



# The Possibility of Converting Some of Mosul's Mosques to Emergency Shelters in Case of Conflicts and Disasters

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## Abstract

Mosul, the second-largest city in Iraq, sits in the north of Iraq with 3.5-million population. Mosul underwent brutal battles against extremist groups after 2003, which ended victim with the fall of the city in the grip of ISIS troops in 2014. Subsequent military actions have led to an internal displacement of millions of Mosul's residents to other safer neighbourhoods. Displacement of families also took the form of migration to other cities in Iraq. This horrific scenario necessitated the importance of finding suitable emergency shelters in the city designed and prepared to receive the displaced from all over the war-hit zones. These emergency shelters can be the existing buildings within the city that can be conveniently transformed into emergency shelters. The provided facilities should be regularly distributed within the city's neighbourhoods and are easily accessible. Moreover, they should accommodate many displaced people and meet minimal requirements for establishing shelters. The mosques in Mosul could be the best choice for emergency shelter specifications. Evidence has shown that mosques can be used as emergency shelters during recent disastrous situations. This study investigates the prospect of converting mosques in Mosul into emergency shelters during wars, conflicts, and even natural disasters. To this end, some of the newly constructed and relatively large mosques were selected to verify whether they are designed to meet international standards for constructing emergency shelters. The results revealed that the selected mosques in Mosul city could be used as emergency shelters by just adding a few functions.

**Disciplinary:** Architecture, War and Conflict & Peace Study, Disaster & Emergency Management.

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# 1 Introduction

Mosul is a big city in northern Iraq, which serves as the capital of the Nineveh Governorate. In Iraq, Mosul is the second-largest city in terms of population and area after Baghdad, the capital city of Iraq, with a population of over 3.5 million. The recently inflicted war against terrorism that some Iraqi cities were involved in, and subsequently the beginning of military actions against ISIS extremist groups had led to the displacement of millions of people from their homes. Therefore, is a dire need to find alternative emergency shelters inside the worst-hit cities; these shelters can absorb and accommodate displaced people from affected areas, particularly during armed conflicts or natural disasters, such as floods and earthquakes. The city of Mosul in Iraq is one of those cities that suffered from severe military conflicts, which led to displacing of many residents in this city.

As an effective strategy to mitigate the potential risks of natural disasters and wars, some international organizations have proposed provisions and criteria for establishing appropriate emergency shelters or making use of public building spaces as ready-made emergency shelters. Many previous studies were conducted to investigate the use of different facilities and buildings, which contain large spaces as potential emergency shelters. These facilities include universities, libraries (Ettou, 2012), commercial activities (Ota et al., 2017, Sanuki et al., 2018), and religious temples. Disasters, which have recently been witnessed around the world, have shown that mosques are more suitable for use as shelters, as happened in the Kashmir flood in India (PTI, 2014), the Sungai Pahang flood in Malaysia (Ghani, 2015), the flood that occurred in northern England (Feed, 2015) and the earthquakes, which struck Japan (Kotani et al., 2021), which all demonstrated the functional role of mosques as a communal and social institution during previous incidences of natural disasters. This study, thus, aims to investigate the prospects of converting mosques into emergency shelters during conflicts and disasters in Mosul city. This study will not shed light on the Islamic perspective of mosques as centres for religious, social, and charitable activities, but it mainly focuses on the possibility of using mosques as emergency shelters. To this end, the architectural criteria and provisions for establishing emergency shelters set by international organizations were, therefore, presented and discussed, especially those related to the site, location of the mosque, and its surroundings, the architectural spaces that will accommodate the displaced, and the supportive service spaces. For the analysis and description, several mosques in the city of Mosul were selected from the mosques in Mosul, and it was investigated whether they are ready to be used as emergency shelters in times of crisis. This study also aims to summarize the provisions that are not included in the mosque's design and, therefore, recommendations were forwarded for consideration in the initial stages of the design process.

