bulletin 36

fib CEB-FIP

2006 *fib* Awards for Outstanding Concrete Structures

Winners, Special Mentions and Nominees

2006 *fib* Awards for Outstanding Concrete Structures

Contents

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President's Foreword

Concrete is certainly the most frequently used construction material in the world; it is also characterised by a continuous evolution of its characteristics, so that it can be adjusted to the variations of environmental conditions and/or to the specifications prescribed for different structures.

Looking at the very wide range of research activities in the field of concrete, we can see that there are still important issues to be resolved in the improvement of the material itself, both in its strength and its durability characteristics, in the better understanding of the material's behaviour in both ordinary and extreme conditions, in the advancement of design procedures required by increasingly complex structures. These important research issues are filtered and synthesised by *fib*, which produces specific technical bulletins and Model Codes that support the creativity of the designer in his work.

Designers today are well assisted by codes and design guidelines in the creation of safe, functional, durable and outstanding structures, with a high level of collaboration between architects and engineers to ensure the integration of environmental considerations. In addition, some completely new materials, such as self compacting concrete (SCC), are opening up the field of concrete and stimulating the imaginations of architects and engineers with new applications, such as sculptured concrete facades and repair of old structures, that in the past were typical of other materials.

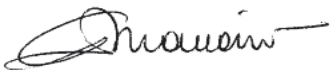
Another important issue in recent years is the analysis of structures built during the past decades, which has improved the knowledge of concrete behaviour over time, leading to the realisation that concrete structures now need to be conceived in four dimensions, the fourth being time. This recent refinement in the knowledge of concrete has considerably improved collaboration between research, design and construction, contributing to the awareness that only the full integration of those procedures can fulfil the requirements for their preservation during the service life. We can expect that future trends in the design of concrete structures will include environmental integration, durability and verification of functionality and safety.

fib, as part of its promotion of concrete structures, attributes its "Awards for Outstanding Concrete Structures" every four years at the occasion of the *fib* Congress; this is the continuation of a tradition established by FIP, one of *fib*'s founding organisations. This booklet, which presents the jury's selection of submitted structures built between 2002 and 2006, shows examples of outstanding projects in which designers and builders have demonstrated their ability to conjugate functionality and beauty with the proper use of concrete.

The very high quality of the awarded structures presented here is certainly encouraging for the future of concrete as the principal material for construction.

In conclusion, we express our thanks to the supporters and to participants in this competition, the results of which will undoubtedly stimulate and improve the quality of future realisations in concrete.

Giuseppe Mancini



President of *fib*

About the Awards

The *fib Awards for Outstanding Structures* are attributed every four years at the *fib* Congress, with the goal of enhancing the international recognition of concrete structures that demonstrate the versatility of concrete as a structural medium. The award consists of a bronze plaque to be displayed on the structure, and certificates given to the main parties responsible for the work.

Applications are invited by the *fib* secretariat via the National Member Group. Information on the competition is also be made available on *fib*'s website, www.fib-international.org/about/awards and in *fib*-news.

The submitted structures must have been completed during the four years prior to the Congress at which the awards are attributed, not counting the year of the Congress. The jury may accept an older structure, completed one or two years before, provided that it was not already submitted for the previous award attribution (Osaka, 2002).

The submitted structures must also have the support of an *fib* Head of Delegation or National Member Group Secretary in order to confirm the authenticity of the indicated authors.

Entries consist of the completed entry form, three to five representative photos of the whole structure and/or any important details or plans, and short texts of about one page (or 500 words) each, explaining the

- history of the project;
- description of the structure;
- particularities of its realisation (difficulties encountered, special solutions found, etc.).

A jury designated by the Presidium selects the winners. The awards are attributed in two categories, *Civil Engineering Structures* (including bridges) and *Buildings*. Two or three 'Winners' and two or three 'Special Mentions' are attributed in each category, depending on the number of entries received.

The jury takes into account criteria such as:

- design aspects including aesthetics and design detailing,
- construction practice and quality of work,
- environmental aspects of the design and its construction,
- durability and weathering potential,
- contribution made by the entry to the development and improvement of concrete construction.

The decisions of the jury are definitive and cannot be challenged. They are unveiled during a special ceremony during the Congress.

Chairman of the Jury's Foreword

The *fib* Awards for Outstanding Concrete Structures give international recognition to projects that demonstrate the versatility of concrete as a structural medium.

The judging and presentation of these prestigious Awards is held every four years and corresponds with the *fib* Congresses. Whilst the first *fib* Awards for Outstanding Concrete Structures were presented at the first *fib* congress in Osaka, Japan, 2002 they carried on from the tradition of the FIP Awards inaugurated in 1990.

I was delighted and honoured to be invited to act as Chairman of the Jury for the 2006 *fib* Awards to be presented at the 2nd *fib* congress in Naples, Italy in 2006.

By recognising the versatility of concrete the Awards play a large part in enhancing the image of concrete and concrete structures both within our industry and with the public at large. They also greatly enhance the reputation of the *fib* as the leading international body promoting excellence in the concrete structures. Indeed the *fib* Awards are given for just that; excellence and innovation. They are not given for simply doing common things well!

In addition to excellence and innovation, the Jury puts great store in the extent to which an entry recognises and solves engineering and construction challenges and sets new benchmarks. Tangible and intangible benefits to the community are important as are solutions that are sensible from a commercial and economic point of view.

The Jury insists that Award Winners follow and clearly demonstrate sound engineering principles and, where appropriate, align with the objectives of ecologically sustainable development.

The entries are judged in two categories, Buildings and Civil Engineering Structures, and as well as overall Awards, other projects are often singled out for Special Mention.

In the 2006 edition, the Jury saw fit to distinguish two projects with "Exceptional Recognition".

For the 2006 Awards a large number of high quality entries were received from a wide cross section of the *fib* National Member Groups covering a variety of construction types.

As follows tradition, the Jury was made up of the *fib* Presidium and a number of invited Honorary Presidents, as follows:

- Jim Forbes, Chairman of the Jury and Honorary President
- Michael Virlogeux, Honorary President
- Jan Moksnes, Honorary President
- Giuseppe Mancini, President
- Hans-Rudolf Ganz, Deputy President
- György L. Balazs, Presidium member
- Michael Fardis, Presidium member
- Jean-Phillippe Fuzier, Presidium member
- Shoji Ikeda, Presidium member
- Ulrich Litzner, Presidium member
- Tippur Subba Rao, Presidium member
- Rüdiger Tewes, Secretary General

Entries were circulated electronically to the Jury in October 2005.

The Jury met in Berlin in November 2005 to select the winners in all categories. The Jury examined each entry in detail and, following discussion, selected the nominees to be voted upon and subsequently published in the Awards Brochure. A series of secret ballots were cast to select the winners.

The Jury congratulate all the Winners and Special Mentions as well as those singled out for Exceptional Recognition.

Jim Forbes
Chairman of the Jury

Previous Winners and Special Mentions: Category Buildings

2002 fib Awards for Outstanding Structures

Winning Structures
- Tower at La Défense, Paris, France
- The Scientia, University of New South Wales, Australia

Special Mentions
- City Library, Roermond, Netherlands
- Engineering Design and Research Centre, Chennai, India

1998 FIP Awards for Outstanding Structures

Winning Structures
- Belfast Waterfront Hall, Northern Ireland
- Osaka Municipal Central Gymnasium, Japan

1998 Special Mentions
- Indoor swimming arena, Osaka Pool, Japan
- Indoor stadium, Bangalore, India
- Laakhaven Hollands Spoor parking garage, The Hague, Netherlands

1994 FIP Awards for Outstanding Structures

Winning Structures
- Administrative building, ECC Construction Group, India
- Tennis center, Yale University, USA

Special Mentions
- Hyderabad Auditorium, India
- ANA Hotel, Sydney, Australia
- Hassan II mosque, Casablanca, Morocco
- Ministry of Social Affairs Building, The Hague, Netherlands

1990 FIP Awards for Outstanding Structures

Winning Structure
- La Grande Arche, Paris, France

Special Mentions
- New Parliament House, Canberra, Australia
- Thorp Receipt and Storage Facility, UK
- Sludge fermentation installation, Bottrop, Germany

Category B Buildings

The entries in this category admirably demonstrated the use of concrete in a wide variety of structural forms.

The Jury were particularly impressed by the use of concrete to provide light and airy forms that contrasted with the stereotypical view of concrete as being only associated with heavy, bulky and brutal elements.

However, the Jury noted that the emphasis on concrete as a primarily load-bearing and durable element was not hidden or compromised by the architectural expression of the buildings; indeed it complemented the form and function of the building.

The fact that a considerable number of entries were received from North America and Asia, as well as the more traditional entries from Europe, indicated to the Jury that the Awards are truly international.

