



## RISKS MANAGEMENT DESIGN FOR BUILDINGS IN IRAQ

**Mohammed Jasim Alrubaye**

Technical University of Civil Engineering of Bucharest, Romania /Ph.D Student

**Mohammed Sami Mahdi\***

Technical University of Civil Engineering of Bucharest, Romania /Ph.D Student  
\*Corresponding Author

**Prof. Univ. Dr. Ing. Nicolae Postavaru**

Technical University of Civil Engineering of Bucharest, Romania

**ABSTRACT**

The aim of this project was to identify effective modes of interaction between designers, construction design and management coordinators and builders, in which they collaborate with the aid of a virtual reality tool as a catalyst for their conversation to design safe construction processes. The objectives were to develop a method for assessing the safety implications of a detailed design model of a building; develop immersive and augmented visualization techniques for use in this assessment; and trial the process with construction workers on a construction project. Strategies were developed for visualizing models and recording collaborations. Experienced safety professionals will discuss risk during design affecting by hazards relating to a crane, a roof, edge protection, voids, stairs, scaffolding and cladding in Iraq. Through interaction with the model, these professionals were able to understand the constraints of the building and the site. As building information modelling (BIM) becomes widely used in construction in middle east, it raises new opportunities and questions about how digital models can be used to build safely by design. This study suggests a new trajectory of research on digital tools that fosters mindful practices, and the rich interactions associated with these practices. Further research is underway to extend this study and address some of its limitations.

**KEYWORDS** : BIM, Design risks, Siesmic, visualization.

**1. Introduction**

Within the framework of formulating and actualizing the design of buildings, the outcomes are strongly influenced by the overall extent to which risks are identified and addressed (Jinquan, Gardoni, & Rosowsky, 2010). In the event that the designers do not use a highly effective and reliable platform for risk management, the intended outcomes can be compromised extensively. In the Iraq construction industry, it is notable that there are numerous risks that characterize the process of design of buildings.

**2. Buildings in Iraq- Broad Overview**

In recent years, the building and construction industry in Iraq has developed extensively. Numerous factors have been influential towards such growth including improvement in the economic performance of the nation, an increase in the demand for modern housing, as well as the reconstruction of cities and regions decimated by the war. While some of the buildings across the country have been characterized by the application of high standards, this has not been the case elsewhere as a result of the different risks associated with design of buildings.

**3. Design Risks for Buildings in Iraq**

As briefly outlined in the previous section, there are numerous risks associated with design within the construction industry. The effectiveness with which such risks are addressed is immensely pertinent towards the attainment of the highest standards of safety in the buildings. Following is an elucidation of the main design risks for buildings in Iraq.

**Risks Relating to a Crane**

As far as the risks within the process of design of buildings are concerned, one of the most notable issues of emphasis pertains to the risk relating to a crane. Despite the fact that cranes are integral components of the construction of buildings, it is also essential to accentuate that they can be a source of risk. In the event that the relevant strategy is not employed in the design of cranes, construction workers can be exposed to the risk of injuries or even death (Fantilli & Chiaia, 2013). This accentuates the need to ensure that the relevant models are employed when developing cranes as well as the overall framework of their actualization at the construction site.

**Risks Relating to a Roof**

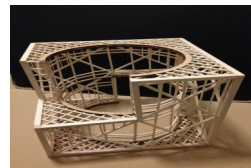
Apart from cranes, the risks in the process of design of buildings can also be evaluated from the perspective of perils relating to a roof. Roofing is an essential element when it comes to the construction of buildings. However, it is essential to accentuate that different buildings require different techniques of roofing. While a given strategy for roofing can be effective for one type of structure, this might not necessarily be in line with the needs of a different type of structure. The use of an ineffectual roofing can be risky towards the overall safety of a building not only in the long-term as well as in the short-term. In view of these aspects, it is hence evident that the issue of roofing serves as a pertinent element of evaluation when it comes to the risks.

**Risks Associated with Edges**

Risks associated with edges also constitute a notable peril within the process of design of buildings. Based on the approach used in the planning and actualization of the edges of a structure, there is always the possibility that one or more risks will occur. This is because of the effect of edges on the extent to which slanting occurs within a building. The use of an ineffectual model as well as design strategy can compromise the extent to which the risks associated with edges occur.

**Risks Relating to Voids**

The risks associated with the process of design of buildings can also be analyzed from the standpoint of voids. This encompasses the gaps or spaces that can occur at one or more locations of the building that is being constructed. A notable aspect of emphasis as pertains to the risks associated with voids is that they can easily cause the collapse of part of or the entire structure. The extent to which effective modeling is integrated into the design process is immensely influential towards determining whether the perils associated with voids occur or not.



