviced and maintained as much by engineers as by industrialists, politicians, and generals.[1] Perhaps it is a continuation of the tradition of Pugin, who demanded "that there should be no features about a building which are not necessary for convenience, construction or propriety" and "that all ornament should consist of the essential construction of the building."[2] Perhaps it follows from the British professional tradition that requires architects to concern themselves with, and be responsible for, the technical details as well as the spaces, forms, and surfaces of their buildings. Or perhaps it is merely a reflection of that British literal-mindedness that sees architecture not as high-flown art or philosophy, but first and foremost as technique. Perhaps, perhaps not. They are only theories, yet there is something indefinably British about High Tech.

2. Function and representation - Technique or style?

The exponents of High Tech, like the pioneer Modernists of the 1920s, believe that there is such a thing as the "spirit of the age" and that architecture has a moral duty to express that spirit. The spirit of our age, according to High Tech architects, resides in advanced technology. Architecture must therefore participate in and make use of that technology - the technology of industry, transport, communication, flight, and space travel. Why, they ask, should buildings be any different from the other artefacts of industrial culture? Why do we continue to make buildings out of cumbersome, messy, imprecise materials such as bricks, mortar, concrete, and timber when we could be making them out of light, precision components of metal and glass, fabricated in factories and quickly bolted together on site?

The High Tech architect sees architecture as a branch of industrial technology. He claims no social or artistic privileges. He wishes his buildings to be judged by the same criteria of performance as any of the other tools of everyday life. He wants them to be functional and efficient, not artistic or symbolic.

But there is an ambiguity here. Architecture, it seems, can never be purely functional, no matter how hard it tries. The typical High Tech building symbolizes and represents technology rather than simply using it in the most efficient way possible. It may be cheaper and quicker to build a load-bearing brick wall, but the High Tech architect will always prefer the steel frame and the lightweight metal panel because this is a technique more in tune with the spirit of the age. He is committed to the idea that building must eventually catch up with the rest of technology, and he is determined to "drag building into the twentieth century". In this endeavour, symbolism and representation have on important part to play. The motifs of High Tech - exposed steel structure, visible air conditioning ducts, plug-in service pods, and so on - are almost never the most economical solutions. There is nearly always a cheaper, more practical alternative. But this is architecture, not engineering.

High Tech architecture, then, is not purely functional. But neither is it purely representational. It is an article of the High Tech faith that there must be a functional justification for every design decision. Take, for example, the tension structure of Nicholas Grimshaw's Ice Rink in Oxford. It converts a straightforward, shed-like building into a dynamic, self-advertising, instantly identifiable piece of architecture that irresistibly brings to mind the romantic image of a sailing ship. A similar effect might have been achieved by the application of a couple of fake masts to an ordinary portal frame structure. But the true High Tech architect would never resort to such deception. The structure has to be real and there has to be a functional justification for it. In this case, the justification is the low bearing capacity of the subsoil. Of all the possible ways to overcome this problem, the tension structure was chosen, however, not for its economy but for its symbolic power.

Le Corbusier described the house as a machine for living in, but he built houses that were technologically primitive and looked nothing like machines. High Tech buildings do look like machines. The machine is more than a metaphor; it is a source of technology and of imagery. Machines are usually mass-produced, either mobile or portable, and made of synthetic materials such as metal, glass, and plastic. These characteristics have become the reference points of High Tech architecture. The buildings may not be mass-produced, or even assembled from mass-produced components, but they look mass-produced, or at least capable of repetition. They may not be mobile, like cars, or portable, like television sets, but they will usually be made of distinct components and will often appear to hover a few inches above the site as if, one day, they might be dismantled or moved.

Look at Norman Foster's Sainsbury Centre for the Visual Arts, and Michael Hopkins' Brewery in Bury St Edmunds. These buildings have very different functions - an art gallery and a warehouse - but they are both simple, finely proportioned metal boxes that make no formal concessions to their particular locations. They sit on the ground like pieces of equipment (huge refrigerators, perhaps) airlifted in by giant helicopter. Evidently, their form does not arise from any detailed articulation of the activities housed. But how much is it determined by the technology of their construction, and how much by the wish to give them a machine-like appearance? It is hard to say. Function and representation, engineering and architecture, are delicately balanced.

3. The mass production problem

An architecture that tries to imitate the methods and products of manufacturing industry encounters some special problems. Chief among these is the problem of mass production. Cars are made in millions; buildings are usually one-off. It takes many years and very large sums of money to design and develop a car. Many prototypes must be made and tested. If a building is to make use of the same technology, and achieve the same level of sophistication, then there must be a similar level of investment in its design and development. But this is economically out of the question unless identical buildings are to be produced in thousands. There have, of course, been many attempts to industrialize the production of buildings, but no one has yet succeeded in marketing the successful building equivalent of the Model T Ford. It seems that the necessity for constant adaptation to different site conditions and different use requirements means that, in the end, it is usually cheaper to build in bricks and mortar. Meanwhile, the mass production of certain building components has increased steadily. Windows, doors, curtain wall mullions, raised floors and suspended ceilings are mass-produced to standard patterns in factories and it is now commonplace for buildings to incorporate whole systems of components. Even buildings that are apparently thoroughly traditional turn out to contain many non-traditional synthetic components and materials, such as asbestos tiles, glass fibre insulation, steel joist hangers and plastic windows. Building has quietly been industrialized, as it were, behind the architect's back. The technology has changed profoundly, but the architecture has not. High Tech architects want to bring buildings back into line, not by returning to traditional building technology (though this is a possibility seriously proposed by present day neo-classicists), but by creating an architecture that looks mass-produced and machine-like.