Jim Forbes
Chairman of the Jury

Winner

Turning Torso
Malmö, Sweden

owner: HSB Malmö Ek. För. Turning Torso ♦ **main authors:** Santiago Calatrava architect & structural engineer Sten Forsström (SWECO VBB) verification of structural design ♦ **contractor:** Construction Management Organisation, HSB Malmö ♦ **subcontractor:** PEAB AB foundation, basement NCC Construction AB core and superstructure ♦ **completion:** 2005

The “Turning Torso” is a 54 storey 190 m high-rise building that was built as a landmark for both the city of Malmö and the region. Its twisting effect was achieved by dividing it into 9 cubes which turn in total 90° from the ground to the top. Windloads became the decisive design criteria, durability requirements for 120 years life span were met through appropriate concrete cover and special insulation layers on sensitive surface areas.

The primary structure is made in concrete. In the vertical direction it is composed of a cylindrical core supported by a 7 m thick foundation slab and the apex of one column supported by a pile foundation. In each of the nine cubes the lowest slab has been made conical. The conical slab is built-in at the core that was constructed by the climbing form method. Every conical slab supports 11 steel columns at the façade. These steel columns are outer supports for the upper five “normal” slabs. Thus, the “normal” 27 cm thick slabs are built in at the core and supported locally at

the façade. Prefabricated formwork and reinforcement elements were used for these slabs.

The concrete column (pumped K 60) at the apex is continuous along the entire height. Outside the façade there is a visible steel truss-work (“Exoskeleton”), which strengthens the main concrete structure. The steel truss is connected to the core by two local shear walls in each cube.

"Whilst structural engineering is often referred to as an art and a science, it is rather rare that a building is inspired by a work of art. Such is the case with Turning Torso: the architect created a sculpture of turning cubes and then designed a building based on the same rotated form.

The Jury were impressed by the imagination and boldness demonstrated by the local authorities and by the architect. Equally as impressive was that, unusual as the project is, the design and construction were achieved with the use of relatively conventional structural techniques, suggesting that little economic penalty was paid for achieving such a distinctive building."

Winner

Shawnessy Light Rail Transit Station Calgary, Canada

owner: The City of Calgary, Alberta, Canada ♦ **main authors:** Enzo Vincenzino (CPV Group, Architects & Engineers Ltd.) architect Gerry Culham (CPV Group, Architects & Engineers Ltd.) engineer Don Zakariasen (Lafarge Canada Inc.) precast concrete ♦ **contractor:** Walter Construction Corporation ♦ **completion:** 2004

The objective of the design was to create canopies that provided both durability and low maintenance, while blending with the station's appearance and creating a light, unobtrusive look.

The designers claim to have created the world's first ultra-thin precast canopy system, made of ultra-high performance, fibre-reinforced concrete. The concrete, which included a high percentage of silica fume, offered a compressive strength of 151 MPa (22,000 psi) and flexural strength of 25 MPa (3,600 psi). The 18 mm thin canopies measure 6 m wide, 5.15 m deep and 5.64 m tall. They are curved in two planes and do not use any passive reinforcements for support. They were cast using an injection-molded casting technique. This helped minimise trapped air voids while providing a uniform finish on all exposed surfaces. The canopies were cast on edge, while their supporting columns were cast vertically.

Very precise tolerances were required due to the project's complex geometry. The structure also needs to carry heavy snow loads and to tolerate severe winds. Full-scale prototype tests were made. The canopies were preassembled at the precast plant and connected to the precast concrete columns on the station platform and the internal struts by stainless steel connections. The nine columns for each platform were erected in one day followed by temporary scaffolding for proper positioning of canopies.

This project demonstrated the ability of precast concrete to be used in thin-shelled applications and showed the enormous potential for such uses in the future.

"The distinctive elements of this building are the thin high performance fibre-reinforced concrete shells forming a series of canopies.

The Jury were impressed not only with the thinness of the shells, but the fact that they were made from ultra performance concrete with high compressive and tensile strength.

In addition, the moulding of the canopies represents a breakthrough in manufacturing techniques for concrete, adopting methods an techniques from the injection moulding industry.

The lightness and transparency of the final structure fulfilled the Jury's desire to demonstrate the versatility of concrete."

Special mention

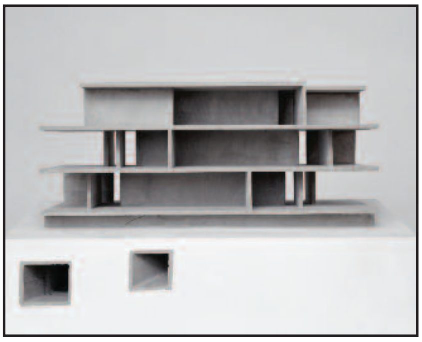
Forsterstrasse Apartment House Zürich, Switzerland

owner: Gisela Kerez ♦ **main authors:** Christian Kerez architect Joseph Schwartz civil engineer ♦ **contractor:** Jäggi & Hafter AG ♦ **subcontractor:** Stahlton AG ♦ **completion:** 2003

In the Forsterstrasse apartment house, the rooms are equivalent to each other with respect to their construction and to the applied materials. All of the rooms are occurrences of the same basic architectural concept and only differ by their proportions, their scale and their coherence. A view across the entire depth of the apartment is generally possible between the walls. In this sense, the corridors and the bathrooms are an extension of the living rooms and there is no hierarchy between the different rooms of the apartment.

The walls are generally supported in the vertical direction at only one point or over only one vertical edge. The walls are generally arranged crosswise from one storey to the next and have only one point of intersection. Other walls are connected by their interior edges to the core. The slabs work like flanges in combination with the walls and are responsible for the equilibrium in the horizontal direction. They also work as confining elements in the region of the crossing points of the walls. On one hand, the slabs are conventionally supported by the walls below, and on the other hand, they hang from the walls above.

The requirements for the design and project development were much higher than those of a conventional building construction, and reached the level of a bridge construction. The outstanding collaboration of all participants of the project, architect, civil engineer, contractor, concrete supplier and prestressing company made the successful realisation of the building possible.



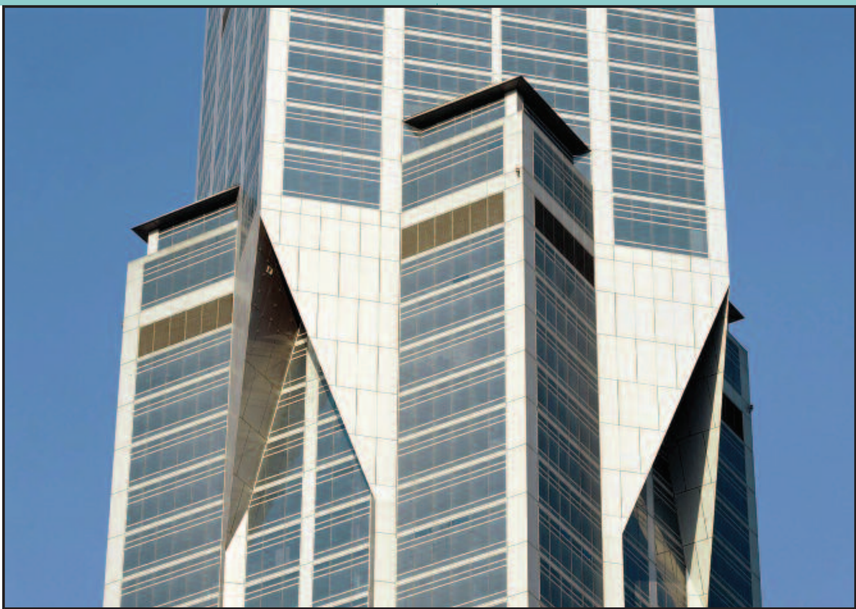
"Concrete apartment buildings are too often closed, bulky and unexciting. However this apartment block shows that concrete can be used in such a way as to appear to float above each level.

The Jury liked that the concrete panels were built to such a high surface standard that they were generally unadorned.

The Jury appreciated the essential structural logic of using large panels as deep beams with the floor slabs acting as flanges."

Special mention

Tomorrow Square Shanghai, China



owner: Tomorrow Square Co. Ltd. ♦ **main authors:** Yu Menglin (Shanghai Institute of Architectural Design & Research Co. Ltd. – SIADR) chief designer Bao Zuo (SIADR) designer Ren Baohe (SIADR) designer ♦ **contractor:** Shanghai Construction Group ♦ **subcontractor:** Shanghai No. 2 Construction Co. Ltd. ♦ **completion:** 2003

The Tomorrow Square complex consists of a podium and tower, with a total height of 283 m and 58 stories with three basement levels. It houses a hotel and luxury apartments, as well as shops and other facilities. The six-storey podium surrounds the main building and is connected to it by an arched atrium.

