Adopting sustainable development in reconstruction Post War City of Mosul Architecture- Case Study

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Abstract. Reconstruction represents an opportunity to achieve sustainable development for each cities and buildings destroyed by wars and disasters. Many previous studies highlighted reconstruction although their presentation in most cases was general and selective in adopting some aspects but not others. The research problem was determined by the lack clear vision to the possibility for adopting sustainable development, with its multiple dimensions, is in reconstruction of both cities and buildings, so that the Objective of the Research is to present the most organized and clear knowledge in a way that serves the reality of the local situation by adopting a descriptive-analytical approach for several studies and applied experiences. The research has realized distinction for the importance of each of the organizational, institutional and Cultural dimensions in reconstruction along with all the economic, social and environmental dimensions in a way that achieves sustainable development based on multiple Basis, principles, and techniques that contribute in their entirety to the advancement of the reality of cities and buildings after wars and disasters, which therefore requires the necessity of taking them into account in the local experience of reconstruction.

Keywords: Reconstruction, Sustainable Development, Dimensions of Sustainability, Disasters and Wars, Mosul, Tamayouz Excellence Award.

1. Introduction
Wars and disasters cause devastation to cities and societies in a way that causes a decline in the quality of human life in light of unstable circumstances, but it may nevertheless constitute an opportunity for sustainable development to advance the reality of those cities and societies through reconstruction.

According to view point of the architect (Aldo Rossi), wars and disasters hastie to achieve fundamental transformations in the body of the city, which would inevitably take place in peace and normal conditions, but at a slower pace, as it allows the implementation of available plans that were previously developed and was not possible to achieve before. [1] On the other hand, the reconstruction after wars and disasters may be arduous, but it turns into an opportunity that any society can invest in create healthier, more comfortable and energy-efficient buildings. [2] And the achievement of normal, Healthy living conditions in the destroyed areas, in accordance with the principles of sustainable economic and social development. [3]

This research seeks to define the dimensions of sustainability that must be adopted in the reconstruction within the framework of a comprehensive and integrated vision in a way that contributes to enhancing the local experience in light of the actual need of many Iraqi cities liberated from the occupation of ISIS. The research defines the reconstruction in general, address the most critical effects
of wars and disasters, and review of previous studies, leading to the determination of the correlation of the dimensions of sustainability in the reconstruction, according to which they are clarified in the global experiences and design proposals in a manner that enables the most critical aspects of them to be indicated within a set of conclusions.

2. The Concept of Reconstruction

Linguistically, the concept of reconstruction refers to the process of rebuilding or reshaping cities and societies, on the one hand, and to the product that has been reconstructed and rebuilt after being damaged and destroyed by disasters and wars, on the other hand. [4]

The World Bank defines the idea of the post-war reconstruction as building the social and economic framework for society and re-creating the conditions for establishing a society that works in peacetime, especially those related to governance and the rule of law as the two main elements for building that society. [5]

The Burra Charter has defined the reconstruction as the restoration of the damaged building to a known previous state by introducing new materials into the fabric, within the broad scope of the term architectural preservation, whose exact meaning differs according to the context in which it is used. [6] Baradan (1999) has defined reconstruction as the process of interaction of complex social, technological, and economic factors and procedures, which are different from what they are in typical situations and circumstances because they are concerned with meeting needs in abnormal and unstable conditions. [7] Barakat (2003) has stressed the necessity of achieving a balance between reform, improvement and maintaining the status quo, which requires much change in settlement planning, technology or location for example, with the possibility of having unexpected consequences, which requires the adoption of community participation as an essential component of reconstruction. [8]

Martz (2010) has defined reconstruction as a large-scale reconstruction of post-conflict countries, especially concerning rebuilding infrastructures. Reconstruction can be seen as part of the development and on the other hand, it refers to both psychological recovery and humanitarian reform. [9]

On the other hand, Ohiorhenuan (2011) has indicated that the reconstruction involves a socio-economic transformation and requires a combination of long-term economy, institutional and legal reforms that allow war-torn countries to re-establish the foundations of sustainable development, so the reconstruction means recovery and preparation of a new system of economy by rebuilding differently and better. [10]

