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I. Inner-city regeneration: works and projects

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## THE SPANISH ARTS FESTIVAL

# I. Inner-city regeneration: works and projects

SANTIAGO CALATRAVA

*Architect and engineer*

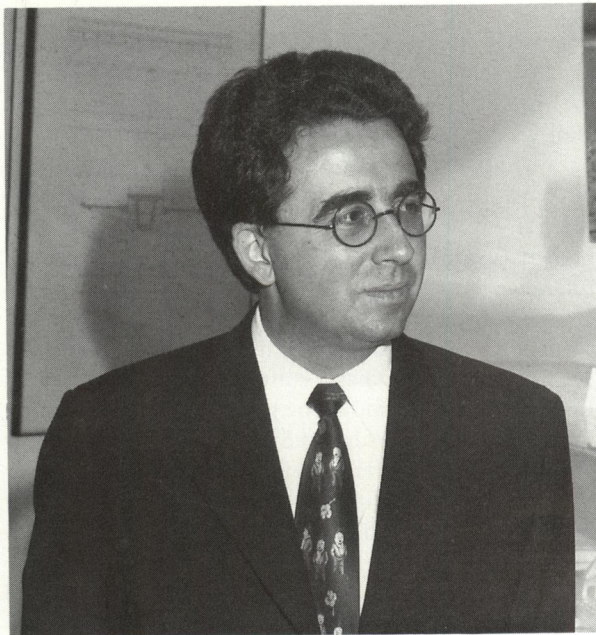
*Delivered to the Society on Tuesday 22 March 1994, with Neil Parkyn,  
architect and town planner and a member of the Society's Council,  
in the Chair*

*The first of three lectures sponsored by Cookson Group plc*

THE CHAIRMAN: Dr Santiago Calatrava is equally well known in this country today as he is in Europe. We can place him securely in the tradition of what are known as the *grands constructeurs* in Europe – the architects and engineers who shaped major structures that have become landmarks in their own right. His interest extends to structural pioneers such as Felix Candela, Robert Maillart and Gustave Eiffel. In this country we had Sir Owen Williams in the 1930s and, still very much active, Sir Ted Happold, former Master of the Faculty of the Royal Designers for Industry. After a false start with the East London River Crossing bridge, a Calatrava design that

achieved great fame but sadly was not built, he tells me that his footbridge at Salford Quays is to go on site in May and will be finished by the end of 1994. We are delighted that we shall at least soon see a project of his realised in this country.

One of Dr Calatrava's heroes is Isambard Kingdom Brunel, the celebrated British engineer. In his biography of Brunel, written in the 1970s, L. T. C. Rolt concludes of Brunel, but I also think one could say this about Dr Calatrava: 'There are some few men, rare in any age, who are mysteriously endowed with such an excess of creative power that it can be truly said they were born to greatness.'



*Dr Santiago Calatrava*

I would like to explain some of the fundamental approaches applied for the various products of my practice. First of all there is the concept of forces, the understanding of forces at play. This is the approach of the engineer, the use of forces with which one can work, transform and compose. Secondly, there is the concept of kinematics and movement. Thirdly, there is a very abstract and formal approach to architecture, applied and expressed through construction and the use of materials.

### THE CONCEPT OF FORCES

The Alamillo Bridge in Seville has a span of 200 metres and the pylon has a height of 142 metres. In designing a bridge you have not only to support the loads to be carried, but also to separate the circulation of motor traffic and pedestrians. In this case we chose to provide for the pedestrians through a raised pavement on the central section of the bridge. A more comfortable relationship with the surrounding traffic is achieved and pedestrians are safer there. The spine of the bridge



*Alamillo Bridge and La Cartuja Viaduct, Seville, 1987–92*

also serves as access to the pylon. Placed on top of the pylon is a small meteorological station.

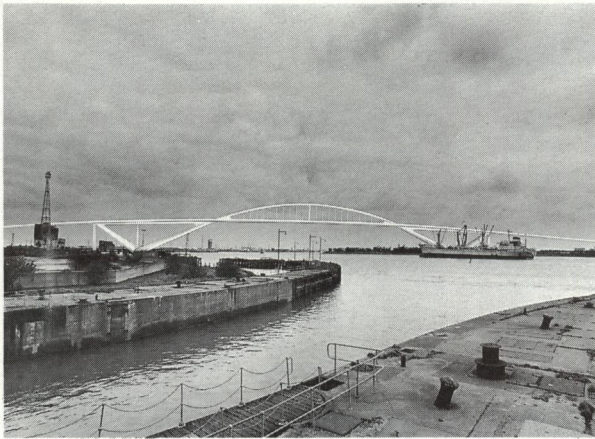
Behind the bridge there is a 500 metres long viaduct, the Cartuja Viaduct, separating the northern entrance to Expo '92 from the car park. We also tried to include another component – a bridge need not be viewed as having only one purpose. In this case the area under the viaduct is used every Sunday as a flower market.