A flat slab was used for the foundation and the construction method from top to bottom for the basement and from bottom to top for the superstructure (known as the "contrary construction method") was adopted. Although the tower and the podium have a great difference in height and weight, there is a single foundation. In order to balance the weight difference and satisfy the requirements of the contrary construction method, several transfer post-pouring belts were provided between the main building and podium.

A 45° rotation is made from the 31st to the 39th storey. Eight special-shaped columns are provided in an outer tube, through which walls and diagonal rods are gradually extended outward to form a huge outward extended truss. This transition is completed within the seven-storey height, and special construction measures are taken on the last transition floor to ensure the common action of these outward extended trusses.

There are four steel structural towers on the top of the structure, each of which is inclined to bear a large overturning moment. The base of the towers is supported on the column-wall, and the overturning moment is transferred to the main structure through huge anchorages.

"The Jury were impressed by the fact that whilst the building shape is rotated through 45° at the 37th level it is done in a transitional way that avoids direct transfer structures.

In addition the Jury noted that recognition was given to accommodation of the differential movements associated with the varying heights of the development by incorporating pour strips and other movement devices."

Nominee

Braga Stadium
Portugal

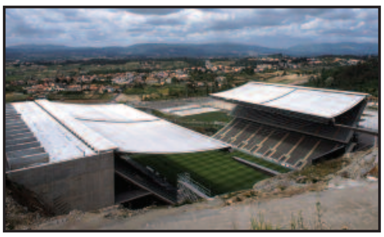
owner: Câmara Municipal de Braga ♦ **main authors:** Rui Furtado coordinator Carlos Quinaz, Renato Bastos structural engineers (AFAssociados – Projectos de Engenharia SA) ♦ **contractor:** ACE - Assoc/Soares da Costa, SA ♦ **sub-contractors:** Tensoteci, Tecnasol, FGE ♦ **completion:** 2003

The stadium for the European 2004 football championship, was designed to have only two stands: one carved into the rock, the other erected on the ground. The 202 m spanning roof and the stands were the main design challenges. As the roof needed to be as light and clean as possible, the design resulted in a suspended roof built as a set of suspension cable pairs at 3.75 m distance. Particular attention was given to wind loads.

The east stand is made up of 50 m-high walls (extremely slender 1 m thick 'uprights') that are "pierced" by the slabs of the different floors of foyers of the stadium. It is longitudinally stabilised by the existing slabs under the steps of the stands.

The west stand was even more complex due to the uprights anchored in the rock, the compatibility between the structural functioning of elements with very different stiffnesses, the laying of foundations in embankments that had first to be stabilised.

An underground two-storey building lies beneath the entire area of the pitch, including a car park, changing rooms and all backup services.



Nominee

FIU School of Architecture
Miami, Florida, USA

owner: Florida International University ♦ **main authors:** Gustavo Berenblum architect Paul Martinez engineer (both BEA International, Inc.) Susan Snyder (Coreslab Structures, Inc.) precast concrete producer ♦ **contractor:** Biltmore Construction ♦ **completion:** 2002

The new buildings for the architecture school were designed to create a learning and congregating space that was functional as well as inspiring. The project consists of four buildings totalling 9'300 m^2 around a central courtyard.

The major challenge derived from the extremely low budget of $ 1'345 per m^2 for four distinct entities, each with its own enclosure and two with irregular geometry. Most ductwork, conduits, sprinklers and acoustical baffles had to remain exposed for cost-cutting reasons.

The successful design combined structure and envelope into one single material—precast concrete architectural panels and structural components. Approximately 220 precast concrete wall panels were inset with three bright colours of ceramic tile: red and yellow on the far ends of the buildings, which gradually blend into orange at the center.

The panels support a series of precast concrete double tees. The system was used in both the studio and office wings and in the more geometrically challenging lecture and gallery buildings. The design allowed for spans up to 23 m in length in addition to inclined precast concrete walls.

Nominee

Aurora Municipal Center Colorado, USA

owner: City of Aurora ♦ **main authors:** Paul Todd (Barber Architecture) architect Joe Rapp (S.A. Miro) engineer Jim Albertson (Rocky Mountain Prestress) precast concrete producer ♦ **contractor:** The Weitz Company ♦ **completion:** 2003

The 26'600 m^2 municipal center and its 22'400 m^2 parking structure were designed using all-precast concrete structures for load-bearing wall panels, core walls, beams and double tees. The system offered significant schedule advantages over a steel-frame building with cladding. In addition, the size and proximities of the departments to be housed dictated a 5'200 m^2 floor plate with spans of 21 m in some areas.

Two five-storey office wings connect to a glass, six-storey curving element with a sloping metal roof. On the building's west façade facing the lawn, a two-storey loggia, created from double-sided, freestanding precast columns, rises from a plaza and shades a lobby beyond. The clear span above the 300-seat city-council chamber was made possible by using 3 m wide and 0.8 m deep precast double tees.

A key challenge came in fabricating and erecting the large cornices that project 90 cm from the building façade and curve in two directions. Also the loggia required close attention to ensure the pieces fit so that they could be viewed from all sides without any joints being apparent.

Nominee

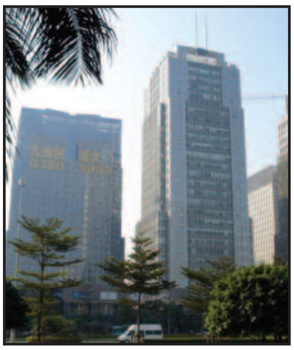
Fujian Industrial Bank Shenzhen, China

owner: Shenzhen Zhengxian Investment Company Ltd. ♦ **main authors:** Fu XueYi chief structural designer Gu Lei structural designer Chen Zhaohui structural designer (all: Institute of Architectural Design and Research at Shenzhen University) ♦ **contractor:** China Huashi Enterprises Company Ltd ♦ **completion:** 2003

This cast-in-situ reinforced concrete building with a height of 106 m has three basement levels and 28 above-ground stories.

Using the latest philosophy of seismic design, the ultimate bearing capacities and ductilities of the lapping column transfer structure are designed to meet the requirements of a load combination with a severe earthquake. Shaking table tests on scale models for the whole structure, static tests for a lapping column section and extensive theoretical analyses became necessary.

The building has an outrigger of 3.3 m at the 4th level and set-backs of 1.65 m at the 10th and 22nd levels. Both are realised with 1 storey height lapping blocks transfer. The external moments due to the outrigger and the setbacks of columns are balanced by the internal moments formed by the axial forces of floor girder-slab connected with the lapping blocks. Compared to traditional bending transfer beam structure, this lapping column transfer structure provides varied lateral stiffness and better seismic behaviour: a new generation of these structures.



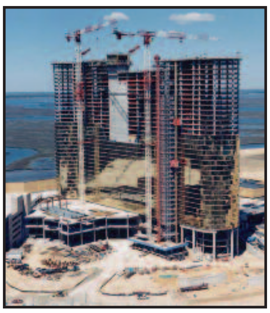
Nominee

The Borgata Hotel, Casino & Spa Atlantic City, New Jersey, USA

owner: The Borgata Hotel Casino & Spa ♦ **main authors:** M. Stewart (A. A. Marnell II, Chartered), E. Rahe, I. Cope (BLT/C A), T. O'Connor (SOSH) architects D. Kirk Harman (Cagley Harman & Associates, Inc.) structural engineer ♦ **contractor:** Yates/Tishman ♦ **subcontractors:** Collavino Northeast Construction, DSI – Lang Geotech, Penn Jersey Building Materials, L. Feriozzi Concrete Co., Atlantic County Concrete & Material, Ralph Clayton & Sons Concrete ♦ **completion:** 2003

The structure features a 142'000 m^2, 46-storey hotel tower. Post-tensioned, cast-in-place concrete construction was chosen, as it provided the lowest floor-to-floor heights, thinnest floor slab construction, most efficient use of materials, and the flexibility to adapt the structure to the design requirements.

The use of 62 MPa concrete on the lower level columns and shear walls greatly reduced the amount of reinforcing steel that was required in those elements. The tower's height and geometry, location on a hurricane coastline, and a distinct full-height glass curtainwall system necessitated the use of a sufficiently stiff lateral load resisting system. A cylindrical zone at each end of the tower lends a distinctive architectural appearance. The circular floor areas in these cylindrical zones were economically designed and constructed with cast-in-place, post-tensioned concrete, despite irregular column locations and numerous openings in the floors. Perimeter slab edges support a "mullionless" glass curtainwall façade requiring careful attention to deflections. Additional tendons were added at perimeter slab edges to provide the required stiffness and to reduce dead load and long-term creep deflections.



fib Bulletins

fib Bulletins are published irregularly, about five to six volumes per year. A subscription to all bulletins published in the current year is included in the Subscribing Membership category and in all Corporate Membership categories.

