

Review article

Load transmission between slabs and shores during the construction of RC building structures – A review

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ABSTRACT

Shoring successive floors is at present the most frequently used technique when constructing reinforced concrete (RC) building structures. This technique allows the recently poured slabs to be supported by the lower slabs by means of shores. Considering the particular characteristics of shoring successive floors, it is very important to be able to estimate how loads are transmitted between shores and slabs in order to maintain adequate structural safety and avoid situations of risk or even collapse in buildings under construction. The transmission of loads from shores to slabs during all the construction stages is a complex phenomenon and has been the subject of numerous studies, especially in recent years. The research carried out to date has included experiments on full-scale buildings and the development of advanced numerical models, the estimation of the loads acting on slabs during construction, the definition of simplified calculation methods to estimate loads on slabs and shores during building construction and estimating the appropriate construction times taking into account the evolution of the mechanical properties of early-age concrete. This paper was conceived in order to give an answer to: (1) advances in the field of constructing RC building structures, (2) the growing interest of the scientific community, and (3) the need for the structural and construction engineering sector to have the tools available to increase the safety and design of building construction processes. The paper is unique in the field of RC building structures in that it is the widest, most complete and most ambitious review carried out to date and includes the most important advances in the study of slab-shore load transmissions. This work will be of interest to researchers who wish to go deeper into the field of building construction, and to more experienced professionals who require all the up-to-date information in a single document. However, engineers, architects and builders could also find the paper an excellent guide that will help them to improve their daily work in the field of designing and constructing buildings.

1. Introduction

Shoring successive levels of floors is the method most frequently used to build reinforced concrete (RC) building structures. This method consists of supporting the newly poured slabs, while keeping some of the lower floors totally or partially shored. The weight of the newly poured floor, plus any possible construction live loads, is thus distributed among one or more of the lower floors. This construction method allows the option of choosing from a number of variations, each one involving different operations on each floor: shoring/striking (SS), shoring/clearing/striking (SCS) or shoring/reshoring/striking (SRS). A scheme of the operations in these three variants can be seen in Fig. 1 up to the shoring of the third floor, with two successively shored floors. The shoring and striking operations are always present to support the new slab and remove the shores at the right time, respectively, although

intermediate operations, such as clearing or reshoring, can also be used. Clearing (or partial striking) consists of removing more than 50% of the shoring components, without completely striking the slab, a few days after pouring. On the other hand, reshoring consists of removing all the shores under the slab some days after pouring and re-installing them to help support subsequent load increases. One or other of these intermediate operations is often used, thus recovering a large proportion of the materials (formwork boards, joists and shores) for later use in building the upper floors.

Discovering how the loads are transmitted between shores and slabs in a building under construction is quite a complex problem and has been studied by many authors. Although experimental studies are the only way to really know how these loads are transmitted, full scale experimental tests are extremely costly and are not justified in most cases. In situations like this, numerical studies come into their own, as