Bridges sometimes have to be built in difficult locations. The Bach de Roda in Barcelona was just such a bridge having to connect two streets separated by railway lines in the El Clot area. My personal approach to this bridge – it was built in a very depressed area – was an attempt to illustrate how public works can be oriented to improving living conditions. People were living in small shacks around the railway; they were transferred into new apartment blocks and the land around the bridge and along the tracks became two parks.

We tried not only to provide a convenient crossing, but also to create the idea that a bridge is not just a

junction between two points but can also become a place, even if a very modest one – a balcony. In the middle of the bridge the pavement widens. The walkway is clearly separated from the traffic and 35 cm higher than the road level, giving more freedom to the pedestrian. The bridge, even if very modest – it was an extremely low-cost bridge – has become a symbol for its surroundings and a common reference point.

Bridges are built in an already existing landscape and we have to understand landscape as part of our culture. Landscape certainly has a cultural value, in the case of Lusitania an exceptional one because there is a Roman bridge, the oldest bridge in Spain, close by. Like in the Alamillo, we wanted to create a bridge comfortable for pedestrians to use as it links the two parts of the city of Merida more than half a kilometre away from each other. We divided the bridge into three parts of 200 metre spans each, the pedestrians circulating on a kind of promenade along the bridge. In a similar way to the other bridges, we emphasise the importance of



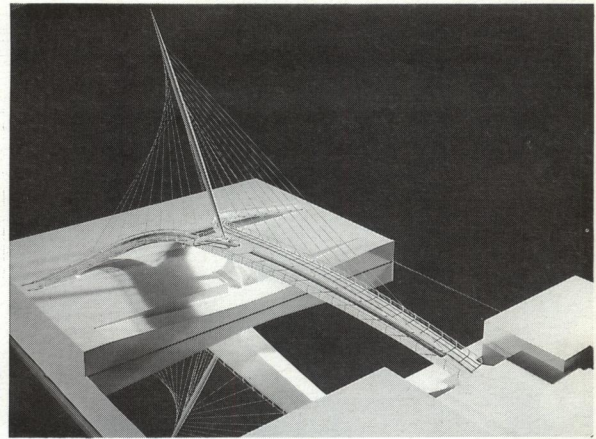
*East London river crossing, projected bridge, 1990*

sympathetic lighting of the bridge so that the silhouette of the Roman bridge is seen in the background.

The Gentil bridge in Paris was to be located near the Gare d'Austerlitz. Directly close by is the Pont d'Austerlitz and looking towards the centre of Paris the towers and spire of the Cathedral of Nôtre Dame can be seen. We proposed a unilateral arch that would be inclined. The engineers thought it was impossible to construct and so we went somewhere else to build it. It, or a variation of it, was built in the small community of Ripoll in northern Spain. A courageous mayor gave us the opportunity to experiment with a small footbridge of 70 metre span connecting to the station. It is made out of just two tubes – one horizontal and the other sprung. The arch is slightly inclined.

In the grandiose scenario of the River Thames, which at a certain point becomes one of the widest rivers in Europe, our idea was to propose an arch jumping almost from one side to the other with a span of more than 500 metres. With all height limitations considered due to the close vicinity of the City Airport and the passage of ships, we proposed for the East London River Crossing a kind of big gate between the sea and the city.

The small Trinity footbridge of 60 metre span across the Irwell is between Salford and Manchester and is now under construction. The idea is very simple. Through the asymmetrical solution, the juxtaposition of one side lying lower than the other is emphasised. The bridge silhouette enhances this equilibrium and at the same time tries to react to it. The footbridge close to St Paul's Cathedral in London would be an extremely



*Model of Trinity footbridge, Salford, opening 1994*

light steel bridge with a wooden platform, with a span of 170 metres in the centre.

A lot of inventions can be derived from observation of nature. Nature teaches us and we can learn from nature. Flowers, plants, trees, grass can serve as a measure for architecture. Nature can be approached in two different ways: we can learn from nature, from natural movement and we can imitate and interpret nature. The concept of metaphor is of interest here. Nature is so inherent and immediate to us and to all existence that when there is a reference to nature, whether for justifying or interpreting a situation, it can serve as a point of orientation for our thoughts.

In the project for the Cathedral of St John the Divine in New York the tree was used as a model: the foundations and crypt are like the roots; the nave, with the columns in its centre, is like the trunk and the crown could also be a place for the leaves, the birds, the light and for life. The competition called for a bioshelter to be added to the Cathedral of St John the Divine and this was the basic idea that we presented.

St John the Divine is built in a neo-Gothic style. In the 1930s the vaults in the cathedral and the dome in the centre were built. If you read Viollet-le-Duc on the origins of the Gothic, you will find that he says that it was probably invented in Anatolia (Turkey). Parabolic arches evolved there and later the pointed arch appeared which follows the line forces more effectively. They then invented buttresses, and also the idea of transepts and other features which can be seen in some of the caravanserais in ruins today. The basic structure of the Gothic design is still recognisable.



