Reconstruction of a Historic Riverfront: Heritage Preservation and Urban Sustainability After Conflicts

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ABSTRACT

The city of Mosul is over 4,000 years old and has a riverfront in its oldest quarter that was heavily damaged during fighting in the wake of the conflict in 2017. This devastation led to the squandering of architectural features and historical memory. The purpose of this study is to create a framework for rejuvenation of the riverfront in consideration of its heritage aspects, as well as integrating it with contemporary urban development. Such technicality is built on maps, location data, mapping systems, detailed satellite photographs, and even 3D models to help us re-create the area's original city plan and the property lines. Field surveys and community engagement assist the rebuilding process to better meet local needs. The findings suggest that even as technology would make rebuilding more precise, it is necessary to engage the community. Long-term rebuilding is essential. The research provides another way to reach a goal – using prior information and analysis of detailed maps to make a plan for city improvements. The study contributes to the recovery from conflict, in particular, safeguarding cultural heritage and modern city planning, showing how utilizing digital technology for reconstruction can benefit sustainability, renewing and enhancing old cities with history. Fresh designs on property lines in post-conflict spaces, especially as the war discarded whatever was left. This work describes a simple procedure to mimic or replicate, to get back on its rail after the fight. One of the probabilities of making cities better is using maps and location programs, planning, and training to help reach a better climate.

1. INTRODUCTION

War destroys urban life, leaving cities to struggle to re-create and conserve what remains. Historic riverside city centers are much more than structures; they embody our social, cultural, and ecological values. The task of rebuilding these areas is tricky because we owe it to them to honour our past, to develop a community identity that is cohesive, and to rebuild new buildings to take on disasters of the future.

It does not mean simply rebuilding those places but also requires people coming together to share memories and enlist the community as an important part of the process. Whereas more people are realizing the importance of multi-disciplinary collaboration, most previous studies analyze them separately. Some studies have indicated the means of integrating GIS with local knowledge and community active participation. This technique intends to contribute both to the physical character and culture of a place. This gulf is particularly obvious in the riverfronts of post-conflict cities. Here, planning of the ways that space is organized and how people remember it, and the environment, needs to be thoughtfully meshed [1].

Lately, researchers have been exploring how to rebuild war-ravaged cities, particularly in Iraq and the city of Mosul. In her PhD work, Jasim and Al-Bazzaz [2] demonstrate how common mental imagery helps in selecting the steps to rebuild the Old City of Mosul. Her research concludes that the invisible things are important for how cities are rebuilt after the war: memories of a place and type. This approach gives us insight into memory-based reconstruction but does not handle location analysis as implemented by advanced GIS tools, nor does South2North address riverfront restoration, which is not widely researched but is both ecologically significant and of significant cultural value for many Middle Eastern cities. This analysis seeks to connect those dots by proposing a blueprint for how war-torn historic cities can rebuild riverfronts, especially at the intersection of planning and geography is the task which is translated by this project across maps and, of course, by tools like Geographic Information Systems (GIS) [2]. Remnants of post-conflict reconstruction are not just things: they represent parts of the past. They are emotional reminders for people. The ordinary existence of the lives of the people as they know it has changed in our daily life is now seen, and thus, it becomes part of this new tale (or life) in a different way from life before reconstruction. Building on one case study as a reference, the article aims to show how, in urban settings, spaces are transformed at the interface of

conflict and regeneration. "We recognize the need to develop a model of revitalization for the riverfront that emphasizes local culture, respects the environment and is responsive to the voices of the communities that live on the banks of those rivers, and we see this piece of advice as a practical guideline for local planners and agencies." This, we hope, will connect on the ground while living in the rhythms of global events. Reconstruction in the aftermath of a conflict should consider not only the impact it can have but also the memories, traditions and cultural concerns that extend past buildings. Through this analysis of our case, we hope to disclose the ways post-conflict urban landscapes become re-configured, with local planners and officials receiving useful inferences. We do hope to build, finally, a model for revitalizing riverfronts that pays homage to elements of the community's culture, cares for the environment and promotes true community engagement. Eventually, we hope that someday we can integrate our strategy into wider global reconstruction efforts, while retaining the unique characteristics of the people from the neighborhood.

1.1 Aims of the study

Cultural Heritage:
We are determined to repay the project with the riverside sidewalks using old architecture by restoring the original architectural style of the riverfront and the cultural symbols, celebrating Mosul city-side by bringing in cultural symbols to remind visitors of the city and its rich history of Mosul.

Modern Technology Application:
Applying modern technology to the present to achieve a dependable image of streets, houses and topography is the objective, which can be used to facilitate environmental management construction.

(Inclusive) Community Involvement:
The ability of participants to develop their own voice and choose the areas that impact their lives and passions.
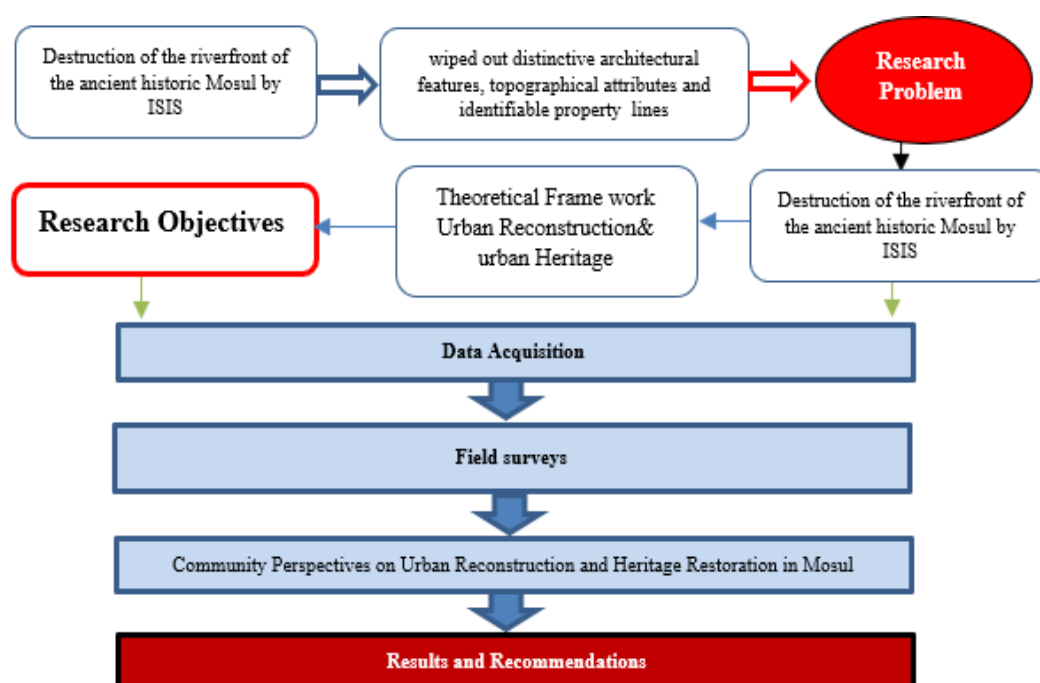

Figure 1. A research methodology flowchart

The Rehabilitation Model:
We believe that a process of rehabilitation should take place to re-create the place, to restore it to a rich culture, not a backward-looking thing. This initiative aims to rebuild a diverse society that is modern and recognizes its unique position within the nation's history. It demonstrates that Mosul has the potential to reclaim its connection to the river and rejuvenate the city as an essential resource in its own right.

Also, it incorporates digital technology and retains historical and cultural context by reanimating an abandoned urban landscape on a worldwide level. This is a novel that takes on a post-conflict reconstruction in comparison to previous research, with three crucial components: heritage conservation, digital spatial analysis, and community engagement. Unlike the approaches of most studies on Mosul that have tended to focus on intangible assets, cultural symbols + collective memory, this paper contributes with a spatial analysis approach. In particular, it defines the limits of lost properties and urban organizations through multiple testing

methods. Many studies, however, do not view community involvement in technical aspects as crucial. This approach focuses on participative planning to guarantee that the outcomes are correct and adjusted to the lives of the inhabitants. Such a system can be applied to restore riverbanks in post-conflict riverbank restoration. Figure 1 represents the research methodology flowchart.

2. THEORETICAL FRAMEWORK

2.1 Urban reconstruction: Definition and basics

2.1.1 Definition of urban reconstruction
City reconstruction involves rebuilding cities following disaster or conflict, where multiple dimensions of urban life—economic, cultural, and social—are addressed. The task is not only to rebuild the physical environment, but to enhance and re-enrich its urban use while maintaining its cultural heritage.

