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Reports from *fib* commissions and task groups

An important feature of *fib*-news is the regular reporting of progress made in commissions and task groups, on new groups formed, on new publications, and on any problems or questions connected with the commission's and task group's terms of reference: contributions from commission chairmen or task group convenors are particularly appreciated in this respect, and all involved are invited to contact the secretariat whenever they wish to use *fib*-news for dissemination of information. In view of the upcoming symposium on *Connections between Steel and Concrete*, held in Stuttgart in September 2001 and co-sponsored by the *fib*, it is very appropriate to report in the following on the mission and activities or fib's Special Activity Group (SAG) *Fastenings to Structural Concrete and Masonry*. This group is now active in its 14th year with a truly global participation and has published very substantial and comprehensive state-of-art information and guidance, contributing very effectively to the international harmonisation in this field. ●

fib SAG 4 'fastenings to structural concrete and masonry': mission and activities

Modern fastening systems are increasingly employed for the transfer of concentrated loads in concrete and masonry structures. Their use has proliferated in structural applications, viz., the attachment of a structural steel member to a concrete foundation or wall, and in so-called non-structural uses such as securing pipe, ductwork, electrical systems, and building cladding to the building substructure. Cast-in-place systems (which are placed in the formwork before casting of the concrete) and post-installed systems (which are installed in hardened concrete and masonry) are equally common.

Although a large number of safety relevant fastening assemblies are installed every day on construction sites around the world, the level of understanding in the engineering community regarding their behaviour is generally very limited.

In order to improve the general knowledge and awareness of the engineering profession in this area, the formation of a Task Group was initiated by the former Comité Euro-International du Béton (CEB). Convened since by Prof. Dr-Ing. Rolf Eligehausen at the University of Stuttgart, the group has immediately attracted participants from around the globe, and currently lists 35 active members drawn from industry, academia, and the building professions. Since the inaugural meeting in Stuttgart 1987, some 25 annual or bi-annual technical sessions have been held in Asia, Europe and North America, each organized by a member, association, or firm from the host country.

Until 1991, the group produced a state-of-the-art report on fastenings to concrete and masonry, first published as CEB Bulletins 206 and 207, and later in a revised hardcover edition entitled *Fastenings to Reinforced Concrete and Masonry Structures*, by Thomas Telford in 1994.[1] Since that time, the group has concentrated on the design methodologies for fastenings in concrete as well as the state of the art in fastenings for seismic retrofitting. In 1995, a comprehensive design method for cast-in-situ headed anchors and mechanical post-installed fasteners in concrete based on the Concrete Capacity (CC) method was published as CEB Bulletin No. 226. This approach to the design of anchors forms the basis for design codes in Europe and the US. A revised hardcover edition of the Bulletin was published by Thomas Telford in 1997 in two volumes under the titles *Design Of Fastenings In Concrete*,[2] and *Fastenings for Seismic Retrofitting*.[3]

More recently, the group's efforts have been directed towards the design of grouted and bonded (adhesive) anchors. Ultimately, it is hoped that a design method compatible with the CC method can be formulated for these systems as well. In addition, the design of anchors for

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earthquake loading continues to be a focus for participants from the US, Japan, and Greece, and a new subject, the design of cast-in-place channel bars, has been undertaken as well. The activities of the group in each of these areas are briefly summarized below. ●

Design of bonded (adhesive) anchors

Design models for single bonded anchors have been compared to a worldwide database of test results. Comparisons of the models for bonded fastenings under tensile loading indicate that a design model based on uniform bond stress provides the best fit to the test records.[4] This approach has also been confirmed with non-linear numerical three-dimensional finite element studies. Correspondingly, the uniform bond model has been integrated into the modified CC method for the design of bonded anchors.[5, 6] It combines the advantages of the CC method with the accuracy of the uniform bond model. Figure 1 provides a comparison of test results with predicted capacities for quadruple fastenings using the CC method. A similar level of agreement between test and calculation has been found in many other cases. Work in this area is ongoing.

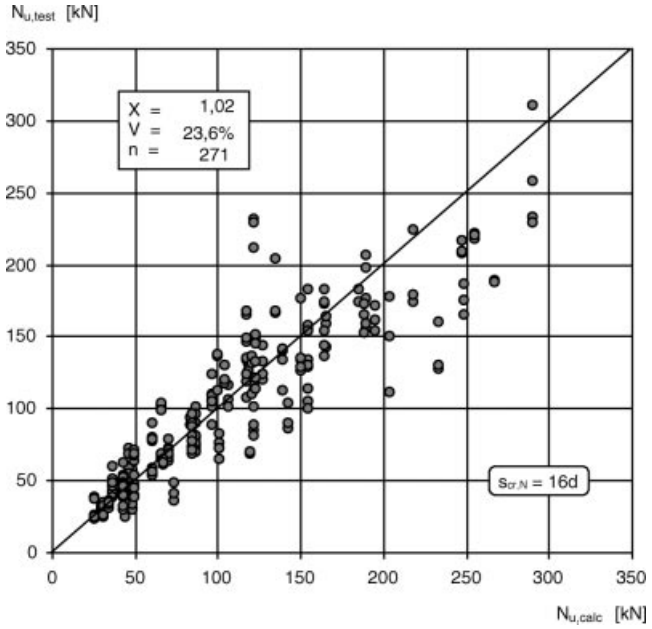


Fig. 1 Adhesive anchors: comparison of test results with predicted capacities for four-anchor groups, after[6]