*Projected St Paul's footbridge, 1994*

How did the Gothic come to Europe? According to Viollet-le-Duc, it was the Arabs who brought the technique to Europe, particularly to Sicily. In the Norman palaces in Sicily the transition from the Arab and later so-called Gothic style can be seen. The Norman monks took it to northern Europe. There are also examples of the Gothic in Mediterranean areas such as Majorca, Perpignan and Montpellier, or even southern Italy, in which the vaults form the separation between outside and inside. You have flat terraces and then the terraces are supported on the vaults and the vaults are carried by the walls. If you go into St John the Divine and even Nôtre Dame de Paris, Chartres or any of the magnificent Gothic cathedrals here in England, you will see that the trusses of the roof (which are usually wooden if they have not been burned and changed to steel) transfer the forces directly to the walls. The walls simply define the interior space. Between them they support a huge empty roof space into which light can penetrate

through some holes. These are good places for pigeons to live.

We thought there might be an opportunity to use that space for the requested bioshelter. We proposed a new transparent roof for the whole Cathedral and also the construction of the incomplete north and south transepts. They would follow the pure order of the Gothic interpreted through modern techniques, using for example pre-stressed stone arches, with the transparent roof in wood and steel. The idea is to make the transepts more transparent by using glass windows, painted by contemporary artists, as, for example, you can see at Sainte Chapelle in Paris. The spire recreated would function as a kind of exchange chimney drawing convective air currents into the interior. The interesting thing about the bioshelter is that it follows the same plan as the Cathedral, taking the shape of a cross.

We won a competition to create a new public space, BCE Place, in Toronto, proposing a covered gallery. The Galleria, as it is called, was fitted in between and

tucked away behind existing buildings. We wanted to introduce a very light structure in metal and glass leading to Heritage Square. Its structure follows strictly the order of the columns of the existing buildings, of which one is rather old, the Clark and Gordon building. The transition from the Galleria to Heritage Square is marked by a large window that can be opened and closed.

We emphasised the importance of light, even introducing lighting through the paving, because on the level below there is a concourse, part of the city's underground pedestrian network. The enclosed space of the Galleria is merely public space – a kind of entrance hall to the different buildings.

At one stage I was very interested not so much in aspects of anatomy as how anatomy affects the architect. I arrived at the idea that the real working instruments of architects are not so much their hands as their eyes. The architect looks at things and through his perception and estimation he takes decisions, while also emphasising the importance of light as a construction material. I once made an eye – a kind of mechanical divertimento. It could open and close. It consisted of two major parts that came together and opened like eyelids.

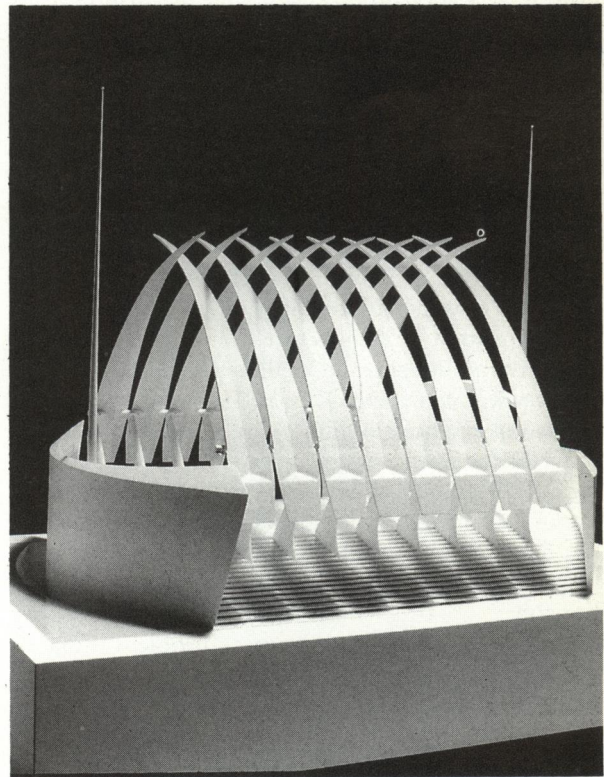
#### THE CONCEPT OF MOVEMENT

This idea introduces us to a new field of movement. My first attempt to introduce these valuable insights into movement in a building were with the doors of the Ernstings clothing factory in Germany. They are doors of a big delivery bay, each 13.5 metres wide by 6.5 metres high. The doors are hoisted upwards, operating in a similar way to the mechanical eye sculpture, and when open they form canopies as an entrance for the lorries that come and go. The two concrete pillars at either side protect the corners of the doors and are bigger than a man – each one is something like 2.30 metres high. The scale is such that one does not realise exactly how big they are.

When speaking of movement, you will see in understanding mechanical analysis that forces are made up of two components: mass and its acceleration. A force is the result of the product of a mass and its acceleration. Mass is the universal constant of each body whereby acceleration is variable. The most interesting thing is that in this simple formula, acceleration belongs to a kinematic variable. 'Kinematic' means a variable

for movement and in fact acceleration takes place in space and time. So in a force, time is also a variable because forces represent mass as a universal constant, and the product of acceleration, which in itself is a product of space and time. Therefore in fact forces are not permanent. You could say that forces are like crystallised movement. This is of course a very poetic and idiosyncratic interpretation of these matters. You could say that forces are things that could happen. But they do not happen because, like ice, they are crystallised. When you let them go, they immediately produce movement.

