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Review of Thesis

submitted in partial fulfilment of requirements for promotion to associate professorship

Specialization: Theory of Building Structures and Materials

Applicant: Ing. Özgür Yurdakul, Ph.D.

Reviewer: prof. Ing. Bc. Radoslav Sovják, Ph.D., LL.M.

Thesis title: Structural Repair of Heavily Damaged Reinforced Concrete Columns: Experimental and Numerical Study

Importance of topic of thesis

Comments: The thesis titled "Structural Repair of Heavily Damaged Reinforced Concrete Columns: Experimental and Numerical Study" submitted by Özgür Yurdakul is significant due to its comprehensive investigation into the performance of substandard reinforced concrete (RC) columns repaired with carbon fiber reinforced polymers (CFRPs). This research is crucial for enhancing our understanding of structural deficiencies in RC buildings, particularly in developing countries, and developing innovative repair solutions.

By focusing on the repair of heavily damaged RC columns, a critical component in the structural integrity of buildings, the study addresses a vital gap in ensuring the safety and resilience of infrastructure against earthquakes and other disasters. The experimental and numerical approaches used provide valuable insights into effective repair strategies, contributing to reducing economic losses and enhancing the durability and serviceability of existing structures.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Method of solution

Comments: The method of solution in the thesis involves a combined experimental and numerical approach to assess the repair of damaged reinforced concrete (RC) columns using carbon fiber reinforced polymers (CFRPs). The experimental component included testing damaged RC columns, repairing them with CFRPs, and retesting to evaluate repair effectiveness.

The numerical study utilized ATENA software for finite element modeling of both damaged and repaired columns, comparing these simulations against experimental results to validate the models. This dual approach allowed for a detailed analysis of the CFRP repair strategy's impact on the structural performance, including improvements in load-bearing capacity, stiffness, and ductility of the columns.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Quality and correctness of results achieved

Comments: The thesis successfully validates the efficacy of carbon fiber reinforced polymers (CFRPs) in repairing damaged reinforced concrete (RC) columns, demonstrating significant advancements in structural repair methodologies. Through a combination of experimental and numerical analyses, it accurately replicated the responses of damaged and repaired RC columns, confirming restored structural capacities and altered failure mechanisms post-repair.

Although it highlighted a limited enhancement in bond-slip performance, the overall findings underscore the effectiveness and reliability of CFRP repairs in improving the structural integrity

and response of heavily damaged RC columns. This consolidates the thesis's contributions to developing more resilient repair strategies for existing concrete structures.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Originality of results achieved

Comments: The originality of the results achieved in the stems from its comprehensive approach to addressing a critical issue in structural engineering: the effective repair of substandard reinforced concrete (RC) columns using carbon fiber reinforced polymers (CFRPs). This research stands out for its detailed exploration of both experimental and numerical analyses to validate the repair strategies. Notably, the study contributes original findings by demonstrating how severely damaged RC columns can be effectively repaired to meet or even exceed their original structural capacities.

The incorporation of advanced material technologies (i.e., CFRPs) in the repair process and the development of experimentally validated numerical models offer new insights into the repair mechanisms and the improved performance of RC columns post-repair. These contributions are particularly relevant for enhancing the resilience and safety of existing buildings, representing a significant advancement in the field of structural engineering and repair methodologies.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Publication rate of results achieved

Comments: The publication record of this research is impressive, with 26 documents indexed in Scopus and featured in esteemed journals like Engineering Structures, Structure, and Construction and Building Materials. These publications signify the research's high quality and relevance, showcasing its impact on the engineering and construction sectors. Being recognized in such high-caliber journals and Scopus highlights the work's academic merit and its significant contributions to the field, underlining its influence on future studies and industry practices.

Superior	Good	Average	Poor	Not applicable
☒	☐	☐	☐	☐

Response to results and citation rate

Comments: The scholarly impact of this work is notably significant, as indicated by its performance in the Scopus database. It has achieved 247 citations across 192 documents, highlighting its broad recognition and influence within the academic sphere.

The work's h-index stands impressively at 8, a testament to its quality and relevance, which adjusts to 6 when excluding self-citations. These metrics not only demonstrate the work's substantial contribution to its field but also underline its role in fostering further research and discussion among scholars, solidifying its value and prominence in the academic community.

Superior	Good	Average	Poor	Not applicable
☒	☐	☐	☐	☐

Applicability of results to development in the field and for further research

Comments: The study on repairing heavily damaged reinforced concrete columns with CFRP sheets contributes significantly to structural engineering by providing insights into effective repair strategies. It highlights the potential for improving construction practices, informs updates to building codes, and lays a foundation for further research into advanced repair materials and methods.

The findings encourage the exploration of innovative repair techniques, offering a roadmap for enhancing the resilience and durability of structural systems. This work not only advances the field but also serves as a valuable educational resource for future engineers and researchers.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Applicability of results to technical practice

Comments: The study's findings offer practical benefits for technical practice by demonstrating an effective method for using CFRP sheets in repairing damaged reinforced concrete columns. This can guide structural engineers in enhancing the safety and durability of buildings, influence the update of construction codes, and serve as an educational tool for engineering students. Overall, it promotes more resilient construction practices and paves the way for integrating advanced repair materials and techniques into everyday engineering applications.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Compliance with requirements on thesis – quality of thesis

Comments: The thesis stands out for its high-quality original research on the repair of substandard reinforced concrete (RC) columns using carbon fiber reinforced polymers (CFRPs). Its quality is exemplified through a rigorous methodological approach that combines both experimental testing and advanced numerical simulations to validate the effectiveness of CFRP repairs.

The work's significance is underscored by its focus on a critical structural engineering challenge-enhancing the resilience of existing buildings, particularly in regions prone to seismic activity. By providing experimentally validated insights into the repair process and outcomes for damaged RC columns, the thesis contributes valuable knowledge to the field, potentially influencing repair strategies and guidelines in structural engineering practices.

This combination of experimental validation with numerical modeling ensures the findings are robust and applicable to real-world scenarios, marking a significant contribution to both academic research and practical applications in structural repair and rehabilitation.

Superior	Good	Average	Poor	Not applicable
☐	☒	☐	☐	☐

Comments

Overall evaluation of thesis
The overall evaluation of the thesis titled "Structural Repair of Heavily Damaged Reinforced Concrete Columns: Experimental and Numerical Study" reveals it as a thorough and innovative contribution to the field of civil engineering, particularly in the area of structural repair using carbon fiber reinforced polymers (CFRPs). This work stands out for its detailed examination of substandard reinforced concrete (RC) columns and their repair, combining both experimental trials and advanced numerical modeling to explore the effectiveness of CFRPs in restoring structural integrity. The thesis successfully demonstrates the recovery of load-bearing capacities and shifts in failure modes of damaged RC columns post-repair, contributing valuable insights into repair methodologies for extending the service life of existing structures. While highlighting the significant recovery of structural performance, it also identifies limitations in bond-slip performance enhancement post-repair, pointing towards areas for future research. The comprehensive data, rigorous analysis, and clear presentation underscore the high quality and originality of the research, making a significant contribution to both academic knowledge and practical applications in structural engineering. Additional comments on the thesis and the author: There are no other comments.

Promotion to associate professorship recommended	***yes*** ☒	***no*** ☐

Date: 17.4.2024

Reviewer's signature: [redacted]