Design for earthquake loads

The study of anchors in the context of earthquake design can be subdivided into two subject areas as follows: (1) discrete anchors as used to attach (steel) elements to concrete; and (2) dowels used to join new concrete elements to existing concrete and masonry structures. With respect to discrete anchorages, the focus has been on methods of qualifying anchors for the unique conditions of seismic loading that might affect anchor behaviour, i.e. shock, cyclic loading and extreme damage to the base material (concrete, masonry). It must also be recognized that design for earthquake loads is a limit state problem. An approach to effectively control the load that can be transferred to the anchor through the inclusion of a ductile link in the load path is under consideration (see Figure 2). Test methods that yield information regarding anchor response (stiffness and load) over the entire load range are also required.

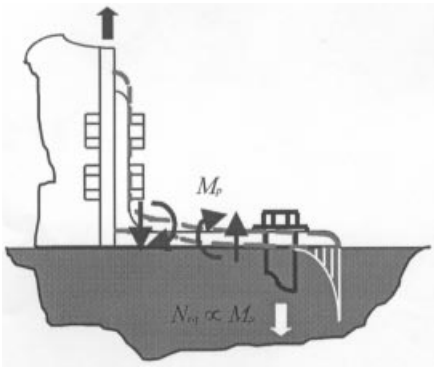
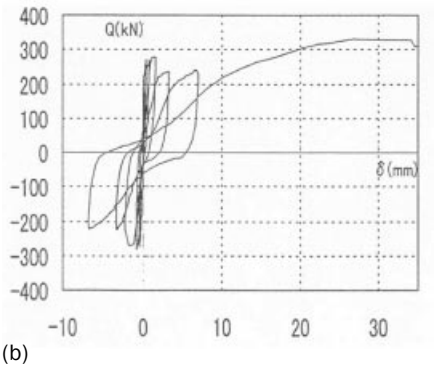


Fig. 2 Example of the use of a ductile link to limit earthquake loads to the anchor, after[7]

(a)



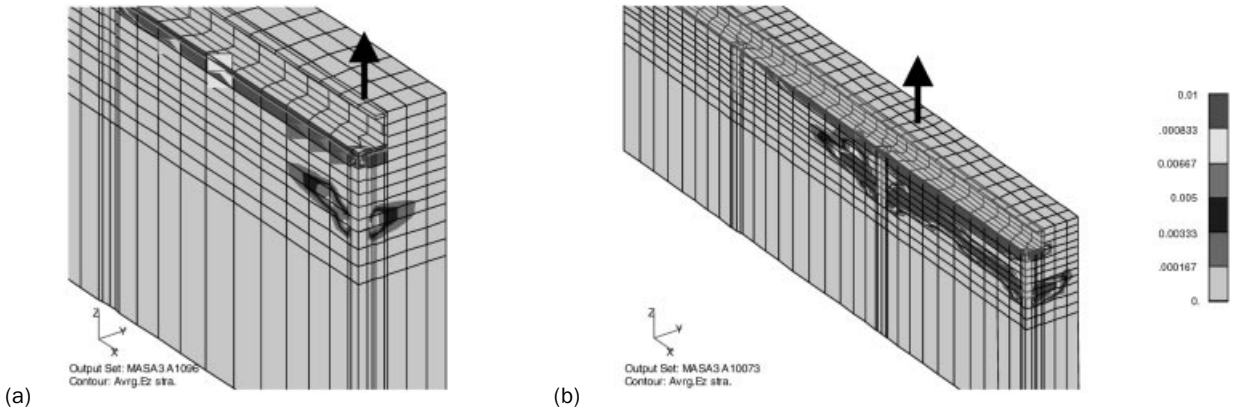
(b)

Fig. 3 Testing of dowels across a concrete-to-concrete interface, after[8]; (a) test frame; and (b) hysteretic loops

The study of dowels as used for retrofitting infill walls and braced frames to reinforced concrete structures has been studied extensively both in full scale tests (Figure 3) and with finite element models. The formulation of test results into a comprehensive set of design recommendations remains to be accomplished, however.

