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EFFECT OF BEAM DEPTH REDUCTION AT THE JOINT OF RC STRUCTURES AND STRENGTHENING USING FRP SHEETS

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The most important parts of the reinforced concrete structures are their connections because they are used to integrate the whole system. Therefore, any weakness in the beam-column joint leads to reduction in the capacity and ductility of the structure (Unal & Burak, 2013). Conventional concrete structures are generally constructed using cast in place concrete. In this case, columns are casted before beams and connections of the next floor. Due to the construction errors, the final height of the concrete column may exceed the specified value. In such cases especially in existing structures, usually the change in the column height is compensated just by bending of rebars of the intersecting beam inside the joint area. Reduction in the height of the joint reduces the resistance of the connection. FRP sheets can be used to strengthening the RC structures especially for joints. In this study, the effect of this factor on the behavior of RC connections is investigated. Also, effects of different layout arrangements of FRP sheets on the behavior of the connections with reduced joint depth are studied.

The finite element method and ABAQUS software have been used to investigate the behavior of RC joints in this study (ABAQUS Inc., 2014). To verify the adequacy of the developed model, two independent connections previously tested by other researchers are selected for pushover analysis. Comparison between experimental results and numerical models indicates that the finite element method is capable to simulate the behavior of interior and exterior connections with appropriate accuracy.

This study demonstrates that reducing joint depth leads to a significant reduction in the strength of the RC joints. Figure 1 demonstrates the decrease in the height of the beam in the connection area. Effects of different values of joint depth reduction on the strength of the joint for exterior and interior connections are shown in Figure 2.

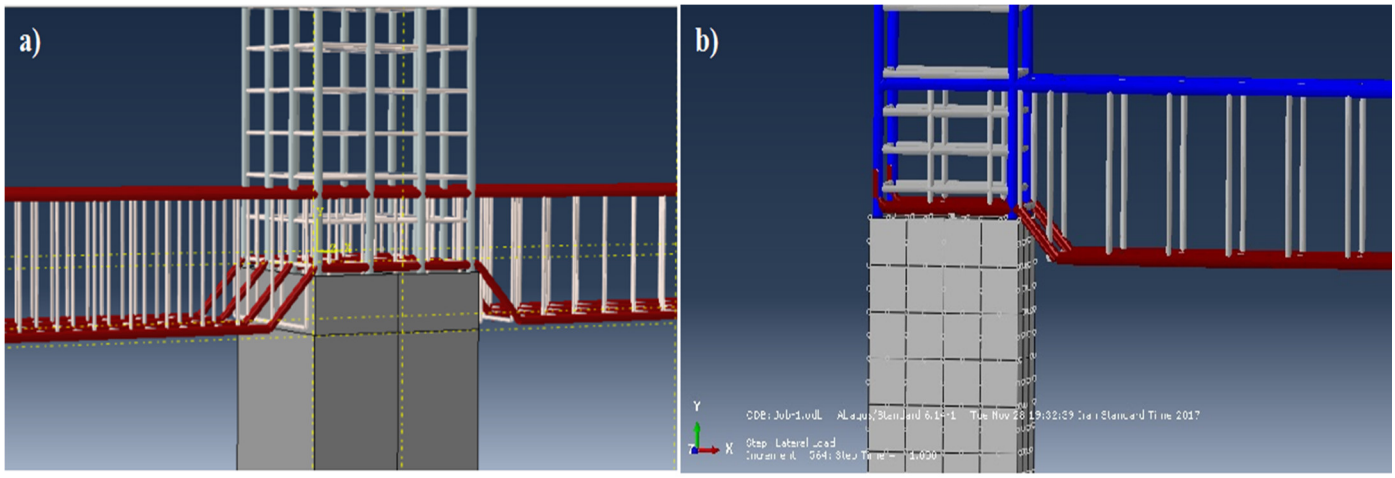

Figure 1. Joint depth reduction; a) interior connection, b) exterior connection.

