

**STRUCTURAL BEHAVIOUR OF
REINFORCED CONCRETE DEEP BEAMS
WITH WEB OPENINGS
UNDER REPEATED LOAD**

A THESIS

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ABSTRACT

Construction industry has different nature of risks involved as part of the industry. It is mainly because of a complex and highly dynamic working environment with a number of stakeholders. Uncertainties and risks are inherent within the construction industry as compared to other industries. Hence, the process pertaining to planning, execution and most importantly, maintaining different project activities is quite time consuming and highly complex. The complete process requires a number of different people having diversified skill-set together with the coordination based on a vast scale of interrelated and complex activities.

The objectives of this thesis are to determine the factors contributing to the effective risk management for buildings and structures, to evaluate the implications of risk management within the design process for buildings and structures and to scrutinize the key risk indicators in the design of buildings using innovative means. In addition, to assess the positive effects of allocating more budget to the risk management.

Thesis analyses the risk management and cost management of the proposed residential tower if it was implemented in two countries, Iraq and Romania. Based on the analysis of risk management and cost management in Iraq and Romania, for the construction of the residential tower, Romania presents a more feasible and less costly option compared to Iraq. Many risks are involved in Iraq including the high rate of inflation (high cost of construction materials), geological risks (floods and landslides), construction delays (due to a high number of unofficial holidays), implementation of Building Information Modelling as a new technology, and a water shortage problem. For Romania, the risks involved are the shortage of construction workers, geological risks (earthquakes and floods), and poor health and safety procedures. Romania presents a better option for the construction of the residential tower project. Both planned maintenance and unplanned maintenance are recommended for the residential tower. Planned maintenance will look to prevent any failure in the building while unplanned maintenance will aim to repair damaged parts of the building that are already damaged. The cost of buildings designed to resist earthquakes in all respects increase the cost of the proportion little amount, and this percentage cannot be considered effective if compared with the benefits of the building and the first increase the life of the virtual building to double.

Second case study was total of 50 different risk indicators pertaining to different stakeholders are discussed. For the design approach, a G+10 building has been analysed using Staad Pro for identifying and subsequently, addressing them as part of the study. For the risk assessment, a 5x5-risk assessment matrix is used for assigning respective risk rating to different risk indicators.

The determination of key risk indicators show that most of the risks result in the delays pertaining to timelines and hence, increased cost for project completion. Apart from that, the design aspects of structural engineering and infrastructure planning are a quite complex topic that needs significant development. The risk indicators would also provide ample grounds for corrective and preventive actions pertaining to the issues faced by the construction industries.

This thesis added to the existent studies of risk management and the advantages of increased risk indicators in the design of structures. Specifically, it will advocate for the incorporation of risks in the design of structures thus increasing their probability of being robust and durable against the incorporated risks.

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List of Articles

It.no.	Articles	Authors	Journal
1	Study the Effective Location of Shear Wall and Its Cost of Multi-story Building under Seismic Loading in Iraq.	1.Mohammed Alrubaye 2.Prof.Nicolae Postavaru	The Ninth International Conference on Construction in the 21st Century (CITC-9)
2	INVESTMENT RISKS IN CONSTRUCTION PROJECTS (The Challenges In Middle East And Romania).	1.Mohammed Alrubaye 2.Prof.Nicolae Postavaru	BULETINUL ȘTIINȚIFIC U.T.C.B. NR. 2/2017
3	RISKS MANAGEMENT DESIGN FOR BUILDINGS IN IRAQ.	1.Mohammed Alrubaye 2.Mohammed Sami 3.Prof.Nicolae Postavaru	GJRA - GLOBAL JOURNAL FOR RESEARCH ANALYSIS
4	How Building Information Modeling (BIM) Helps in Facility Management.	1.Mohammed Sami 2.Mohammed Alrubaye 3.Prof.Nicolae Postavaru	International Journal Of Modern Engineering Research (IJMER)
5	AUGMENTED REALITY IN RISKS REDUCTION.	1.Mohammed Sami 2.Mohammed Alrubaye 3.Prof.Nicolae Postavaru	GJRA - GLOBAL JOURNAL FOR RESEARCH ANALYSIS
6	Study Cost Design & Risks of Reinforced Concrete Buildings Resisting To Seismic Loads.	1.Mohammed Alrubaye 2.Mohammed Sami 3.Prof.Nicolae Postavaru	International Journal of Scientific & Engineering Research

