15th World Congress on Computational Mechanics (WCCM-XV)
8th Asian Pacific Congress on Computational Mechanics (APCOM-VIII)
31 July – 5 August 2022, Yokohama, Japan

Study on Thin Reinforced Concrete Slabs Subjected to low-velocity Impact - Preventing scattering debris by using steel deck plates -

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Key Words: *Steel Deck, Steel Pipe, Reinforced Concrete Slab, Impact Test, Finite element analysis*

When constructing a building above public traffic lines such as roads and railway tracks, it is necessary to ensure sufficient safety to the space under the slabs. If a hanged object fall and perforate the reinforced concrete slab, and debris caused by the impact are scattered under the slab, those could cause serious consequences such as human casualties. This study focuses on those debris scattering under the slab. To prevent this, this study proposes an anchoring mechanism into concrete at the edge of steel deck plate used as permanent formwork.

In a typical steel-framed building, slab is constructed by pouring concrete on the deck used as a permanent formwork. Since the deck is usually not anchored into the concrete, it can easily fall off by the impact, and the generated debris scatter under the slab. In this study, the deck is anchored into the concrete by folding up the deck plate ends. The anchoring mechanism would be effective in preventing the deck plate from falling off by the impact, and damaged concrete from scattering.

In this study, half scale impact tests were conducted on specimens assumed to be RC slabs used in buildings, and it was confirmed that the proposed anchoring mechanism was effective in preventing the deck plate from falling off and scattering debris. In the cases without the anchor mechanism, the deck plate fell off at a falling height of 7.5 m, but in the case with the anchor mechanism, the deck did not fall off at 14 m, and fell off at 15m.

Moreover, it was confirmed that the effects of this experiment behaviour could be evaluated by finite element analysis. This analysis was performed with LS-DYNA. The anchoring mechanism between the concrete and the deck plate was reproduced using tie-break contact in LS-DYNA. In the case with the mechanism, the deck falling off and debris scattering were suppressed at a falling height of 13m in the analysis as well as the test. In addition, the falling object velocity, penetration depth of impact area of the slab, and reaction force were also in close agreement with the experiment.

It is now possible to suppress the scattering of debris caused by the impact under the slab in the event of a collision with a falling object during construction work above the public traffic line, thereby improving the safety of the lower part of the slab. As a result, such construction work can be made smoother, which will contribute to the advanced use of space on public traffic lines and the development of the city.