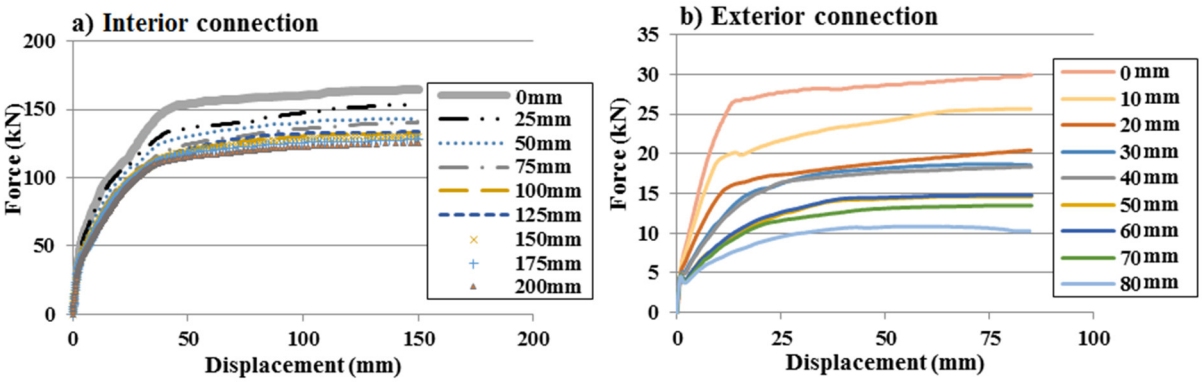

Figure 2. Effects of different values of joint depth reduction on the strength of the connection.

FRP sheets can be used for strengthening of the RC connections. The effects of different arrangement of FRP sheets on the strength of the RC connection with joint depth reduction are investigated. Four different layout of FRP sheets are considered in this research as shown in Figure 3. This study showed that the use of horizontal FRP sheets at the lower level of the joint has the most effect on the strength of the connection. Also, the use of vertical FRP sheets does not significantly affect the strength of the connection. Comparing the results of strengthened specimen and original specimen without joint depth reduction demonstrates that the use of appropriate FRP arrangement can greatly increase the strength of the connection. Therefore, the strength of the repaired connection may be higher than the original specimen in some cases.

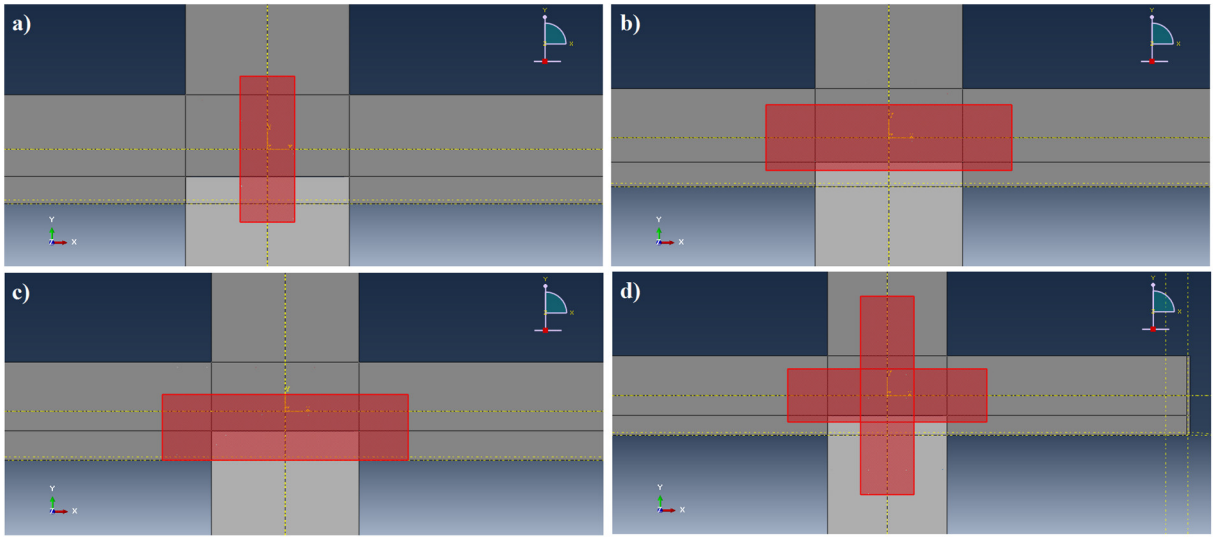

Figure 3. Different types of arrangement for FRP sheets; a) vertically, b) horizontally, c) horizontally at the lower level, d) crosswise.

REFERENCES

ABAQUS Inc. (2014). *ABAQUS/Theory User Manual-Version 6.14*. Providence, Rhode Island: ABAQUS Inc.

Unal, M. and Burak, B. (2013). Development and analytical verification of an inelastic reinforced concrete joint model. *Engineering Structures*, 52, 284-294.