Precast reinforced concrete components are widely used for construction of buildings in many industrialized countries. The benefits of the precast method, as compared to the cast in-situ method, lie primarily in the easier quality and production control of the structural components and in the onsite construction speed. The challenges appear in the on-site assembly phase, where structural integrity has to be ensured by in-situ cast connections in narrow zones. These connections are essential for the overall structural behavior and for this reason, strong and ductile connections that at the same time comply with the construction sequences for the particular structure, are important for a well-performing solution.

Current best practice for design of shear connections has been developed over decades and has primarily been aimed at solutions that are easy to implement on the construction site. The related calculation methods are mostly based on experience and empirical formulas. The strength and ductility of the current connection design are not necessarily adequate for structures, where large loads have to be transferred. The potential for improvement of the structural connections is therefore significant, as better solutions may enhance the overall structural behavior and lead to more economic designs. This study concerns an investigation of in-plane connections between precast shear walls. A new design with '2-on-2' loop connections is suggested. The significance of the new design is the orientation of the U-bar loops and the use of a double T-headed rebar in the overlapping area of the U-bars. The investigation covers several independent research topics, which in combination provides a broad knowledge of the behavior of keyed shear connections.

As the first topic, the structural behavior of mortar is investigated. This is relevant as mortar with small aggregates is typically used to grout the narrow connections between the precast components. The study comprises triaxial tests and push-off tests aiming to investigate the behavior of mortar during failure. Next, the tensile capacity of the new loop connection design is tested and analyzed by use of upper bound plasticity models. This study is relevant as the ability of the U-bar loops to transfer tension is a prerequisite for the shear connection to transfer shear loads. The established models, supported by tests, can be used to design the loop connection in such a way, that the tensile capacity is governed by yielding of the U-bars and not by a brittle failure of the grout. This is important in order to obtain a ductile response when the connection is loaded in shear.

The main focus of the thesis is test and modeling of keyed shear connections. An extensive experimental program is presented. The particular layout of the test specimens allows for a direct comparison of the conventional shear connection design with the new design concept. The performance of the two designs is evaluated and it is found that the new design is superior in terms of strength and ductility. Upper and lower bound plasticity models are developed for strength prediction and satisfactory agreements are obtained when comparing the models with the test results. A theoretical exact solution is not possible to obtain, as the models are based on assumptions that are not fully identical. However, the establishment of both types of models provides a range of expected results and thus valuable information for practical applications. Finally, second-order plastic modeling is used to establish the load-displacement relationship for a casting joint loaded in shear and transversely reinforced with rebars. Despite the simplicity of the model, rather satisfactory agreement with tests is found. The model may be used to predict the available plastic energy and has potential for practical assessment of structural robustness.