There are two obvious answers then, to the mass production problem. The first is to design, develop, manufacture, and market a standard building. This is what Michael Hopkins has tried to do with his Patera buildings. These are simple but extremely refined, small factory/office buildings. Their details have been developed in collaboration with the manufacturer just as if they were vehicles or consumer products. And they have the approved, High Tech, machine-like appearance. They are, however, not cheap and they have failed to find a mass market among the small, go-ahead, image-conscious businesses for which they were designed. It seems that once again bricks and mortar, or their equivalent, have triumphed over the Model T building.

The second answer is to make buildings entirely out of catalogue components. The most famous example of this approach, and one which has had an enormous influence on High Tech, is the Eames house of 1949 in Pacific Palisades. The tradition is carried on in California, mainly by the German architect Helmut Schulitz. However, in Britain, the heartland of High Tech, there seems to be a resistance to using mass-produced building products straight and unmodified. Partly, no doubt, this is because of what these British architects consider to be the poor visual quality of these products. A plastic-framed window with fake Georgian glazing bars is a highly developed, mass-produced component made entirely of synthetic materials but it is likely to be dismissed with contempt by a Richard Rogers or a Norman Foster. Somehow, the various proprietary components and systems never quite come up to these architects' exacting standards. It is not unusual, therefore, for a High Tech architect to invent and develop his own components and systems and to have them custom-made in small, specialist workshops. The essential thing is not that the component in question, be it glazing mullion, aluminium flashing, steel truss, or pipe sleeve, should be mass-produced, but that it should look right. High Tech has its own flourishing craft tradition.

The other way to solve this aesthetic problem is for the architect to collaborate with product manufacturers in the development of component systems. This often happens in an informal way. A technical representative visits the High Tech architect's office and is promised an order, provided he can alter this profile, conceal that fixing, get rid of that ugly junction. The modifications are made, the deal is done, and the system passes into that select group of products that have the approval of this most demanding group of architects.

Occasionally, in the biggest projects, the collaboration between architect and product designer is formalized. The best example of this is Norman Foster's HongkongBank Headquarters in which all the main elements of the building, including the curtain wall, structure cladding, service modules, floors, ceilings, partitions, and furniture, were designed, developed, and tested by architect and manufacturer working together. Norman Foster has given the process a rather vague title; he calls it simply "design development". A certain percentage of the building budget was allocated to design development from the start, in the same way that a car manufacturer might invest in the development of a new model.

The difference is that in building it is the client, not the manufacturer, who pays, which is the reason why design development is so rare.

Foster's great achievement in Hong Kong was that he managed to raise the real quality and sophistication of building technology, instead of merely presenting the image of quality and sophistication. For Jan Kaplicky, however, who once worked for Foster, this is not enough; he feels there is still a very long way to go. Kaplicky is the technological conscience of High Tech. For him there must be no self-deception. He refuses to pretend that merely to use metal, glass, and Neoprene adds up to anything that can be described as "high technology". He wants to bring real high technology, especially the technology of the aerospace industry, to bear on the problem of building.

His is a futuristic architecture, an architecture of "if only": if only structural engineers would abandon their primitive analysis techniques and confront the structural possibilities that modern metallurgy offers; if only someone would develop an airship with sufficient lifting capacity to carry big, prefabricated pieces of buildings; if only some manufacturer would be prepared to make the necessary investment to mass-produce, for example, a complete, integrated bathroom capsule. For the present it remains a dream of a possible future, and Kaplicky's projects (apart from those commissioned, significantly, by NASA) remain theoretical. The building industry, it seems, is not yet ready for real high technology.

4. Structure and services - The glorification of technology

Exposed structure and exposed services are the two most visible distinguishing features of High Tech architecture, even though not all High Tech architects expose the structure and services of their buildings as a matter of course. In fact this is one of the most important stylistic differences between the two leaders of British High Tech, Norman Foster and Richard Rogers. Rogers loves to drape pipes and ducts all over the facades of his buildings, even if it means that every one has to be separately insulated, protected from the elements and made accessible for maintenance. There is a functional justification, of course (the "differential life span" argument - see below), but Rogers also frankly admits that the picturesque effect, the play of light and shade, is equally important. Foster, on the other hand, almost never exposes service ducts, and certainly not on the outside of the building. He prefers to tuck them away behind suspended ceilings, raised floors, and diaphanous screens (see the insides of side walls of the Sainsbury art gallery, for example). Rogers loves the bristling, visceral composition; Foster loves the slick, clean skin.

Both, however, are tempted by the expressive power of structure, especially steel structure. Steel is one of the very few building materials that is strong in tension. Given High Tech architecture's tendency to dramatize the technical function of building elements, it is not surprising that steel tension members should be given such prominence. Bear in mind also that the staple diet of the High Tech architect has been the simple industrial shed, a building type that often can hardly be described as architecture at all. At first the shed was made into architecture by providing it with a shiny metal skin, bright colours and bold graphics. But there is only so much that can be done with such a limited palette, and before too long High Tech architects began to experiment with elaborate decorative tensile structures. Of all the innovative features of that seminal building, Foster and Rogers' Reliance Controls Factory in Swindon of 1967, it is the external steel cross-bracing (much of it structurally redundant) that has had the most influence on High Tech architecture down the years.