For instance, the "CURE Framework," created by UNESCO, stresses incorporating dynamic cultural elements of reconstruction to ensure sustainability and the health of the local community. Furthermore, Urban Reconstruction: A Path to Long-Term Sustainability [3]. Following the Sichuan, China earthquake of 2008, we have seen the good potential that flexible urban planning can make a city's long-term sustainability. When rebuilding urban areas after disasters or conflicts, our approach must follow these principles:

- **Preserving Community Spirit:** We need to respect this cultural identity of the city as well as its inhabitants. This is getting people back in touch with their roots, essence and heritage.
- **Community Ownership of Reconstruction:** Ideally, reconstruction initiatives follow the financial capacities of the impacted community. A study of disaster recovery in Turkey notes how various actors can work together to find solutions that integrate social and economic considerations [4].
- **Fostering Sustainable Development + Resilience:** Preparing for unexpected occurrences helps build resilience with strength in future disasters. Further, lessons learned from the Chilean experience suggest that fundamental resilience in rebuilding is achieved with considered urban design and sustainability elements to prevent future crises [5].
- **Innovative Technologies:** We access modern technology such as Geographic Information Systems (GIS) and 3D modeling that can contribute significantly to improving the precision of urban renewal. Technology such as the Terrestrial Digitization Technology, a project funded by the government, allows us to perform our jobs uninterrupted by conditions such as heat, rain, or bugs [6].
- **Establishing a Comprehensive Aim for Holistic Goals:** Our objectives in construction are to find a balance between economic goals, cultural goals, and environmental objectives. It was problematic, though, for post-conflict housing projects in Bam, looking to create a balance of modern houses for the post-conflict period as well as the city's historic setting and historic values. If planning is inclusive, those complexities can be resolved and conflicts averted [7]. These principles say a lot about the complexity of new-build in a city. But rebuilding physical structures is not all the equation — it should also be about protecting cultural heritage and enabling the city to succeed far down the road.

2.2 City reconstruction: Designing for sustainable recovery and inclusive growth

Reconstruction involves more than the physical structure of roads and structures, and building and housing, but also involves the development of community and the relationships between people. True recovery is the creation of a safe space for all people in which they engage and blossom. Reconstruction of a city involves not only mending fences, tearing down barriers, and making good the losses to community spirit, culture, and livelihoods. It is an effort to create a strong city that lasts for a long time, solidifying its origins and remaining itself.

The reconstruction project on catastrophe cities has several possible steps proposed by Fayazi and Lizarralde [8]. Hitting the local economy prevents it from making major changes; it

maintains indigenous minority cultural traditions over generations, supporting sustainable growth at the community level. This stage lasts longer than any single period of time and is likely to remain so for quite some time in the future. Rowley, on the use of PMMM in the succession from a phenol oxidase Research Institute to Garran Hall Plathottam, Fergus P., Comparative Pathobiology Research Center. To focus on its succession process, a medical center uses Bennis's integrative approach as it contains both transformational and transactional leadership theory. EAT Rowley High School product Best Yes makes a synonym for "dirt" look less hard, rather a conjoining brief term (DA) Because of various numerical methods for regional models dealing with three levels of elevation, Improvements in Winter Rainfall Prediction Over East China [6] exists as an all-encompassing field unto itself and this is why disaster reconstruction must not neglect placing more emphasis on ways to make vulnerable areas stronger. This means pursuing plans with a two-fold purpose: one that can help both society and nature thrive while making us less dependent on the goodness of easy days in future scenarios. A study of rebuilding after the 2008 earthquake in Sichuan Province, China, shows that environmental planning and disaster-prevention works make the houses safer for residents to live in, as well as better for the environment [9]. Preservation of cultural and architectural heritage is also a goal in urban reconstruction. UNESCO has pursued its CURE Framework, which foregrounds culture as a driver for reconstruction initiatives and requires safeguarding the historic sites and traditional townscape patterns as part of the reconstruction procedure. This does not only mean the physical elements, but also the cultural bricks and mortar of city life. Research in post-conflict cities, such as Beirut, indicates that the integration of cultural elements into an urban recovery process incurs social reconstruction along with the redevelopment of the economic sector, plus tourism and heritage sectors [8]. The improvement of the quality of life for locals is another purpose of urban reconstructions. Post-disaster shelter construction in Bam, Iran, also demonstrates that responding to local requirements and preserving culture substantially increases post-disaster life quality of the affected community [10]. Moreover, the sample of participatory planning in a post-disaster reconstruction process applied to Turkey implies that the reconstruction works are made suitable to the socio-economic needs of communities and contribute to higher ownership and satisfaction among people. Therefore, urban reconstruction should concentrate on developing a plan to reconstruct the city, not only in terms of fixing the physical infrastructure, but rather with respect to sustainability and retention of culture and quality of life for the affected parts of the city. The reconstruction of urban areas takes advantage of more sophisticated technology, taking into consideration participatory processes and cultural sensitivity. All are essential to creating thriving communities [11].

2.3 Urban planning and reconstruction theories

Urban planning and reconstruction are underpinned by narratives via various theoretical frameworks to explain the complex sustainability that comes from Human Centered Design, urban open space intervention, among other numerous urban theories. Urban planning and redevelopment are an integral part of sustainability. They highlight a human-scale approach at the same time as working toward long-term sustainability, to achieve environmentally and culturally sensitive urban balance [12-15]. The three dimensions of

sustainability: economic, social, and environmental, are mainstreamed to enhance multi-sectoral collaboration, critical to the resilience of a post-conflict city [16-18].

2.4 Theoretical foundations of urban heritages

2.4.1 Closing thoughts on cultural heritage preservation and modern-day progress as a whole

Agisheva and Pokka [19] present this concept of what they refer to as 'Historic Urban Landscape' (HUL) as a pioneering idea. Although it diverges from traditional urban designs, it achieves an achievement in urban environments of both historic preservation and sustainable development. When we integrate the current uses of these historical sites, we make sure they are vibrant and are fully preserved [20, 21]. Moreover, Puren and Jordaan [22] introduce very well-integrated models for preservation as a means to realize a link between spatial planning, cultural conservation and cultural preservation. To create dynamic mosaics of history among the cities and at the same time as modern living environments, national urban policies or urban planning systems must incorporate heritage values [19, 22]. To restore the cultural and spatial identity of historic cities, our dream is therefore alive and well, and we look to preserve urban life as has always been traditionally understood from both a cultural and spatial point of view. As Kenneth Frampton says, restoration aims to create a sense of place and community that people will take to heart as they share their experiences with those who have long lived there. This vision is in accordance with Council Policy No: CERC-CWP-008-1, which gives urban living a connection to historical context. Wang and Fan [23] emphasize that the rapid pace of urbanization means that historic neighborhoods will soon lose their unique character and identity. Integrating cultural heritage into sustainable urban projects—as was demonstrated by Hosagrahar et al. [24]—nations could gain cultural benefits. This requires new ways for us to plan with our heritage's future—in other words, creative approaches for future opportunities for our cultural heritage. These initiatives should be guided by sustainable development goals that seek to integrate conservation efforts into urban development practices. Today, this requires cities that are more resilient and equitable—where they remain true to the past, yet modernize in new ways, and recreate past local locations that are informed by history. Such approaches would have to be sustainable, but this would involve local communities as stakeholders and finding ways that would preserve those traditions of heritage [23, 25, 26].

2.5 The relevance of modern methods for "urban reconstruction" - GIS and digital models

Urban regeneration is improved with the help of Geographic Information Systems (GIS) and digital modeling techniques. Thanks to these high-level tools, planning data can be entered with much more spatial clarity and precision. They offer a more tangible way of seeing things and, crucially, help us make better decisions for post-disaster or rapid urbanization areas. Using 3D GIS in web-based environments gives urban planners better visualization and interactive options and more enhanced decision processes [24, 27].

Digital models, including 3D GIS models, are developed to deal with the difficulty of effectively simulating urban surroundings. For instance, Hamzah and Ebrhaeem [28] present a prototype of a 3D urban GIS that can fuse various sources of data to model urban volumes on a hierarchical basis for environmental purposes such as air pollution and noise control.

These capabilities and the integration of geometric structure from geospatial data, Li-DAR, and procedural modeling with advanced work such as urban digital twins are still beginning to be encapsulated for the large-scale visualization of urban geometries [29].

