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Real strength of in-plane restrained slabs using compressive membrane action theory

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In-plane restrained slabs and beams are different to simply supported or rotationally fixed ones. Free to rotate condition for simple supported members and rotationally fixed condition for restrained members are assumed in determining flexural strength of structural members. However, restraint to in-plane expansion due to deflection has largely been ignored in determining service and ultimate load behaviour of flexural members. Restraint to in-plane expansion induces compressive membrane action (CMA) or arching action in slabs and beams. Experimental investigations carried out on in-plane restrained slabs and beams show the enhanced strength capacity of flexural members due to compressive membrane action or arching action. However, only a few design codes and guidelines incorporate the benefits of CMA. Hence slabs and beams are designed for much higher strength capacity than required. Understanding the influence of CMA is beneficial as it can contribute to reduction of reinforcement in in-plane restrained flexural members.

This study discusses the CMA theory that was proposed by Rankin. Test results from two different experimental investigations were obtained and strength of the slabs were predicted using standard flexural equations proposed in BS EN 1992-1-1 and CMA theory. The comparison of the test results with predictions demonstrates the influence of compressive membrane action and emphasizes importance of arching resistance in design calculations.

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