Zeitschrift: Bauen + Wohnen = Construction + habitation = Building + home : internationale Zeitschrift

Herausgeber: Bauen + Wohnen

Band: 24 (1970)

Heft: 4: Konstruktionssysteme = Systèmes de construction = Systems of constructions

Rubrik: Summary

Summary

On this Issue

The first part of the Issue deals with novel structures of plastic. The problems which come up in the development of plastics are exemplified in the work of the Italian architect Renzo Piano.
Z. S. Makowski in his Introduction presents a systematic survey of the potentialities of plastic substances as applied to the building trades.
Then two projects by Renzo Piano are presented.
The articles by M. Forné and N. Gough, "Flexible Polyvalent Construction System", take up the topic of "multi-storey building systems"; Jacques Bardet's "Town-planning system and first application in the 'La Nérac' Colony" and Marcel Lod's "Building system for 500 housing units in Rouen" deal with the same theme.
An example of the application of wide-span diagonal grid space-frame structures is the new hangar for jumbo jets in London.
The contribution by Hans Bieri takes up the application potentialities of paper and cardboard in the construction of furniture and exhibition equipment.
The special feature for this month is a Catholic parish centre by Kenzo Tange.
This month's contribution to the theme of construction research analyzes this field in the USA.

Plastics Structures of Renzo Piano

by Prof. Z. S. Makowski
Dept. of Civil Engineering, University of Surrey

(Pages 113–119)

Italy has lately been playing a leading role in the field of plastics, and that is perhaps why the work of Italian designers is so outstanding, for instance, that of the young and talented Italian architect, Dr. Renzo Piano. He was born in Genoa in 1937. He chose architecture as his main field of study, attending the architectural course at the University of Florence, and then obtaining his Doctorate in Architecture at the Technological University of Milan in 1964. During this time, Piano became involved in the research work being done by Prof. Giordano Forti, and, in 1962, as a member of a team consisting of G. Forti, B. Huet, R. Foni and C. Ruggeri, he participated in the design of a small prefab plastics holiday house. Renzo Piano was decisively influenced by this early contact with plastics materials. In fact, he decided to dedicate his life to the exploration of the architectural possibilities of plastics. Piano with a number of colleagues set up in 1964 a research and design institute dealing with plastics. This same year was also marked by another great achievement, the first plastics structure designed by Piano and constructed by his brother's firm, I. P. E. of Genoa. Piano has always gone on the assumption that plastics are just another building material. He approaches his problems with an original and unbiased mind. He fully realizes the limitations of plastics – he knows that plastics are expensive if any attempt is made to copy in plastics the shapes more appropriate for metal or concrete. He is aware, of course, of the low fire resistance of plastics. Nevertheless, he does realize the potential of this new material, and he feels that many designers are still not using it in the proper way. – "You have a material of low modulus of elasticity – you shouldn't use it as a direct replacement for steel or concrete – you have to use it in a different way. The methods of manufacture and assembly for plastics structures differ from those already tried out and accepted for other materials. Let us investigate them and explore the possibilities" –. These words of Renzo Piano provide the key to his activities during the last six years. He is exploring all the time the fascinating potential of plastics. In Piano's work one can see the interaction between shape, form and structural function. "With new materials we have new means of architectural expression." "A new material may lead to new shapes." "The properties of plastics require a new approach in design and analysis." Piano, feeling the need to learn more about plastics, returned to the Technological University of Milan in 1965 to become an assistant to Prof. M. Zanuso. He turned his attention to industrial methods of production and soon realized how they could be applied to building. In this connection, he sees the possibilities of plastics as the means of achieving complete freedom of design. What he sees in plastics is their combination of many properties: light weight, high strength, translucency and extreme degree of formability. Piano's formal training and his experience provide him with the right perspective for his development. In all his work he succeeds in unifying the visual aspects of architecture with the practical aspects of building. He shows that prefabrication techniques do not necessarily mean dull, uninteresting structures. There follows below a brief account of some of his projects:

A. Piano made his first contact with plastics as a structural material in 1960. With colleagues, he designed a prefab all–plastics holiday house, which was displayed in 1962 at the first International Prefabrication Exhibition in Milan. The hexagonal plan permitted the linking of several units in an integral and logical entity. The house consisted of 12 prefab roof and floor units and 6 vertical wall units made as plastics sandwich panels. The central core unit contained the bathroom and the heating and ventilating services. Conclusions: Plastics are costly and must be used in forms which take advantage of the particular properties of the material, they have a low modulus of elasticity and should therefore be used in stressed-skin systems, plastics are amenable to prefabrication and thus lend themselves to industrialized production techniques.

B. All these aspects were taken into consideration by Piano when he produced his first plastics space roof structure consisting of modular GRP pyramids on square base (1.20×1.20 m) (height: 0.6 m each, and weight: 10 kg). The plastics pyramids provide the main load-bearing parts of the structure and at the same time act as the roof covering. Square-based pyramids can yield not only flat canopies but also circular barrel vaults of considerable span.

C. The first large-span barrel vault structure by Piano is an industrial building in Milan covering an area of 25×18 m. Thin sheet steel was used for the rhomboidal diamond-shaped units. All the pressed steel plate units were provided with integral flanges through which steel bolts passed to connect the units so as to form a light, rigid space frame. Neoprene gaskets make up the water-tight joints between the individual units. Polystyrene foam on the underside of the units furnishes the required thermal insulation.

D. In 1966 Piano was asked to design a factory near Rome on the same principles. The client needed a light, transportable cover for a sulphur ore processing plant that would be moved from one location to another. Also, the roofing material had to be resistant to chemical action. Only plastics met these requirements. The building is made up of low-pressure moulded G.R.P. segments. Each rhomboidal segment measures 2.72 m× 1.20 m and weights only 14 kg. About 30% of the segments are translucent and provide uniform distribution of light under the roof.