At first it was simply a matter of putting the lattice trusses above the roof rather than below (see, for example, the Patera buildings by Michael Hopkins - though these are actually portal frames, not trusses) but this was soon elaborated into a series of variations on the mast and suspension rod theme. All four of the major British High Tech architects have explored the dramatic potential of suspension structures: look at Rogers' Inmos factory, Foster's Renault warehouse, Grimshaw's Oxford lee Rink, and Hopkins' Schlumberger laboratories. There are not many good, practical reasons for putting a steel structure on the outside of a building, but plenty of reasons for not doing it. It is exposed to the weather and, therefore, in most cases, needs more frequent maintenance. Painting masts and cables is not an easy or cheap job. And when a roof is suspended from above, it is necessary to puncture the roof membrane at the points of support, creating weak points in the weatherproofing.

Much ingenuity has been applied to solve these problems. At the Oxford Ice Rink, for example, Grimshaw specified expensive but maintenance-free stainless steel for all the tension rods and cleverly minimized the number of points of support by including a heavy internal spine beam. But the technical disadvantages of exposed steel structures remain, and no amount of "justification" (more economical foundations, column-free interiors, increased flexibility) can dispel the conviction that the real reason for their popularity among High Tech architects is that they convert ordinary factory sheds into colourful works of architecture. Black is quite common (Oxford Ice Rink and Schlumberger laboratories) but primary colours are usually preferred for the painted steelwork.

The classics of the type are undoubtedly the Inmos factory in Newport by Richard Rogers and its American sister, PA Technology, Princeton. In these buildings the masts have a double function. They support the roof beams via tension rods, but they also support the mechanical plant over the main circulation spines. This congruence of plan, structure, and services has great conceptual elegance and formal power. These are relatively small buildings, but they have a big architectural presence.

The contribution of the structural engineer to the design of buildings such as these is obviously very important. Two names dominate High Tech engineering: Peter Rice, who designed the PA Technology structure, and Anthony Hunt, who was the structural engineer for no fewer than seven of the buildings illustrated in the main section of this book.

A single-storey building can expose its steel structure to view in all its muscular, metallic glory. But the frame of a multi-storey building must be fireproof. Traditionally, that means either using reinforced concrete or, if the frame is steel, encasing it in concrete. Neither of these is likely to meet with the approval of High Tech architects for whom dry, factory-made, bolted steel is always to be preferred to wet, messy, cast-in-place concrete. At the Centre Pompidou, the problem was solved by a combination of water-cooling for the columns, dry insulation for the trusses, and spray-on fireproofing for the joints. These techniques, however, have not been without their technical and maintenance problems. When Richard Rogers came to design the structure of Lloyd's of London, water cooling was considered in the early stages, but eventually the decision was made to play safe and opt for a combination of cast-in place and precast concrete. As a result, the structure, though of very high quality, plays a secondary architectural role.

The structural frame of Foster's HongkongBank Headquarters, on the other hand, could hardly be more prominent. The floors are not supported on columns in the normal way, but hang from structures very like suspension bridges (known to their designers as “coat hangers”), which in turn are supported by eight massive masts. The original reason, or rather justification, for this unusual structure was the early requirement to retain the old Bank building during construction. This idea was soon abandoned, but the tension structure remained. It offered certain advantages, such as a completely column-free plaza beneath the building; but more important, it had become an essential part of the architecture. The opportunity to use the tensile strength of steel and to give it full expression both inside and outside the building was too good to be missed, even if it meant breaking one of the unwritten laws of High Tech: that materials should always be used with complete honesty. Because the steel had to be fireproofed, by means of a special ceramic fibre insulating blanket, it was then necessary to encase every column, beam, brace and strut in aluminium in order to preserve the smooth, metallic finish essential to the High Tech aesthetic.

5. Space and flexibility - The omniplatz

The various elements of a High Tech building - the muscular steel structure, the smooth, impervious skin, the deliberately exposed pipes and air ducts - are often powerfully expressive of their technical function, but the form of the complete building is often remarkably inexpressive of its intended use. The moulding of space, whether to suit particular patterns of use or simply for visual effect, has never been an issue in High Tech architecture. The Lloyd's building illustrates this distinction perfectly. Externally it is an extremely complicated object, the elements of which are very clearly articulated and expressive of their functions. There is absolutely no ambiguity: it is perfectly clear which elements are the staircases, which the lifts, which the air ducts. The only possible doubt is about the nature of the internal space being serviced by all these technical contraptions. A glance at the plan reveals the space to be the plainest of rectangles pierced by a central atrium. The purpose of the complicated exterior is precisely to keep the internal space as simple as possible.

The issue of space has been replaced in High Tech architecture by the more technical issue of flexibility. The idea is summed up in the word "omniplatz". What we are providing, say the High Tech architects, is not an enclosure - a room or a hall or a spatial sequence - but a serviced zone. It might be internal or external. The possible uses of this zone are maximized by providing facilities of various kinds - air, heat, light, power, and something to fix partitions to on a regular grid.