Scianna [30] investigated the potential of open-source frameworks in building and maintaining 3D GIS models. Data access and interoperability are preserved, and urban planners can create and share their 3D models using SW tools like Blender in conjunction with Post GIS, free of charge [31].

Finally, a further crucial element for reconstructing the city with GIS and digital modeling is that these tools will make it possible to solve complex problems in an accurate and sustainable way complex problems. In these respects, they act as a bridge for past recovery techniques and present requirements, advocating sustainable urban rebuilding [32].

2.6 Cultural heritage as a factor in post-conflict development

Local communities need to find ways to identify themselves after conflicts and rebuild their economy. These practices become very significant parts of culture as an economic resource. Selecting to preserve or salvage one's own cultural heritage, as it used to be done in previous times, is akin to letting a steadfast friend die. This, then, calls for appropriate ethical standards on intervention from outside one's territory in order that Western purchasers do not force their own values onto local people [30]. Restoration of their heritage by local communities becoming involved. A workaround for permanent recovery is to join local groups and draw on all sectors of the population to handle this work. The role of local communities in the restoration of their heritage is key to a sustainable recovery. Larkin and Rudolf [33] have examined initiatives in Mosul and isolated the significance of heritage sites identified by local populations as symbols of their past, like markets and traditional neighborhoods, to the unity of the people and the rebuilding of the economy. This study highlights the need for local consultations and the negotiation process of heritage restoration between the different stakeholders. Cultural heritage must be integrated into broader frameworks of urban recovery for long-term resilience. The CURE (Culture in City Reconstruction and Recovery) Framework represents UNESCO's integrated approach to culture as an asset and a means to recovery in cities. Approaching heritage preservation as integral to urban development helps rebuild cultural significance while serving contemporary needs [33-35].

Bishop [36] examines IHAF in the post-war revitalization of Dubrovnik, Croatia. The traditional role of cultural heritage is to preserve history, but, as shown by a research summary on preservation efforts in post-war Dubrovnik using IHAF (Institute for Heritage Aid Foundation) by Bishop [36], it can also help advance physical spaces, the entire economy, and community progress, too. The framework thinks of heritage as an intervention, an advocate in recovery, not something merely to be restored [37]. Barakat [38] discusses and draws some lessons from processes of post-conflict recovery in the Middle East North Africa (MENA). He argues that cultural heritage must be considered in post-conflict reconstruction policies. Highlights include the problem of local capacity-

building, development as a work-gaming rather than time-intensive system, and incorporating local beliefs and practices into reconstruction efforts. In sum, culture is an essential element of post-conflict recovery—it clarifies, moves people out for rebirth, and provides the means for reconstruction. Yet the ingredients are simply missing. It requires commitment on the part of both the community and global society to have good quality work that meets these ideals, with public buy-in at home as well as ethical standards globally compatible [39].

3. METHODOLOGY

3.1 Description of the study area

This study centers on the riverfront area of Mosul's ancient city, located in a medieval urban pattern on the west side of the Tigris River. For 6,000 years, it has been an important place of culture and economy. This city had markets, places of worship, and people's homes all within its walls. Extending from Iron Bridge (west) to Fifth Bridge (east), the study area is about 1,250 meters long and 280 meters wide. In the 2017 conflict, this area was heavily damaged.

Many ancient buildings and critical land records that were unique to the region vanished. This made it difficult to rebuild the original design while keeping it historic and meeting today's city needs. In achieving this aim, GIS systems, high-resolution satellite images, and 3D modeling technology were utilized in the digital reconstruction.

This methodology also embraces seeking community agreement to develop things that are in line with local needs. Figure 2A and 2B: A high-resolution satellite photo over the study area that shows the destruction and basis for reconstruction efforts, combined with an aerial photo of that area (2010). Figure 3 gives its geographic distribution.
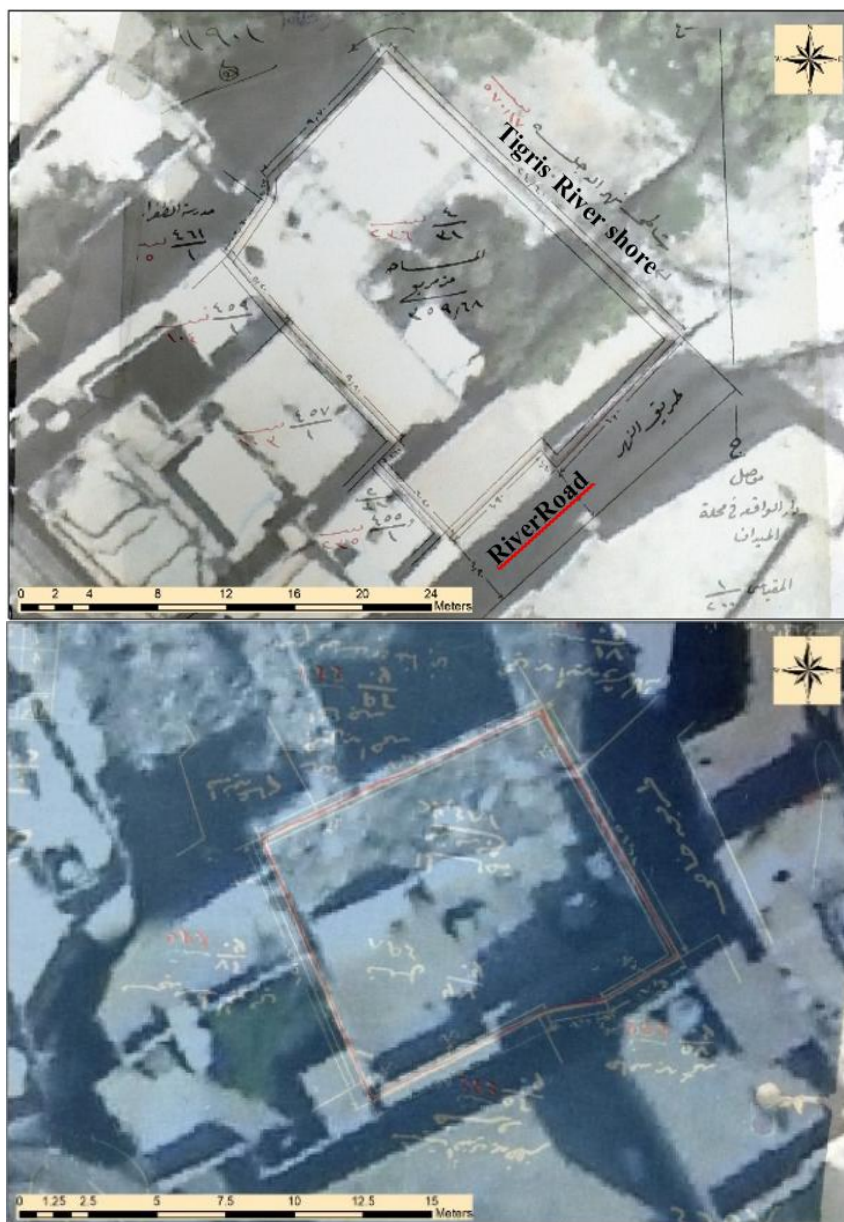

Figure 2A. High-resolution satellite image of the project (November 2022)