This paper aims to investigate the possibility of converting mosques in the city of Mosul into emergency shelters in case of conflicts and disasters. This can be achieved by selecting some of the newly constructed and relatively large mosques and verifying if they are designed to meet the international standards for constructing the emergency shelters adopted by this study. Thus, provisions that are not included in the mosque design must be considered in the initial stages of

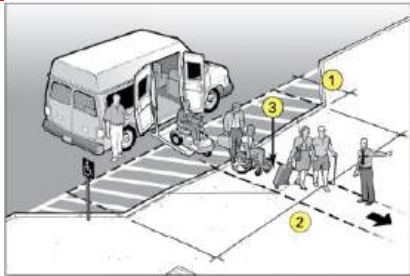
the design process as basic requirements when mosques are prepared to be used as emergency shelters in the worst-case scenarios of wars, conflicts, or natural disasters.

## 2 Method

Emergency shelters are designed to ensure the preservation of life in times of disaster. It is the place, where the displaced and those, who fled their homes, temporarily stay and receive support. Therefore, many international relief organizations have developed plans or criteria for establishing appropriate emergency shelters. Mosques can serve as a transit facility and act as a pre-existing hub in the community if the design of these mosques meets the provisions for establishing emergency shelters, particularly in the post-disaster recovery period when displaced people are unable to return to their homes. There are two types of criteria set by international relief organizations for establishing emergency shelters. The first criterion is the personal assistance services, which are related to the training of specialized cadres, assessment teams, and logistic support cells that are responsible for managing the shelters and distributing humanitarian aid to displaced people and alleviating their suffering (Federal Emergency Management Agency (FEMA), 2010). The second type of criterion involves the design and planning criteria related to the architectural details of shelters with the supportive services attached to them, and the details of the mosque site and its surrounding. This study focuses on the second type of criteria as it is an architectural study; therefore, it is limited to shelter design requirements only according to the criteria set by international relief organizations. Table 1 shows the design criteria for emergency shelter establishment, which are taken from the guidelines of international relief organizations. The researcher has checked whether the selected sample of mosques in Mosul city would satisfy the emergency shelter establishment requirements. The design criteria of emergency shelters are listed in Table 1, together with a detailed description of each criterion set by the researcher.

**Table 1: Adopted design criteria of emergency shelters set by international organizations**

	Criterion	Description
1	“Shelters should comply with building regulation, and must be located away from potential hazards” (International Organization for Migration (IOM.OIM), 2013)	The mosque might have a building license from an officially authorized institution like Sunni Endowment Department or Mosul Municipality. It might be situated away from important governmental, military establishments, Electrical substations, and fuel stations
2	“Ample natural ventilation and lighting are required” (International Organization for Migration (IOM.OIM), 2013)	Mosques might include in their design, openable windows, at least on two opposite sides of their walls to facilitate the process of natural ventilation and daylighting.
3	“The building may be self-sufficient with rainwater tanks and potential for integrated solar power” (International Organization for Migration (IOM.OIM), 2013)	Mosques might have an alternate water source like a water well or a rainwater harvesting system and... Might have a solar panel
4	“The shelter must be accessible, preferably within walking distance to the affected community” (International Organization for Migration (IOM.OIM), 2013)	Mosques might not be more than 400 m away from the affected community (Yang et al., 2012)
5	“Design of the shelter needs to promote vernacular architectural typologies and should be contextual” (International Organization for Migration (IOM.OIM), 2013)	Check if the mosque design fits the vernacular architectural typology in terms of: floor plans & facades
6	“The shelters need accessible entrances and routes to all services/activity areas: Routes to toilets rooms Passenger drop-off and pick-up areas	Check if routes to toilet rooms, sidewalks, and walkways are paved. Must be at least 90 cm wide. Check if there is a (passenger loading zone) which is needed for people using mobility aids to get off the bus and proceed to the mosque’s accessible entrance.

