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A new simplified procedure to estimate loads on slabs and shoring during the construction of multistorey buildings

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ABSTRACT

This paper presents a new simplified procedure for estimating loads on slabs and shoring during the construction of multistorey buildings. The new procedure takes into account the actual stiffness of the shoring and for the first time includes the hypothesis that the average deformation of the shores coincides with that of the slabs they support. The procedure was verified by an experimental study that consisted of the construction of a full-scale three-storey building using a shoring–clearing–striking (SCS) process. Further verification was provided by the results of a finite element model of the same building. The results of the new process were then compared to those obtained from the proposals of other authors who had also considered the real stiffness of the shoring.

1. Introduction

During the construction of multistorey buildings it is often necessary to place shores on slabs that still have not achieved sufficient strength to bear the weight of the upper slab during its construction phase. It thus becomes necessary to place shores on several successive floors to ensure that the load is distributed over several slabs to guarantee the integrity of the structure.

The integrity of the structure during construction is the most important consideration in programming building times. A large number of studies [1–4] agree that the most critical stages for the safety of a structure is precisely when it is being built, as shown by the fact that it is during this period that most building collapses occur [2].

There is therefore a clear need to know how loads are transmitted between shoring and slabs during the construction of a building and to determine whether the slabs are capable of safely bearing the loads to which they are subjected without excessive deformation during the construction process.

Different authors have designed different theoretical models to estimate load distribution between slabs and shoring during the building process. Some consist of complex two- and three-dimensional finite element (FE) models, such as those designed by Liu et al. [5], Stivaros and Halvorsen [6], Mossallam and Chen [7], Moragues et al. [8], Díaz [9] and Alvarado et al. [10]. However, as these models require advanced software, their application is limited in practice.

Other models have been developed with simpler methodologies to determine load transmission during construction. Among others, Grundy and Kabaila [11], Duan and Chen [12], and Fang et al. [13] produced simpler methods of calculating load distribution between slabs and shoring in multistorey buildings under construction.

In 1963, Grundy and Kabaila [11] proposed a simplified method that in most cases errs on the side of safety and is still being applied today to calculate the loads on slabs and formwork. The main feature of this method is that it considers shores as being of infinite stiffness with respect to the flexibility of the concrete slabs. The hypothesis of considering shores as infinitely stiff can lead to an overestimation of the loads on the shores, as has been pointed out by Liu et al. [5], Stivaros and Halvorsen [6], Mossallam and Chen [7], Moragues et al. [8], Díaz [9], Duan and Chen [12], Fang et al. [13], Beeby [14] and Alvarado et al. [15].

Duan and Chen [12] designed a procedure which they called the *improved simplified method*, which assumes the following assumptions:

- The slabs are considered to have elastic behaviour with stiffness that varies during the construction.
- Shores are modelled as elastic elements with finite stiffness.
- The effects of shrinkage and creep are ignored.

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