**Fig. 1 : Model of design of buildings associated with voids**

### Risks Relating to Stairs

Within the process of design of buildings, stairs can also be a major source of risk. When the stairs are designed ineffectively, there is always the likelihood that they will increase the possibility of fractures within the structure. This is an undesirable aspect as far as the safety of buildings is concerned. The perils associated with stairs can also be evaluated from the standpoint of occupational health. This is whereby the individuals or construction workers at the site are exposed to potential falls as they actualize the distinctive phases of the construction process. In view of these aspects, it is hence evident that there are many aspects of construction risks associated with stairs.

### Risks Relating to Scaffolding

Scaffolding serves as another notable aspect of emphasis when it comes to the evaluation of the risks associated with the process of design of buildings. In the Iraqi construction industry, designers have been focused towards the alignment of scaffolds into the framework of actualizing their respective designs. However, there is the need to accentuate that there are many risks that can occur in such processes including the heightened potential of fractures (Song, Dyke, & Harmon, 2013). While some of the risks associated with scaffolding can occur in the short-term, others occur in the long-term. An effective interventional model must hence be used in order to minimize or prevent the occurrence of such risks.

### Risks Relating to Cladding

The framework of risks associated with the process of design of buildings also encompass the perils related to cladding. Over the years, cladding has been used extensively in the finishing of buildings especially as a platform for aesthetic enhancement. While the value of cladding is evident in buildings, it is also notable that there are many perils for the integration of cladding into buildings. For instance, cladding is a strategy that is strongly associated with the heightened risk of infernos in buildings. This is because some of the materials used in the process of cladding are highly flammable (Qian & Li, 2013). In view of this aspect, it is hence evident that the issue of cladding is a notable element of emphasis when it comes to the identification and prevention of risks in the process of design of buildings.

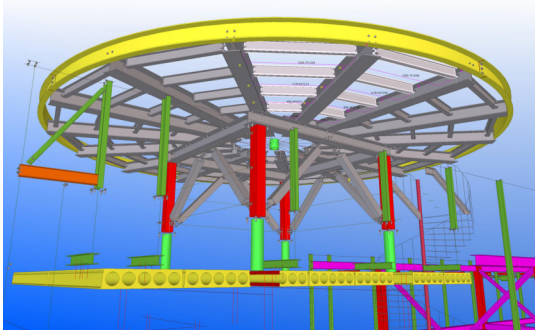


Fig. 2 : Model of cladding into buildings

### Wrong selection of materials

The framework of risks associated with the process of design of buildings can also be analyzed from the perspective of the wrong selection of materials. Despite the fact that there are many factors contributing towards the attainment of the intended outcomes during the construction of buildings and other structures, the approach used in the selection of materials is immensely pertinent. In the event that the selected materials are not in line with the required standards, there is always the risk that the building will be characterized by voids or even potential collapse. This accentuates the pertinent role played by the issue of wrong selection of materials within the context of analyzing risks in the process of design of buildings.

### Unsuitable equipment

In addition to the choice of poor materials, another notable risk within the process of design of buildings encompasses the issue of choosing unsuitable equipments. The equipments and tools used in

the process of construction of buildings is immensely pertinent when it comes to the attainment of the intended outcomes. In essence, it is evident that the use of unsuitable equipment would not only increase the risk of cracks, but also the ineffectual completion of important phases of the building process. In view of these aspects, it is hence evident that the use of unsuitable equipment serves as a major risk in the process of design of buildings.

### Too many projects

It is notable that there are instances during which the process of design of buildings can be characterized by the risk of inclusion of too many projects. This occurs when the administrators of a project integrate numerous projects and initiatives within their respective plans. This is a major contributor towards the occurrence of many perils including the wrong choice of materials as well as the use of inappropriate tools among others. The inclusion of too many projects can also culminate into ineffectual allocation of time.

### Legal Conflicts

The risks characterizing the process of design of buildings can also be analyzed from the perspective of legal disputes. There are instances whereby some buildings might be scheduled for construction on areas or lands that are characterized by legal disputes. This is an occurrence that makes it difficult for the design process to be actualized as effectively as possible. It is also vital to accentuate the fact that legal disputes can culminate into the partial demolition of structures, and this is always a major risk as far as the stability of the constructed building is concerned. In view of these aspects, it is hence evident that the issue of legal conflicts serves as a notable peril when it comes to the process of design of buildings.

### Late surveys, that may be incomplete or wrong

Surveys constitute an integral component of any building or structure. In the event that the framework of surveying is not actualized accordingly, the attainment of the intended outcomes is compromised extensively. This is a risk that can potentially occur within the context of the process of design of buildings. The use of an ineffectual strategy of planning is always an issue that can heighten the possibility of the occurrence of late surveys.