	Criterion	Description
	 <p>Accessible drop-off area with an access aisle provided at the same level as the vehicle.</p> <ol style="list-style-type: none"> <li>1 Access aisle depth is at least 5 feet.</li> <li>2 Access aisle length is at least 20 feet.</li> <li>3 Curb ramp connects the access aisle for the accessible drop-off area (which is at the level of the parking lot) to the accessible route to the accessible entrance of the shelter.</li> </ol> <p style="text-align: center;">Parking Sidewalks and walkways (Federal Emergency Management Agency (FEMA), 2010)</p>	<p>Check if there is parking attached to the mosque.</p>
7	<p>“In terms of capacity, 1.8 to 3.7 m<sup>2</sup>/person should be available for short-term and long-term shelter residents respectively.” “People, who use wheelchairs, lift equipment, a service animal, and personal assistance services can require up to 9.3 m<sup>2</sup>/person.” (Federal Emergency Management Agency (FEMA), 2010)</p>	<p>The mosque’s area (prayer hall) is divided by the space allocated for each displaced person (3.7 m<sup>2</sup>) to determine the number of people the mosque would accommodate if it were used as an emergency shelter. Same as for people who use wheelchairs, except that you should be divided by (9.3 m<sup>2</sup>). Bearing in mind that the percentage of disabled people is 15% of the Iraqi population. (UNAMI), UNITED NATIONS ASSISTANCE MISSION FOR IRAQ, 2016)</p>
8	<p>“There should be one toilet and one shower for every 15 persons in the shelter.” (Department of State Health Services, April 2011)</p>	<p>“For many emergency shelters, evacuees are not expected to shower or bathing facilities due to the short period they may stay at the shelter.” (Federal Emergency Management Agency (FEMA), 2010) (Appendix1, p. 49). But The Department of State Health Services (the State of Texas) recommended in their “emergency shelters recommendations” that it should be one toilet and one shower for every 15 persons. Therefore, the number of displaced people (from the previous step) who will be accommodated in the mosque is divided by 15 to find out the number of toilets and showers needed.</p>

## 2.1 The Sample and Case Study

There are two types of mosques in Mosul city, a relatively large one, in which, the five daily prayers are performed along with the Friday prayer, whereas the second is quite a smaller type, in which, only the five daily prayers are performed. For the study sample, four mosques were chosen from the left side of the city to investigate the capability of using them as emergency shelters in case of conflicts or natural disasters. This sample was selected according to certain conditions. First, they should be relatively large to serve abundant displaced people. Second, they should be situated among several neighbourhoods of the city; it is better that these mosques are newly built and not dilapidated to ensure that they contain more new services. Third, they should be located on more than one street so that they are accessible and close to main facilities, such as shopping

centres, health centres, and schools. In other words, they should be located in the centre of the residential neighbourhood. The selected mosques in this study include:

- Al-Nuaimi Mosque
- Algufran Mosque
- Selat-Alarham Mosque
- Alwahab Mosque

The next step of the methodology is to verify whether these mosques are suitable to act as emergency shelters that accommodate many displaced people during conflicts, wars, and natural disasters. This can be achieved by satisfying the approved guidelines of international relief organizations for establishing proper emergency shelters. In doing so, this study aims to verify whether the selected mosques satisfy the set requirements for the establishment of emergency shelters.

