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Behavior and effects of shear studs in composite 12-sided members used in transmission towers

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Composite construction including composite columns is widely used in structural design. In the transmission towers' industry, composite columns are replacing the old timber and steel adopted designs. Research on the capacity and behavior of these traditional columns has been previously performed, yet few researchers investigated the behavior of hybrid composite columns such as concrete-filled steel tube (CFST) with embedded steel section or embedded steel tube (Double skin column) and studs. Besides the non-homogeneity in concrete composition, choosing the right geometry for embedded steel components and their distribution pattern in the column section presents a challenge in achieving maximum section capacity. This study focuses on the hybrid composite column design that can minimize the concrete volume and make the columns more efficient in stiffness and capacity as well as more economical. Three-dimensional nonlinear finite element models were built using ABAQUS to compare and validate the behavior of the transmission towers against experimental work. The models include detailed analysis and investigation of the concrete and steel components behavior up to failure using Concrete Damage Plasticity (CDP) and Bilinear Elasto-Plastic Model respectively. The further extensive study was performed using different load cases to predict the behavior of bonds and load transfer between concrete and steel components in composite transmission towers. Good comparison between the FE results of such sections and previously studied columns has been achieved which leads to studying and investigating multiple forms of composite transmission towers.

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