Figure 2B. High-resolution aerial image of 2010
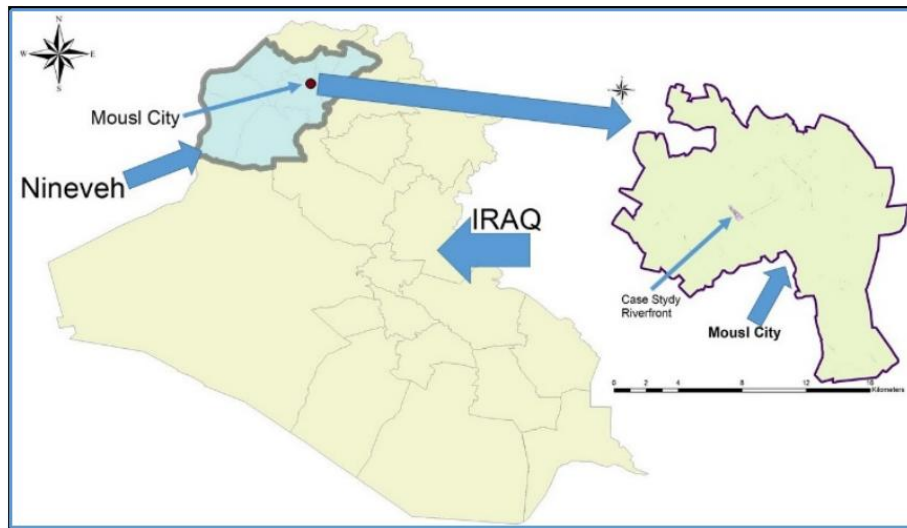
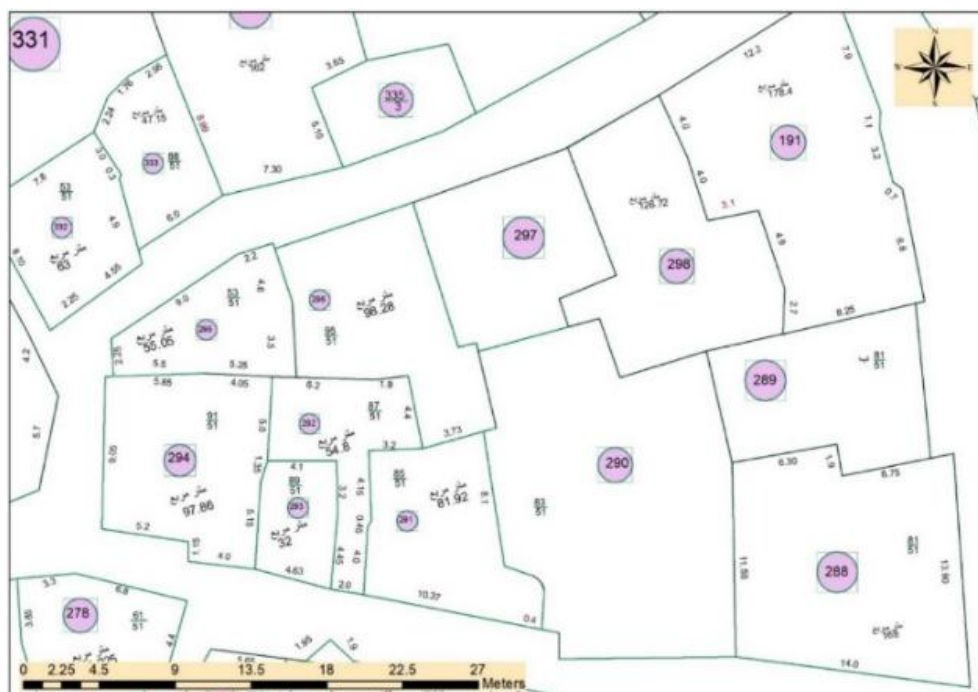**Figure 3.** Study area location due to Iraq on the left and Mousl City on the right

Figure 4. Forms to correct the location, scale and orientation of the real estate map on the corrected high-resolution satellite image

Figure 5. Completing the Real estate map and referring it to auditing with 2010 areal map

Figure 6. Final display of information and display of the property number, area in m^2, and side dimensions

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3.2 Acquisition and processing of data

3.2.1 Historical and contemporary spatial data integration

To accurately reconstruct the riverfront, this study combines both historical and contemporary spatial data, including:

• High-resolution satellite images (pre- and post-conflict) to assess the urban damage.

• Archival aerial photos (2009) to restore lost property boundaries.

• Historical cadastral maps and records at the municipal level, geo-referenced for the sake of spatial precision.

Difficulties in Data Alignment:

• Historical records were distorted and had to be rectified using GIS transformation tools.

• By overlaying multiple datasets and through field validation, gaps in the historical map have been filled. The real estate map can be adjusted for alignment with high-resolution satellite images by location, size, and orientation (Figure 4).

3.3 GIS-Based spatial analysis and digital reconstruction

3.3.1 GIS database development

We set up a comprehensive GIS database that could bring the collected data together for processing:

• Cadastral boundaries and property plots were digitized and vectorized. The original urban structure of historical maps was restored by overlaying them with satellite images Figure 4. To analyze topographic changes, a Digital Elevation Model (DEM) was created.

3.3.2 Urban modelling and digital reconstruction

3D modeling software was used to reconstruct each building, street scene, and historic site from GIS data. Urban modelling software included AutoCAD, Sketch Up, Rhino, and ArcGIS. Thus, contemporary urban demands were met by reuse and adaptive strategy. The real estate map was completed and audited against an aerial photograph from 2010 Figure 5.

Data on property numbers, areas, and dimensions that were necessary for 3D modeling became clear for visualization Figure 6.

3.4 Community organization and participatory planning

3.4.1 Methods for public engagement

The approach to public involvement in the reconstruction initiative encompassed:

•A sequence of workshops designed for officials, historians, and urban planners to collaborate with stakeholders.

• There were also 150 public opinion polls taken in town for residents to give their views on the reconstruction effort. These met with an average favorable response of 93% from participants.

• The use of GIS-based models allowed residents to help achieve historical verification and make urban planning decisions.

3.4.2 Challenges in community engagement in a post-conflict context

The lack of trust in any planners whom they themselves had not chosen hampered involvement with government stimulus plans.

• Mistrust in government-led planning hindered participation.

• Displacement of residents resulting in difficulty in collecting input.

About online interactions, there is limited digital literacy ability and few internet users, yet the city cannot help Guilin in evening meeting people for consultation 4. Figure 7 was the first digital model of the riverfront area to be presented to the community for feedback.
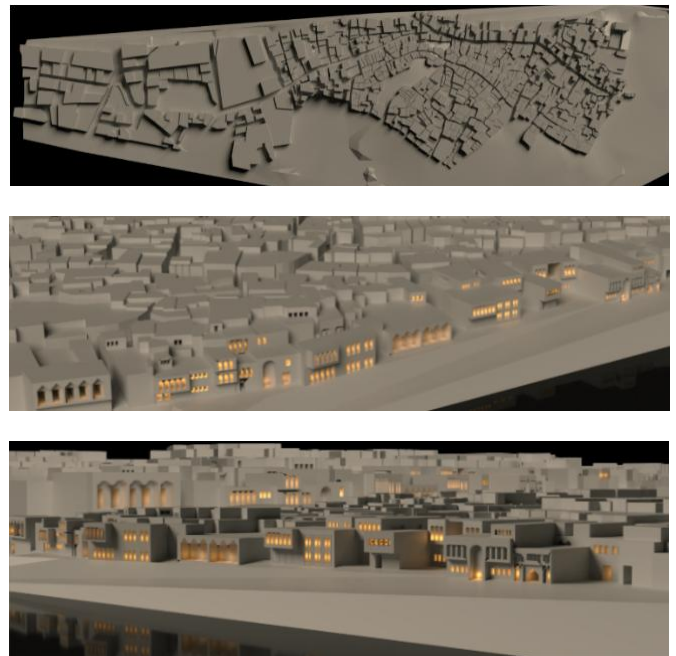
Figure 7. The first digital model of the riverfront area

3.4.3 Community engagement mechanisms in practice

The research was designed primarily to make the community in concrete ways to obtain first-hand feedback that is needed from residents, while simultaneously addressing the problems and difficulties present in post-conflict environments.

The main method used was an organized survey answered by about 150 riverside residents living in or near them, so we could discover their views on how well things are going now. We also wanted to know how much faith they have in the government, which items of planning have community participation, and where they think cultural relics should be rebuilt.

The survey responses were both quantitative and qualitative indicators that can be analyzed using descriptive statistical methods. These studies found that reconstruction elements, such as infrastructure or cultural identity, should be put first from the point of view of residents' expectations. In addition to the survey, researchers also did field mapping and interviews on-site during visits to places with the help of local guides. People living nearby are invited to take part in discussions about the history of this area. This skill is important for restoring both property lines and city layouts historically accurately, using high-resolution satellite photographs combined with GIS. Due to digital skills and the limited supply of online tools, the project primarily conducted face-to-face conversations with people, as it showed them the city's image. Around 68 respondents who could be seen in data gathered from other sources attended a lecture on three-dimensional computer graphics at the local college. Afterwards, the models underwent iterative adjustment based on feedback from the community so that the new shapes corresponded to places in people's memories and familiar

examples seen in nature.

Local adaptation through shape language spread naturally across cultures and took place. While this had been made more difficult by the great migrations which followed the war, an increase in remuneration ensured that the views of people in the community had a role in rebuilding and led to decisions which were rooted close to home.