## **3 Data Analysis and Findings**

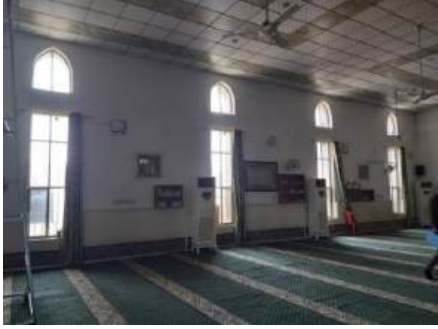






### **3.1 Complying with Building Regulations and Location from Potential Hazards**

Before their construction, all mosques in Iraqi cities, including the city of Mosul, are subject to several approvals from the Engineering Departments at both the Ministry of Endowments and Religious Affairs, and the local governorates' municipalities to complete the procedures for issuing construction licenses for those mosques. These procedures include the urban design provisions and determinants for siting those mosques, complete architectural and construction plans and details, the engineering services, and technical specifications that consider the identity of traditional local architecture, especially in the form of the mosques' plans and facades. Therefore, the designs of all mosques in Mosul comply with the requirements of the local building regulations in force. Based on the researcher's field visits to the selected mosques and their surroundings with the aid of aerial photographs, it was found that all mosques in the selected sample are far from facilities of potential hazards, as they are essentially located in the centre of Mosul's neighbourhoods.

### **3.2 Natural Ventilation and Lighting**

It is well known that widespread, strong winds in Iraq, including the city of Mosul, in particular, are northwestern. All mosques are directed to Mecca, specifically with a slight deviation from the southwest, which means that one of the two walls on both sides of the (Qibla) wall will be directed towards the northwest facing the direction of the winds, and the other, towards the southeast. All mosques in the selected sample have an openable window on both sides of the (Qibla) wall; this would facilitate the process of natural ventilation through the mosque. In addition, these tall windows promote, at the same time, the penetration of direct daylighting to wide areas in the mosque, as illustrated in Table 2.








**Table 2: Natural ventilation and daylighting**

		Windows from inside	Windows from outside
1	Al-Nuaimi Mosque		
2	Algufran Mosque		
3	Selat-Alarham Mosque		
4	Alwahab Mosque		

### 3.3 Availability of an Alternate Water Source (Water Well) and an Alternate Electricity Source (Solar Panels)

All mosques contain water tanks, either from metal or stone built on the ground and used simultaneously for ablution purposes. In addition, each mosque contains a water well, which was dug during the crisis that Mosul experienced when ISIS occupied the city and the subsequent destruction of government water projects. All mosques lacked alternative electric energy sources, especially solar panels. Some mosques use diesel generators, but they cannot be relied upon in times of crises and wars due to the lack of fuel, as illustrated in Table 3.




**Table 3: Availability of alternate water source (water well) and an alternate electricity source (solar panels)**

		Water well	Water tanks or stone water tank	Solar panels
1	Al-Nuaimi Mosque			—
2	Algufran Mosque			—
3	Selat-Alarham Mosque			—
4	Alwahab Mosque			—

### 3.4 Accessibility within Walking Distance to the Affected Community

Every mosque in the selected sample has at least three accessible routes within walking distance to the affected community, making the mosque site more convenient to be used as an emergency shelter, as shown in Table 4.

**Table 4:** Accessibility within walking distance to the affected community

		The accessibility of mosques
1	Al-Nuaimi Mosque	 A satellite map of a dense urban area with a grid of streets. Red lines with arrows indicate walking routes starting from various points in the neighborhood and converging on a central mosque building.
2	Algufran Mosque	 A satellite map of a dense urban area with a grid of streets. Red lines with arrows indicate walking routes starting from various points in the neighborhood and converging on a central mosque building.
3	Selat-Alarham Mosque	 A satellite map of a dense urban area with a grid of streets. Red lines with arrows indicate walking routes starting from various points in the neighborhood and converging on a central mosque building.
4	Alwahab Mosque	 A satellite map of a dense urban area with a grid of streets. Red lines with arrows indicate walking routes starting from various points in the neighborhood and converging on a central mosque building.