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CONCLUSION

Construction industry requires rigorous risk assessment and analysis from time to time. The determination of key risk indicators show that most of the risks result in the delays pertaining to timelines and hence, increased cost for project completion. Apart from that, the design aspects of structural engineering and infrastructure planning are a quite complex topic that needs significant development. Following key considerations have been analyzed and discussed as part of the dissertation:

- Importance of using risk management in quantifying strong building design. Based on the findings of the study, one of the most notable aspects of focus pertains to the implications of external and internal risks on structures.
- In Iraq, the risks that pose the greatest threat to the implementation of the residential tower in the country include floods, poor economic conditions, construction delays mainly due to numerous unofficial holidays in the country, risk of implementing new technology (Building Information Modelling), and a serious water shortage.
- In cost management, due to economic and political instability, more costs will be incurred in obtaining water for the project and in the construction delays due to the high number of unofficial holidays.
- In Romania, the risks that pose the greatest threat to the implementation of the residential tower in the country include earthquakes and floods, poor health and safety procedures, and a shortage of construction workers.
- In cost management, due to the shortage of construction workers, more costs will be incurred in acquiring labour.
- Implementation of the project in Romania is less risky and less costly compared to Iraq. If the project were to be implemented in Iraq, there would be more risks and more costs involved. The risks in Romania can be mitigated through planning.
- Maintenance of the proposed residential tower is also another key aspect to be considered before implementation of the project. Given that the building is a tower and will be occupied by residents, the state of the building should always be very good.

- The maintenance practices will aim to achieve this goal.
- The research findings highlight the important role played by the program towards the attainment of the highest standards of cost management and efficiency in the construction process.
- Vulnerability to earthquakes can determine the strategy of risk management.
- However, the software and technological advancements are also associated with a number of risks that can be catered through rigorous verification and validation from the senior management of the firm.
- Social and external pressures that include political and environmental influences can also result in delays pertaining to design and development phase of the project.
- Based on the analysis, a total of 50 different key indicators have been analyzed. Among those key indicators include, administrative risks, financial risks, HSE related risks, and most importantly, design related risks as part of the study.
- Each of the 50 key indicators have been analyzed via 5x5 risk assessment matrix that is used for assessing risk rating pertaining to different risks. The risk are then analyzed via bar chart diagram to assess the potential risk rating of the respective risk indicator. Apart from that, the risks are also facilitated by corrective and preventive actions that could reduce the risk.

CONTRIBUTIONS AND ADDITIONS TO THE SCIENTIFIC FIELD

- The current research will be helpful for construction managers who are looking to carry out projects in either Iraq or Romania. The research identifies the risks involved for construction managers in the two countries.

- The results were obtained from experts in the construction industry from the two countries including engineers, contractors, clients and construction managers. The findings of the research are, therefore, reliable and applicable in construction management practice.

- The study has provided an outlook to different risk indicators that a construction industry faces; however, that could vary moderate to extreme risk rating based on geography and local political and environmental aspects.

- Risks assessments are integral part of construction industries. It is conducted by professional engineers to assess every single risk factor involved in construction activity and is not limited to designing.
- This specific method of risk assessment provides an insight to what is happening in industries and how collective decision making is made.
- My contribution is providing a more direct and simple approach to the complex risk assessment techniques in this domain.
- The maintenance practices developed for the proposed residential tower can also be applied to other residential towers proving that the current research makes a great contribution to the field of construction management.