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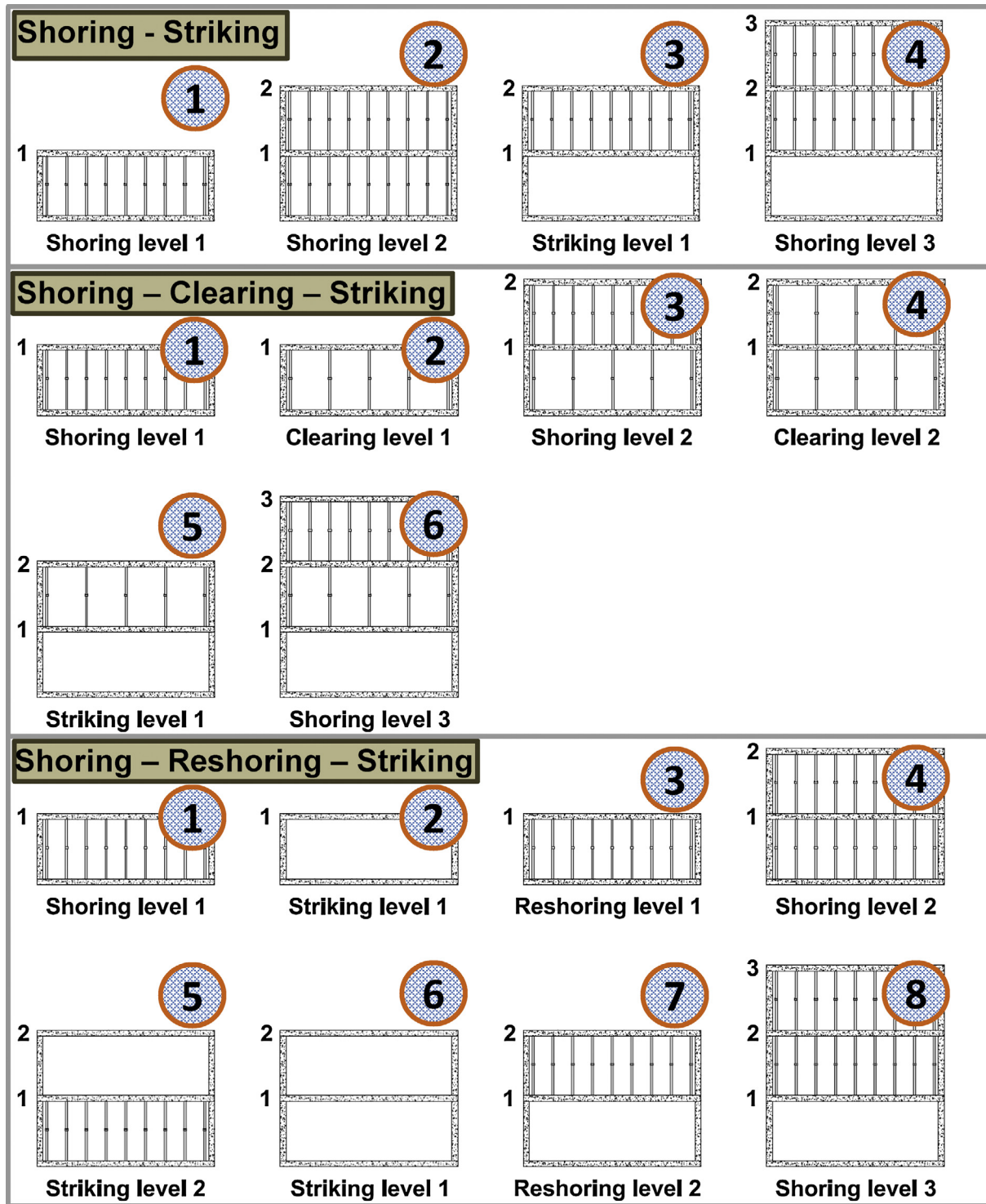


Fig. 1. Types of construction processes most often used: shoring/striking (SS), shoring/clearing/striking (SCS) and shoring/reshoring/striking (SRS).

they can be used to simulate the behaviour of a building under construction, without the need to use expensive resources. They can also be used to study many other cases that would otherwise be impossible due to their excessive cost. In addition, the calculation methods, especially the simplified methods, can be used by professional engineers and practitioners, thus transferring the knowledge generated by researchers to the actual construction of building structures.

This paper presents an ambitious review, including all calculation methods, experimental and numerical studies carried out to date that analyse and determine slab-shore load transmissions during the

construction of RC building structures. The review gives the present state of the topic, promotes the application of recent developments and indicates where future research should lead. Due to the scope and magnitude of the work involved, the paper is expected to be of use to research groups in the field of RC building structures, as well as to engineers and architects in their day-to-day design and construction of building structures.

The paper is organised as follows: Section 2 explains the importance of knowing the magnitude and distribution of the loads generated during construction. Section 3 reviews all the approaches to estimating

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