PERFORATED RIB PLATE DESIGN IN STEEL-PLATE COMPOSITE (SC) MEMBERS

Steel-plate composite (SC) structures are modular, composite-member structural systems that have emerged in applications such as safety-related nuclear facility, blast, and high-rise building design. A typical SC member consists of steel faceplates, ties, anchors, and concrete infill. Steel rib plates can also be attached to the faceplates if desired. Adding steel ribs helps retain the module shape during construction and provides additional stiffness beneficial to preventing faceplate buckling under service loading. A perforated rib plate cuts circular flow holes into the steel rib creating more area for the concrete to spread through the SC module during casting. The concrete dowels forming inside the perforated holes create tension limit states to the rib plate anchorage capability and control the available tension strength the rib can provide towards buckling prevention. This thesis investigated the tension behavior of perforated rib plates in order to establish guidelines to design perforated rib plates around their anchorage capabilities. The steel and concrete tension failures occurring during pullout of a perforated rib plate were investigated. Three-dimensional finite element modeling in ABAQUS was performed to benchmark previously tested perforated rib plate pullout experiments identified from past literature. The benchmarked model approach was then used to conduct a parametric study exploring how perforated rib plate and concrete design parameters influence the controlling failure mode and available tension strength. The conclusions made in this thesis provide a design approach for perforated rib plates utilizing the steel rib plate strength prior to concrete failure.