Heavy duty composite material for prestressing

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Heavy Duty Composite Material for Prestressing

Matériau composite pour la précontrainte

Vorspannung mit Hochleistungs-Verbundwerkstoff

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1. PRESTRESSING WITH COMPOSITES

Composite materials in the construction industry - for prestressed concrete and ground anchors - mark a new development in our technical world. Thorough research and development have enabled some promising applications of a modern material with very specific features.

By correct choice of fibers such as glass, carbon or aramide type together with a polyester or epoxy resin matrix, this material is extremely adaptable to widely varying demands. It is actually possible to compose new materials with high resistance to media; with a strength greater than steel; the elastic modulus can be set within wide ranging limit values. The material is very light and is electromagnetic neutral.

2. CONTROLLING WITH COMPOSITES

Great importance is today placed on the ability to detect, at an early stage, any sort of fault in a load-bearing structure. By integration of optical fibers into the composite material, the composite structure itself becomes controllable, that is to say an "intelligent load-bearing structure". The physical properties of the optical fibers allow the measurement of light transmission and reflection and thus facilitate the determination of stress limitions at any point.

3. PROTECTING WITH COMPOSITES

This new material is now available in bridge construction, where its high strength - comparable with the best prestressing steel -, corrosion resistance against water and salt, low elastic modulus and controllability through the integration of optical fiber sensors, makes it ideal.

3.1 First applications

Other than prestressing for the first time in the world, of a bridge subject to heaviest traffic - the roadbridge Ulenbergstrasse, Düsseldorf (FRG) - mast bracing using this material was carried out for military authorities already in 1980 whereby 150 individual rods between 1 m and 50 m long and having a diameter between 12 and 25 mm, were involved. At the same time, in 1980, Strabag also constructed the "Lünensche Gasse Brücke", a small bridge in the north of Düsseldorf for the Roads, Bridge and Tunnel Authorities. This involved 12 tendons with varying anchor systems and non-composite prestressing. These 12 prestressing tendons were removed 5 years later in 1985 and made available to university institutes with a view to the upcoming Ulenbergstrasse project. Especially the so-called "grouted prestressing tendons" which we have developed to application stage showed excellent results.

3.2 Fire tests

Fire tests were carried out last year at the Technical University of Brunswick by Prof. Kordina, with the test reflecting the requirements of Ulenbergstrasse. This involved a 6 cm concrete cover to the conduits as minimum requirement in accordance with the "Additional Technical Requirements for Civil Engineering". The exposure resistance reached 105 minutes which falls into the fire class F90.

3.3 Further applications

Further projects are in preparation, e.g. a pedestrian bridge construction with external prestressing, and the application of the composite materials for soil anchorage. Meanwhile, in last October, new covers to the salt pits in the Bayer plant at Dormagen (FRG) were provided. Replacements of the previous covers type SLW 60, i.e. 60 tons truck load, became necessary due to heavy chloride attack in the past.

4. MATERIAL PRICE

The cost of the complete preassembly of the prestressing tendons for the Ulenbergstrasse project with the inclusion of bar material, manufacture of the anchor parts by hand, the preparation and execution of works for the production of the anchorage obviously cannot be compared with commonly used steel tendons. They also reflect investments for the preparation of technical concepts and expert opinions by competent scientists. Compared to the initial 400% of common production cost for steel tendons, the production price has meanwhile been reduced to approximately 200% for composite materials. Well equipped manufacturing plants with relevant production rates, allowing for economic output, will in the future enable a more competitive price, as opposed to steel on the basis of equal tensile strengths.