3.4.4 Key issues against transparency and participation in a post-conflict environment

Informing and bringing the general population into the effort to reconstruct Mosul post-conflict had its own specific set of challenges. These challenges influenced the manner in which the reconstruction unfolded. One of the major reasons for this was that people no longer trusted their government, years of fighting, unstable politics, and the lies that were not called out.

This loss of confidence meant that many of the residents are indifferent or even opposed to the planning and implementation of irregular party planning activities. Physical movement of individuals from their homes made participation difficult. For those who had not yet returned to their residence or had to move temporarily, this made it difficult to consult people widely or to ensure that the views of one part of the community were well represented in design choices. Technical issues restricted people's participation. Because Internet access in many parts of the city is not convenient, and people are not so familiar with using technology, these inputs are not brought online through virtual forums. Instead, research uses interviews and face-to-face surveys, which take more of our time, but are necessary to give everybody an opportunity to be included. Moreover, institutional and bureaucratic fragmentation impair transparency in decision-making. Multiple stakeholders—including local departments of the city government, national organs of the central government, and various NGOs working holistically with social assistance programs respectively- operate in different sectors without any coordination among them. Residents were left to wonder who actually owned and carried out responsibilities for the myriad aspects of postwar rebuilding.
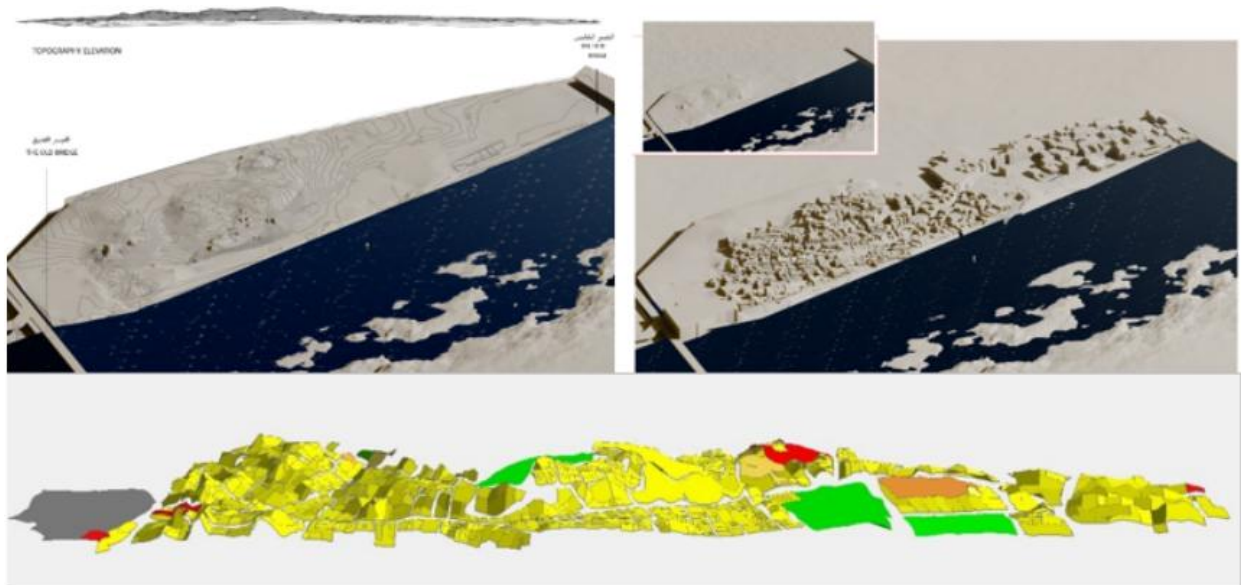
Figure 8. Building a model of the land uses and building blocks of the facade area
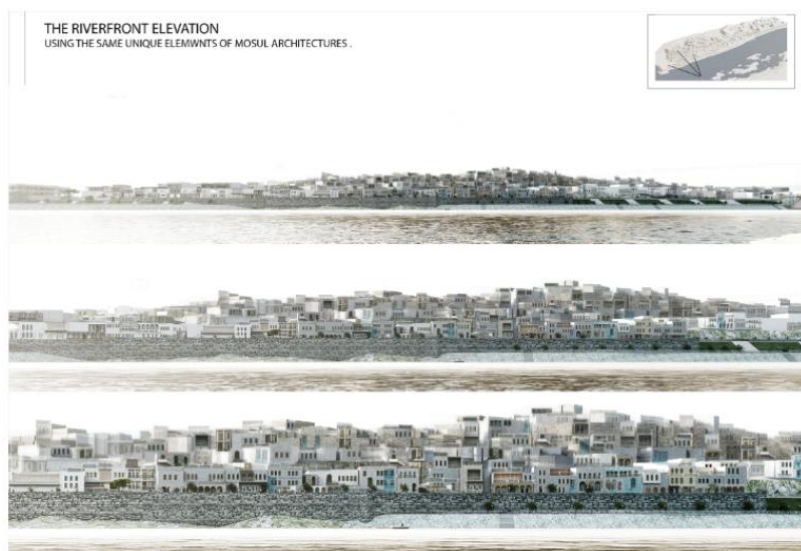
Figure 9. Derivation of a new architectural facade panorama based on the real dimensions of the real estate plot inspired by the ancient riverfront

Figure 10. A comparison between the ancient riverfront panorama and the facade derived from it

Finally, cultural sensitivity and psychological trauma (trying to heal from loss) reduced the propensity of others to speak out or protest openly. The project methodology in this respect aimed to do justice to local dynamics through the use of indirect participatory methods (e.g., mental mapping; anonymous surveys) and by privileging visual and spatial representation over abstract planning discourse. This is an example of how people must be included in the complexity of post-war city planning. Flexible, understanding—local assistance required to ensure everyone is properly integrated into the reinvention of cities.

3.5 Reconstruction: Transparency and governance

3.5.1 Practical transparency problems in post-conflict urban regeneration
- An open-access Geographic Information System (GIS) platform has been implemented to allow the public to engage with ongoing project developments.
- Engaging current stakeholders in the decision-making process has improved transparency.
- Regular updates and community meetings have established a basis of trust between planners and the public.

3.5.2 Barriers to complete engagement by local communities
The sluggish pace of participatory planning initiatives illustrates the challenges and bureaucratic characteristics associated with large institutions.

3.6 Application of advanced technology in cultural heritage restoration

In the research phase, we were mainly concerned with re-projecting the property units in the study area. To do so, we required high-resolution satellite images taken from a height of 30 cm. We simply did not have any documentation available at that time. We decided against single images and used stereo images instead, as we had a more complete view of the area. This matters because varying gradients significantly influence how we would later define and design the boundaries. The stage at which this activity happens is important, as it serves as the basis for making the digital model of the study area. However, we hope that we can improve this model later with field GPS observation taken from a stereo, high-level image using the GPS to select a point and make the high-resolution image into an orthophotography (Figure 8). After that, we classified the layers of land use with GIS in this stage, but no

matter how long it takes process all hard copy property maps to match and georeference their own ortho image form and get all land use information, then by GIS, we set boundaries so that we can produce a new property state map. The next problem we had to face was that all the study areas did not have documentation describing their style and patterns. However, through surrounding areas and public participation with enough locals around them, we had to create a sustainable design that conserves the original spirit of an area rather than replacing it with something else; this is achieved by exporting a digital city model from GIS to which the designers can add whatever is needed, using other programs such as REVIT, in order so (though only at this stage will we be able to complete a full set of maps) with land use, property, and architectural details.

3.6.1 Digital tools for the field protection of historical landscapes
The existing structures were captured in high-resolution photogrammetry and LiDAR scanning.
• AR and VR tools allowed an immersive heritage restoration journey.

3.6.2 The challenge of using preservation in a digital approach
Very destroyed buildings are hard to digitize. Data loss in conflict destruction made it necessary to refer to memories of communities and historical records. In Figure 9, it creates a circular panorama of new architectural façades constructed from ancient documents and the footprint of real estate titles. Figure 10 then directly compares these reconstructed façades with the historical riverfront panorama from which they were derived.

3.7 Field survey and validation techniques

3.7.1 Data acquisition and accuracy check
There were 3498 GCPs on the ground, which he led us to check the georeferenced data.
• Sub-centimeter accuracy was achieved through the use of dual-frequency differential GPS (DGPS) technology.
• Survey landmarks were restored and abandoned houses, religious sites, and ash access/knowledge BLD-12 and information activities for communities.
The results are being used to focus rehabilitation efforts on specific buildings that have a significant local impact in an effort to leverage resources, enhance cultural preservation and promote heritage-based tourism.

