

Abstracts of PCI Special Publications

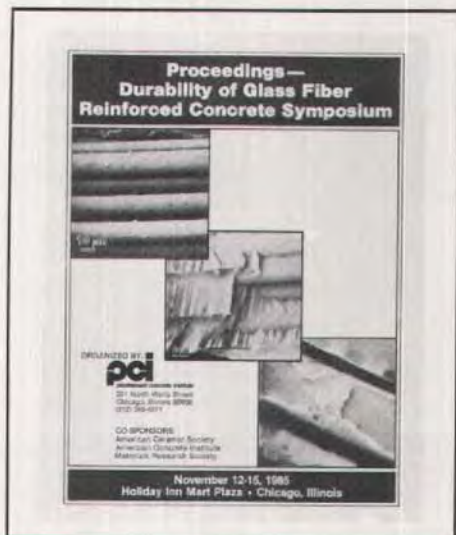
Proceedings — Durability of Glass Fiber Reinforced Concrete

This symposium, consisting of 28 papers, provided a focus for current information on developments relating to the in-service durability characteristics of glass fiber reinforced concrete products.

The first two sessions were designed to provide background information as a preliminary to the main question to be addressed by the Symposium, the GFRC durability problem. In the first of these sessions, three speakers intimately associated with the development of the industry provided a summary of the early history of GFRC development and a look at current industry practices and perspectives world-wide.

In the second session three internationally-recognized authorities provided fundamental background on (a) the technology of glass fiber design and manufacture as applied to GFRC-specific fibers; (b) the processes of portland cement hydration chemistry, as they influence the characteristics of the internal structure and chemistry of GFRC; and (c) the current, and unfortunately limited, state-of-the-art understanding of the complex mechanics governing GFRC systems. The session was concluded by an assessment of the current status of the reliability of GFRC products from the point of view of a technically sophisticated customer.

These introductory sessions were followed by three sessions comprising the heart of the program, and addressed specifically to the durability problem itself.



These were concerned respectively with: (1) the mechanisms responsible for the problem, (2) appropriate tests and test methods, and (3) new and modified GFRC technologies developed to avoid it.

The main points established at the Symposium can be summarized as follows:

1. This appears to be a critical time for the establishment of large-scale usage of GFRC. Despite the progressively increasing use in the U.S., the expected large scale adoption has been stymied by the perceived question of durability.

2. The original "BRE/GRC" formulation with CemFIL-1, and its near relatives, are subject to loss over time of composite flexural and tensile strengths down to little

more than those of the matrix, and loss of essentially all of the strain capacity. These losses occur in every case of exposure to wet conditions, given time.

3. The importance of retaining strain capacity, especially for sandwich panels but also for imperfectly fixed single-skin products has not been sufficiently stressed in the past.

4. There has been a major dispute with respect to the fundamental cause of the problem. One group of researchers focuses on alkaline attack on the glass. While another group suggests that (a) the loss of strain capacity occurs as a result of deposition of calcium hydroxide and other cement hydration products between the individual fibers of the strands and consequent bonding of all of the individual fibers to the matrix, and (b) that the loss of composite strength, at least with alkali-resistant glass composites, is mostly due to the same effect; only a minor contribution is perceived to result from alkali attack on the glass.

5. CemFIL fibers made with identical glass but a modified coating, marketed as CemFIL-2, show significantly slower and less severe strength and strain capacity losses. The cause of the benefit may be that an active agent in the new size "reduces the rate of alkali/glass chemical reaction" or that the active agent(s) in the size may interfere with calcium hydroxide precipitation between the fibers, at least at early ages.

6. A large number of GFRC formulations different from "BRE/GRC" are possible, and many are being explored and some used in practice. Many of these formulations are of specific interest in terms of potential reduction or complete elimination of the loss of strength and strain capacity.

Some of the more prominent alternate systems or potential systems discussed at the Symposium are: (a) Incorporation of polymer latices; (b) Use of higher percentage of glass fiber; (c) Use of new glass formulations, including higher ZrO₂ content glasses and other novel glasses; (d) Matrix modification and substitution, including (1) the use of the special CGC cement developed by Chichibu Cement Co., (2) the potential use of metakaolinite as an effective admixture to portland cement, and (3) the potential use of slag and silica fume incorporations; (e) A system of incorporating a concentrated suspension of silica fume directly into the spaces between the glass fibers preventing local deposition of calcium hydroxide and presumably lowering local alkalinity.

Proceedings - Durability of Glass Fiber Reinforced Concrete Symposium is a 356 page, 8½ x 11 softcover volume. It is available from the Prestressed Concrete Institute, 201 North Wells Street, Chicago, Illinois 60606. Cost is \$45 in U.S. funds drawn on a U.S. Bank. Payment must accompany order.