### Lack of specialized staff

The issue of perils associated with the process of design of buildings can also be evaluated from the perspective of the lack of specialized staff. In any construction site, the quality of outcomes is strongly influenced by the extent to which professional staff members are integrated into the different phases including decision making. In the event that the staff members are incompetent, the attainment of success within the entire design process is compromised extensively. Additionally, incompetent staff can undermine the manner in which the distinctive elements of design are actualized. These aspects are hence indicative of the reasons as to why the lack of specialized staff constitutes the risks characterizing the process of design of buildings.

### Incomplete or wrong Environmental analysis

There is also the need to accentuate the fact that an incomplete analysis of the environment serves as a major contributor towards the occurrence of hazards within the process of design of buildings. Environmental impact assessment is immensely pertinent in the process of design of buildings in that it helps in determining the best approach when building a structure. Additionally, environmental analysis is also beneficial in that it helps in the evaluation of the potential adverse implications of a proposed construction before the implementation has been done. In line with such aspects, it is hence evident that an erroneous framework of environmental analysis can compromise the overall success with which different risks are identified and addressed in the process of design of buildings.

### Inadequate Funding

While there are many factors that contribute towards the attainment of success in the process of design of buildings, the

effectiveness of funding is always an important determinant. In the event that an ineffectual framework of funding is used, the attainment of the intended outcomes is compromised. This is largely because of the inherent impact of funding on the other components or elements of the entire design and construction process (Guner & Vecchio, 2011). Additionally, inadequate funding is also a major risk because of the effect it can have on the actualization of the required processes on time.

### Inadequate and incomplete design

The risks of the process of design of buildings can also be evaluated from the perspective of inadequate or incomplete design. When the process of design of buildings is not aligned towards an effective process, there is always the potential of occurrence of numerous errors at some point within the implementation phase. In line with such an aspect, it is vital for the construction administrators and site managers to ensure that the entire design process is accurate, and also aligned towards the required standards especially from the standpoint of regulation.

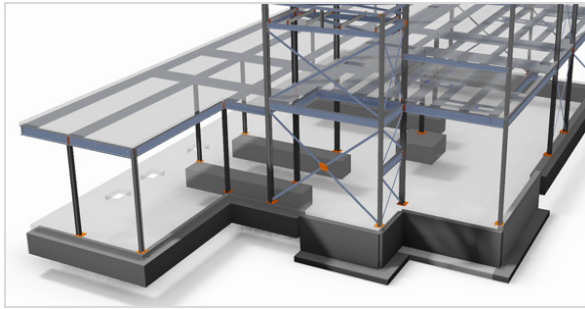


Fig. 3: Model of design of buildings

### Inaccurate contract time estimates

The issue of inaccurate contract time as well as erroneous estimation also serves as a vital aspect of emphasis when it comes to the analysis of the perils characterizing the process of design of buildings. Contract time has an inherent effect on how the different components and stages of the design process are actualized. When the contract time is inadequate, there is always the risk that the intended goals and outcomes are not achieved as required (Song, Dyke, & Harmon, 2013). This is hence an aspect that is strongly indicative of the pertinence of contract time within the context of identifying the risks of the process of design of buildings.

### Hazardous waste, preliminary site investigation wrong

The risks associated with the process of design of buildings can also be evaluated from the perspective of the occurrence of hazardous waste materials or even the erroneous investigation of the site that is to be used for the construction of the building. Across Iraq, there are numerous construction sites or lands that are characterized by high levels of hazardous waste. This is an occurrence that increases the overall risk for the stability of the constructed structure as well as occupational health, and safety.

### Habitat Sensitivity

The issue of habitat sensitivity is also an essential peril of evaluation when it comes to the determination of the risks that can occur within the context of process of design of buildings. This risk encompasses the occurrence of undesirable or unpredictable components of the immediate environment of the site on which a building is constructed (Liel, Haselton, & Deierlein, 2011). In the event that the issue of habitat sensitivity is not addressed effectively, the entire process of design of buildings is compromised. This is a risk that not only applies to the short-term, but also the long-term.

### Errors in completion of structural / geotechnical / foundation

The distinctive risks for the process of design of buildings can also be evaluated from the perspective of errors that may occur within the framework of completing the geotechnical or structural foundation. In the event that the structural foundation is designed erroneously, then the entire process can be characterized by numerous risks. This

is also the case when it comes to the framework of completing the geotechnical foundation. There are many ways in which this risk can compromise the process of design of buildings including voids as well as cracks in the completed structure.