Nizi (2001) showed that the disaster represents an opportunity to start the development process in a more sustainable situation, an opportunity to develop modern (improved) systems and technologies and construction processes that improve the quality of life and are compatible with regional geographical, environmental conditions through a comprehensive approach to the reconstruction of the essential physical infrastructure and shelter (home) so that vulnerabilities are reduced and families can stand on their feet and thus pave the way for long-term rehabilitation. [11]

It is clear from all the above that reconstruction is concerned with the large-scale reconstruction of countries after wars and disasters (at the urban and infrastructure levels) to ensure that needs are met in abnormal and unstable conditions so that this represents an opportunity to lay the foundations for sustainable development through reform, improvement or conservation for the current situation in order to achieve:

- Human recovery at the psychological and physical levels.
- Building the social framework and relying on community participation.
- Restoring economic capacity and achieving self-sufficiency.
- Institutional and legal reforms as well as governance and the rule of law.

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1 The Burra Charter 1999: It is a set of basic principles and procedures in preserving architectural heritage sites in Australia that warn against change. The charter also provides for appropriate decision-making procedures and ensures the involvement of cultural groups. [6]
3. The Effects of Disasters and Wars

Akar (2016) has pointed to the economic, social, and environmental impacts of disasters in general, in terms of the negative impact on human capital, employment, economic growth and infrastructure [2].

Al-Taheer (2011) showed that wars are the most dangerous thing that a person can attain in the built environment and that their danger increases as tools and weapons of these wars evolve, causing several effects that can be identified as follows: [12]

- **Physical Impact**: It is one of the clearest, most costly, and urgent visual effects for reconstruction, as buildings, public facilities, infrastructure, and urban structures are damaged in the urban environment.

- **Economic Impact**: This includes everything that affects the economic movement and development process and leads to the destruction of the economic environment and impeding the growth process through sudden changes and disruption of the production movement and weak human resources as a result of migration, homelessness, and injuries, and that causes the collapse of social security and the increase of external debt and sometimes having to resort to bringing foreign aid.

- **Social Impact**: It is considered as one of the invisible effects that have a significant Reflect in to the society. Social problems in wars are exacerbated by the lack of basic needs, deteriorating living conditions and widespread poverty.

- **Cultural Impact**: It consists in seeking to change the visual image in the urban environment, falsifying history and imposing a new identity for the place by destroying historical and cultural evidence by intentional act as in wars, whether this evidence is physical constructs (cultural centers, historical cities, monuments, religious symbols), or a moral culture (habits and traditions), or a history in books or subjects taught in schools.

- **Political impact**: Represented by confusion, dispersion, and instability of political conditions accompanying wars, which may lead to extreme weakness or the collapse of governments at various local, regional, or national levels.

4. Sustainability and Reconstruction: Literature review

Several previous studies dealt with different aspects of achieving sustainability in reconstruction. A study conducted by Mariko (2012) has demonstrated the importance of taking into account the requirements of sustainable development in reconstruction within the medium and long-term planning after the emergency intervention period, to include the redevelopment of more Resilience urban areas and work orientation towards sustainable interconnected land within new plans for the city, providing sustainable housing for the victims, restoring high-quality public services, reviving economic activity, as well as developing a plan to invest in renewable energies and adopting recycling mechanisms. [13]

Salama Study(2018) has showed the opportunity provided by the process of reconstruction and rehabilitation of buildings destroyed by military operations or natural disasters to achieve the goals of sustainable development, especially achieving energy efficiency by adopting modern technological methods, according to a future vision based on integrating the energy efficiency of buildings within a general plan, stressing the importance of the commitment of the city’s leaders and society to it. [14]

According to Akar’s study (2016), disasters represent an opportunity for societies to build healthier, more comfortable, and energy-efficient buildings within the approach of green architecture to contribute to avoiding other disasters in the future. The study, through its review of the Turkish experience in facing earthquakes, demonstrated the importance of encouraging green construction using environmentally friendly building materials, recycling and energy efficiency that contribute to the reform process by setting economic mechanisms such as adopting disaster insurance and providing discounts to legalize their use by consumers. [2]

Unisdr Study(2017) showed the importance of rebuilding better livelihoods for communities affected by a disaster through the framework of social and economic recovery in terms of the necessity of cooperation and coordination between each of the public, emergency managers, community
development professionals, government agencies, private sector professionals, Non-governmental organizations, as well as improving the economic climate for society and supporting both legislation and regulations. [15]