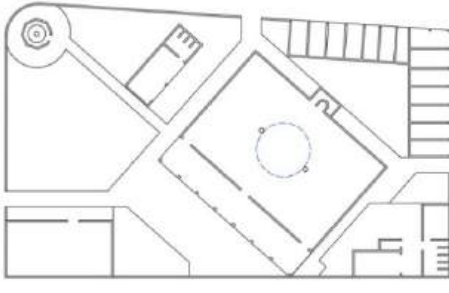

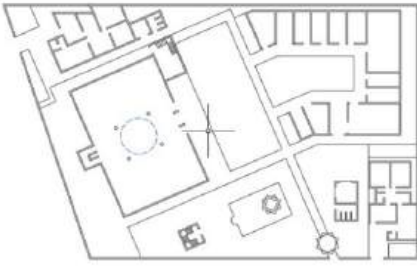

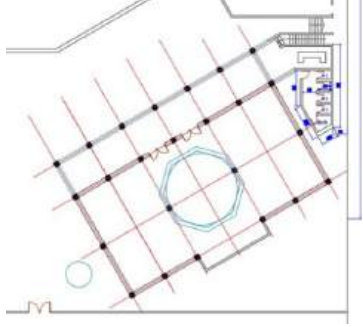

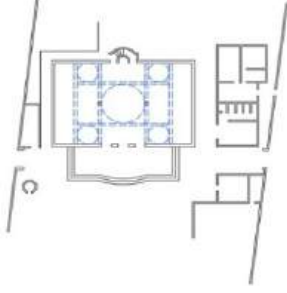
### 3.5 Harmonization with Vernacular Architectural Typologies

The plans of mosques in Mosul do not contrast so sharply with the known traditional local typical style in the rest of the buildings, which exhibit the presence of a central courtyard. Mosul's architectural style provides a harmonized style with the mosques' external facades regarding very few small-size openings, bearing in mind that these buildings were built within a compact urban fabric. Modern mosques follow the same vernacular styles and typologies to some extent, with slight differences in harmony depending on certain changes in the urban fabric. The main difference between the mosque and the surrounding context is the presence of the common



architectural elements associated with the mosque, such as minarets and domes, as illustrated in Table 5.



**Table 5: Harmonization with the vernacular architectural typologies**

1	Al Nuaimi Mosque		
2	Algufran Mosque		
3	Selat-Alarham Mosque		
4	Alwahab Mosque		

### 3.6 Accessibility to Toilets Rooms, Passenger Drop-off and Pick-up Areas, Parking, and Paved Sidewalks and Walkways




Everyone must be able to have access to toilet rooms, especially people who use mobility devices, such as wheelchairs. All the routes in the selected sample to the toilets rooms and inside these rooms were paved without steps from the accessible main entrance to the toilets complex, as shown in Table 6.

**Table 6: Accessibility to toilets rooms**

		Routes within toilets rooms
1	Al-Nuaimi Mosque	
2	Algufran Mosque	
3	Selat-Alarham Mosque	
4	Alwahab Mosque	

The passenger loading zone is provided in two mosques, Selat-Alarham and Alwahab mosques, but they did not follow the same details as recommended, as per the international standards; however, they met some of these requirements. The same two mosques also have accessible parking spaces with accessible routes that connect these parking spaces with the main mosque gates and entrances. These accessible routes constitute the sidewalks (also called walkways), which exist in all the selected mosques, as shown in Table 7.

**Table 7: Passenger drop-off and pick-up areas, parking and paved sidewalks and walkways**

			Passenger drop-off and pick-up area	parking	Sidewalks and walkways
1	Al-Nuaimi Mosque		—	—	•
2	Algufran Mosque		—	—	•
3	Selat-Alarham Mosque		•	•	•
4	Alwahab Mosque		•	•	•

### 3.7 An Adequate Number of Toilets and Showers for an Expected Number of Displaced People

Considering the criterion of the space occupied by long-term shelter residents, equal to 3.7 m<sup>2</sup>/person, the selected mosques accommodated between 48 and 76 displaced people, which is considered to be a relatively small number. However, it is in line with shelter size requirements, which recommended accommodating only a few displaced people as self-regulation within smaller groups is more likely and may foster solidarity.