The most obvious example of this is the building that, more than any other, gave the High Tech style its momentum through the 1970s, the Centre Pompidou. As with Lloyd's, there is a contrast between a simple, abstract, rectangular floor plan and a complex, technically expressive exterior. This, however, is a multi-functional building with art galleries, museum, library, theatre, concert hall, and restaurant. Still, the basic elements of the interior, including the massive long-span trusses, remain the same, whatever the function. Space cannot be committed to a single function because the whole design is committed to the idea of flexibility.

Of course there is nothing exclusively High Tech about the omniplatz idea. Most modern office blocks allow a degree of flexibility in the placing and moving of partitions. But the High Tech philosophy takes flexibility a stage further. It introduces the idea that not just partitions but also more permanent elements, such as external walls, roofs, and structural frames should also be demountable. External walls are the common subjects for these exercises in additional flexibility. The elevation, like the plan, becomes an abstract grid that can accommodate a number of different functions: an insulated panel, a door, an opening window, or a metal louvre. When the function of the space changes, the configuration of the external wall can respond accordingly. And because it is an assemblage of tough, dry components, the change can be made in a matter of minutes with simple tools and no mess. That, at least, is the theory. In practice clients very rarely find it necessary to carry out such alterations, but as with so many aspects of High Tech, the abstract concept is at least as important as the practical reality.

It is much less common for structural elements such as frames, floors or roofs to be made demountable in any practical sense. Nevertheless, the idea is often implied in the form of the buildings. The Centre Pompidou, Lloyd's and the HongkongBank are all "incomplete" forms. At the Centre Pompidou, sections of the upper floors are omitted to form open roof terraces; at Lloyd's, the simple hollow rectangle of occupied space is eroded on one side in response to the scale of the surrounding buildings; at the HongkongBank, the three elements of the tower rise to different heights and the upper floors are cut back at the sides, between the main structural masts. All these buildings are open-ended and incomplete, so that floors and other elements of structure could be added or taken away without destroying a perfect composition. Once the principle of general demountability has been established, the building becomes not a single artefact, which will one day wear out or outlive its usefulness, but a collection of artifacts of different types and with different life expectancies. This is the theory behind the High Tech habit of hanging mechanical equipment and services on the outside of the building instead of burying them in the core or basement. The main reinforced concrete frame of a building like Lloyd's is virtually indestructible; it will last forever. The air handling plant, lift motors, wiring and ductwork, on the other hand, might be expected to last 15 or 20 years at the most. It makes sense, therefore, to place them outside the main volume of the building where they can be altered or replaced without interrupting the use of the internal spaces.

6. The plug-in pod - A practical strategy

There is one High Tech device that combines the various preoccupations with flexibility, demountability, renewability, and mass production. This is the plug-in pod. The sources of this idea are many and various. Buckminster Fuller, the Japanese Metabolists, Archigram, the container revolution, and the development of the offshore oil platform all have made their contributions. The idea of the bathroom pod has been around since at least 1937, when Buckminster Fuller designed the steel prefabricated Dymaxion bathroom. More recently, in 1967, the youthful Nicholas Grimshaw, then in partnership with Terry Farrell, produced a conceptually very advanced cluster of bathroom pods spiralling around a central pipe duct in a circular, glass-clad tower. The tower plugged into the back of nineteenth-century housing converted into a student hostel. Grimshaw has also designed stainless steel toilet modules, suitable for mass production, and installed prototypes in his economical industrial buildings.

For Japanese Metabolists like Kisho Kurokawa the plug-in pod was not just a service module, it was a personal dwelling capsule. The Nagakin Capsule Tower of 1972 is a building composed almost entirely of plug-in pods, and no doubt owes a great deal to Peter Cook's Plug-in City project of 1964 - a whole city of plug-in pods.

But the best examples are again those two High Tech tours de force, the Lloyd's building and the HongkongBank. It is the Lloyd's building that gives the idea clearest expression. 33 shiny, stainless steel-clad boxes with round windows are stacked up in concrete-framed towers like shoe boxes on racks. The boxes, or pods, contain the toilets, perhaps the most architecturally expressive toilets ever built. It appears that the concrete frames were built first and the pods slotted in subsequently. Visually, the clear implication is that the pods can be unplugged and replaced by new pods when they wear out, or perhaps that they might be moved to another location in response to some alteration in the use of the building. But in fact the two elements, frame and pods, were assembled in parallel, floor by floor, and it would be extremely difficult to separate them. As usual with High Tech, the idea and its visual expression are as important as the practicality.

The equivalent pods at the HongkongBank are slightly different, both in function and expression. As at Lloyd's, they contain the toilets, but they also contain the localized air handling plant. At Lloyd's the possibility of the building owner ever wishing to replace the toilet pods is very remote. Toilets do not, after all, wear out very quickly. Air handling plants do wear out quickly, and it therefore makes more sense for the Hong Kong pods to be unpluggable. In fact, however, they too are permanently fixed in place, and the stacks of pods have been clad in a continuous aluminium skin so they do not even look unpluggable.

But renewability is only one of the reasons for the use of plug-in pods. The main reason, and an eminently practical one, is that it enables complicated and highly finished parts of the building to be made on a production line and shipped to the site complete, fully fitted out and tested. This offers three important advantages. First, it speeds up work on site, since the building and fitting out of the pods can proceed in parallel with the construction of the main frame of the building. Second, it improves the quality of the product, which is being made in clean, controlled workshop conditions, and not in the chaotic and dirty environment of the building site. Third, since mechanical plant, pipework and ductwork are being installed at ground level on a production line with access all round, it can be arranged much more compactly. (This, of course, might turn out to be a disadvantage if the plant has to be replaced at a later date, in position in the building.)