Recently published Bulletins are listed below. The complete list of *fib* Bulletins published since 1998, including abstracts, as well as lists of available CEB Bulletins and FIP Reports, and the publications order form are given at www.fib-international.org/publications.

35 *Retrofitting of concrete structures by externally bonded FRPs.* Technical Report (220 pages, ISBN 2-88394-075-4, April 2006)

34 *Model Code for Service Life Design.* Model Code (116 pages, ISBN 2-88394-074-6, February 2006)

33 *Durability of post-tensioning tendons.* Recommendation (74 pages, ISBN 2-88394-073-8, December 2005)

32 *Guidelines for the design of footbridges.* Guide to good practice (160 pages, ISBN 2-88394-072-X, November 2005)

31 *Post-tensioning in buildings.* Technical report (116 pages, ISBN 2-88394-071-1, February 2005)

30 *Acceptance of stay cable systems using prestressing steels.* Recommendation (80 pages, ISBN 2-88394-070-3, January 2005)

29 *Precast concrete bridges.* State-of-art report (84 pages, ISBN 2-88394-069-X, November 2004)

28 *Environmental design.* State-of-art report (86 pages, ISBN 2-88394-068-1, February 2004)

27 *Seismic design of precast concrete building structures.* State-of-art report (262 pages, ISBN 2-88394-067-3, January 2004)

26 *Influence of material and processing on stress corrosion cracking of prestressing steel - case studies.* Technical report (44 pages, ISBN 2-88394-066-5, October 2003)

25 *Displacement-based seismic design of reinforced concrete buildings.* State-of-art report (196 pages,

About fib

The International Federation for Structural Concrete (*fib* - fédération internationale du béton) is a non-profit organisation created in 1998 from the merger of the Euro-International Concrete Committee (CEB - Comité Euro-International du Béton) and the International Federation for Pre-stressing (FIP - Fédération Internationale de la Précontrainte). The parent organisations CEB and FIP existed independently since 1952.

Objectives

The objectives of *fib* are to develop at an international level the study of scientific and practical matters capable of advancing the technical, economic, aesthetic and environmental performance of concrete construction.

These objectives are achieved by the stimulation of research, the synthesis of findings from research and practice, the dissemination of the results by way of publications, guidance documents and the organisation of international congresses and symposia, the production of recommendations for the design and construction of concrete structures, the information of members on the latest developments. The objectives are pursued in conjunction with the existing international technical associations and regional standardisation organisations.

Membership in fib

fib is an association composed of statutory, corporate and individual members.

Statutory Members are National Member Groups acting as forums for co-operation and co-ordination between the various participants (i.e. governmental, academic, technical and industrial bodies). There are currently 37 national member groups forming *fib*.

Corporate Members may be Sponsoring or Supporting (for example companies, research or technical organisations) or Associate Members (for example companies, consulting or design offices, libraries, research institutes, etc.).

Individual Members may be Subscribing Members or Ordinary Members. The level of their subscription determines the type and number of publications that they receive, and further benefits, as given to the right. Of course, they may originate from countries that do not form a National Member Group in *fib*.

Further information and the membership application form can be found at www.fib-international.org/membership.

Organisational Structure

fib is organised so as to ensure the effective use of the resources made available through the National Member Groups and other members and, above all, through the voluntary work of many individuals.

General Assembly
The General Assembly (GA) consists of the Heads of Delegation and further Delegates or Deputies, as appointed by the National Member Groups. It deals with elections of the President and of Presidium members, finances and budgets, amendments to the statutes, resolutions, approval of Model Codes, voting rights of National Member Groups, and honorary memberships.

Presidium
The Presidium acts as the executive committee of the association. It decides on the appropriate dissemination of the results of the work of various bodies, the dates and venues of congresses and symposia, admission of members to the association, and attributes various honours and medals.

Technical Council
The Technical Council consists of the Heads of the National Delegations, the Presidium, the chairpersons of Commissions and Special Activity Groups, the Honorary Presidents, the Secretary-General, and further appointed members. It is responsible for initiating commissions, Task Groups and Special Activity Groups, including the appointment of their chairpersons, and for monitoring their output.

Commissions and Task Groups
The technical work of *fib* is carried out by its Commissions and Special Activity Groups (SAG), normally resulting in the publication of bulletins. The Commissions are composed of Task Groups that focus on specific topics. Combining the input from all commissions, SAG 5 is currently preparing a new Model Code.

Secretariat
The secretariat of *fib* is located in, and hosted by, the Civil Engineering Department of the Swiss Federal Institute of Technology in Lausanne, Switzerland.

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Previous Winners and Special Mentions: Category Civil Engineering Structures

2002 *fib* Awards for Outstanding Structures

Winning Structures

- Bras de la Plaine Bridge, La Réunion, France
- Vltava River Metro Tunnel, Prague, Czech Republic
- Sart Canal Bridge, Belgium

Special Mentions

- Tensho Bridge, Miyazaki, Japan
- TGV Viaducts, Avignon, France
- Ticino Bridge, Switzerland

1998 FIP Awards for Outstanding Structures

Winning Structures

- Normandy Bridge, France
- Great Belt East Bridge, Denmark

Special Mentions

- Lerez River Bridge, Spain
- Heidrun tension leg platform, Norway
- Odawara Blueway Bridge, Japan

1994 FIP Awards for Outstanding Structures

Winning Structures

- Skarnsundet bridge, Norway
- Vranov reservoir footbridge, Czech Republic
- Breakwater jetty, Sakai, Japan

Special Mentions

- Bray Viaduct, North Devon, UK
- Helgeland Bridge, Leir Fjord, Norway
- Bridge over the Isère, France
- Kikki pedestrian bridge, Japan

1990 FIP Awards for Outstanding Structures

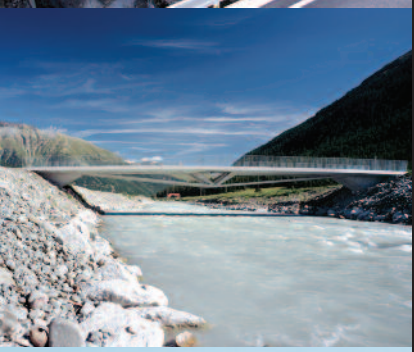
Winning Structures

- Altmühl River Pedestrian Bridge, Kelheim, Germany
- Oosterschelde storm surge barrier, Netherlands
- Gullfaks C oil platform, Norway

Special Mentions

- Bridge over the Parana River, Argentina/Paraguay
- Beppo Myoban Bridge, Japan
- Protecting wall, Ekofisk oil drilling platform, Norway
- Elbe River Bridge, Podebrady, Czech Republic



Category C
Civil Engineering Structures

Entries in the Civil Engineering Structures Category showed a strong emphasis on innovative construction methodology to achieve outstanding and very practical results.

The Jury noted that many projects made use of traditional structural forms that emphasise the simple structural actions of tension and compression to achieve their aims.

The elegance shown in this simplicity of form was achieved by the marriage of concrete and its complementary material in a manner that demonstrates the strength of each element.

Many of the Civil Engineering Structures are located in areas of outstanding natural beauty and the Jury were most impressed at the way the structures enhanced rather than detracted from the natural setting.

Jim Forbes
Chairman of the Jury

Winner

Rion-Antirion Bridge Greece

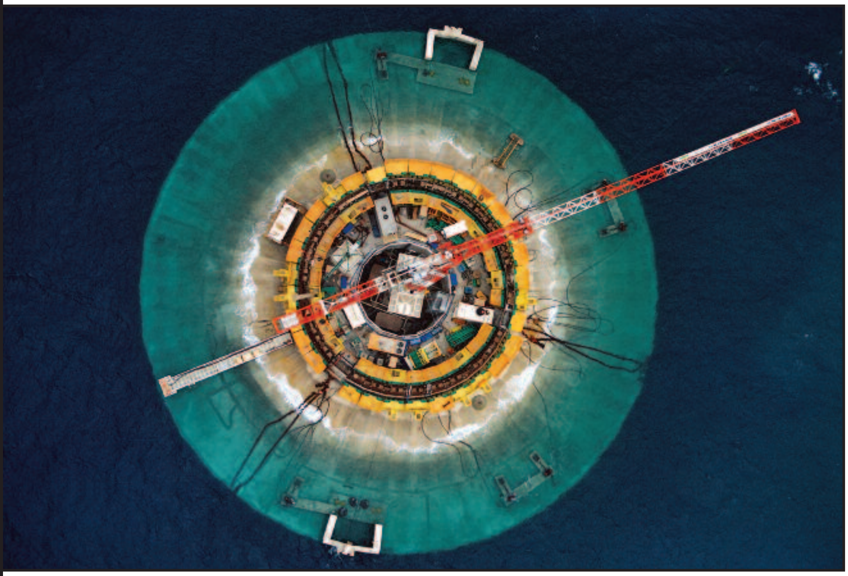
owner: GEFYRA SA Concession company ♦ **main authors:** VINCI CGP design of main bridge INGEROP design of main bridge DOMI design of viaducts ♦ **other participants:** Géodynamique et Structure geodynamic studies Buckland and Taylor design checker DENCO design check partner Jacques Combault external advisor Michel Virlogeux external advisor ♦ **contractor:** Kinopraxia Gefyra joint venture: VINCI CGP, Aktor ATE, J & P - Avax SA, Athena SA, Proodeftiki SA, Pantechniki SA ♦ **completion:** 2004

The Rion-Antirion cable-stayed bridge crosses the Gulf of Corinth near Patras in western Greece with a total length of 3 km including its two access viaducts. The three central spans measure 560 m each.