### Delayed deliveries and disruptions

The perils associated with the process of design of buildings can also be analyzed from the standpoint of delayed deliveries as well as the occurrence of disruptions within the construction process. While there are many factors that contribute towards the attainment of success within the design of a building or structure, the issue of timeliness is immensely influential. This is because there are instances during which delays compromise the attainment of the required standards. Additionally, delays and disruptions can heighten the risk of ineffectual decision making processes. These aspects are hence indicative of the pertinent role of delays and disruptions as major risks within the entire process of design of buildings.

### Change in seismic criteria

As far as the risks are concerned, there is also the need to accentuate that the issue of potential change in seismic criteria serves as a major peril when it comes to the completion of buildings. This is not only a major risk in Iraq, but also other parts of the world that are prone to earthquakes. The occurrence of abrupt changes within the framework of seismic criteria can heighten the risk of cracks as well as unplanned alterations in the entire design of a building. These elements highlight the vital role of changes in seismic criteria when it comes to the analysis of risks for the process of design of buildings.

### Interventions for the Risks

In view of the numerous risks that characterize the process of design of buildings in Iraq, it then follows that there is the need for the evaluation of the best interventional strategies that can be aligned towards the construction process. In the event that the different risks are not addressed effectively, the attainment of the intended outcomes is compromised extensively. On the other hand, the development and actualization of the relevant interventions ensures that the goals of the construction process are achieved. In addition to the promotion of the standard of goal attainment, another notable reason as to why the formulation of effective interventions is concerned pertains to the fact that such interventions go a very long way towards the enhancement of safety. The safety of buildings is not only essential for the workers, but also inhabitants. This section of the research focuses on an evaluation of the distinctive strategies that can be used as interventions for addressing the risks of the process of design of buildings.

### Immersive and augmented visualization techniques

One of the main ways in which the design risks for buildings in Iraq can be addressed pertains to the use of immersive and augmented visualization techniques. This is a strategy that is heavily reliant on modern technologies as well as digitized models of construction. One of the beneficial implications of using augmented visualization techniques is that they enhance the effectiveness with which data is documented for the design process. When the framework of data gathering and analysis is ineffectual, the success of the entire design process can be compromised extensively. Additionally, the use of augmented visualization techniques help in the implementation of a design that is strongly aligned towards the environmental components of the construction site.

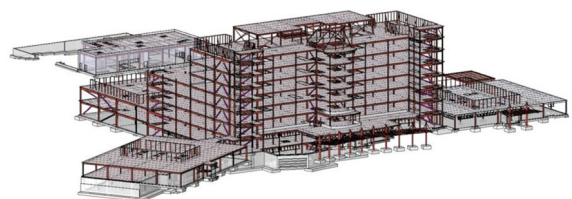


Fig. 3: Digitized Models Of Construction

### Recording Collaborations

Apart from immersive and augmented visualization techniques, another notable aspect of emphasis when it comes to the interventions for the different risks characterizing the process of design of building encompasses recording collaborations. This is a strategy that encompasses the integration of different professionals into the design process so as to enhance the extent to which the design is aligned towards the intended outcomes. It is vitally important to accentuate that recording collaborations also goes a very long way towards improving the decision making process in the design of buildings. In view of these aspects, it is hence evident that recording collaborations would serve as a valuable interventional strategy for the different risks of design.

### Professionalism

The framework of interventions for the different risks can also be evaluated from the perspective of high levels of professionalism. Despite the fact that there are many causative attributes of the occurrence of mistakes and errors in the choice of materials and equipments, the lack of professionalism is a notable cause. When the required standards of professionalism are not used in the entire process of design of buildings, there is always the potential of numerous risks.

### Effective Planning

The interventional strategies for the different risks of the process of design of buildings can also be evaluated from the perspective of effective planning. Planning is always vital when it comes to the minimization of perils because it helps in the objective analysis of all possibilities. When such an approach is aligned into the process of design of buildings, decision making is improved while also minimizing the risk of delays and disruptions. Additionally, it is also evident that effective planning enhances the extent to which gaps are identified and rectified before they compromise the entire process.

### Continuous Monitoring

The framework of interventions for the process of design of buildings can also be evaluated from the standpoint of continuous monitoring. While there are many ways in which the process of design of building can be enhanced in the long-term, the actualization of continuous monitoring is one of the most notable ways in which it can be enhanced. This involves the strategic evaluation of the outcomes attained at each stage of the construction process. This is an effective strategy in that it enhances the extent to which errors and risks are identified before they compromise the entire design.