3.7.2 Check and calibration

It was adequately verified the geometric accuracy by comparing the property data with 3D digital models. Verification, by the community, confirmed old property arrangements.

4. BRIEF SUMMARY

Multistage Approach, All Together Now. So, what this work does is to combine GIS, satellite imagery, and 3D modeling with community engagement and participatory planning in order to ensure a culturally sensitive but state-of-the-art reconstruction approach. Advanced digital techniques and transparency-driven governance will underpin the sustainability of Mosul's riverfront restoration, with this project becoming a reference point for post-conflict urban regeneration.

4.1 Field surveys stage

After a complete survey of the work area and selecting the best locations to install the ground control stations, the survey work began using dual-frequency differential GPS devices of the type (Hi-Target V90+). The ground control station was monitored using the static monitoring method for a period of more than 3 hours of observations. The station values were continued, then the observations were sent to the global correction site (AUSPOS) so that the station values could be corrected and approved in the survey work using the RTK method to raise ground features and alleys between houses. The device used was characterized by high accuracy in all surveying work. Below is the accuracy with which the device worked according to the two methods used in monitoring:

4.2 Static GNSS surveying

Horizontal: 2.5 mm + 0.5 ppm RMS
Vertical: 5 mm + 0.5 ppm RMS
Initialization time: Typically, < 10 s
Initialization reliability: Typically, > 99.9%
Network RTK
Horizontal: 8 mm + 0.5 ppm RMS
Vertical: 15 mm + 0.5 ppm RMS
Initialization time: Typically, < 8 s
Initialization reliability: Typically, > 99.9%

The satellite image of the riverfront area in Mosul, taken from the French satellite PNeo, was prepared using the Universal Transverse Marker coordinate system (UTM) within the global reference system World Geodetic System - WGS 84, with an explanatory resolution of 30 cm, and a cloud coverage percentage equal to 0%, as shown in Table 1. The following explains its specifications:

Table 1. Characteristics of the satellite used in the study area

PNeo-6 Bands	Spectral Mode	Mono	Product Type
UTM	Map Projection	16	Bit Depth
WGS84	Datum	Geo TIFF	File Format
9°	Nadir Angle	3 Oct 2022	Acquisition Date
0.0%	Cloud Cover	0.3m	Product Option

The field work began by surveying the project site (the riverfront of the old area) with a distance of (1,250) meters extending from the iron bridge of the city of Mosul all the way to the fifth bridge of the city, with a width of (280) meters, and an area of approximately (140 dunums), using a (DGPS) type (Hi-Target) dated (01/02/2023).

Two survey teams started the field work from the Fifth Bridge and ended at the Iron Bridge. The teams relied upon a recent satellite image of the city of Mosul with a resolution of 30 cm, dated September 2022) to fix the boundaries of the study area and draw them on the satellite image as in Figure 11.
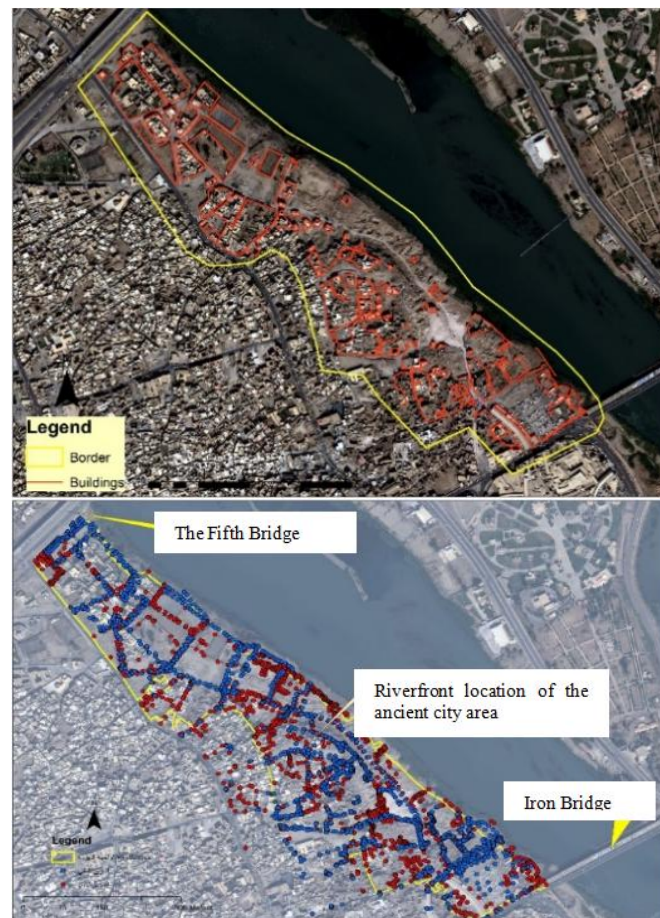
Figure 11. Survey field work to get CGP

The first team specialized in clearly visible phenomena, whether they were dilapidated or new. The first team carried out a survey to record all landmarks within the area, including restored homes, abandoned homes, mosques, and other objects present in the area. All corners and remains of landmarks, beams, and existing and demolished buildings were monitored for the purpose of matching them with the real estate maps. The maps were produced for the totality of phenomena present in the reality of the situation. The second team surveyed all the alleys, site beams, and all open lands of the area for the purpose of producing topographical maps and drawing and producing longitudinal sections of the area's alleys.

The monitoring process took 4 working days (14) working hours per day. The days reached after sunset, bringing the total number of monitored points for the project to 3498 points, as follows:

1- On the first day of field surveys, 870 ground survey points were monitored.
2- On the second day, 968 points were monitored.
3- On the third day, 755 points were monitored.
4- On the fourth and final day, 905 points were monitored.

4.3 Building a GIS database

There was no clear and accurate map available about the properties in the study area. The boundaries of the plots, as most of the sources, had either been burnt or damaged due to military operations during the occupation of ISIS and liberation, or were already missing before that due to time obsolescence.

The sources of this data were mainly limited to:
1. Real Estate Registration Directorate/ Right-Side Real Estate Registration Department.
2. Mosul Municipality Directorate/Old City Municipality Department.

Through these two sources only, it was possible to verify and collect parts of the area's components to produce a real estate section map that matches the reality of the condition of the plot boundaries in the study area.

The number of plots in the riverfront area reached approximately 964 plots, which means accessing and verifying a map of each plot. A stereo satellite image was also relied upon to produce a digital terrain model (DTM) for the region. This model was adopted to match the field survey data and ensure its accuracy.

ArcMap software was used to create a TIN digital model of the study area. After the built TIN in the Civil 3D program was exported to the ArcMap program, a map was produced showing the topography of the area according to its levels within the ArcMap environment to give a three-dimensional view of the study area and show the direction of the level rise according to a color gradation, as shown in Figure 12.