Lamphere’s study (2015) stressed the need for reconstruction to be accompanied by economic growth, which contributes to facilitating the start-up of projects as much as possible by paying attention to available job opportunities and streamlining work policies and legislation, along with the importance of strengthening local institutional capacity before starting the reconstruction through the organization of administrative structures and governance and the implementation of control and anti-corruption measures from the beginning. [16]

Ismail & Halog Study (2017) have highlighted the importance of adopting sustainability in the reconstruction in a way that guarantees a Resilience, environmentally friendly urban system capable of facing disasters in the future by integrating the dimensions of environmental, social and economic sustainability into the planning, design, construction and maintenance stages, and as follows: [17]

- Adopting sustainable planning that takes into consideration interactions between the inhabitants, land uses, location, material sources, and resource management.
- Adoption of sustainable design based on adaptation to climatic conditions, cultural, and economic aspects.
- Adoption of sustainable construction focusing on land and waste management.
- Adoption of sustainable maintenance, that includes both recycling, reuse, and the ability to continuously update.

On the other hand, disasters and wars may pose a threat to the cultural heritage of societies, as Kosi Study (2015) showed that urban damage is the living record of the devastation caused by wars and armed conflicts; the foremost of which is the destruction of urbanization linked to society, which represents its memory and identity, especially the destruction of heritage architecture, which includes different types of buildings in different periods of history, where each of these buildings imposes a different approach to dealing, according to the importance of the building, its historical value and the available capabilities. [18]

Samih et al. Study (2018) have identified three strategies for reconstruction, in a way that guarantees post-war cities' recovery and preserving their cultural and historical values based on the as Kassouha (2014) following proposals: [19]

- Preserving the same impression of the city for the reconstruction of the city as it was before the war (construction and reconstruction).
- Renovating the existing buildings of the city depending on what remains after the war.
- Rebuilding new buildings with a new image of the city (new forms of reconstruction).

Through a study review of the experience of rebuilding Beirut, Lebanon after the civil war and the reconstruction of Dresden, Germany after World War II, the importance of each of the following is explained: [20]

- The necessary to put three strategies for any sustainable development into account in the reconstruction process.
- The necessity for the new post-war master plan to preserve the traditional image of the city, not change it.
- The necessary for reconstruction, to ensure that most of the immigrant population return abroad to overcome the pre-war trauma.
- The importance of social justice among all social groups.
- The need for the reconstruction process to provide different job opportunities suitable for all returning residents.
- The necessity of achieving the first stage of the reconstruction process; the stability of the military situation and the government, as the government must participate in this process and not give the private sector all decisions.
• The need for the private sector to be an important factor in financing the post-war reconstruction process, as the government cannot help financially in this post-war process.

• The necessity of community participation in any decision taken in the reconstruction process to determine needs, problems, and alternatives to solutions.

A study conducted by Al-Samarai and Kazem (2016) presented a set of strategies for reconstruction that seek to revive the urban heritage to include each of the following: [21]

• Urban Strategies: In terms of reviving urban structures, restoring functional balance, andreviving the city's memory.

• Social Strategies: In terms of improving the level of social life, activating the role of society in reviving neighborhoods through community participation, raising the level of cultural awareness among the population, achieving social cohesion, and reviving customs and traditions.

• Economic Strategies: In terms of strengthening the local economy, raising the economic level of the region by introducing new activities, primarily cultural and tourist activities, and providing appropriate financing to manage the process of revitalizing the cultural heritage in the city with the participation of different parties that achieve this, such as the private sector or international organizations and institutions that are concerned with heritage such as UNESCO and the World Bank, with the granting of advances to the community to carry out restoration, maintenance and repair of their heritage properties, such as homes, markets and heritage neighborhood within the ancient fabric of the city.

It is clear from all the above that previous studies have indicated many aspects of sustainability that must be adopted in the reconstruction and related to the dimensions of environmental, social and economic sustainability, with their mention to other important aspects related to organizational affairs, the advancement of institutional reality, as well as attention to cultural aspects.

