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Improving Quality of Post-Tensioning Tendons with Plastic Duct

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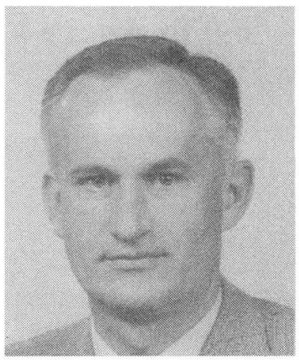

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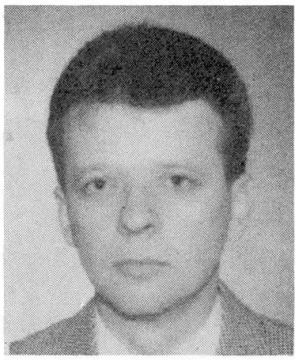

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Summary

While the durability of post-tensioned structures is generally good, corrosion problems with post-tensioning tendons have occasionally been reported. A thick walled and tight plastic duct system has been developed, which offers extremely good corrosion protection. In this paper experiences and evaluations of site measurements are presented, which were gained when working with plastic duct for the first time on German construction sites (Ludwig-Erhard-Haus in Berlin and HTS – Bridge in Siegen).

Keywords: Post. tensioning ; quality ; plastic duct ; tendon elongation ; site measurements.

1. Introduction

Post-tensioned tendons in steel ducts are protected against corrosion by concrete cover and grout. With proper structural detailing and careful execution of the construction work on site, the concrete cover will have sufficient thickness and the material properties of grout and mortar will be of high quality. While the durability of post-tensioned structures with steel duct is generally good, corrosion problems with post-tensioning tendons have occasionally been reported [1].

In order to provide an enhanced corrosion protection for post-tensioning tendons, a plastic duct system was developed by a post-tensioning company [3]. Plastic ducts offer greatly increased corrosion protection for tendons and a higher resistance against fretting fatigue compared to conventional steel ducts. The friction coefficient for plastic ducts is lower than the friction coefficient for steel ducts. On one hand plastic ducts offer advantages for practical applications because of their low weight and the convenient duct couplers, on the other hand special care has to be taken during the placing of the duct and specifications have to be closely followed.

Investigations of the bond behaviour, the friction coefficient, the influence of the ten times higher thermal expansion coefficient of polypropylene in comparison to concrete, injectability and fretting fatigue have been compared to experimental results of steel ducts in [5].

In the eight page version of this contribution experiences are reported which were gained when working with plastic ducts for the first time in Germany.

2. Plastic Duct for Post Tensioning Systems

According to the German certificate of approval [2], plastic duct is available with round cross-section with inner diameters of 59, 76 and 100 mm for up to 22 strands of 0,6" (Fig. 1) and with flat oval cross-section for up to 4 strands of 0,6" (Fig. 2). The material used for the production of the ducts is polypropylene.

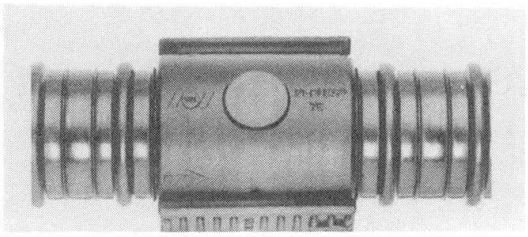

Fig. 1 Round plastic duct with coupler

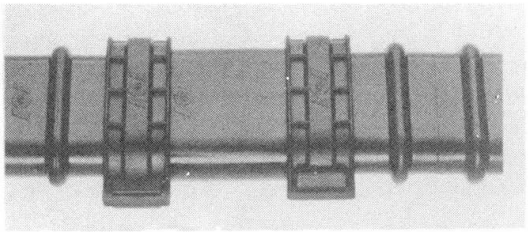

Fig. 2 Flat plastic duct with coupler

The design of post-tensioned structures with plastic duct can follow exactly the same principles as for structures with corrugated steel duct. Friction losses during stresses can be determined with the conventional method

$$P_{(x)} = P_o \cdot e^{-\mu(\alpha+\beta \cdot x)} \tag{1}$$

In the certificate of approval [2] design values for μ equal to 0.14 and β equal to 0.3 are suggested.

For ultimate conditions rigid bond between post-tensioning strands and concrete may be assumed which allows to develop the yield strength of the post-tensioning strands at critical sections.

3. Recommendation

Laboratory experiments and experiences from using plastic ducts on site have shown that the duct system [3] will remain tight if design recommendation on maximum support distances and minimum radii of curvature are followed. With plastic ducts as a tight barrier the corrosion protection of post-tensioning tendons is greatly improved. Plastic ducts should therefore become the regular choice for designers and are strongly recommended for tendons which might be highly exposed to corrosion like transverse tendons in bridge decks and tendons of parking garages.

4. References

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