

Journal of Building Engineering
Shear Behavior of Infra Lightweight Concrete (ILC) with Stirrups
--Manuscript Draft--

Manuscript Number:	JBE-D-22-09061
Article Type:	Research Paper
Section/Category:	Structural design
Keywords:	Infra Lightweight Concrete; ILC; Ultra Lightweight Concrete; Shear; Stirrups
Abstract:	<p>Infra Lightweight Concrete (ILC) serves as a high-performance building material that contributes significantly to building sustainability and allows architectural innovation. The prefix "infra" was added since its dry density falls below the lower bound of structural Lightweight Concrete (LC) set by the EN 206-1, 800 kg/m³. Such low density, attained by mixing Lightweight Aggregates (LWA) with cellular cement matrices, results in good heat insulating characteristics. These characteristics in combination with its sufficient bearing strength qualify ILC to serve in fair-faced buildings of monolithic cross sections. Thus, a single layer of ILC can practically replace non-homogeneous building façades containing both bearing and highly heat insulative materials, making construction easier, saving resources and improving recyclability. Recent several studies have led to a better understanding of ILC's mechanical properties and structural behavior. As a result, several ILC buildings have recently been constructed in Germany, and ILC is in high demand among architects and ecologically aware builders. However, some structural aspects, such as the shear behavior, have not yet been fully investigated. This paper provides the experimental findings of 16 ILC beams with web stirrups. The experiments primarily aim was to investigate the impact of ILC strength and stirrup characteristics on the shear behavior of ILC. Observations at failure demonstrated a partial-to-complete loss of the mechanisms governing the ILC contribution to the shear stress carrying mechanisms. In parallel, the ultimate shear capacity of most of the ILC beams was found to match closely with that calculated using the original 45° truss model. However, the ILC beams with a relatively higher web stirrup ratios and/or lower strength, failed prior to the yielding of the web stirrups due to a partial loss of bond, which led to a spalling of the concrete cover in the upper part of the ILC beams. The diagonal crack width of ILC beams appears to be substantially related to the web stirrup ratio rather than to the stirrup field strength or ILC strength.</p>