5. Dimensions of Sustainability in Reconstruction: Theoretical Framework
The research has classified the multiple aspects indicated by previous studies into two groups of the general and specific essential dimensions of sustainability, in a way that be a comprehensive framework can be adopted in reconstruction, which include each of the following:

5.1. General Essential Dimensions of Sustainability in Reconstruction
These are the dimensions that represent a framework for action that must be adopted to organize and manage the reconstruction in a manner that ensures the achievement of sustainability in its detailed dimensions, to include the following:

• The organizational dimension, which defines each of the time ranges of sustainable planning, levels of achieving sustainability, stages of application, as well as sustainable development responsibility.

• The institutional dimension, which includes both the necessity of stabilizing the military and government situation, strengthening the institutional power of the local authority, as well as the importance of developing legislation and laws regulating for sustainable reconstruction.

• The cultural dimension, which is considered an essential component of the cultural identity to include, accordingly, both the revival of the city's memory, the restoration of functional balance, as well as the importance of raising the level of cultural awareness of the population.

Table 1. shows the main and sub-items and the possible values of these dimensions.

5.2. Specific Essential Dimensions of Sustainability in Reconstruction
These are the dimensions that establish a better sustainable environment, according to the following:

• The economic dimension: which is an essential component in terms of the importance of improving the economic environment, reviving economic activity, providing a fundamental basis for starting reconstruction.

• The social dimension: which determines the importance of improving the level of social life, adopting community participation, and cooperation and coordination within the community, in a manner that guarantees the effectiveness of reconstruction.
• The environmental dimension: It is the dimension that seeks to achieve a balance between the natural environment and human lifestyles.

Table 2. Shows the Main and Sub-items and the Possible Values of these Dimensions. The correlation between all dimensions of sustainability for reconstruction can be represented in Figure 1.

Table 1. Dimensions of General Essential Sustainability in the Reconstruction (researchers)

| The organizational dimension | Time ranges for sustainable planning | Short-term emergency intervention |
|------------------------------|--------------------------------------|----------------------------------|
| Sustainability achievement levels | Urban spaces development | Sustainable interconnected lands |

| The institutional dimension | Achieving stability in the military and government situation | Organizing administrative structures |
|-----------------------------|----------------------------------------------------------|-------------------------------------|

| Stages of sustainability application | Commitment to development plans by leaders |
|--------------------------------------|-----------------------------------------------|
| Sustainable development responsibility | Commitment to development plans by community |

| The cultural dimension | Reviving the city's memory |
|------------------------|----------------------------|

| Preserving buildings of historical, cultural and other importance | Establishing legislation and laws |
|-------------------------------------------------------------------|----------------------------------|
| Building rehabilitation | Implementing control and anti-corruption measures |

| Achieving stability in the military and government situation | Organizing administrative structures |
|-----------------------------------------------------------------|-------------------------------------|

| Stages of sustainability application | Commitment to development plans by leaders |
|--------------------------------------|-----------------------------------------------|
| Sustainable development responsibility | Commitment to development plans by community |

| The cultural dimension | Reviving the city's memory |
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| Achieving stability in the military and government situation | Organizing administrative structures |
|-----------------------------------------------------------------|-------------------------------------|

| Stages of sustainability application | Commitment to development plans by leaders |
|--------------------------------------|-----------------------------------------------|
| Sustainable development responsibility | Commitment to development plans by community |

| The cultural dimension | Reviving the city's memory |
|------------------------|----------------------------|

| Preserving buildings of historical, cultural and other importance | Establishing legislation and laws |
|-------------------------------------------------------------------|----------------------------------|
| Building rehabilitation | Implementing control and anti-corruption measures |
Table 2. Dimensions of Specific Essential Sustainability in the Reconstruction (researchers)

| Economic dimension | Enhancing the economic environment | Providing adequate financing | The private sector | International organizations and institutions | Public sector - government | Disaster insurance | Offer discounts to encourage sustainable construction | Other |
|--------------------|-----------------------------------|-----------------------------|-------------------|----------------------------------------------|--------------------------|-----------------|------------------------------------------------|-------|
| Improving the level of social life | Revive economic activity | Simplify work policies and legislation | Boosting the local economy | Other | Social cohesion | Achieve better livelihoods | Other | Social Justice |
| Social dimension | Community participation | Finding alternative solutions | Taking decisions | people | | |
| Community cooperation and coordination | Community development | Government agencies | |
| Environmental dimension | Site site | Natural | Not natural | |
| Green trend | Adapt to the capabilities of the site | Preserving biological diversity | Disaster preparedness | Reducing environmental pollution | Reducing climate change | Achieve health and comfort |
| Using and managing materials and resources | Efficient use and management of water | Efficient use and management of water | Use of environmentally friendly materials | Recycling | Collect rainwater |
| Flexibility and adaptation considerations to ensure continuous updating | |