Figures 13 and 14 show examples of maps of real estate registration plots, as it is not technically possible to call them a map. Each plan contains a group of unrelated sites, as there is no relationship between each plot and its neighbors. There may be a plan for only one plot in the plot that has a relationship in the study area.
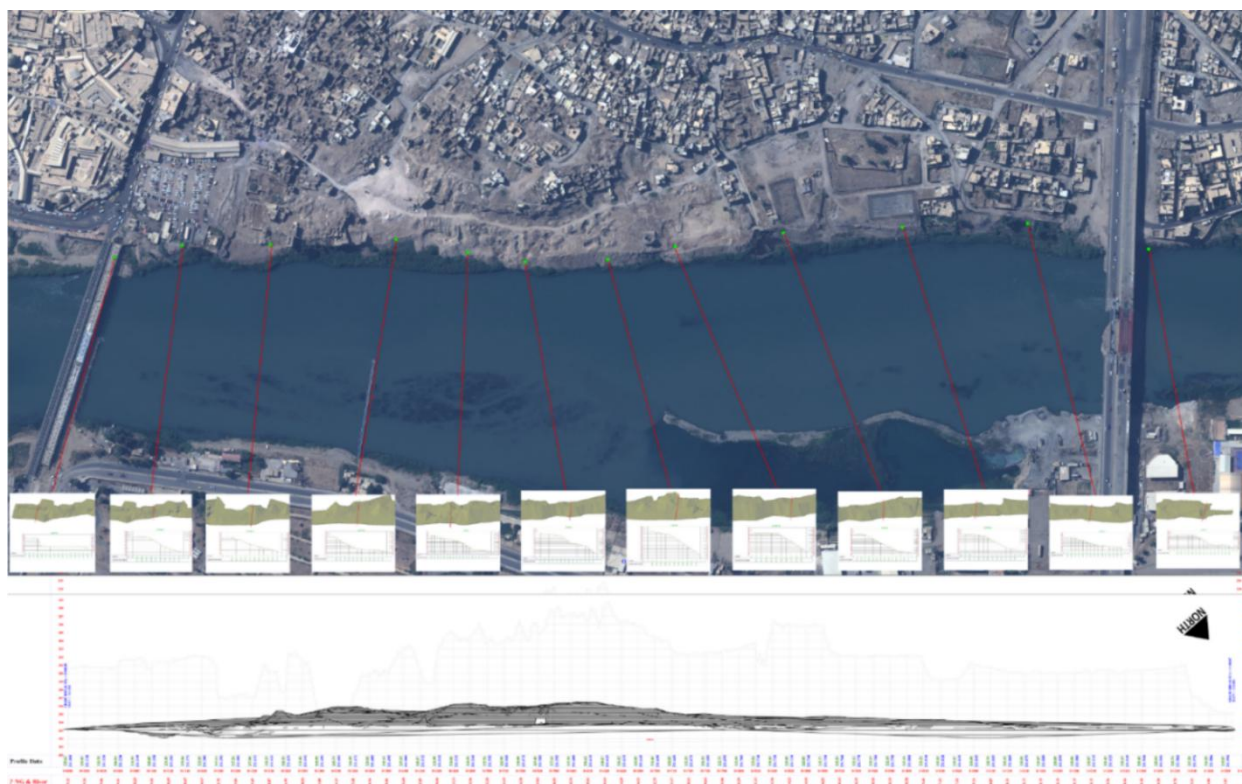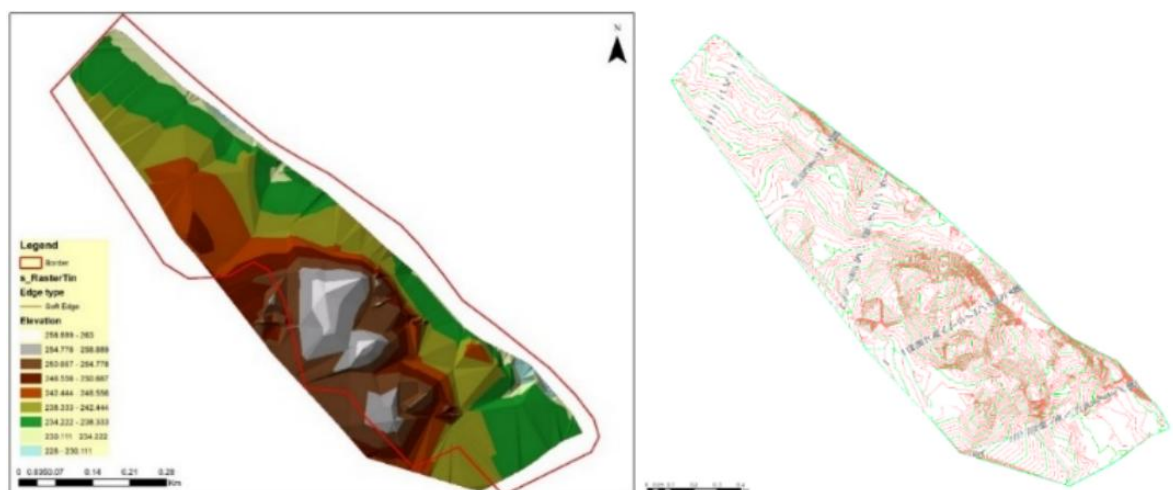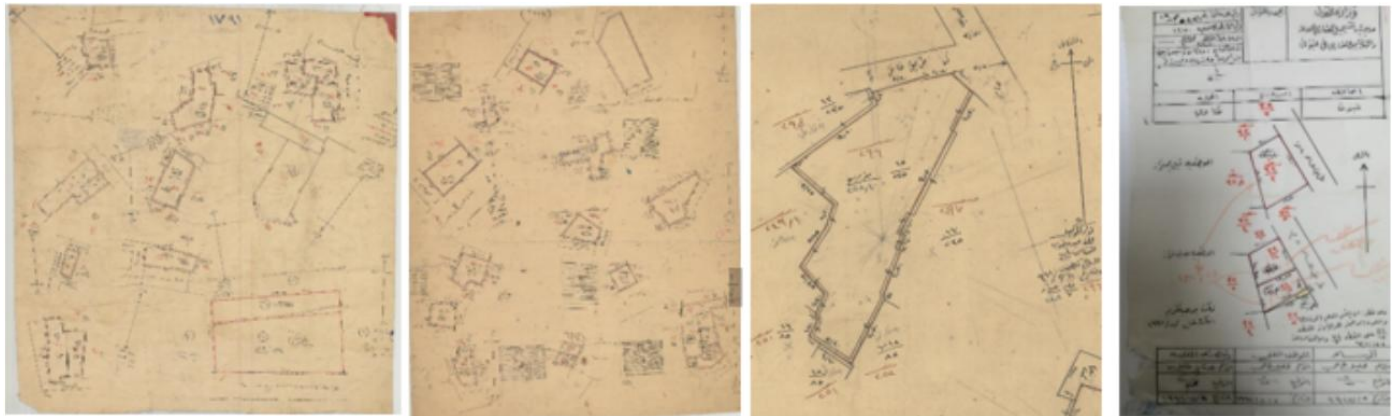

Figure 12. Building cross-sections and profiles according to all areas

Figure 13. Building the digital model and constructing the contour model of the study area

Figure 14. A sample of real estate registration records

5. COMMUNITY PERSPECTIVES ON URBAN RECONSTRUCTION AND HERITAGE RESTORATION IN MOSUL

5.1 Satisfaction with current designs and reconstruction efforts

Table 2 below summarizes the responses regarding satisfaction with the current designs and reconstruction efforts. The mean score for the design meeting community needs is 3.01, indicating a neutral stance among respondents. Similarly, respecting cultural identity scored an average of 2.93, reflecting a slight dissatisfaction or scepticism.

Table 2. Satisfaction with current designs and reconstruction efforts

Question	Mean	St. Dev.	Min	Max
Design meets community needs	3.01	1.41	1	5
Design respects cultural identity	2.93	1.42	1	5

These are results of the mean response of 3.01, and this suggests that people generally said that this was a neutral thing, even if these questions are about the way of doing the design to meet the needs of the community. Respect for cultural identity 2.93 reflects some disappointment among the sample members also. Meaning reconstruction remains active but must address local cultural interests and expectations. Moderate satisfaction suggests that designs require an increased effort by the community to recognize their significance in the context of history and the evolving needs of modern city life.

5.2 Transparency and community involvement

In reconstruction plans, we received mean responses of a transparency rate of 2.81, a moderate dissatisfaction. However, community involvement in decision-making averaged a slightly higher 3.10, which suggests a higher engagement but also indicates that much room for improvement is needed.

Table 3. Transparency and community involvement

Question	Mean	St. Dev.	Min	Max
Transparency in reconstruction plans	2.81	1.43	1	5
Community involvement in decisions	3.10	1.42	1	5

The results in Table 3 reveal that community participation was slightly more dissatisfied with the transparency of reconstruction plans, but this participation remains below expectations and should be stressed more as a positive driver of more constructive dialogue between the community and the city planners to be able to shape the public project in a way that integrates local voices in the plans.

5.3 Restoration of Cultural Heritage

Table 4. Restoration of cultural heritage

Question	Mean	St.Dev.	Min	Max
Restoration of heritage sites is essential	3.05	1.38	1	5
Preference for multi-use heritage sites	3.08	1.39	1	5

Based on the results in Table 4, it is shown that the restoration of heritage sites is regarded as important by the respondents, with an average of 3.05. Similarly, they also

prefer multi-use heritage sites, which scored 3.08, indicating their will for the adaptive reuse of cultural landmarks.

The heritage site reviving community had received a significant amount of support with a mean score of 3.05. There is also a marked preference for multi-use heritage sites—a rating that reached an even higher 3.08. It shows a readiness to combine modern use and preserved buildings. Therefore, these insights highlight the importance of developing adaptive reuse strategies together with conservation strategies in order to realize ongoing cultural sustainable heritage protection in Mosul.