The small pavilion we designed for the State of Kuwait for Expo '92 was done in a hurry. The ground area is something like 16 metres by 12 metres. The idea was simple: we created an enclosed space for exhibitions and on top of it the floor area forms a small square. The covered square is entered between the columns that support the mobile roof. For the floor surface, we used marble cut into thin sheets and glued to



*Kuwait Pavilion, Expo '92, Seville, 1991–92*

glass. One can walk over it without any fear of damage. Daylight penetrates the marble to light the interior space, and at night, when the interior is lit, the square is lit from below.

The mobile roof is made of wooden fingers that interlock. Each one could move independently of the others as they were all motorised individually. Consequently, the shape of the pavilion could be altered and transformed especially at night, but also during the day, creating complementary forms to the closed state. Viewed from outside the pavilion became a kind of moving sculpture. When open the magnitude of the pavilion is revealed and it appears much bigger than it is.

Following this, we had the opportunity to make a non-function-related, purely sculptured piece for the Museum of Modern Art in New York – a white concrete sculpture machine. We tried to create a relationship to its surroundings, the weeping willows close by and even to the shadows on the ground of the Museum's sculpture garden. When the machine was in operation the large leaves or fingers moved wave-like, slowly, in a very orderly way, and the shadows cast drifted from left to right, as when one walks around a tree.

#### THE ABSTRACT CONCEPT

The third step is that of pure sculptural understanding: the sculptural element is one of the huge variables of architecture. We spoke about movement, in my opinion a fundamental variable which especially offers lots of opportunities. It is a source of inspiration and innovation in architecture. What was done with the Ernstings doors could be done for a whole façade. What was done with the Kuwait pavilion roof could be applied to a whole building which could open like a flower letting the energy in and closing together at night. There is a huge source of innovation when moving from the static understanding of forces into the dynamic understanding of forces with the same degree of safety. In my opinion it opens up a wide horizon.

Another, perhaps more classical, problem is that of form. Form and how to resolve the problems it presents in sculpture and architecture is a major goal. The span across Lyon Airport Station at Satolas near Lyon is 140 metres and the length of the station is 500 metres. The platform areas are concrete, and the central station hall

between the platforms had to be of steel. When developing such a strong form, the only way to get into the real discipline of architecture is to respect the logic and consequences of the construction processes and, following them, to give form to the different parts, understanding the shape of this or that piece according to whether it is a structural or functional member.

The central spine of the bird-like station hall, in the middle of the complex, is supported by a big concrete element at one end which not only takes all the forces but the rainwater as well. Opposite this focal element there are concrete buttresses supporting the steel roof arches. Between the arches is a distance of 140 metres.

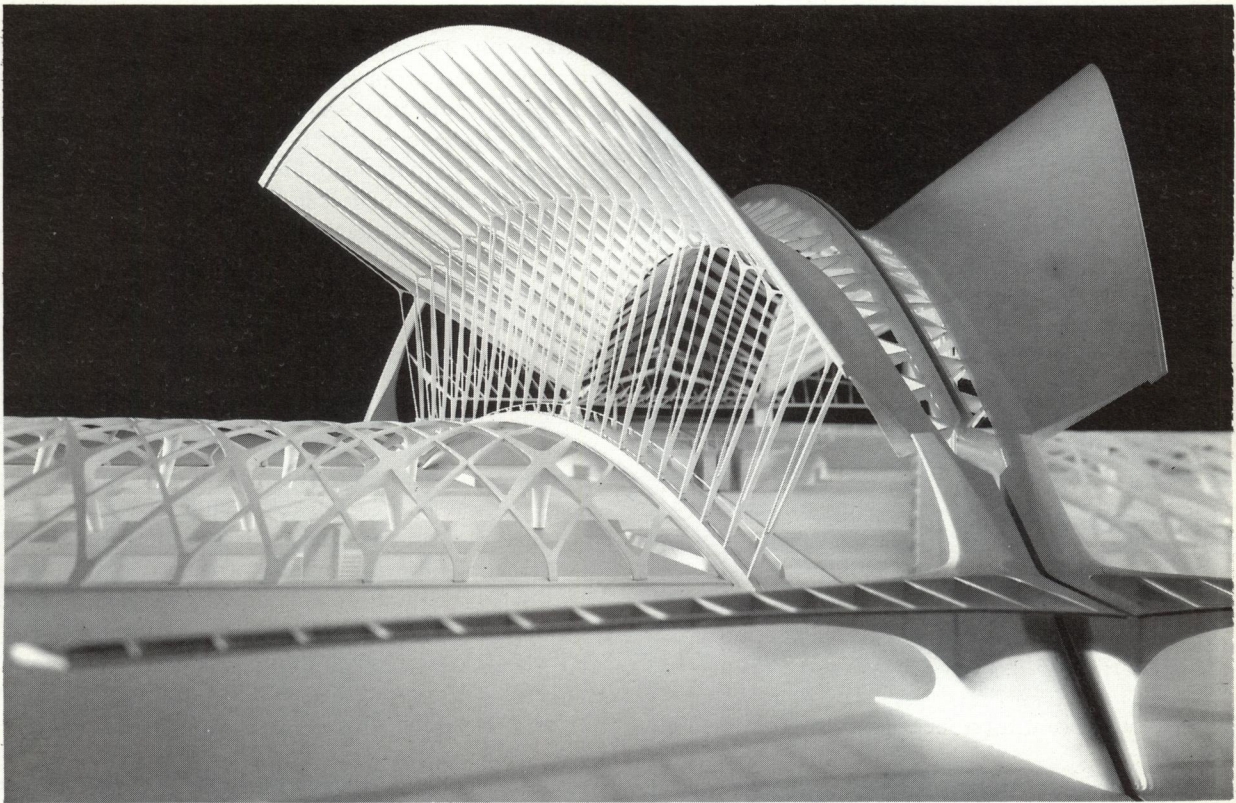
The side wings covering the platforms measure 250 metres and were made of concrete. They are modulated, with the modules fabricated almost industrially but on site. Two modules could be produced each week moving the formwork and laying the reinforcement anew. Within a very short time, after only 16 months, it was possible to open the lower and partly subterranean part of the station for train traffic.