All these are real, practical advantages. There is one more possible advantage, but here again we are in the realms of theory rather than practicality. One might assume that all the pods for one building, and possibly the pods for several buildings, would be identical and therefore suitable for mass production. This would be the High Tech ideal: to make buildings, or at least substantial parts of buildings, the way cars are made. In practice, however, this seems to be almost impossible to achieve. Buildings are just too big, too complicated, and too specialized. There are 139 service pods in the HongkongBank and no two are identical.

7. The typology of High Tech

The whole idea of a building typology based on function or use seems irrelevant when the aim is to make buildings flexible enough to adapt to almost any use. In practice, however, High Tech is commonly associated with a rather narrow range of building types.

The typical High Tech building is a factory. In fact, so pervasive has been the influence of the High Tech style on factory design that we can now almost say that the typical factory is High Tech. The old factory archetype - a brick-clad building with a saw-tooth north-light roof and a tall chimney - has been replaced by the shiny metal-clad shed painted a bright colour and decorated with bold graphics. High Tech, of a more or less diluted kind, has become a sort of vernacular for factory building. Norman Foster's Modern Art Glass factory at Thamesmead or Nicholas Grimshaw's Herman Miller warehouse at Chippenham are only slightly more elegant versions of the metal shed that is common on industrial and research parks all over Britain.

The factory type, defined as a long span structure with a simple skin enclosing an undifferentiated space, has been adapted in recent years to house other functions. Supermarkets, leisure centres and even art galleries are likely, these days, to resemble factories in their basic form. They have therefore become suitable cases for the High Tech treatment. Look, for example, at the Sainsbury supermarket in Canterbury by Ahrends, Burton and Koralek; the Link Centre in Swindon by Thamesdown Borough Council; and Foster's Sainsbury Centre for the Visual Arts at the University of East Anglia. Modern offices, too, especially those sited in so-called “science parks", are likely to be housed in High Tech sheds. Indeed, as modern industry becomes cleaner and quieter, the distinction between office and factory becomes increasingly blurred. The factory has taken over from the house as the characteristic modern building type.

It is in housing that the influence of High Tech has been weakest. Here we have to make a distinction between house and housing. There are plenty of examples of individual houses that are thoroughgoing exercises in the High Tech style. It may be significant, however, that a high proportion of these ore occupied either by their designers or by relatives of their designers: the Hopkins House, the Schulitz House, the Rogers House, the Benthem and Crouwel House, and so on. High Tech of the purest kind creates a hard, metallic, austere environment that few people would describe as domestic. The very few examples of High Tech mass housing, such as Foster's housing at Milton Keynes, have not been successful. When High Tech architects tackle housing, they commonly resort to traditional building methods and materials.

If High Tech is biased toward certain building types, it is also biased toward certain types of client. It is perhaps not surprising, given High Tech architects' enthusiasm for industrial technology, that their clients should commonly be industrial and business corporations. By transforming the imagery of manufacturing industry into an architectural style, High Tech reinforces industrial capitalism's claim to be working for the general good. It is the willing servant of industrial society, ready to receive instructions from those in power and carry out its task conscientiously. When it adopts a critical stance it is usually on a technological and institutional rather than a political level.

The Centre Pompidou is designed to break down the traditional boundaries between different forms of high culture and make them accessible to a wider public. To that extent it is a critical statement. It claims to be neutral and value free, a multi-purpose tool to be used and enjoyed in many different ways. But it is also on obvious celebration of industrial technology and therefore, despite itself, transmits its own clear cultural message. Some of High Tech's critics - the promoters of "community architecture", participatory design, and alternative technology - are quick to point out that advanced technology has its dark side. For them, High Tech architecture is a glorification not of technology itself, but of "the military/industrial complex".

8. Revolution versus continuity - High Tech and the city

High Tech's natural affinity with the factory as a building type has important implications for its relationship with the city. The three biggest and most important High Tech buildings - the Centre Pompidou, Lloyd's and the HongkongBank - are city buildings, and their architects would certainly claim that an urban context had a profound effect on their design. Nevertheless, it is true to say that urbanistic concerns, like the manipulation of space, are not a major element in the High Tech philosophy. For the High Tech architect, space is an abstract entity that is devoid of specific qualities until it is inhabited and adapted by its users. But for the urbanist, or contextualist, space is necessarily specific because it is defined by its relationship to the context of the city.

Take, for example, the Lloyd's building. It occupies on irregular site bordered by streets and alleyways of different scales with very different spatial qualities and patterns of use. The building responds to these irregularities only in a limited way. The boxlike form of the main volume steps down on one side to acknowledge the difference in scale of the surrounding buildings, and the service towers are arranged to fit into the leftover corners of the site. But these are adaptations of a perfect diagram, and it is the diagram that takes precedence. It is as if the city were not allowing the building to be what it wants to be. Freestanding buildings on green field sites (the Inmos factory, for example), which do not have to adapt to their context, are more characteristic of the High Tech style.