Its environment presents an exceptional combination of physical conditions which made the project quite complex: large water depth, deep soil strata of weak alluviums, strong seismic activity, and possible tectonic movements. Furthermore, the bridge has to withstand the impact of a 180,000 dwt tanker sailing at 16 knots.

It is the first bridge to combine off-shore techniques for the foundations and cable-stayed span techniques for the super-structure. The four main foundations consist of large diameter caissons resting on the seabed. The top 20 m of soils is reinforced by so-called “inclusions”, i.e. 30 m long hollow steel pipes of 2 m diameter, driven into the upper layer at a regular spacing of 7 m. They are topped with a 3 m layer of gravel, on which the foundation caissons rest.

Another unique feature of the project is its continuous fully suspended cable-stayed deck. This creates an effective isolation system that reduces seismic forces in the deck and allows the deck to accommodate fault movements thanks to its flexibility. In the transverse direction, the deck can behave like a pendulum and therefore must be kept in place even during the strongest winds. This is insured by a metallic strut connecting the deck to each pylon. However, this strut will yield during a strong seismic event and movements of the deck will then be buffered by the dampers.



"The Jury were most impressed by the sheer number of challenges that were overcome in order to make this important crossing a reality.

Deep water, strong seismic activity, weak alluvial soils and a busy shipping lane could have resulted in a brutal solution, but the elegance of the structure is testament to the ingenuity of the whole team responsible for this project.

Construction techniques borrowed from the off shore oil platforms industry and applied to bridge construction further impressed the Jury."

Winner

Floating Breakwater Monaco

owner: Service des Travaux Publics de Monaco ♦ **main authors:** René Bouchet (STP de Monaco) conceptual design François Sedillot (Doris Engineering) conceptual design Jean Marc Jaeger (SETEC TPI) concrete detailed design Philippe Cortes (NFM Technologies) ball joint system design ♦ **contractors:** Dragados SA, FCC Construccion SA, BEC Frères SA ♦ **subcontractors:** BBR Pretensados y Tecnicas Especiales S.L., Construcciones y Dragados Drace, BAC Corrosion Control ♦ **completion:** 2002

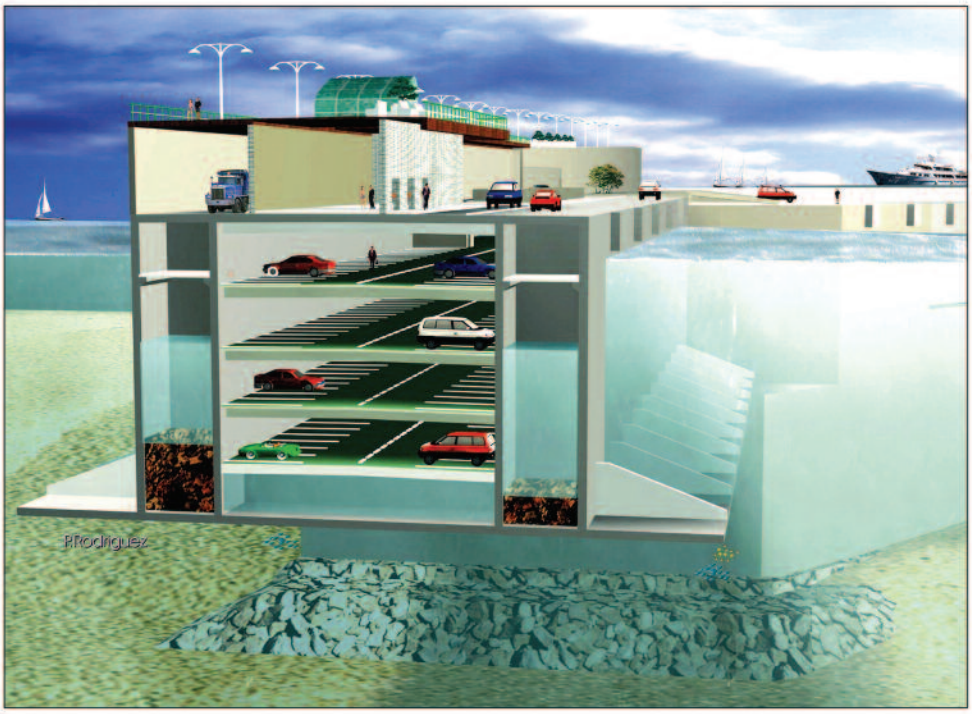
Due to the local situation and the topography (great depths near the coast) of the area, conventional solutions of large, quarry material banquettes for building breakwaters were unviable and led to design a floating breakwater instead. It is one of the first large-scale adaptations to civil engineering of the offshore technologies used for large, high-sea floating oil rigs.

The breakwater consists of a large, double hulled, precast structure of 353 m length, 44 m width and 24 m height. The internal spaces house a 380 place car park and a dry dock for recreational craft.

Superstructures for maritime stations, port outbuildings, etc., are laid out on the roof slab. The breakwater is connected to land by a large metal swivel joint anchored to a fixed abutment, and is moored at the opposite end by eight long anchor lines. The swivel joint weighs over 850 tons and was one of the main design, manufacturing and installation achievements of the project.

The breakwater was built entirely in a dry dock near Algeciras in the south of Spain, from where it was towed to Monaco. The construction was highly complex due to the high densities of reinforcement placed in thin walls and slabs and to the strict quality controls as set to guarantee the structure's durability and leak-tightness for a 100 year service life.

Post-tensioning was used extensively in order to meet these requirements. Very specific concrete was used to achieve impermeability and durability, and to meet on-site placing specifications in areas with a very high density of reinforcement.



"Breakwaters are normally passive structures designed with only one use in mind. The fact that this project also incorporated a massive car park, a dry dock for recreational craft and extensive retail and administration facilities impressed the Jury as an excellent way of making utilitarian structures useful.

From a construction point of view, the Jury recognised that this project was made possible by the application of offshore technologies used in floating oil rigs.

In addition, the extensive use of pre-stressing and the high quality of the concrete assured a very durable structure in a severe maritime environment."

Winner

Seiun Bridge
Tokusima, Japan

owner: Town of Yamashiro ♦ **main authors:** Kazuhiko Yamazaki (Eight Consultants) chief engineer ♦ **contractor:** Sumitomo Mitsui Construction Co. ♦ **subcontractor:** SE Corporation ♦ **completion:** 2004

The Seiun Bridge is a single-span highway bridge with a span of 94 m. A self-anchored composite truss bridge using a suspension structure was selected. After the abutments, the suspension cables that would carry the entire subsequent construction load were constructed. Then the lower chord members, and the steel diagonal members which are all precast segments were positioned, followed by the construction of the girder. After concreting cast-in-place slabs and pouring wet joints and closure, the suspension cables beneath the lower chord were released and anchored to the girder. The self-anchoring produces a simple composite truss structure for the completed bridge.

Due to the suspension cables strung between the abutments that supported the weight of the bridge itself, no falsework was needed during the erection process. This also minimized tree-cutting and ground excavation work, thus making a major contribution to environmental preservation which is of growing importance nowadays.

The suspension cable tension was gradually increased during the erection process, with the maximum value reached when closing the concrete for the upper and lower chord members. This eliminated the need for ground anchors after completion and reduced the impact on the ground.

Self-anchoring using the tensioning of suspension cables acts as prestressing force on the upper and lower chord members. This makes the structure extremely rational, as the tensioning acts effectively as the necessary prestressing force with regard to local bending of the upper chord member and to the lower chord member ties. The Seiun Bridge is the largest bridge in the world, and also the first highway bridge, to use this configuration.