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6. The Practical Study

The practical study of this research attempts to clarify the extent to which the dimensions of sustainability have been achieved in global reconstruction projects. In the way that available vision can be developed in the local experience, accordingly, these dimensions will be investigated in the German experience of reconstruction as it is one of the distinctive experiences in overcoming the effects of war within a record time period and various applied practices through the election of (3) projects. Then well be read reality of the post-war Mosul city situation and select (4) designed projects and awarded with the ranks presented by Tamayouz Excellence Award\textsuperscript{2} to represent the future ambition (there are no designed and proposed projects for implementation until now). Also, to find out the dimensions of sustainability in its ideas, and investing what is reached to advance the reality of Iraq reconstruction in general.

6.1. German experience in reconstruction

After the end of the Second World War, Germany suffered from difficult socio-economic conditions and massive destruction of the infrastructure and superstructure as shown in Figure 2. In addition to its division into East Germany and Western Germany with its three sectors and International trusteeship, but the Germans were able to succeed in the reconstruction operations through surprising period of time. As East Germany turned into one of the most prosperous countries within forty years, while its western neighbor regained its economic recovery, and began economic growth and prosperity that did not stop until thirty years from its inception. Both countries relied on external funding mainly to rebuild the wreckage and followed a methodology based on the participation of civilians in the reconstruction process intensively and without compensation. German historians refer to the spirit of sacrifice and teamwork that characterized the Germans at this stage, where social tensions between the Germans themselves disappeared and everyone was involved in building the state. West Germany forced its citizens to volunteer for two hours every day, free of charge, in the removal of rubble and reconstruction. West Germany also obtained the necessary funding for the reconstruction of its cities Demolished by the Marshall Project, which is an American in which urban planning relied on Western theories. While East Germany obtained its funding from the Soviet Union, and urban planning for East Germany was

\footnotesize{The Tamayouz Award for Iraqi Graduation Projects aims to reward young talents in Iraq by recognizing\textsuperscript{2} excellence in architectural design and education by highlighting the best graduation projects in the country and supporting academies and institutions working to advance architectural education in Iraq and promote a culture Of excellence.\textsuperscript{[22]}
based on a purely socialist basis. So the German experience in reconstruction included many architectural projects, among them are the following: [23]

![Figure 2. massive destruction in Germany(https://www.google.com/imgres?imgurl=https)](https://www.google.com/imgres?imgurl=https)

6.1.1. Kaiser Wilhelm Memorial Church- Berlin 1957-1963
The church built during the period 1891-1895 was subjected to vast destruction during the Second World War (1943), to be rebuilt according to the designs of (Egon Elerman) during the period (1957-1963) by keeping the reality of the old and destroyed church tower and the establishment of a building and a modern tower adjacent to it as shown in Figure 3. achieving the symbol of the rise of the city of Berlin from the rubble. [24]

In this regard, the importance of the cultural dimension is high lighted in preserving the parts of the building from demolition as a witness to the event, and to contribute to the revival of the city's memory, as well as contribute to raising the level of cultural awareness of the population.

![Figure 3. Church of Memories(https://www.google.com/search?q=Kaiser)](https://www.google.com/search?q=Kaiser)

6.1.2. Reichstag, New German Parliament 1999
The Reichstag, built in 1894, suffered a major fire in 1933 that destroyed large parts of it, as well as the damage caused by the bombing of the Allies during World War II, to be rebuilt and used in the 1970s as a museum of German history [25]. However, in the 1990s, it was reconstructed by the architect (Norman Foster) and transferred to the headquarters of the German Parliament in line with the trend to build the past of the city of Berlin in a new contemporary style through the adoption of advanced technology. Foster added a modern dome of glass and steel to the building of the nineteenth century in an attempt to reflect the idea of political transparency while preserving the traces of the past, so history and hope in the future were combined. [26]