Foster's Willis, Faber and Dumas office building in Ipswich is another case in point. It fits its irregular site perfectly, its all-glass, serpentine external wall conforming precisely to the site boundary. Claims have been made for it as a contextual building because it reflects (literally) the older buildings that surround it. The reflective serpentine wall, however, is just another way to adapt a centralized, inward-looking, diagrammatic, spatially uniform and typically High Tech plan. Of course most building plans can be reduced to diagrams, which is not in itself anti-urban. But it is a question of priorities. One only has to look, for example, at the recent work of James Stirling to see the very different architecture that results when context is given priority over diagram.

There is another reason why urbanism is not a major element of the High Tech philosophy, and that is its lack of relationship with the past. High Tech is a forward-looking, optimistic architecture that believes in progress through industrial technology. It believes in invention rather than tradition, in temporary arrangements rather than permanent institutions, and in the ability to control the environment rather than adapting to it. If the city is the embodiment of tradition, permanence, continuity, and history then High Tech is an anti-urban style. High Tech buildings imply a revolutionary, rather than a traditional, view of the city. If a complete High Tech city were ever to be built it would be an abstract, fully serviced matrix or megastructure, flexible and demountable, like the utopian urban visions of the 1960s: Peter Cook's Plug-in City, Yona Friedman's "Ville Spatiale", or the indeterminate city structures envisaged by the Japanese Metabolists. In these theoretical projects, as in their built High Tech counterparts, structure, access, services and equipment are more important than space and place, whether internal or external, private or public.

9. From Ironbridge to the Challenger space craft - A short history of High Tech

Where did High Tech architecture come from? There are two useful historical perspectives, of long range and short range, of 200 years and 20 years. For the long-range perspective. we have to go back to 1779 and the construction Of the first cast iron bridge over the River Severn at Coalbrookdale. It is an all-metal prefabricated structure, completely honest in its use of materials and structural forms, but designed as much for elegance as for practicality. In the long term, this must be the favourite candidate for the title "first High Tech structure".

This may seem like far too remote a source for an architectural style born in the 1960s, but the bridge is still standing and we should not underestimate the influence of eighteenth- and nineteenth-century engineering structures on British architects. Decimus Burton's Palm House at Kew Gardens of 1848, the long-span iron, steel and glass roofs over the great railway termini built throughout the second half of the nineteenth century, Eiffel's tower and Contamin and Dutert's Galerie des Machines built for the Paris Exhibition of 1889, and of course Paxton's legendary Crystal Palace built for the Great Exhibition of 1851 -

structures such as these are enduring influences on today's High Tech architects. They represent an alternative mode of building, based on industrial technology rather than architectural tradition. High Tech architecture shares their confidence and optimism and also, to a large extent, their relatively primitive technology. Throughout the first half of the twentieth century it was to remain an alternative rather than a mainstream mode of building. The characteristic material of Modern-movement mainstream is reinforced concrete, exactly the sort of wet, in situ material that High Tech architects prefer to avoid. Mies van der Rohe is, of course, the exception, but building technology was never his primary concern. The most famous of Mies's construction details - the decorative steel pilasters on the Seagram building - has a dishonesty that most true High Tech architects would deplore. Nevertheless certain habits, the use of external structure, for example, can be traced bock to Mies .

Except in structures that we think of as "pure engineering", the alternative Modernism was kept alive mainly in theoretical projects, most notably those of the Italian Futurists and the Russian Constructivists. The perspective sketches of Sant' Elia's Citta Nuova, exhibited in 1914, are among the earliest depictions of an architecture that glorifies the technology of concrete, steel, and glass, and which gives dramatic external expression to lift towers, girder bridges, and elevated walkways. The similarities to the more sculpturesque examples of the High Tech style, especially the work of Richard Rogers, are striking. "We no longer believe in the monumental, the heavy and static, and have enriched our sensibilities with a taste for lightness, transience and practicality," wrote Sant' Elia in the catalogue to the Citta Nuova exhibition. "We must invent and rebuild ex novo our modern city like an immense and tumultuous shipyard, active, mobile and everywhere dynamic, and the modern building like a gigantic machine. Lifts must not longer hide away like solitary worms in the stairwells... but must swarm up the facades like serpents of glass and iron."[3] The Centre Pompidou and the Lloyd's building would be quite at home in the Citta Nuova.

With the Russian Constructivists we come even closer to the precise sensibilities of High Tech. Look, for example, at lakov Chernikhov's "Fantasies", the Constructivist equivalent of Sant' Elia's visionary drawings; or at Alexander Vesnin's project for the Pravda building in Moscow of 1923. This bristles with proto-High Tech motifs, such as diagonal steel cross-bracing, lifts in glass shafts and even what appears to be a satellite dish on the roof (in fact it is a searchlight). We can even begin, at this point, to trace direct and acknowledged influences on High Tech. In Western Europe, the influence of Constructivism was felt most strongly in the Netherlands and is most visible in the work of Mart Stam, who collaborated with El Lissitsky, the chief propagandist of Constructivism, and Johannes Duiker. Duiker's partner, Bernard Bijvoet, was to collaborate with Pierre Chareau in the design of the Maison de Verre in Paris, completed in 1932. This building is a curious assemblage of mass-produced, machine-like components with a flexible plan and an external wall made entirely of glass lenses. In 1959 Richard Rogers visited the Maison de Verre and he now acknowledges it as the building that has had the most influence on his architecture.