The elements are sometimes completely perforated, sometimes they are half perforated and sometimes they are completely opaque. The two boxed-in tracks in the middle, are for trains that do not stop at the station and the tracks on either side are for those that do. In the centre, over the tracks of the through trains is the pedestrian walkway for passengers descending through stairs and elevators onto the platforms below.

There are naturally not many places for delicate details in a station because it has to be very resistant and robust in order to ensure low maintenance costs and because a station is just about always in use. However, we achieved what we could at, for example, the junction between handrails or landing platforms.

The roof structure of the platform areas is perforated in order to let light enter. Where it was not necessary the structure was not glazed. It became quite a filigree composition. However, it is strictly modulated and the modules again were all made equal, in order first of all for the structure to be built rapidly and also to achieve and maintain a competitive price.

Let us look at another example of the way the architect tackled the site. Of course the station in Lyon-Satolas follows principles of form. The site was quite undefined – it was an entirely open site, close to the airport, the only other existing building. Like the station complex, the airport terminal is a symmetrical



*Lyon Airport Railway Station, Satolas-Lyon, 1989–94*

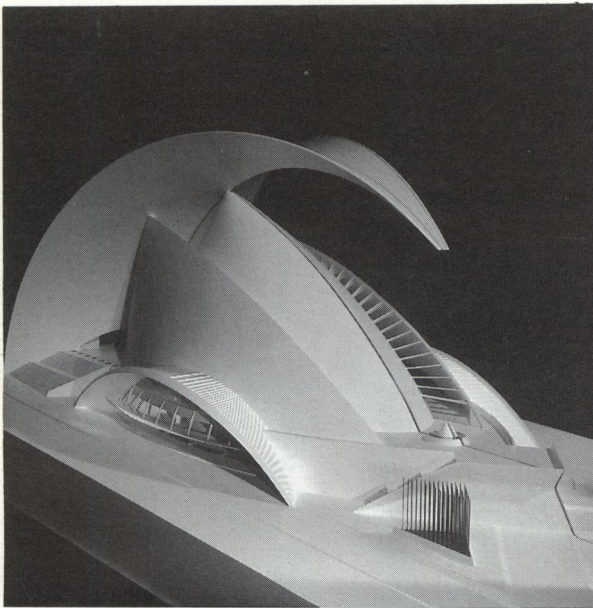
building, with a central part and two wings. We understood we should have freedom to introduce a strong form that would characterise the place. The strong presence of the station would in turn call for the whole area around it to be orientated towards it, including all future developments. Therefore we made a very clear, urbanistic statement.

We have also worked in dense urban situations such as Zürich. The Stadelhofen area is close to the opera house and the lake in a very delicate, beautiful area of Zürich. The station has always separated this area with its commercial activity from the quieter slope of the Ober Promenade in Stadelhofen. So we maintained this separation in our proposal. We built a transparent roof, a kind of canopy along the lower, lake side of the station. On the higher-lying side towards the hill we constructed a very solid balcony, supported by inclined columns of steel. As a promenade with a pergola it links the existing and new gardens to recreate and emphasise

the character of the area. Four bridges jump across the rails to the promenade. The platforms are connected by an underpass which is in effect a shopping area, in grey concrete with granite paving.

We also tried to integrate the lighting, in order to play up the expressive formwork renouncing any cladding of the concrete. That was also a means for economy. Although the formwork was more expensive than usual, exposed concrete turned out to be much less expensive than cladding a roughly cast structure.

The Tenerife Concert Hall is an expressive building. For the first time I renounced the use of two materials. Most of the buildings and projects I have worked on are designed of steel and concrete, the two materials being put together in a relation, similar to the sculptures, complementing and contrasting each other, creating a kind of tension. As on the Canary Islands there is no steel production of any magnitude, we decided to use lava stone – basalt and other volcanic materials. They



*Tenerife Concert Hall, 1991—*

have a lot of beautiful stones that could be mixed into the concrete.