The building is now famous for its glass and steel dome, which is 23 meters high and 40 meters wide, and it consists of (800) tons of steel and (3000) square meters of glass. The main hall of the Reichstag building is lightened by natural light entering through the glass dome and reflected from the reflecting surfaces at the center of the dome, while a giant canopy moves automatically around the dome's
perimeter to protect against unwanted direct sunlight. The dome itself provides natural ventilation to the Parliament Hall. Visitors can go to the dome to get a panoramic view of Berlin, allowing people to see the city from a distance, making it look more homogenous as a whole and not a bunch of parts. On the surface, visitors literally stand above the plenary hall and, theoretically, they can look at it, which indicates the openness of true democracy as shown in Figure 4. [26]

![Figure 4. German Parliament Building, Berlin(http://www.syrs-res.com/pictures/167098184.jpg)](image)

In terms of sustainable environmental systems, the building is designed to improve passive use while reducing active systems. A central BMS system controls both artificial lighting and ventilation and the heat exchanger recovers waste heat from the exhaust air. The dome plays a fundamental role in the strategies used to ventilate the building and illuminate it naturally and lies in the heart of the dome sculptors of light that reflects the light of the horizon into the hall, and at the same time, the automatic sun-visor tracks the path of the sun to prevent the thermal gain and glow caused by sunlight. When the night is clouded, The same process takes place, but in reverse, so the dome becomes a beacon, illuminating its lights on the horizon, in a sign of German democracy and its strength and vitality. [25]

In this regard, the organizational dimension is highlighted in terms of developing urban structures within medium and long-term ranges, and the cultural dimension associated with reviving the city's memory through preserving, rehabilitating and raising the level of awareness among the population, as well as achieving the environmental dimension through green approach and adapting to the natural capabilities of the site and the efficiency of use the materials gained from construction and demolition waste management and environment-friendly materials.

6.1.3. Dresden Central Station, Berlin (2006)
The main train station in Dresden is one of the largest and most impressive train stations established in the late nineteenth century in Europe. The railways played a significant role in the industrial and economic growth of the city, linking Dresden to Berlin and Prague. Nevertheless, when a large part of the old city was destroyed in 1945 due to raids bombing of Allied forces, the station building was also severely damaged. After the war ended, the building was imperiled to inappropriate reconstruction efforts, poor maintenance, and inappropriate repair work. Finally, at the end of the 1990s, the building reached a state that required a comprehensive program of corrective maintenance work. [27]

The starting point was the removal of the various accessories and modifications made to the building over the past 60 years in order to restore the perfection and clarity of the original design. This process included pulling the central rail endpoint back to create an open space in the heart of the building, which could be used as a marketplace or for cultural events. During this process, the public's transportation method inside and through the station was diverted. On the outside, the most striking new element is the glass dome, which is located above the main transit crossing. The approach here, throughout the building, is identical to that of the Reichstag. The remaining building structure and original surfaces were stripped wherever possible, but there was no attempt to recreate old figures or recover lost decorations as the new and ancient approaches were clearly formulated, as shown in Figure 5. [28]
Figure 5. Dresden Central Station, Berlin (www.fosterandpartners.com/ar/projects/dresden)

The largest of the new elements is the fabric that covers the roofs held above the train docks with panels covered in a tight film that permits daylight penetration, which significantly reduces the need for complementary lighting. After dark, artificial lighting is reflected on the underside of the canopy to simulate the daylight that floods the central square. [28]

According to that, the importance of the organizational dimension is highlighted in terms of developing urban structures at medium and long-term temporal ranges is highlighted. In addition to the cultural dimension in terms of city memory neighborhoods and functional rebalancing, the environmental dimension in terms of green trend and energy efficiency. As well as the economic dimension by reviving the economic activity through providing job opportunities to addition to strengthening the local economy.

