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Deviation in deflections of eccentrically prestressed reinforced concrete structures

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Abstract

The pre-service stage deflections, caused by prestress, should be evaluated when calculating the final deflections of the members. The deflections of neighboring prestressed reinforced concrete structures should not differ beyond the allowable range. The significant difference of deflections in neighboring structures could violate not only the economical and aesthetical requirements but also could have negative influence on the overall structural behavior. The research shows that the behavior of prestressed reinforced concrete structures is influenced by many technological factors. Most of the influence takes place during the production of prestressed RC structures and mainly caused by initial prestress in reinforcement and variable deformations of concrete.

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Keywords: prestressed concrete; deflection; serviceability; design; technological factors.

1. Introduction

The use of prestressed reinforcement in concrete structures significantly increase their stiffness and resistance to cracking. In the service stage all the deformations of flexural members and deflection particularly mainly depend on the cross-section stiffness. The pre-service stage deflections, caused by prestress, should be also evaluated when

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calculating the final deflections of the members. The deflections of neighboring prestressed reinforced concrete structures, e.g. slabs, should not differ beyond the allowable range. The significant difference of deflections in neighboring structures could violate not only the economical and aesthetical requirements but also could have negative influence on the overall structural behavior [1, 2]. Despite the strict requirements of the design codes, the above mentioned uneven deflections often could be observed in real life structures (Fig. 1).

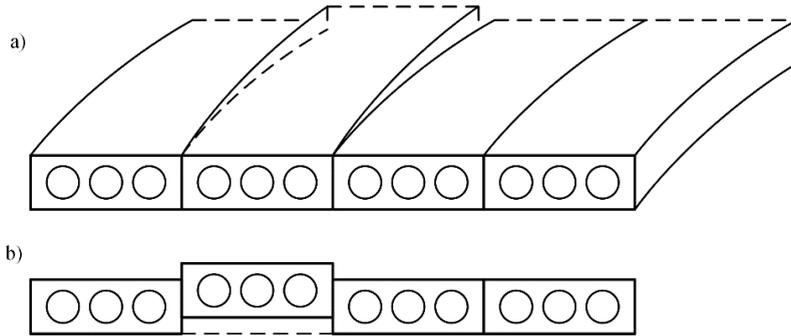


Fig. 1. Uneven deflections of floor slabs: (a) a view from support; (b) midspan section.

The research shows that the behavior of prestressed reinforced concrete structures is influenced by many technological factors [3, 4]. Most of the influence takes place during the production of prestressed RC structures and mainly caused by initial prestress in reinforcement and variable deformations of concrete. The serviceability of the structures highly depend on initial state of stress and strain. The latter, in turn, is mainly caused by prestress force during the hardening of concrete and during the release of prestressed reinforcement from abutments when concrete is hardened enough. Since the resultant prestressed force is applied eccentrically, during the release of prestressed reinforcement the concrete strength must be at least $0.70f_{ct}$. The prestressed members deflects (v_0) during the release of reinforcement but this deflection is partly counteracted by the self-weight caused deflection (v_g) (Fig. 2).

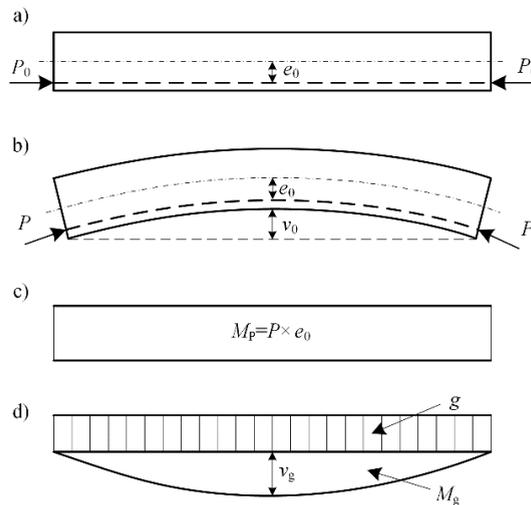


Fig. 2. State of stress and strain of flexural members during the release of prestressed reinforcement: (a) before the release of prestressed reinforcement; (b) deflection of member during the prestress (precompression of concrete); (c) distribution of bending moment caused by prestress; (d) deflection of member and distribution of bending moment caused by self-weight.

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