We wanted to make a very open and inviting building. However, the auditorium itself had of necessity to be closed to outside noise. The auditorium will hold 1,800 seats and there is a smaller auditorium at one side for chamber music, seating 600. The stage can be adapted for small opera productions and yet it is wide and big enough to accommodate stage sets from all the world.

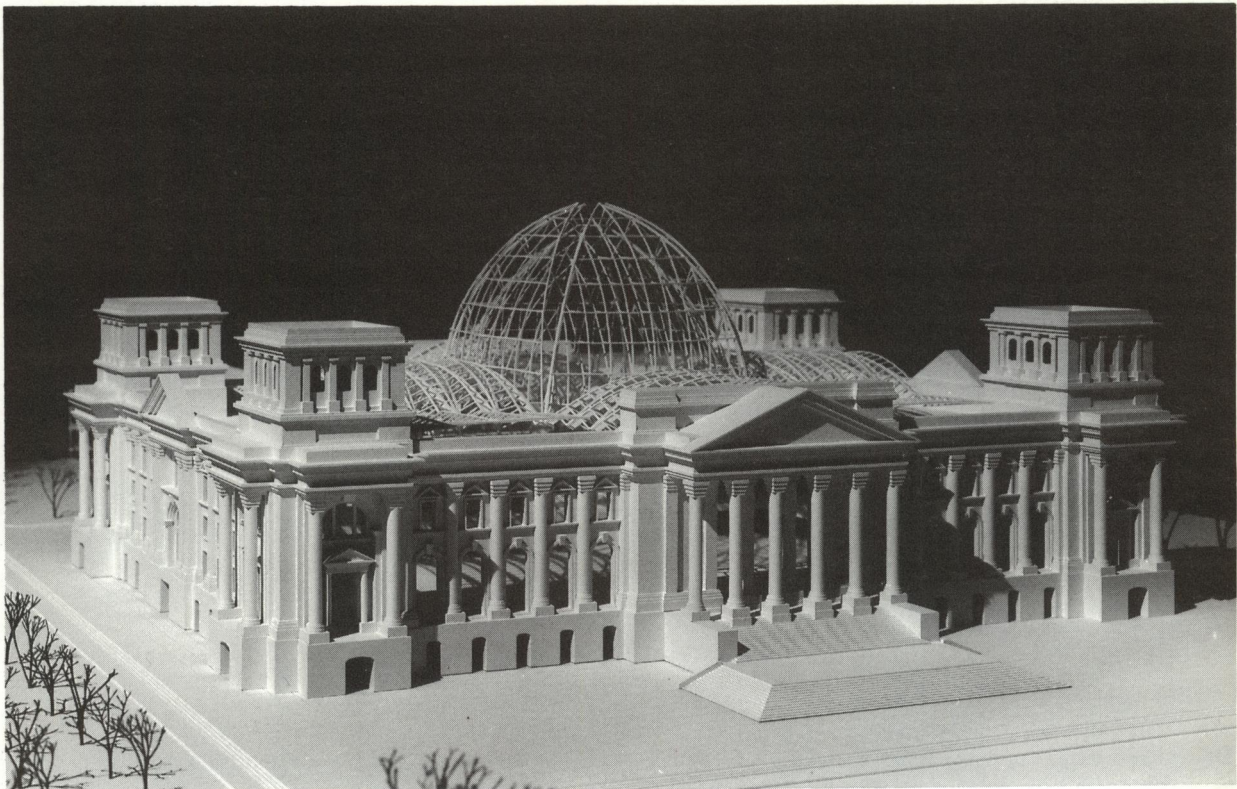
Finally, I would like to present our entry for the competition for the Reichstag in Berlin. The competition was held in two phases. The first phase was judged by a jury of architects. Our entry for this phase was based on an understanding of the Reichstag having an important place in the history not only of Berlin and Germany but also of Europe. Secondly, the Reichstag is situated on a crossing, one could say, between east, west, north and south. The building takes the form of a cross that was adapted by its original architect. I decided that the remains of the building must be left alone. You did not have to touch it or, for example, cover it. It did not need a roof of glass, because the roofs were there. It did not need to be complemented because it is outstanding enough as it is. This was one of the main principles of the first design.

The two other project entries that also won a first prize with ours were radically different. One project contemplated a roof of two and a half hectares of glass over the whole area of the Reichstag, with the offices placed outside in the front. The other proposed taking the chamber out of the building and putting it in front of the building, to one side, as an extension.

After the Reichstag burned down it was reconstructed in a short time and the whole centre or core was greatly altered. The cupola, partially destroyed, was taken down and even the courtyards were transformed but the outside of the Reichstag stayed almost the same as the original design by Paul Wallot. Baumgartner, the architect who conducted the renovations, made some alterations to the façades of the building, but very few. So I thought it very important to leave the outer structure of the building intact. Using the existing original structure we dropped a new construction into the middle of the building, ie the part damaged by fire, while hinting at the idea of the silhouette of the old cupola. As it is a classical building, if I want to treat it as a single object, I have to look at the internal relationship between its parts in order to achieve an equilibrium. At the time in which architects like Wallot worked, not only were there many cupolas or domes in the Berlin city-scape but also in this particular case the proportion of the whole building was strongly linked to the proportions of the cupola or dome.