5.4 Priorities and infrastructure

The results show a balanced view, with infrastructure priority scoring 2.91 and sustainability concerns averaging 2.89 (see Table 5). This indicates that while infrastructure improvements are seen as necessary, there is also notable concern about the long-term sustainability of the reconstruction projects. Planners must ensure that both infrastructure and heritage restoration efforts align with sustainability principles to meet community expectations and environmental considerations.

Table 5. Priorities and infrastructure

Question	Mean	St.Dev.	Min	Max
Infrastructure priority over cultural restoration	2.91	1.37	1	5
Concerns about project sustainability	2.89	1.44	1	5

And we then enter the middle ground area, where infrastructure gives us an average priority of 2.91 and sustainable development 2.89. This demonstrates that although infrastructure needs to be repaired, it is good quality sustainable development that is also considered for doing this work. As regards the public at large, it is therefore imperative that planners need to meet environmental principles in their infrastructure and restoration of ancient buildings, if they are fulfilling the demands of the community but also the reality of the ground. This excludes the issue. Results indicate an overall balance, scoring at 2.91 for infrastructure priorities and 2.89 for sustainable development issues. However, we also do not discount the issues of durability, although essential, as upgrading of the infrastructure can result. To avoid becoming subjects of criticism or Even worse yet--having problems with both environmental impact and community acceptance What matters most to the common people: Planners must guarantee are thus left with no choice but to make sure that environmental principles equally governs ordinary construction and ancient building restoration projects as (a precondition) otherwise community expectations will not be met and also becomes necessary as state work. The will to point.

5.5 General satisfaction with reconstruction efforts

Regarding reconstruction initiatives, there is an average level of satisfaction among the sample to whom the questionnaire was distributed, as shown in Table 6.

On average, the satisfaction rating is 3.04, which implies a relatively positive attitude towards reconstruction activities. But for this group, views of these measures returning a significant part of cultural identity are a bit less optimistic, at 2.92. This means that while local citizens recognize the progress, they do not know if this reconstruction helps regain its place in history and culture. These findings highlight the need for more open, culturally considerate approaches to urban renewal.

Table 6. General satisfaction with reconstruction efforts

Question	Mean	St.Dev.	Min	Max
Satisfaction with reconstruction efforts	3.04	1.44	1	5
Reconstruction restores identity	2.92	1.40	1	5

6. COMPARISON WITH PREVIOUS STUDIES

The same concern in Jasim and Al-Bazzaz [2] addresses concerns for moderate satisfaction with cultural identity restoration (mean = 2.92). They find that some Old Mosul residents draw a lot on Laborouver, Hitchin city's symbolic and emotional epitomes of place in expressing a preference for rebuilding priorities. These two research cases are evidence of the collapse of a design and technical paradigm of a culturally appropriate environment at work here. Some communities, then, do not fully welcome it as a mirror of their collective history. Participatory planning, which serves as a major framework in municipal urban recovery (including municipal revitalizations and interventions), also scores this study moderately in terms of both transparency (mean = 2.81) and community participation (mean = 3.10). This means that, despite some public participation programs taking place, residents still believe they are separate from politics. Reference Pyramids on the Giza Plateau. Draughtsman drew circles around ward boundaries of the county council elections -- a similar phenomenon was encountered, and even the postwar reconstruction of Sarajevo after hostilities receded as Miller et al. (2019). Without these institutionalized mechanisms for participation, trust in urban renewal initiatives suffers in the public eye. To ensure a proper trade-off between infrastructure development and heritage restoration, responses on both domains have the same marks (2.91 and 2.89, respectively), so they assign equal weight to both types of work while still analyzing the sustainability of existing initiatives. This resonates with Baraka [39], who observes in the MENA region that both the speedy rebuilding of these regions as well as the reshaping of the physical structures that represent the collective memory have always been the priorities. Successes as opposed to failures have emerged, for example, Dubrovnik and Warsaw [38] are now successful examples which show how, through a single overall plan framework created with the input of different local communities, heritage preservation and infrastructure development have all become feasible. This work validates what many scholars have already argued: post-conflict reconstruction must now go beyond simple technical and aesthetic requirements to meet community needs; the city's past, which has been the best-established from a historical perspective, must also be considered and, not only for the history of the people of the city, but also when it comes to remembering the city, identifying the city and the participation that is meaningful and meaningful in the city. This is a relevant theoretical contribution to the understanding of post-war urban recovery that is culturally tailored, socially inclusive, and spatially appropriate.

7. CONCLUSION

Rebuilding the historical riverfront in Mosul has served as a good example of how traditional cultural heritage preservation and modern urban renewal may come together through technological revolution.

There is a tradition in Baghdad of counselling by might and plenty of methods to rule it (theocratic, militarist, paramilitary). But even more important than that, we have developed three decades after the United States recognized Palestine for what it is as 78% was taken by Israel in 1948 followed by years of warfare and statelessness for most people from both peoples how this great city works; it has gone through no territorial changes since World War I except those planned straight into an Age of God's Kingdom whereby Muslims may see their state (according to The Translations of Ibn Ishaq, Translated into French by A. Guillaume), we are born with all authority before The Applications of God's Grace, but if we meet opposition our salvation is impossible even as he abases himself.

In the method of flow control, as described by Sansom, decisions are presented on paper to the staff at subway barriers, and they make a choice that leaves an empty slot in line behind this unpopular method.

However, the urban plan for regeneration was used to serve only this purpose. These instruments of redevelopment were meant to measure—measure the composition, therefore the content of new buildings (they will present the socio-cultural structure of their environment) and also to create new examples of how new spatial forms might be interlaced in the fabric of an urban setup. At this point, the content is constitutive of the structuring tool and can provide the means through which a new urban character stands. The historical data-to-modern-technology integration was an achievement of the project, reconstructing property lines and urban layouts. The renovation itself improved physical structure, but it was also one of the major positive impacts on social and cultural conditions. Through reconstruction after the war (a work of) such elements will be faithful to their originals, often adopting the same architectural style or fashion, and serve as a marker of life—things that get wiped out but which appear visible for everyone to see and whose existence is visible everywhere.

Moreover, the results of this research) Both support and help define how post-war reconstruction work should proceed with the community.

In addition to identifying problems, such as openness and participation, these reports have some promise for making planning more inclusive so that public confidence the ultimate understanding and gain of any projects. The experiences of this project can provide a reference for similar work in other cities emerging from war and marked by history. In sum, resuscitation of the banks of the river Tigris in Mosul has shown how these apparently conflicting elements — reviving historical consciousness and contemporary urbanization–will converge well in a total Regenerative Planning. It not only restores the physical form of a city. Rather, it renews both city and people, culture—a model for the post-war re-urbanization of other parts. To conclude, it is clear from the study that though geographic information system technology was combined with technical work to face the challenges of post-conflict urban reconstruction, we preserved the authenticity of cultural heritage as both city and community memory were restored in digital form. From this work, an instance of combining technology with social understanding and cultural reality is available to learn. By publishing new thoughts and experiences, it may hopefully emancipate only one part of the entire picture that post-conflict recovery depicts.

8. RECOMMENDATIONS

1.   We must have reinforced transparency and public participation, as this is necessary to achieve active success in the reconstruction, and this ensures public contribution in decision-making with their benefits.

2.   Achieving equilibrium between conservation of heritage on one hand, and on the other, modern development; the comprehensive approach in reconstruction of conflict areas guarantees conservation of heritage, also getting new strategies in adaptive reuse, all that in an urban development context, the result of which appears in economic and social activities.

3.   Depending on new technologies like virtual reality, GIS, new documentation technologies, and others, it is very important to make accurate decisions and results in the conflict area, especially in these ways, which can analyze rebuilding destroyed structures. Also, it can easily document heritage landmarks with their aesthetics and bring them back.

4. Enhancing environmental sustainability with urban resilience; so, we can accommodate all efforts of reconstruction with goals of sustainability, at the same time, giving more attention when dealing with social infrastructure, green areas, local building material, and sources of energy.

5. Increasing financial governmental policies; through supporting local developers and companies, putting cultural tourism on the priorities of the central government, supporting economic families from family projects, all these matters are necessary to create a sustainable reconstruction area.

6.   Building capacities and transferring knowledge, so this matter is very important, because the reconstruction area will be run by the local community, for that, they must get special training courses, they must be practical and define how to implement the construction strategy. We can be managing that from local univariate and non-governmental organizations, this way ensuring resilience reconstruction area.

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