According to the criterion adopted by this study regarding the number of toilets and showers in comparison to the number of displaced people, the existing number of toilets in mosques is equivalent to what the mosques need if they were used as emergency shelters, and in some cases may be more. However, showers were completely lacking in the selected sample, see Table 8.

**Table 8:** Number of toilets and showers for an expected number of the displaced

		Number of the displaced that the mosque can accommodate	The existing number of toilets and showers in mosques		The recommended number of toilets and showers when the mosque is used as an emergency shelter	
			Toilets	Showers	Toilets	Showers
1	Al Nuaimi Mosque	76	5	—	5	5
2	Algufran Mosque	66	6	—	5	5
3	Selat-Alarham Mosque	62	6	—	4	4
4	Alwahab Mosque	48	5	—	3	3

**Table 9:** Overall results of emergency shelters design criteria

		Complying with building regulations	Far away from potential hazards	Ample natural ventilation and daylighting	Availability of an alternate water source (water well)	Availability of an alternate electricity source (solar panels)	Accessibility within walking distance to the affected community	Harmonization with the vernacular architectural typologies	Accessibility to toilets rooms	Passenger drop-off and pick-up areas	Parking	Paved sidewalks and walkways	Adequate number of toilets for an expected amount of displaced people	Adequate number of showers for an expected amount of displaced people
1	Al Nuaimi Mosque	●	●	●	●	—	●	●	●	—	—	●	●	—
2	Algufran Mosque	●	●	●	●	—	●	●	●	●	—	●	●	—
3	Selat-Alarham Mosque	●	●	●	●	—	●	●	●	●	●	●	●	—
4	Alwahab Mosque	●	●	●	●	—	●	●	●	●	●	●	●	—

## 4 Conclusion

This paper investigated whether Mosul city mosques can be used as emergency shelters during disasters or conflicts. The study examined a sample of four mosques in Mosul city. Based on the description of these mosques, the results revealed that the mosques in Mosul city can be used as emergency shelters because only a few functions need to be considered by adding them to these mosques on their sites. This study has identified the number of displaced people that the mosques could accommodate. This will facilitate the design process by determining the supporting function

for the mosques when they are used as emergency shelters. Once the mosques are determined to function as emergency shelters, the design requirements of shelters should be considered side by side with the mosques' design requirements from the early stage of the design process.

Three main design requirements were determined in this study as the lack of satisfying mosques' design when they are used as emergency shelters. First, the alternate electricity supply is represented by the provision of solar panels or any source of clean electrical energy that can be used in mosques even in normal conditions when there is a shortage of electrical power supplied by the government. Solar panels can easily be installed over the mosque haram around the dome, or in the large unused empty spaces within the mosque site. They can also be installed and arranged along with the height of the minaret so that it does not affect the appearance of the minaret but is integrated with it. Second, the mosques' showers; in general, mosques do not need this function as a part of their design requirements, so it is not available in Mosul mosques. Therefore, they must be constructed in the mosques destined for the future to be used as emergency shelters, even if they are of transit type. Parking was the third design requirement; the local building regulations in force do not require that parking is one of the mosques design requirements; therefore, most of the mosques in the city do not have parking lots. The mosques with parking are basically the result of both the architect's diligence and the donor's desire. Sometimes the large area allocated for constructing the mosque may help add parking areas. It is worth noting that some mosques that were built in modern neighborhoods have large unused spaces which can be converted easily to parking.

Further studies are required to further investigate this important topic regarding dividing the mosque haram, using the largest possible space to accommodate the displaced families if the mosque is used as an emergency shelter. The study also recommends rehabilitating some Mosul mosques to become emergency shelters in case of crises and conflicts, depending on population distribution. This requires initializing an integrated plan for this purpose, including the way-finding maps indicating the rehabilitated mosques, their capacity, and the shortest accessible routes to reach them, as illustrated in Table 9.

## 5 Availability of Data and Material

Data can be made available by contacting the corresponding author.

## 6 Acknowledgments

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