The idea thus was to let light infiltrate into the interior and change the character of the building by easing its heaviness. It would become transparent and, if possible, a public place in which not only politicians but others could meet, rather as you see in the paintings of the Scola de Raphael. I thought of situating the assembly on the ground floor, with a roof that could open. It would be completely transparent so that people walking around on the upper floors or going up and down the stairs, as in the Altes Museum by Schinkel, could look in.

I conceived the building as a solitaire. Then I realised that the required accommodation could not be fitted into the building. The brief stated that it should be placed in the front of the building. That seemed absurd to me. Behind the Reichstag was the older Dorothea block mostly destroyed in the war. Only a small part still remains, the house of the President of the Bündestag. I decided to place the rest of the offices that could not be fitted into the interior of the



*Reichstag conversion, projected 1992*

Reichstag in the area of the Dorothea block behind the President's house. That is how we came up with the proposal for a galleria – underground and illuminated through glass blocks – linking the Reichstag to the Dorothea block. A large passage would connect the assembly hall directly with the Dorothea block, where the house of the President and the rest of the meeting rooms for the political parties and so on would be.

When studying Wallot's original drawings, I noted that the building had had a lot of extraordinary decoration – warriors and statues of people on horseback, pinnacles and even a big projection on the cupola. I decided that although most of this was not important, Wallot's cupola or dome was. I decided to follow the exact profile of the cupola in our proposal for a new dome that could be opened. In developing an understanding of the building, I thought it was not necessary to add any of the complementary elements back.

We proposed the Reichstag as a solitary, freestand-

ing building as it originally was, with its cupola fitted into the roofscape of Berlin with its many cupolas. We wanted to give back to the building some of its symbolic value. The dome would be made of glass and a light metal construction to ensure maximum transparency seen from afar but also in order to bring the light into the interior of the Reichstag. At night it would be lit from within.

A cross section through the Reichstag as if it is today, with the proposed structure dropped into the centre, ie on the axis of the building, reveals how daylight would illuminate the different floors. All floors or levels in turn would be directly connected to the cupola. Visitors would have views to the sky from the visitors' level. The assembly chamber would have an ocular-like transparent roof that could be opened by sliding it to the side. The politicians would be effectively seated below the cupola. The assembly hall would be related to the whole vertical space of the central core of the building.

For the Reichstag, as in the Kuwait pavilion, we would have liked to introduce semi-transparent floors made of laminated glass and marble, through which the light coming from the roof could penetrate down through the whole building to the level of the meeting rooms and the foyers around the assembly hall. This concept of transparency of the interior is essential.

For the second phase of the competition, three architects were chosen. The second jury was made up of politicians; no architects were involved. We were presented to the politicians on the basis of 'Here you have three architects – now choose the one with whom you want to work'.

We heeded some of the criticism of the position of the assembly hall and raised it into its original position. We also adapted and modified the space of the hall to

accommodate fewer members. Among our studies we also developed a possible square assembly hall. However, we kept the idea of the big open space above the hall and below the cupola. We also moved some of the party facilities out into the Dorothea block that had originally been in the Reichstag.

The other two architects also adapted the solution of the concept of the Reichstag as a solitaire, ie a free-standing object. The big roof disappeared, the assembly hall outside was drawn in and the Dorothea block with the offices was also developed by them because it could accommodate all the offices so well. This was in essence my solution and what it would seem happened in the second phase was that the politicians effectively chose my project – but decided to build it with one of the other architects.

## DISCUSSION

**BERNARD KAUKAS (Architect):** In your sketch of St John the Divine one detected a distinct note of Gaudi's Sagrada Familia. You appear to eschew 'post and lintel' architecture almost entirely in favour of the dynamism and thrust of those structural elements which need to be nicely balanced and resolved, so the result is like looking at an elegantly solved equation. Have you in any way been influenced by Gaudi?

**THE LECTURER:** On one of the few occasions when Gaudi travelled outside Spain, he went to Carcassonne to visit the restoration work of Viollet-le-Duc, with whose studies of the Gothic and *Dictionary of Architecture* he was apparently very familiar. Cesar Martinelle, Gaudi's biographer, says that he often spoke about the idea of perfection in the Gothic.

Many churches and cathedrals suffer from horizontal shift in the walls because the forces are often transferred in an awkward manner to the buttresses and pillars. Gaudi thought in systems of graphics statics that will re-create catenaries or parabolic arches bringing the resultant weight, always in compression, through the members into the ground. In La Capella de Sainte Coloma Gaudi developed, after many years, a special funicular polygon, out of wire, simulating the weight. It was a very important work, with an unbelievable feeling of space and beauty and, in my opinion, the technique he employed was extremely modern.

Gaudi's work is a great source of inspiration because it is so intense. I don't know if St John the Divine is as ambitious as Gaudi's Sagrada Familia.