E. In 1966 Piano turned to prestressed composite systems consisting of a G.R.P. membrane stiffened by steel tension members. The outcome of his studies is the roof over a garage in Genoa completed in 1968. The total area covered by the prestressed plastics and steel cable system is 60 m×40 m. The roof is divided into modules 10 m×10 m, each of which consisting of a G.R.P. membrane forming the upper layer, stiffened by a lower layer of steel cables, which are prestressed by means of turnbuckles. A system of eight reinforcing ribs has been introduced into the membrane at each of the supports. The G.R.P. membrane is prepared in the factory as a large flat rectangle 2.5 m× 2.5 m. These units are joined on site into larger elements by overlapping protruding glass fibre reinforcement mats and applying polyester resin treated with catalyst and accelerator. Tests have shown that the mechanical strength of the joints is adequate to resist the superimposed loads. The plastics membrane is opaque and provides a very uniform natural light transmission into the interior of the building.

F. Architects in recent years have shown great interest in reinforced concrete shell constructions. These are typical examples of surface structures. The primary stresses in such systems are axial with bending moments exerting only a secondary influence upon the stress distribution. With the use of simple and inexpensive techniques, one can produce models of "optimal" surfaces in which bending stresses are virtually eliminated. Load testing of constinuous "free-form" shells shows their remarkable rigidity. At the same time, their external appearance is extremely pleasing. These "free-form" shapes are, however, very difficult to produce since they frequently have surfaces which cannot be defined mathematically. Piano spent a good deal of time studying this perplexing problem and came up with an ingenious solution. Using plastics he can produce small-scale models of the "free-form" shells withaut any difficulty. He then places the model under a machine which, by means of a travelling gauge plunger, can accurately register the vertical height of any point on the surface of the model, moving along predetermined grid lines and measuring the vertical coordinates of the grid points. The measurements of the model are transferred electronically to a system of vertical plungers in which the displacement is n-times that of the model. In this way a small part of the model can be represented by a geometrically equivalent surface, but with the dimensions increased as required, etc. Piano has built, during the last two years, a number of experimental all-plastics "free-form" shell structures made up of large plastics sandwich laminates. The most interesting study done so far by Piano is the "free-form" plastics exhibition pavilion for the 14th Triennale di Milano. The photographs illustrating this section give full details of this most impressive scheme.
Piano claims that his tests on full-size prototypes prove that large continuous systems, of virtually any shape, can be produced quite economically by this technique. The engineers have to admit that, at present, the mathematical analysis of the stress distribution in these complex shapes is beyond their reach. But it should be possible to obtain a reasonably accurate assessment of stresses by using model techniques. Also worthy of mention is his original and interesting approach to the use of plastics membranes in the type of tension roof in which polyethene sheet pyramids are filled with compressed air, the internal air pressure stabilizing the pyramidal units. Piano has also experimented with large flat G.R.P. panels to produce holiday houses. Two panels are positioned one on top of the other and bent into an approximately circular shape by cables attached to the ends of the panels.
Young though he is, Piano is already making a name for himself in the bewildering world of prastics. His work shows that we have only touched the surface of the immense potential of this versatile material.

Hangar for jumbo jets

Norman Royce, Topping, Hurmey & Stewart
Z. S. Makowski, London

BOAC Hangar, Heathrow Airport

(Pages 135–138)

Description of the construction:
The main feature of the huge, recently finished hangar at London Airport is a tubular steel space frame roof, the largest diagonal steel grid in the world. Having a clear span of 453 ft., the new hangar will enable two of the 360 seater 747 Boeing jets to be housed side by side. It is 560 ft. wide and 275 ft. deep. The raising of the top and extension are envisaged for the possibility of still larger planes. The engineers have studied and compared some ten different structural systems. These studies have clearly shown that, with the conventional structures, deflection limitations become for large spans, and this is all the more the case as the roof supports movable gates weighing nearly 300 tons, not to mention travelling cranes and tail stagings. The space frames, which are more stable especially in the event of fire, are not only less costly, but the concentrated stresses are better distributed throughout the structure. Standardization, prefabrication and assembly of elements are rendered more easy. – The chosen project is a roof structure supported on 3 sides with a span of 453 ft. It is made up of 4 principal elements:

1) A prefabricated diagonal grid low level roof / 2) A spine girder / 3) A high level grid / 4) A fascia girder with a free heigh of more than 75 ft.

Actuality

Kenzo Tange's team of architects and town-planners

Catholic parish centre in Japan

"Notre Dame" Cathedral in Tokyo

(Pages 145–148)

Following a competition organized on the occasion of the centenary of the Catholic mission to Japan, Kenzo Tange and his team of architects and town-planners were entrusted with the execution of the new "Notre Dame" Cathedral in 1962. Two years later, the church was finished; the annexes were erected between 1966 and 1969. – The Catholic centre comprises conference halls for parish work, as well as a cloister for sisters and a kindergarten. An office building, moreover, accomodates a parish hall, assembly rooms and a presbytery. These buildings with diverse functions are spatially related to the cathedral. Over against the impressive dimensions of the latter, they constitute a gradual scaling down to the human dimension and a transition to the nearby housing. The external walls on the ground-floor level have the same rough texture as the foundation masonry of the Cathedral, whereas the 1st and 2nd floors are treated as a unit. An attempt has been made to give expression, on the outside of the buildings, to the complexity of the functions served within. – The different elements have been carefully sited; thus the Catholic centre is situated close to the entrance, while the kindergarten is located in a quiet secluded zone.