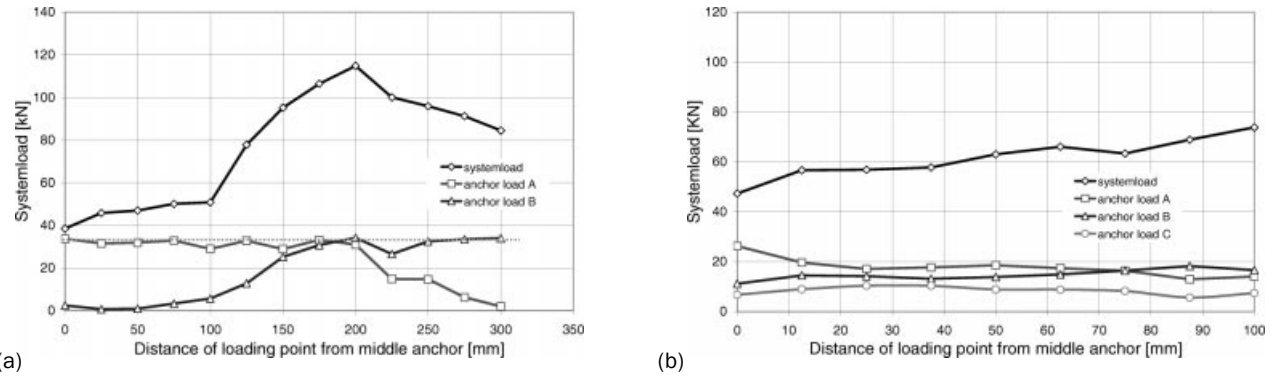
Design of channel bars

The design of channel bar anchorages presents special challenges with respect to the formulation of a universal design model, and currently no such model exists. Channel bars are designed accord-



(a) (b)

Fig. 4 Concrete fracture patterns: channel bar with anchor spacing s = 300m, after[10]; (a) tension load applied concentric with anchor; and (b) tension load applied 200 mm to the left of the middle anchor



(a) (b)

Fig. 5 Influence of load position on the load bearing capacity of 50/30 channel bars, after[10]; (a) s = 300 mm; and (b) s = 100 mm

ing to manufacturer recommendations or approvals based on a limited number of full-scale tests. Currently, three-dimensional finite element studies with the FE programme MASA[9] and full-scale tests are being performed and evaluated to determine the governing parameters for the load-bearing behaviour. The studies include channel bars located close to the edge in thin concrete members and in cracked and uncracked concrete, with the anchorages subjected to tension loads applied at varying locations along the channel. Results of finite element modelling with five anchor channel bars are shown in figure 4 (quarter view).

The effect of the point of load introduction on the anchor load distribution and the channel bar ultimate load capacity is shown in Figure 5. Results are plotted for two so-called 50/30 channel bars, with anchor spacing s = 300 mm and s = 100 mm respectively.

The results of the finite element calculations indicate good agreement with test results. Stiffness considerations dictate that, depending on the particular geometry in question, the anchors of a channel bar do not participate equally in resisting the applied load. Therefore, the CC method, which generally assumes equal stiffness for all anchors in a group, cannot be directly applied to channel bars. It is possible that the CC method can be extended for channel bars by considering their unique load distribution characteristics. Further research in this area is required.

Outlook

The task group is comprised of some of the leading experts on the subject of anchorage to concrete and masonry from around the world, and the meetings are invariably enhanced by contributions from guest speakers and attendees representing research efforts in industry and academia. As a result, the activities of the group have been characterized by an extraordinary degree of cooperation and international camaraderie. Where national differences exist, they are accommodated in an atmosphere of mutual respect and scientific inquiry. It is anticipated that this spirit of mutual interest will continue to be the basis for future valuable contributions to a subject of ongoing interest to the international design community. ●

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Upcoming symposia

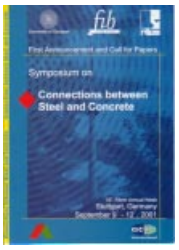
Symposium on 'Connections between Steel and Concrete'

(Press-release from the organisers)

The Symposium on 'Connections between Steel and Concrete' sponsored by fib, ACI, RILEM and IABSE will be held at the University of Stuttgart, Germany from 9–12 September, 2001. These will be 2.5 days of high intensity sessions, where more than 100 papers presented in parallel sessions covering state-of-the-art information about recent technology advances in composite structures and fastening to concrete. A broad spectrum of topics will be discussed including: design, testing, dynamic loading, response to fire, durability and other categories. The symposium will make it easy to connect with people experienced in practice and research in the fields of composite structures and fastening to concrete from many countries around the world and to exchange the latest knowledge in technology and developments in both fields.

The organizing committee has kept the registration fees moderate to encourage participation from all facets of the design and construction community. The fee is €300 before May 1st, 2001 and €400 afterwards. The registration fee includes the symposium proceedings, the welcoming reception, the symposium dinner and the mayor's reception.