"This self-anchored composite truss bridge responds strongly to the desire of the Jury for projects that impact only lightly on their environment. By constructing the lower chord first as a stressed ribbon, very little disturbance was made to the site as the result of construction activities.

The completion of the bridge by the erection of pre-cast diagonals and top chord resulted in a elegant final form that complimented the natural valley.

Initially externally anchored, the load on the stressed ribbon was finally transformed into the top chord in compression, resulting in a pre-stress of the top chord. This essential structural logic further impressed the Jury."

Special mention

Flaz River Bridges
Samedan (Grisons), Switzerland

owner: Municipality of Samedan ♦ **main authors:** Ingegneri Pedrazzini sagl engineers Berserga Mozzetti Architetti architects ♦ **contractor:** G. Lazzarini & Co. AG ♦ **subcontractors:** SpannStahl AG, Von Moos Stahl AG, Motebello AG, PRADER & Co. AG, Sika Schweiz AG, Pfister Metallbau AG ♦ **completion:** 2004

Bridging a diverted river between dams, the lowest possible access and simple structures were required for the three bridges. To achieve these objectives, a light structure with few elements was designed, allowing for transparency and unobtrusiveness in the beautiful landscape.

Reinforced concrete is the construction material for all structural elements and gives the bridges homogeneity and clearness. In addition to important technical and economic considerations, this material was chosen in accordance with the bridge building tradition of the region.

The structure of the bridges is composed of: two abutment walls, built over a foundation plate; the deck as the upper compressed element; two prestressed tension ties; four diagonals, which maintain the tension ties in position and stabilize the deck.

During the construction of the bridges the excavation and bank works for the new Flaz channel were in progress, so it was possible to erect the mould directly on the soil a few metres under the deck. After the excavation and the construction of foundation plates and abutment walls, the tension ties, the diagonals and the deck were cast. The cables were tensioned in three steps: 30% after three days, 75% after eight days and subsequent demoulding, 100% after 28 days following the casting of the edges. The behaviour of the structure was verified by simple deformation measurements before and after tensioning, demoulding and laying the deck paving: the measured and calculated vertical deformation values were very close.

"The Jury were impressed by the simplicity of concept in this series of bridges that enhances the landscape rather than detracts from it.

They appreciated that the bridges did not apologise for their existence by blending in with the landscape, but made a positive statement about the difference between the natural and the built form."

Special mention

Infante Dom Henrique Bridge Porto, Portugal

owner: Metro do Porto, SA ♦ **main authors:** Portuguese structural design team: António Adão da Fonseca and Renato Oliveira Bastos structural engineers (AFA – Consultores de Engenharia SA); Spanish structural design team: Francisco Millanes Mato, José António Fernández Ordóñez and Luis Matute Rubio structural engineers (IDEAM SA) ♦ **contractors:** Consortium of EDIFER Construções SA and NECSO Entrecanales Cubiertas, SA ♦ **completion:** 2003

The Infante Dom Henrique Bridge exhibits high technical and aesthetic qualities and represents an important technological advance in construction, due to its dimensions and the following achievements:

- it is the second largest concrete arch in Europe, with a span of 280 m;
- it holds the world record for shallow deck stiffened arches; with a constant thickness of 1,50 m, it is extremely slender in relation to the usual thicknesses used in conventional rigid arch solutions;
- with a rise of $f = 25$ m it has a shallowness $L/f = 11.2$ of the arch that is unparalleled among large span arch bridges;
- its "static coefficient" " ($L^2/f > 3000$), which is directly proportional to the axial force existing at the crown of the arch, is the largest of any concrete arch built to date.

The construction of this bridge necessitated the erection of two temporary pillars to reduce the span to 210 m. Construction progressed from both sides by cantilever trusses until deck and arch met. The 70 m central span was built by typical cast-in-place segmental methods. A major achievement was a highly efficient monitoring system for the structural behaviour during construction, assessing support reactions, axial forces, bending moments, axial forces in the temporary stay cables etc. Three independent systems allowed to control all movements from the exact positioning of formwork to the removal of the temporary pillars.

"The concept of a new bridge in an exposed location between two elegant nineteenth century bridges is indeed a challenge. The Jury considered the solution that took nothing from either existing bridge and stood on its own merits to be worthy of a Special Mention.

The boldness of the deck is contrasted by the slender members that form the flat arch and piers. The beauty of the flat planes becomes apparent when the bridge is viewed from a variety of positions."

Special mention

New Svinesund Bridge Norway/Sweden

owner: Norwegian Public Roads Administration, Swedish National Roads Administration ♦ **main authors:** Elljarn Jordet (Aas-Jakobsen) engineers, conceptual/preliminary design Pal Björnstad and Hallgeir Kårstein (Lund & Slaatto) architectural design Manfred Matthes and Alfred Krill (Bilfinger Berger AG) engineers, detailed design ♦ **contractor:** Bilfinger Berger AG ♦ **subcontractors:** Norbetong Halden, Strömstad Betong ♦ **completion:** 2005

The new bridge between Norway and Sweden is a four-lane bridge across the Idefjord, with a total length of 704 m. The structure is designed as a single central concrete arch spanning approximately 240 m. The arch is a hollow box made of concrete C 65 with a width varying from 6.3 m to 4 m and a height from 4.2 m to 2.7 m. The crown of the arch reaches 92 m.

Critical loading for the arch is global buckling from dead load and traffic combined with transverse winds. The arch is fixed in sound rock on each side of the Idefjord. Twin steel box girders suspended on each side of the arch form the deck for main and side spans. They are connected to the arch by post-tension cables and therefore have a considerable stiffening effect on it.

The arch was constructed by means of a form-traveller system cantilevered from the already completed parts from each side of the fjord. Each segment of the arch was temporarily supported by cable stays from a temporary concrete tower on each side of the fjord; stays also reduced the transverse movement of the arch. To save construction time, the main span was erected in one prefabricated unit that was fabricated in smaller segments in Germany, then transported by barge to a location 10 km from the bridge. Here the units were assembled, transported to the site and within 12 hours installed by lifting from temporary cross-beams resting on top of the arch.

"The timeless elegance of the arched form and the statement it makes about the strength of concrete was strongly recognised by the Jury.

The Jury were very pleased with the shape selected and the way it blended into the fjord landscape.

The Jury were impressed at the way the lateral stability issue was addressed by linkage to deck, rather than by use of additional of external elements."

Exceptional Recognition

Millau Viaduct
France

owner: Compagnie Eiffage du Viaduc de Millau ♦ **main authors:** Michel Virlogeux engineering design consultant Sir Norman Foster architect Claude Servant (Eiffage TP) engineer ♦ **contractor:** Eiffage TP ♦ **completion:** 2004

The desire for an aesthetically pleasing structure led to the choice of a multi cable-stayed viaduct with slender concrete (C60) piers and a metal deck, touching the Tarn Valley at only seven points within a total length of 2.460 m. The structure is continuous along its eight cable-stayed spans (typical span of 342 m).

Two of the seven piers are the two highest piers ever built in the world to date (P2 = 245 m and P3 = 223 m). From their base to a point 90 metres below the deck, they rise as a single hollow shaft, then they are divided into two separate parallel shafts, which are each prestressed vertically by eight 19T15 cables. Above the deck, 87 m high steel pylons support the eleven pairs of cables for each span.

Wind generated stresses were critical for the dimensioning of the structure, requiring extensive studies and wind tunnel trials; the mean effects (by static calculation) and the effects of the turbulence (by spectrum analysis) were calculated for different configurations both for the construction and operational phases.

The deck was prefabricated in the factory and the cross sectional profile designed to take account of the possibility of prefabrication, transport, on site assembly and erection. The metal deck was put in position by launching consecutive sections of 171 m as they were ready. After the last section was in place the two parts of the deck were joined 270 m above the valley.

"From time to time a project comes along that surpasses so many levels of excellence that it is worthy of Exceptional Recognition.

Allowing the A75 motorway to soar almost 270 metres above the Tarn Valley, this multi cable-stay bridge represents the pinnacle of the art and science of engineering.

Although the deck and pylons are of steel, the Jury felt that fib could do nothing short of recognising this magnificent bridge as a total entity, regardless of the materials used in its construction."

Exceptional Recognition

Döllnitz Creek Bridge
Oschatz, Germany

owner: Grosse Kreisstadt Oschatz **main authors:** Manfred Curbach (Technische Universität Dresden) concept and supervisor Dirk Jesse (TU Dresden) project manager Silvio Weiland (TU Dresden) concept and structural design Matthias Schurig (Betonwerk Oschatz GmbH) execution ♦ **contractor:** Gesellschaft für Wissens- und Technologietransfer der TU Dresden mbH ♦ **subcontractor:** Betonwerk Oschatz GmbH ♦ **completion:** 2005

In order to demonstrate the state of research in the field of textile reinforced concrete, a small footbridge for pedestrians and cyclists was constructed for a local horticultural show. The special features of this material used were in particular its low weight in relation to load capacity and the possibility of slender construction.