6.2. Reconstruction in the post-war city of Mosul

The city of Mosul is one of the major Iraqi cities that have been subjected to massive, unprecedented destruction since the Second World War due to its occupation by the terrorist organization ISIS in 2014 and the military liberation operations that ended in 2017. According to preliminary assessments in the report UN-Habitat 2016 it was exposed to the limits of (20000) buildings for damage or destruction, and a high percentage of these buildings were residential buildings as well as many historical and iconic sites and buildings, most of which are located on the west bank of the Tigris River. As shown in the figures 6,7,8,9, according to which a number of designed and proposed projects were selected as following: [29]

Figures 6. The extent of destruction in the center of Mosul city (https://www.bbc.com/arabic/ 4088 6609), (https://www.dailymail.co.uk/news/article-5208421/Mosul-morgue-workers-row-view-ISIS-brutality.html)

Figures 7. Al-Nuri Mosque before and after the destruction. (https://www.thenational.ae/world/ mena/ uae-funds-rebuilding-of-mosul-s-al-nuri-mosque-and-historic-minaret-1.724106)
Figures 8. The destruction of the University of Mosul, the Central Library, and Insurance building before and after the destruction (https://www.dorar-aliraq.net/threads/761742-) https://twitter.com/MosulEye/status/891616162748018688/photo/1)

Figures 9. Nabi Yunus Mosque before and after the destruction (https://islamitucinta.blogspot.com/2014/08/isis-meluluh-lantakan-mesjid-mesjid-dan.html)

6.2.1. Development of the great mosque of Al-Nuri campus, Mosul Old City (2018)
It is the second-winning project in the Tamayouz Award for Local Graduation Projects, designed by Dima Al-Ramahi, Department of Architecture, University of Petra-Jorden. It was an urban development of the Great Mosque of Al-Nuri and its urban surroundings after it was destroyed and demolished, especially its famous minaret (Al-Hadbaa) on June 21, 2017, which its destruction made a great shock to the whole world because of its historical, religious and symbolic value.

The designer creates a plaza that reflects hopes and dreams to advance reality again, where continuity, centralization, and visual reshaping of the space image bit by bit down to the ruins of the minaret and start dreaming and rebuilding it. [30]

The new memorial to Al-Hadbaa minaret was designed using light steel bars with its original diagonal formation to indicate its previous physical existence, as can be seen in Figure 10. [30]

Figure 10. The development of the Great Mosque of Al-Nuri, Mosul (https://worldarchiecture.org/architecture)

The Referees Committee praised the efficiency, bold and sensitive addition in the use of local materials, which gave the project a definite meaning and focus, and indicated the importance of inspiring future projects in the city of Mosul.
According to that, the organizational dimension has been highlighted in terms of seeking to develop both urban spaces and urban areas and advance the building’s reality for the city within medium and long-term ranges, and the cultural dimension in terms of reviving the city’s memory by preserving the building of historical value, rehabilitation, and functional rebalancing in a way that contributes to raising the cultural level of population. As well as the environmental dimension of planning land use and
material use efficiency in terms of approving local materials and managing demolition and construction waste.

6.2.2. Knowledge Centre in Mosul University (2018)

It is the project that won the third place in the Tamayouz Excellence Award for Local Graduation Projects designed by Hawraa Rahim, Department of Architecture Engineering at the University of Technology. It was to establish a knowledge center in the central library building located in the center of Mosul University that was destroyed by military actions in 2017, as well as the burning and destruction of many books and references that are inconsistent with the ideas of the ISIS. [31]

This project aims to restore the bridges of the relationship between the University and the Mosul community after it was cut off during the occupation period so that the new function contributes to improving the social situation.

The project is based on taking advantage of the undamaged parts of the building, removing that destroyed and replacing them with a steel structure that has been clad with aluminum sheets within an organic formation that reflects the situation of explosions caused by missile strikes. Environmental aspects have been taken into consideration based on a comprehensive analytical study that contributes to reducing energy consumption, as shown in Figure 11.

![Image of Knowledge Centre in Mosul University](https://www.tamayouz-award.com)

**Figure 11.** Knowledge Centre in Mosul University (https://www.tamayouz-award.com)

The Referees Committee praised the project in that it captures a crucial moment in history and the specificity of the center's program, which considers education an essential path towards the future.

In this regard, the organizational dimension is highlighted in terms of redeveloping urban structures within medium and long-term ranges. The cultural dimension of reviving the city’s memory by rehabilitating the building, along with raising the level of cultural awareness among the population, and the social dimension in terms of achieving better livelihoods and social cohesion by improving the level of social life. As well as the environmental dimension by taking advantage of the capabilities of the site and the green trend in terms of energy and material efficiency, management of demolition and construction waste, as well as considerations of flexibility and adaptation.