### Compliance with Regulations

The interventions for the different risks within the process of design of buildings can also be analyzed from the standpoint of compliance with the stipulated regulations. In the construction industry, there are various guidelines that have been developed in order to ensure the required standards are attained by constructors as well as other stakeholders. Based on this aspect, it then follows that the maintenance of the required standards of compliance can serve as an immensely beneficial platform on which the different risks the design of buildings are identified and addressed. Additionally, this is also an essential intervention because it helps in averting potential legal disputes.

### 4. Opportunities Associated with Building Information Modeling

Building information modeling (BIM) is a highly innovative strategy that has gained prominence in the global construction industry because of the fact that it is strongly aligned towards modern technological systems. It then follows that there is the need to evaluate the different opportunities associated with BIM. One of the most notable opportunities pertains to the fact that BIM can be used to develop a flexible model for a building in line with the specific needs. This is crucial towards the attainment of success in the construction process. In addition to flexibility in modeling, another opportunity associated with BIM is that it can be used as a platform on which risks for the process of design of buildings are predicted long before they occur.

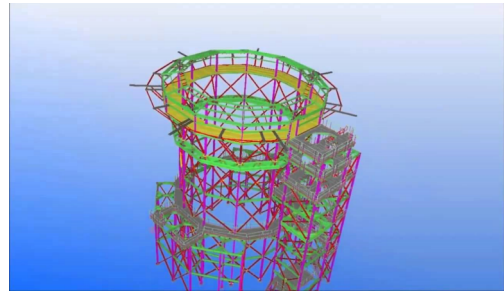


Fig. 5 : BIM flexible model for a building.

### 5. Questions/Concerns Pertaining to Digital Models

One of the main concerns associated with BIM is that it requires a high level of competence. This implies that there is the need for extensive training so that BIM can be used effectively in the construction sector. Additionally, the high costs associated with BIM implementation also constitute a notable concern. In the event that these concerns are not adequately addressed, then it is complex for the model to be implemented effectively.

### 6. Need for Further Research

There is the need for the digital models to be evaluated from the context of how they can promote higher standards of collaboration among role-players in construction. Additionally, the extent to which the digital models enhance the issue of timeliness in construction is also a notable issue that needs further research.

### 7. Conclusion

In recent years, different strategies and approaches have been used towards ensuring that such risks are addressed. This research focuses on an evaluation of the outstanding risks for design of buildings as well as the role that can be played by digital models as interventional mechanisms for addressing such risks. As far as the risks within the process of design of buildings are concerned, there is the need to highlight the fact that errors in the collection and documentation of data constitute the major perils. In the entire design process, data from the site is used extensively. This implies that the extent to which the entire design is reliable is heavily influenced by the accuracy with which the relevant data is collected. In line with such aspects, errors in the gathering of take-off data is immensely influential when it comes to risk assessment for the process of design of buildings.

### References

- Fantilli, A. P., & Chiaia, B. (2013). Golden Ratio in the Crack Pattern of Reinforced Concrete Structures. *Journal Of Engineering Mechanics*, 139(9), 1178-1184. doi:10.1061/(ASCE)EM.1943-7889.0000548
- Guner, S., & Vecchio, F. J. (2011). Analysis of Shear-Critical Reinforced Concrete Plane Frame Elements under Cyclic Loading. *Journal Of Structural Engineering*, 137(8), 834-843. doi:10.1061/(ASCE)ST.1943-541X.0000346
- Jinquan, Z., Gardoni, P., & Rosowsky, D. (2010). Stiffness Degradation and Time to Cracking of Cover Concrete in Reinforced Concrete Structures Subject to Corrosion. *Journal Of Engineering Mechanics*, 136(2), 209-219. doi:10.1061/(ASCE)EM.1943-7889.0000074
- Liel, A. B., Haselton, C. B., & Deierlein, G. G. (2011). Seismic Collapse Safety of Reinforced Concrete Buildings. II: Comparative Assessment of Nonductile and Ductile Moment Frames. *Journal Of Structural Engineering*, 137(4), 492-502. doi:10.1061/(ASCE)ST.1943-541X.0000275
- Qian, K., & Li, B. (2013). Performance of Three-Dimensional Reinforced Concrete Beam-Column Substructures under Loss of a Corner Column Scenario. *Journal Of Structural Engineering*, 139(4), 584-594. doi:10.1061/(ASCE)ST.1943-541X.0000630
- Song, W., Dyke, S., & Harmon, T. (2013). Application of Nonlinear Model Updating for a Reinforced Concrete Shear Wall. *Journal Of Engineering Mechanics*, 139(5), 635-649. doi:10.1061/(ASCE)EM.1943-7889.0000519