The bridge is a single-span girder using the segment construction method, with internal non-bonded prestressing. The span of the superstructure is approximately 8,60 m and the width between the handrails is 2,50 m. The superstructure is buoyantly supported.

The textile-reinforced-concrete used is a fine concrete reinforced with endless glass fibres instead of randomly arranged short glass fibres. Optimising the arrangement of reinforcement to the flow of forces, the overall glass contents can be considerably reduced and cost-effective constructions are possible. Simultaneously, the load bearing glass parts can be increased through the bundling of fibres, as more glass fibres can be placed in the same area in comparison to a random distribution of glass fibres. A considerable increase in the efficiency of the construction compared to randomly distributed glass fibres is achieved through the increase of the reinforcement level.

The pre-cast members were fixed together using the segment construction method with internal un-bonded tendons. The amount of the tension force ensures that the joints between the segments stay closed in all load cases and the transmission of shear within the joints is secured.

"The Jury were delighted by the economy and essential structural logic in the use of continuous glass fibres for textile reinforcement, and saw the possibility of developing this concept for larger structures.

For this reason the Jury decided to recognise the project, and its associated research program, with an Exceptional Recognition mention.

It is hoped that this recognition will be the catalyst to further development of this exciting concept."

Nominee

Delhi Metro Rail Line 3B
New Delhi, India

owner: Delhi Metro Rail Corporation Ltd ♦ **main authors:** Daniel Dutoit , Thomas Paineau, Philippe Arnaud, Abdelghani Mhedden (all: SYSTRA) engineering design superstructure Mahesh Tandon, Jatinder Singh Pahuja, Prerna Mishra, Ashish Srivastava (all: Tandon Consultants) engineering design substructure and stations ♦ **contractor:** IJM-NBCC-VRM JV, Gammon India Ltd., Persys Punj Llyod ♦ **completion:** 2005

Line-3 of the Dehli metro of the 200 km Mass Rapid Transit System (MRTS) stretches in its elevated over 21 km and includes 21 elevated stations.

An innovative U-shaped structure concept was used for the viaduct construction, which in particular offers the following advantages: low rail level reducing visual impact; integration in the station design with use of top flange as part of the platform; use of the structural side beams for various purposes: noise barrier, derailment wall, support for cables, etc. The major part of the superstructure was designed as simply supported post tensioned spans, with span lengths of 16 to 31 m. The U-shaped prestressed concrete deck is composed of two side beams and a bottom slab. Each side beam includes a web and a top flange. The tracks are supported by the slab, which transfers the axle loads to the webs.

To accelerate construction, precast segmental construction was used. To fabricate more than 7000 precast segments within 14 months, a dedicated casting yard was established.

Nominee

River Deba Bridge
San Sebastian, Spain

owner: Guipuzcoa Provincial Council ♦ **main authors:** J.A. Llombart and J. Revoltos (EIPSA) structural design ♦ **contractor:** Murias, Moyua, Galdiano, Altuna, Uria joint venture ♦ **subcontractor:** Mekano4, Puentes y Calzadas ♦ **completion:** 2003

The Bridge over the river Deba runs in a curve, crossing a railway line, the river and a road. The clearance problem was solved by means of a concrete deck with a U-shaped cross-section.

Prestressing in multiple forms was applied in the structural solution adopted: extradosed by means of continuous cables over the whole length of the deck, conventional post-tensioning in in situ built concrete elements, bonding prestressing in precast beams and prestressing inside metal tubes.

Each pier is Y-shaped, braced at its top by three metal tubes anchored at their ends, which acted as passive reinforcement during the first construction phase to support the deck's dead weight. Prestressing strands were threaded into each tube on the pier's outside facing in a subsequent phase, forming a tendon inside each tube. Tensioning was performed at each end so that the passive steel's initial elongation was offset. With this, the piers' inclined shafts are only subjected to centred compression stresses due to the action of the deck's dead weight.

Nominee

Nozomi Bridge
Gifu Prefecture, Japan

owner: Ministry of Land, Infrastructure and Transport ♦ **main authors:** Nobuyoshi Ogawa (Ministry of Land, Infrastructure and Transport) chief engineer Yuji Kamiya chief engineer and Taku Yoshikawa research engineer (both Oriental Construction Co., Ltd.) ♦ **contractor:** Teruaki Kakitsuka (Oriental Construction Co., Ltd.) ♦ **completion:** 2003

The Nozomi Bridge, spanning a deep gorge, was built to provide access for heavy vehicles to a construction site across the Kiso river. Temporary false work and supports could not be used; environmental concerns prohibited the use of large construction equipment. Furthermore, the bridge needed to be recyclable: when the construction project is completed, the bridge will be disassembled and its components may be reused on other location.

To shorten the construction time, it was decided to erect the bridge using a stress-ribbon deck structure. To enhance its relatively small flexural stiffness, too sensitive to the vibrations from heavy traffic loads. a hybrid structure combining the stress-ribbon deck with a truss system was used. Thus the weight of the truss girder is transferred to the suspension cables. Traffic loads do not significantly increase stresses in the suspension cables. As a result, horizontal forces acting on the abutments could be decreased and high flexural stiffness could be achieved. The use of precast concrete panels for the deck and steel tubes for the trusswork resulted in economic and fast construction.

Nominee

Vienne River Bridge
Limoges, France

owner: Communauté d'Agglomération de Limoges ♦ **main authors:** J.M. Tanis (Jean Muller International) engineer M. Virlogeux engineer C. Chéron (AOA Architects) architect ♦ **contractor:** DV Construction ♦ **completion:** 2005

The bridge, with an overall length of 165 metres, links a highly urban right bank to a more natural, uninhabited left bank, and harmoniously integrates a motor vehicle highway access and pedestrian/bicycle traffic.

The construction was characterised by:
• favouring prefabrication by casting in situ only the arches and the prestressed ribs;
• construction of the arches and execution of the access spans with successive sections on temporary bearings;
• construction of the structure's deck by first laying prefab transversal cross beams and then installing pre-slabs, followed by the concreting of the slab; this allowed a 4,500 m2 deck to be completed in less than 4 months.

The building of the four access staircases on the almost rectilinear sloped parts of the arches was a crucial moment in the construction phase as these could not be built conventionally. A specially devised structural adaptation finally allowed prefabrication of the entire outer envelope and the staircases to be built outside the props, using the formwork tools of the main structure.

Nominee
Modena Viaducts
Italy

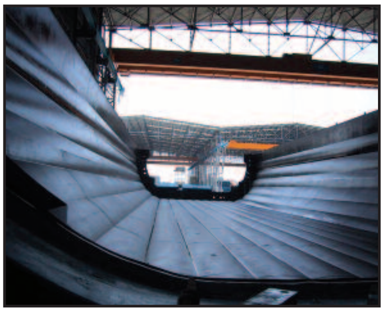
owner: TAV-Treni Alta Velocita, Italian State Railways ♦ **main authors:** Giorgio Macchi and Stefano Macchi (Studio Tecnico Macchi) structural engineering and design ♦ **contractors:** CEPAV UNO, Snamprogetti SpA, IMPRESA PIZZAROTTI & C. ♦ **completion:** 2005

The Modena Viaducts of the high speed line Milano-Bologna are a system of viaducts and bridges for a total track length of 24 km. The main innovation consists in reducing the environmental impact (noise and visual) by using curved open cross sections in prestressed concrete with the trains running inside the profile.

Noise impact levels for these profiles were found to be only negligibly higher than those corresponding to 4 m high walls. A further favourable feature of the curved shape with fluted external surfaces is a dramatic reduction of the visual impact.

The standard 31.50 m spans of the deck were designed as single piece 3.6 m high precast prestressed shells. 760 precast units were produced in one plant and transported into position by a vehicle running on the previously placed spans.

A continuous ribbon of the deck was kept when the railway crosses rivers and motorways, for which wider spans are required. In the Modena case the maximum central free span is 56 m, and 3 span continuous decks are used.



Nominee
Himi Bridge
Nagasaki, Japan

owner: Japan Highway Public Corporation ♦ **main authors:** Akio Kasuga chief engineer Koji Tazoe engineer (both Sumitomo Mitsui Construction Co.) ♦ **contractor:** Sumitomo Mitsui Construction Co. ♦ **subcontractor:** Sumitomo Steel Wire Corporation ♦ **completion:** 2004

The Himi Bridge in Nagasaki is the world's first extradosed bridge with corrugated steel web. In the design of the bridge, the height and section shape of the main girders were selected based on economy, ease of construction and streamlined configuration. To reduce the weight of the girders, and for aesthetic reasons, it was necessary to achieve a configuration that was as slender as possible.