6.2.3. The Re-settlement project, Mosul (2017)

It is the project that won the first place in the Tamayouz Excellence Award - an award category of Rifaaat Al-Jadriji³, which was designed by (Anna Otlík, Wroclaw, Poland). It is based on helping the displaced people to settle on their own in a very simplified way that allows the returnees to design the interior of the home area themselves according to the diverse needs of families (size, beliefs, and culture). The design uses the residue from buildings and construction materials for recycling. The state’s primary role in the reconstruction process will be to provide public services and building materials for new urban centers. Reconstruction will begin by the formation of vital centers with the intensification of green spaces inside the city, and then the displaced arrive and start building their homes and decide what suits them best, dividing the walls inside the housing units according to the occupied area and the functions inside the house. [33], as in Figure 12.

³ An open and objective international competition focused on proposing designs and responding to local challenges in Iraq. The Rifa’a Al Jadriji Award is part of the Tamayouz competition. [32]
The Referees Committee praised the project for having taken into account all the stages of the first emergency housing until the complete housing solution. As well as the project’s attempt to rethink the traditional courtyard to create an updated version of the Mosul house, which is in harmony with the city’s environment to be low-rise buildings that integrate with the urban fabric, besides the possibility of future expansion.

In this regard, the organizational dimension emerges in terms of developing urban areas and developing urban structures within the short, medium and long term ranges. The cultural dimension in terms of reviving the city's memory and reviving habits and traditions, and the social dimension in terms of improving social life and achieving better livelihoods and community participation. As well as the environmental dimension by the efficient use of resources and recycling, waste and demolition waste management, and consider flexibility and adaptation considerations to ensure continuous updating.

6.2.4. New Residential Units Project, Mosul (2017)

It is the project that won second place in the Tamayouz Excellence Award- an award category of Rifaat Al-Jadraji, which was designed by the Student team of Wroclaw University of Science and Technology, Poland). This project is based on the partnership between the state and members of the community to establish a housing complex that accommodates the capabilities and aspirations of the resident. The idea of the project focuses based on the state’s responsibility to create rapid building structures with large quantities while providing infrastructure, as residents complete housing units with designs and divisions that meet their multiple needs and desires through smooth formations that can be easily modified. [34] as shown in Figure.13.

According to that, the organizational dimension is highlighted in terms of developing urban structures within medium and long-term ranges. The economic dimension in terms of providing adequate financing for cooperation between the public and private sectors, and the social dimension in terms of community participation, cooperation and coordination to achieve better livelihoods. As well as the environmental dimension in terms of considering flexibility and adaptation considerations to ensure continuous updating.

7. Conclusions

- The importance of sustainable development is highlighted in promoting the reconstruction of post-war, desacter cities and societies. Which contributes to achieve a better life through the adoption of multiple dimensions of sustainability within an integrated, holistic approach that
starts with the necessary organizational, institutional and cultural dimensions that frame the economic, social and environmental reconstruction.

- The practical study showed a variation in the focus on adopting the dimensions of sustainability in the reconstruction in a way that suits the specificity of each case with the emergence of the cultural dimension in both global and local experiences, to preserve identity and achieve privacy.
- The practical study showed great interest in both the social and environmental dimensions to achieve sustainability in the reconstruction of the latest projects in line with the global trends to preserve and enhance the environment and advance the reality of society.
- Although the importance of the institutional dimension in sustainable reconstruction, it did not appear clearly in the projects selected within the practical study due to the clear focus of them on the Built Environment side.
- The practical study related to the reality of the post-war city of Mosul showed the extent of the massive destruction of the infrastructure and superstructure, which may provide an opportunity that can be invested in reconstruction according to the foundations of sustainable development in terms of adopting the general essential dimensions of sustainability. First, through the organizational dimension of all plans, with their various ranges and levels, preserving military and governmental stability, enhancing the institutional capacity of local authority, and paying attention to enhancing the memory of the city. Also increasing cultural awareness among residents and restoring functional balance, leading to the adoption of the specific essential dimensions of sustainability. Second, in terms of economic, environmental and social aspects.
- In the proposals designed for local reconstruction, many dimensions and energetic aspects emerged, which can be used to prepare designs that can be adopted in Mosul reconstruction, and other Iraqi cities that have been destroyed by wars.

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