# Mesoscopic Study on Axial Compression Performance of New-Old Concrete Strengthened Members Based on Particle Flow: Postprint

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## Abstract

Considering that concrete is a heterogeneous material, numerical investigations were conducted using PFC3D mesoscopic discrete element software to study the interfacial bonding characteristics and failure mechanism of new-to-old concrete, focusing on the double-sided shear performance of bonded specimens and the axial compressive mechanical performance of reinforced concrete members strengthened with the enlarged cross-section method. The results indicate that, for the double-sided shear tests, the numerical shear-displacement curves of new-to-old concrete are basically consistent with the experimental curves; contact fractures in the model mainly occur at the new-to-old concrete interface, the number of cracks increases sharply after the model reaches its peak, forming a through fracture surface at the interface. In the axial compression test simulation, the numerical curves of axial pressure versus concrete strain agree well with the experimental results, and the numerical results can better predict the softening stage; contact fractures in the model mainly occur in the middle and lower parts of the column, which is consistent with the actual failure mode.

## Full Text

## Preamble

**Title:** Mesoscopic Study on Axial Compression Performance of New-to-Old Concrete Reinforced Members Based on Particle Flow

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**Abstract**

Considering that concrete is a heterogeneous material, numerical investigations were conducted using the ^{Z6}! mesoscopic discrete element software to study the interfacial bonding characteristics and failure mechanisms between new and old concrete. The study examined both the double-shear performance of new-to-old concrete bonded specimens and the axial compressive mechanical behavior of reinforced concrete members strengthened using the enlarged cross-section method.

The results demonstrate that for double-shear tests, the numerical shear-displacement curves of new-to-old concrete show good agreement with experimental curves. Model contact fractures occur primarily at the new-to-old concrete interface, with the number of cracks increasing sharply after the model reaches its peak load, ultimately forming a through fracture plane at the interface. In axial compression test simulations, the numerical axial force-concrete strain relationship curves match well with experimental results, and the numerical model can effectively predict the softening stage. Contact fractures in the model mainly occur in the middle and lower portions of the column, which is consistent with the actual failure mode observed in experiments.

**Keywords:** discrete element method; new-to-old concrete; interface failure; mesoscopic; strengthening

*Note: Figure translations are in progress. See original paper for figures.*