**DHAO WOTANSEN (Building Contractor, Cottenham Design Group):** I went to Seville for Expo '92 and I shall never forget my first view of the city from at least 25 miles away. It was the spine of the Alamillo bridge, sticking up like an enormous sundial. I began to wonder why I had to go to Spain, France, or anywhere other than the British Isles to see these great structures. Our ancestors made magnificent buildings. Why are the British now so frightened of the monumental in architecture?

**THE LECTURER:** I have learned many things from British engineers and architects such as Brunel, Telford, and Stephenson. Sometimes a whole culture, the culture of engineering, is taken over by an academic understanding of this discipline, but in fact people like Brunel were almost anti-academic.

Europe was almost destroyed in the war. In the 1950s and 1960s it was necessary to develop roads, bridges, and stations very fast and extremely economically. Big offices specialised in making things quickly and cheaply. Today most of these buildings are not adequate in environmental and landscape terms, and some of them are in a very bad condition.

My generation of engineers has to rethink the rules without losing the spirit of Brunel and Telford, who built not only with knowledge and safety but also with inventiveness and freedom. Because of that they achieved a high expression of artistic quality, and the 20th century would be much poorer without those pure engineered buildings.

JOHN FIELD (Engineer): Some of my most satisfying experiences have been working with architects in situations that challenged both of us. However, the common experience in this country is that the engineers are on one side and the architects on another in their view of a project. Is it a question of education, and having separate professions? Did your upbringing in Spain lead you to combine the two professions, or will people like you always be one-off?

THE LECTURER: The derivation of the word 'architect' is from the Greek for 'chief' and 'building'. He is the one who says how the building is to be carried out on site. In my view there is no difference between architects and engineers. The man who commands the building of a bridge is as much an architect, in the etymological understanding of the word, as the architect of the great building we are in this evening. If we go back to the origins of the profession, we find that its ideals are utility, stability, and beauty. Vitruvius speaks in his tenth book about the machines of construction and techniques of site organisation, from the column to the canal.

The introduction of cybernetics and computing has had a revolutionary influence on the engineer's profession. The engineer has a vast responsibility, and calculation and mathematical analysis are important factors in the safety of a building. Today much of that work is done through the computer, and this permits engineers to work not only on one design but to analyse several variations in a short time in order to achieve a better result.

Understanding of the environment is another cultural good. All buildings have to be better adapted to their environment, in the city just as much as in the country.

BRIAN PARKYN: Eighteen months ago the world's first structural bridge made of reinforced plastic composites with a central span of 63 m, was constructed over the River Tay in Aberfeldy. Could your St Paul's bridge be made not of concrete and steel but of fibre-reinforced composite?

THE LECTURER: Concrete is a very old material. It was used by the Romans and the Arabs, and today it is probably one of the most economic materials. It is often called a non-ecological material. In my opinion it is ecological and it has the quality described in Spanish as *hormegon* – it can be formed. That is the importance of traditional materials.

The pioneering architects of the 20th century, such as Mies van der Rohe, admired engineers because engineers can move into new techniques and materials very easily. They can show the architects the way. First are the poets, painters, sculptors, and engineers. Architects probably follow later.

SANTA RAYMOND (Architect): Is there such a thing as national or regional architecture? Do you consider yourself a Spanish architect and that you design in a Spanish way? Do you design differently, depending on the country and local characteristics?

THE LECTURER: You must relate to the place where you are building, at least from the point of view of materials and building techniques, although these are becoming more universal. Cultures are coming together, but Spain will always be dry in the south and wet in the north, and England will always be a bit more humid, so it is necessary to understand the architecture of the two countries in different ways climatically.

As to whether I consider myself a Spanish architect: I was born in a village near Valencia, as were my mother and father. My wife has a Swedish mother and an Italian father. Our children go to school in England, Madrid, and Paris, although we live in Zürich. This makes things complicated but also extremely attractive.

THE CHAIRMAN: When you were showing us your design for a footbridge proposed for Paris, you said, 'We moved somewhere else to build it.' Your work seems to have a generality, but your designs can stand in their own right.

THE LECTURER: I have never reproduced the same design. That is not possible.

When people think something can't be built, they say the thing isn't stable. As this can't be tested, it can't be proved. This can make one negative, and can even drive one to attempt to define stability. In such cases you often have to look at the positive side of things. You will never appreciate the value of competitions if you respect their rules. Looking at things in a positive way is a good reaction to attempting to solve problems conceptually, but it must be adapted to local conditions.

The two bridges you mention were very different. One had a span of 170 metres, the other only 60 metres. One was for traffic, including two metro lines and the other a footbridge.

THE CHAIRMAN: I should like to conclude by reading a couple of sentences from a 1910 issue of the magazine, *The Engineer*. They are quoted in the introduction of L. T. C. Rolt's biography of Isambard Kingdom Brunel, to which I referred earlier. 'In all that constitutes an engineer in the highest, fullest and best sense, Brunel had no contemporary, no predecessor. If he has no successor, let it be remembered that . . . the conditions which call such men into being no longer have any existence.' This evening has surely been convincing proof that such a statement is now triumphantly untrue.