For further information contact the symposium secretariat (phone: +49–711–685–3320; fax: +49–711–685–3349; e-mail: contact@iwb.uni-stuttgart.de or visit http://www.iwb.uni-stuttgart.de)



Symposium on 'Connections between Steel and Concrete'

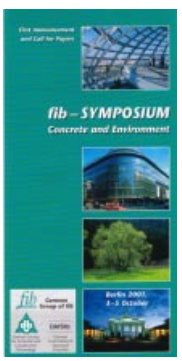
fib Symposium on 'Concrete and Environment'

(Press-release from the organisers)

On invitation of the German National Group, the official *fib* Symposium on 'Concrete and Environment' will be held at Berlin, Germany, from 3–5 October, 2001. It will be preceded on Tuesday, 2 October, by a one day *fib* Technical Activities Workshop during which the laureates of the 2001 *fib* diploma for younger engineers will present and discuss their work in the two categories 'research' and 'design and construction'. The afternoon of that day will as usual see the presentation and discussion of new *fib* bulletins.

The symposium will be arranged in 2.5 days of sessions covering state-of-the-art information on topics as sustainable design, integrated design concepts for strength and durability, environmental compatibility of concrete structures, protective structures, environmental aspects in operation and aesthetical aspects of concrete structures. In connection with the symposium a number of commission and task group meetings will be organised and Council and Steering Committee will also meet in Berlin.

For further up-to-date information contact the symposium secretariat (phone: +49-30-2360-9640; fax: +49-30-2360-9646; e-mail: meyer@betonverein.de or visit from time to time the website http://www.betonverein.de/fib2001.html).



fib Symposium on 'Concrete and Environment'

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Congratulations

Professor René Walther

René Walther, Honorary President of the former FIP (Fédération International de la Précontrainte—International Federation for Prestressing) and Honorary Professor of the EPFL (Ecole Polytechique Fédérale de Lausanne—Swiss Federal Institute of Technology Lausanne from where he retired in 1995 after 20 years in service), received on 26 January 2001 an honorary doctorate from the University of Stuttgart.

Thus, in a way he renewed the contacts to a university where he passed—between 1960 and 1968—an important time of his career as researcher and lecturer in the team of the late Fritz Leonhardt. Born in 1928 he grew up in Basel, and graduated in 1952 from the Technical University of Zurich. He later obtained his doctor degree from Lehigh University, Pennsylvania. Parallel to his engagement in Stuttgart, he founded in 1963, together with his partner Hans Mory, his own design office in Basel, thus becoming involved in the construction of many bridges. Later, during his parallel activity as Professor in Lausanne, he became much involved in research and the design of cable-stayed bridges, which resulted in some well-known publications in this field. Having been active in CEB (Comité Euro-International du Béton—Euro-international Concrete Committee), especially in its commission on shear and torsion, during the sixties, he later was more and more engaged in FIP work, and served as a President to this association between 1988 and 1992. In 1994 he received the Freyssinet Medal, the highest distinction FIP (and now *fib*) had to offer for an engineer. The merger of FIP and CEB which finally could be achieved in 1998, had been for long a matter of concern to him. As Honorary President he is a statutory member of the *fib* Council.

Zdenek P. Bazant, Professor of Civil Engineering and Materials Science at Northwestern University, was awarded the honorary degree Doctor of Science h.c. from the University of Colorado, Boulder, for 'substantial contributions to structural engineering and solid mechanics worldwide'. Prof. Bazant is Ordinary Individual Member of *fib*. ●

New bulletins

The series of *fib* Bulletins counting for the subscription year 2001 started with number 11 *Factory applied corrosion protection of prestressing steel*, mailed in January to all corporate and individual subscribing members. A brief description is given in the following. Non-members may order this and former publications from the fib secretariat by simply using the form below or through the internet (Website http://fib.epfl.ch).

Factory applied corrosion protection of prestressing steel (*fib* state-of-art report)

Without doubt, active corrosion protection of prestressing steels by cement grout can be one of the most economic and durable solutions, if properly executed. Numerous other corrosion protection systems which fulfill requirements such as controllability and exchangeability are available. This state-of-art report, prepared by a Task Group and approved by *fib* Commission 9 *Reinforcing and prestressing materials and systems*, concentrates exclusively on factory applied corrosion protection that can be produced in controlled processes which should assure a better quality than corrosion protection applied on site.

The report is addressed to designers and installers (executing persons) attempting to inform them about the various possibilities for industrially applied corrosion protection and to provide the necessary knowledge for their application:

- *fib* Bulletin 11, format 209 × 297 mm, (approx DIN A4), 20 pages, 3 tables, 12 illustrations
- Non-member price: 50 CHF, surface mail included, airmail at extra charge ●

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