The preconditions for extradosed cable anchorages for the main girders are that the vertical component of the cables must be transmitted efficiently to the main girders, that little additional stress should be applied to the corrugated steel web, and that the weight of the main girders themselves should be reduced.

The corrugated steel webs were joined by welding. The concrete slab and corrugated steel webs were joined by an angle dowel using flange plates so that the vertical component of the extradosed cables and the shear force of the main girders could be transmitted smoothly.

Nominee

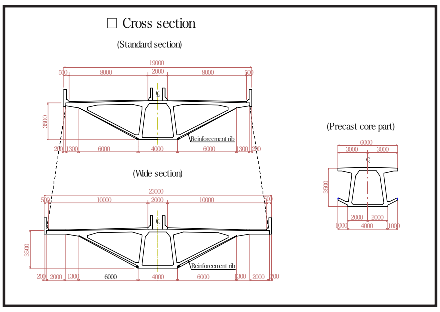
Shin-Meisei Bridge
Nagoya, Japan

owner: Nagoya Expressway Public Corporation ♦ **main authors:** Akio Kasuga chief engineer Katsuihiko Mizuno engineer (both Sumitomo Mitsui Construction Co.) ♦ **contractors:** Sumitomo Mitsui Construction, PS Mitsubishi Construction, Shiraishi Corportion ♦ **subcontractor:** SE Corporation ♦ **completion:** 2004

The Shin-Meisei bridge crosses the Shonai River in Nagoya. For both aesthetic and economic reasons, continuous three-span prestressed concrete extradosed bridge construction was used. It was necessary to reduce the weight of the main girder cross-section due to constraints on the substructure, and to avoid giving a sense of oppression to vehicles traveling on the road below the bridge.

The bridge has single-plane suspension-type cable stays with a wide cross-section. An inverse trapezoid three-chamber box girder cross-section to maintain a constant width for the lower decking was chosen to achieve a main girder cross-section shape that reduces the weight of the main girder and transfers the cable stay tension.

A two-step construction method was applied: (1) pre-cast core parts were erected and connected first; (2) side parts were constructed by the cantilever method and cast in place using a form traveler. To keep the total weight of a core cross-section block below 250 kN, the width perpendicular to the bridge axis was set at 6.0 m and the block length at 1.8 m.



Nominee

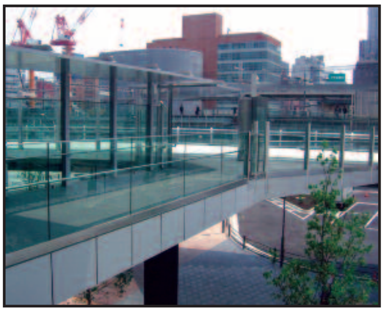
Akihabara Public Deck
Tokyo, Japan

owner: UDX company joint venture: NTT Urban Development Co., Daibiru Corp., Kajima Corp. ♦ **main authors:** Hiroaki Okamoto structural design Hiroaki Tanabe aesthetic design (both Kajima corporation) ♦ **contractor:** Kajima Corporation ♦ **subcontractor:** Sumitomo (SEI) Steel Wire Corp. ♦ **completion:** 2005

The 9 m wide pedestrian deck connects two high-rise buildings to the Akihabara station plaza. It is a two-span continuous prestressed concrete pedestrian deck with a π-shaped cross section. The requirements for the public deck were
- a slender structure with restriction of deck elevation,
- a design aesthetically expressing the state-of-the-art technology of Akihabara's forthcoming IT hub.

The deck consists of an upper slab, webs and steel struts. The upper slab and the webs are made of low-autogenous-shrinkage ultra-high strength concrete (120 N/mm2). The 25 cm thick upper slab was cast in situ, while webs were designed as precast members. Pregrouted cables were used as transversal prestressing for the upper slab.

A light curvature was given to the horizontal alignment of the deck to create a visual perspective effect. Longitudinal interval of the steel struts and the handrail pillars were aligned according to the layout of exterior panels of adjacent buildings to provide the aesthetic conformity with surrounding buildings from the pedestrian's viewpoint.



Nominee

Krka Bridge
Sibenik, Croatia

owner: Croatian Highways Ltd. ♦ **main authors:** Jure Radic, Zlatko Savor, Igor Gukov, Gordana Hrelja, Alex Kindij, Nijaz Mujkanovic, Veljko Prpic associates (all: University of Zagreb, Faculty of Civil Engineering) ♦ **contractor:** Konstruktor-Inzenjering D.D. Split ♦ **subcontractor:** Civil Engineering Institute of Croatia d.d. supervision Geotehnika Zagreb drilling and grouting of rock anchors Duro Dakovic Montaza d.d. steelwork University of Zagreb/Faculty of Civil Engineering bridge monitoring ♦ **completion:** 2005

The arch of the Krka bridge is of double-cell box cross section, 10 m wide and 3 m deep (concrete C 50/60). It spans 204 m with a rise of 56 m. There are six pairs of spandrel columns, distributed symmetrically from the arch crown (columns in C 40/55). The bridge superstructure is a composite grillage with two longitudinal box steel girders joined by steel cross girders and edge girders; it was the first occurrence in Croatia of launching the superstructure of an arch bridge.

The arch was constructed by balanced cantilever technique, working simultaneously from both springing points. The continuously growing halves of the arch were each suspended, a section at a time, by stays attached to the column at the arch springings, which were in turn equilibrated by anchor stays connected to rock anchors.

The superstructure is longitudinally very flexible, which produces large horizontal movements in a case of a seismic event. For this reason, viscous dampers were installed at both superstructure ends, transmitting longitudinal forces to massive abutments.

Nominee

Yahagigawa Bridge
Toyota City, Aichi, Japan

owner: Central Nippon Expressway Co., Ltd. ♦ **main authors:** Yasuo Inokuma and Hiroyuki Ikeda (both Central Nippon Expressway Co., Ltd.) basic and detail design ♦ **contractors:** West Construction Joint Venture: Kajima Corp., Sumitomo Mitsui Construction Co., Yokogawa Bridge Corp.; East Construction Joint Venture: Oriental Construction Co., Taisei Corp., Kawada Construction Co. ♦ **subcontractors:** Sumitomo (SEI) Steel Wire Corporation, Anderson Technology Corporation, Shinko Wire Co., Oiles Corporation ♦ **completion:** 2005

Yahagigawa Bridge is a four-span continuous hybrid cable-stayed bridge composed of two prestressed concrete cable-stayed bridges cantilevering 171 m from the piers and a steel box girder of 133 m in between, supported at mid-span. It is the world's first cable-stayed bridge to apply corrugated steel webs for prestressed concrete box girders. Total bridge length is 820 m, maximum span 235 m, width 44 m. The girder height of concrete box girders goes from 4 to 6 m as it approaches the pier tables. Two reinforced concrete towers suspending the box girder are 110 m in height from the top of piers.

As the bridge is unprecedented in scale and design, tests and analyses were conducted to confirm the design methods, including load capacity tests of the concrete filled steel plates, wind tunnel tests, fatigue-loading tests for the anchorage beam, load capacity tests of the corrugated steel webs with concrete slabs, and a constructability test of the placement of concrete on the lower flange of the corrugated steel web.

Nominee

LBJ Expressway Interchange Dallas, Texas, USA

owner: Texas Department of Transportation ♦ **main authors:** Tom Stelmack, Scott McNary, Jeff Mehle (all: Parsons) engineers – segmental redesign Lex Collins (HNTB) original design ♦ **contractors:** Rizzani de Eccher/H.B. Zachry Construction Company joint venture ♦ **subcontractors:** Deal SRL, Italy supplier of segment erector ♦ **completion:** 2005

The new "Dallas High-Five" interchange rehabilitation provides five-levels of flyover ramps, and highway widening lanes accommodating over a half million vehicles per day.

The 4th and 5th levels of the interchange consist of five ramps, and were originally designed as cast-in place built. Redesigning them as precast segments for balanced cantilever erection necessitated the construction of a custom-made segment erector but allowed a better maintainance of traffic requirements.

In order to minimise falsework and forming issues for a cast-in-place pier table, a precast/cast-in-place hybrid design for the pier segment was utilized. After match-casting against the precast shell for the upstation and downstation cantilevers, the shell was erected over the projecting pier column reinforcement. The shell was aligned and graded to the proper values before the diaphragm was tied to the precast shell using coupled reinforcing. The pier segment diaphragm and the top deck and bottom slab access openings were cast-in-place, making the pier segment monolithic with the pier column.

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Seiun Bridge, Yamashiro, Japan
Floating Breakwater, Monaco
Rion-Antirion Bridge, Greece

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