While Chareau and Bijvoet were designing the Maison de Yerre, Jean Prouvé was developing the first system af replaceable wall components for lightweight metal houses. Prouvé was to continue to develop his own, peculiarly French, metal and glass architecture right up to the 1970s. The extent of his influence on British High Tech can be gauged by Norman Foster's remark when he invited Prouvé to visit his office: "We would never have done all this without you."

Meanwhile, on the other side of the Atlantic, Buckminster Fuller was proposing an even more thoroughgoing application of advanced technology in his Dymaxion House project of 1927, a hexagonal structure of lightweight metal and plastic suspended from a core of mechanical services. If anyone deserves the title "father of High Tech" it is Fuller. His comprehensive and knowledgeable use of materials and technology borrowed from other industries (the Dymaxion House proposed an adaptation of techniques used in aircraft construction at that time), his insistence on a global view of building performance (architects, he said, should know not just how big their buildings were, or how much they cost but also how much they weighed), and his refusal to have anything to do with the conventions of traditional, academic architecture - these have all been built into the ideological structure of High Tech.

It was Reyner Banham, in the closing pages of Theory and Design in the First Machine Age,[4] who first introduced Fuller to British architects as a possible model for the future development or modern architecture. This was in 1960 and coincided with an outpouring of formally and technologically inventive projects from students and teachers at London schools of architecture. especially the Regent Street Polytechnic and the Architectural Association. The group called Archigram (Peter Cook, Warren Chalk, David Greene, Denis Crompton, Ron Herron and Mike Webb) began to publish and exhibit spectacular theoretical projects that clearly displayed many of the features of the High Tech architecture of the 1970s and 1980s: the indeterminate forms, the mass-produced, expendable, plug-in components, the use of technologies from the emerging aerospace industry and, above all, the idea that architects had a duty to increase personal, environmental choice. Architectural historian Robin Middleton has remarked that in the 1960s Archigram did for architecture what the Beatles did for music. Richard Rogers, Nicholas Grimshaw, and Michael Hopkins were all students at the AA. Of the big four' High Tech architects, only Norman foster, who studied at Liverpool school of architecture, was not directly exposed to the influence of the AA in the early 1960s. There is no doubt that projects such as Michael Webb's "bowellist" Furniture Manufacturer's Association Headquarters, a student project of 1958, Cedric Price's Fun Palace of 1963, Peter Cook's Plug-in City of 1964, and Ron Herron's Walking City of the same year were well known to Rogers, Foster and co. They were, after all, well known much further afield, largely due to the publicizing efforts of Reyner Banham. The capsule buildings of the Japanese Metabolists, for example, surely owe a debt to Cook's Plug-in City. But we must not make the mistake of assuming that High Tech is simply built Archigram. There were other, and possibly more important, contemporary influences, both British and American. Of the British influences, Alison and Peter Smithson and James Stirling are the most important. All were teachers at the Architectural Association at the relevant time. The Smithsons' Hunstanton School, designed in 1949 and sometimes described as "Miesian brutalist", was one of the very few British postwar buildings to be accorded any respect by the 1950s avant garde. It had a curiously formal, Palladian plan, but what made it revolutionary at the time was the way it displayed with complete honesty its materials - steel frame, brick infill, precast concrete floors, exposed electrical conduit and pipework, and a proprietary steel water tank raised on a freestanding steel frame like a campanile. James Stirling's Engineering Building at Leicester University, designed in partnership with James Gowan in 1959 and completed in 1963, is another historical marker in the development of British Modernism. A powerful composition in red tile-clad concrete and patent glazing, it combined constructivism, nineteenth century engineering, and the colours and textures of red-brick city of Leicester in such an utterly convincing way that it made James Stirling's international reputation almost overnight.

Both of these buildings can be seen, with hindsight, to contain the seeds of High Tech and both were, without question, powerful influences during High Tech's "student years". The influence of Stirling, in particular, must be emphasized. If it were not for his subsequent metamorphosis into Britain's leading Post Modernist, and therefore at the opposite stylistic pole from High Tech, we might now be describing his 1964 History Faculty library at Cambridge University as the first British High Tech building. It has so many of the High Tech motifs: a glass skin, a freestanding lift and service tower, a prominent roof-mounted maintenance crane, huge lattice trusses over the reading room and, most telling, three air extract units slung between the trusses, clearly visible from below and painted in primary colours.

Rogers, Foster and Stirling all come together for a brief period in 1962 at Yale University where Rogers and Foster were postgraduate students, collaborating for the first time, and Stirling was a visiting critic. The influence of American architects such as Paul Rudolph (then chairman of the architecture school at Yale) and Louis Kahn are detectable in some of the later High Tech buildings. Kahn's concept of "served" and "servant" spaces is especially important: compare the satellite servant towers of Rogers' Lloyd's building with the brick-clad service towers of Kahn's Richards Medical Research Building in Philadelphia, of 1961. But the strongest American influence was Californian - the simple, flexible, lightweight steel and glass houses of Charles Eames, Craig Ellwood and Raphael Soriano. These were illustrated in a 1962 book by Esther McCoy called Modern California Houses (republished in 1978 as Case Study Houses: 1945-1962), which was to be a source of inspiration for Rogers and Foster when they returned to England and set up in practice together under the name Team 4.

Team 4's first important building, a house at Creek Vean in Cornwall, could not remotely be described as High Tech. Concrete blockwork was its main material and its main influence was not Archigram or Eames but Frank Lloyd Wright. The only advanced technical feature was the Neoprene used to seal the sloping glazing. (The Neoprene gasket was to become one of the distinguishing marks of High Tech in its formative years.)

In the short-range, 20-year perspective of the history of High Tech, the title "first British High Tech building" must go to the simple, single-storey Reliance Controls Electronics Factory of 1967 at Swindon. Ironically this was the last building on which Rogers and Foster collaborated. It was Miesian in conception and owed a lot to the much larger Cummins Engine Company factory at Darlington, designed by the American firm of Kevin Roche, John Dinkeloo and Associates and completed in 1965. It had a simple rectangular plan, a fiat roof, and a freestanding water tower copied from the Smithsons' Hunstanton School. It would have been quite unremarkable were it not for the exposed steel structure (painted white), the flexible and extendable multi-purpose plan, and the way that it was rapidly assembled from dry, off-the-shelf components. This was the first of a long line of simple, elegant factory/office buildings designed by High Tech architects for High Tech (in the industrial sense) clients. It was instantly acclaimed by critics, won the Financial Times award for the most outstanding industrial building of 1967, and gave its designers the confidence to develop the new style with renewed energy.

A close rival for the title "first British High Tech building" is the glass-clad spiral of plastic bathroom pods designed in 1967 by Nicholas Grimshaw to plug into the rear of a Victorian house being converted into a student hostel by his then partner Terry Farrell. In Reliance Controls, the mechanical services had been hidden in a floor duct, so it was Grimshaw who first realized the plug-in servant tower concept that was to become a prominent High Tech motif in subsequent years.

The High Tech repertoire was now complete and for the next ten years each element was developed with ever-increasing confidence in successive buildings and projects by Rogers, Grimshaw, Foster and Michael Hopkins, who joined Foster's office in 1969. There was the slick glass and Neoprene skin of Foster's Amenity Centre for the Fred Olsen shipping line in the London Docks, the severely minimal single-storey office building for IBM at Cosham, designed by Foster and Hopkins in 1971, Farrell and Grimshaw's factories for Herman Miller, and a series of vehicle-like buildings and projects by Rogers, with highly insulated, zip-up skins and round-cornered windows fixed, once again, with Neoprene gaskets.

In 1970 Rogers entered into partnership with Renzo Piano, who had been developing his own, highly sophisticated Italian version of High Tech in his office in Genoa. In 1971 the new partnership entered and won the international competition for the design of a new national art and culture centre on the Plateau Beaubourg in Paris. With the Centre Pompidou, High Tech came of age. Pompidou had everything: flexible plan, exposed structure, plug-in services, and the glorification of machine technology. When it was completed in 1977, the image of High Tech suddenly came into focus, entered the public consciousness, and became an internationally influential style. Some of the best examples of that style, mainly from the decade after Pompidou, are illustrated in this book.

So the 20-year story of High Tech has a beginning, the Reliance Controls Factory, a middle, the Centre Pompidou and, just possibly, an end in the two masterpieces completed in 1986, the HongkongBank Headquarters by Norman Foster and Lloyd's of London by Richard Rogers. For there are signs that High Tech is running out of steam. The latest Rogers and Foster projects demonstrate a diminishing interest in technology and a new concern for the less tangible aspects of the complex relationships between people and spaces, and between buildings and cities.

Foster's design for a Mediatheque in the centre of Nîmes, opposite the Roman Temple known as the Maison Carrée, proposes a very un-High Tech palette of materials: concrete, bronze and local stone. On an early published sketch there appears the following note: “No diagonals in structure - must not look 'industrial'.” And Foster's abortive scheme for the new headquarters for BBC Radio in London is curiously subdued - a humble exercise in urban contextualism rather than a glorification of technology. Rogers, too, seems to have discovered the existing city as an architectural theme. When asked to provide a theoretical project for the 1986 Foster, Rogers, Stirling exhibition at the Royal Academy, he presented a scheme for the revitalization of London's South Bank. The scheme included a bombastic and highly technological new bridge across the Thames, but its main thrust was an almost Baroque realignment of vistas and reinforcement of public spaces.

But perhaps the most important change has been in the technological, rather than the architectural, climate. Technology has moved on and once again left architecture behind. There may be an architectural equivalent of the aeroplane or the lunar module, but there is no architectural equivalent of the silicon chip. The aerospace industry has always been the happy image-hunting ground of the High Tech architect but it no longer holds the fascination and promise that it did in the late 1960s and 1970s. Architectural scholiasts of the future, wishing to pin down the precise date of the death of the High Tech style, might well choose January 28th 1986, the day the Challenger space craft blew up in front of the watching millions. The cause of the tragedy, we now know, was the failure of a Neoprene gasket

Notes

1 See Buchanan, P. "A Nostalgic Utopia", *Architects' Journal*, 4 Sept. 1985, pp. 60-69.

2 See Pugin, AWN. *The True Principles of Pointed or Christian Architecture*, London, 1841, p. 1; quoted in: Davey, P. “Pugin Pointed the Wayt”, *Architectural Review*, May 1984, pp. 20-23.

3 Quoted in: Appleyard, B. *Richard Rogers*, Faber and Faber, London, 1986, p. 179f.

4 Banham, R. *Theory and Design in the First Machine Age*, Architectural Press, London, 1960, pp. 325-329.