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The Haven Hood: Adaptive Portable Architecture for Post-Displacement Recovery – A Resilient Design Approach

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Abstract

This study explores the potential of adaptive modular architectural systems to support post-conflict recovery processes for Syrian returnees following prolonged displacement. The research focuses on portable container-based systems as transitional urban recovery infrastructure capable of bridging the gap between immediate humanitarian response and long-term reconstruction efforts. A case-study and design-based methodology was adopted to examine post-conflict urban conditions, infrastructure limitations, and recovery challenges within Northern Syria. The study contributes to the emerging literature on post-conflict urban recovery by extending the application of modular architecture beyond emergency shelter provision and positioning it as transitional urban recovery infrastructure. Unlike previous studies that primarily focused on refugee camps and short-term humanitarian responses, the proposed framework integrates modular housing, healthcare, educational facilities, and off-grid infrastructure within damaged urban neighbourhoods. The findings suggest that modular tactical urbanism can support neighbourhood stabilization, service accessibility, and medium-term recovery processes while permanent reconstruction efforts continue.

Keywords: Modular Architecture; Post-Conflict Recovery; Tactical Urbanism; Resilience; Sustainable Design; Transitional Housing

1. Introduction

Post-conflict environments present major humanitarian and urban recovery challenges due to large-scale displacement, damaged infrastructure, and the deterioration of essential public services. In many affected regions, the return of displaced populations places additional pressure on urban systems already weakened by conflict, particularly in relation to housing, healthcare, education, sanitation, and energy infrastructure. As a result, post-conflict recovery increasingly requires adaptable and resource-efficient approaches capable of supporting both immediate humanitarian needs and medium-term urban stabilization (World Bank, 2017; Sphere Association, 2018).

Within this context, Syria represents one of the most severe contemporary examples of prolonged conflict-related urban destruction and displacement. Following approximately thirteen years of conflict, many Syrian cities experienced extensive damage to residential neighborhoods, infrastructure networks, and public services. In response to major political developments and changing security conditions in late 2024, increasing numbers of refugees and internally displaced people began returning to their communities. However, many returnees encountered heavily damaged urban environments lacking adequate housing, infrastructure, and access to essential services (UNHCR, 2025; World Bank, 2017; Taher & Al-Chikh Ali, 2025).

Despite ongoing reconstruction efforts, the pace of rebuilding remains insufficient to address the urgent needs of returning populations. Many returnees continue to inhabit temporary shelters, informal settlements, or partially damaged structures due to financial hardship and limited reconstruction capacity. Traditional humanitarian shelter responses, particularly tent-based systems, and temporary camp infrastructure, often provide limited durability, inadequate thermal performance, restricted privacy, and strong dependence on damaged infrastructure networks. In addition, these systems are designed for short-term displacement conditions rather than medium-term urban recovery and neighborhood reintegration processes (Global Shelter Cluster, 2021; Sphere Association, 2018).

In response to these limitations, modular and adaptive architectural systems have increasingly attracted attention as potential tools for transitional recovery. Modular architecture offers advantages, including rapid deployment, portability, scalability, and adaptability within damaged urban environments. Similarly, tactical urbanism approaches emphasize temporary and flexible urban interventions capable of activating underutilized public spaces and supporting localized recovery processes during reconstruction phases. Within post-conflict settings, these approaches may support temporary housing, healthcare, educational facilities, and community services while longer-term rebuilding efforts continue (Aznar & Tejedor, 2020; Ksaiby & Ibrahim, 2024; Al-Betawi, 2024).

Previous literature on post-conflict recovery highlights the importance of restoring housing, infrastructure, and public services as part of broader urban stabilization efforts (World Bank, 2017; Kawther & Hassan, 2022).
Parallel studies on modular and portable architecture have explored the use of prefabricated shipping container systems within humanitarian and emergency-response contexts due to their rapid assembly potential and adaptability. In addition, tactical urbanism research has demonstrated the potential of temporary urban interventions to address urgent spatial and infrastructural challenges through flexible and small-scale deployment strategies. Human-centered and trauma-informed design approaches further emphasize the importance of dignity, privacy, psychological comfort, and healing-oriented environments within displacement and post-conflict conditions (Desai, 2025; Blackmore et al., 2020).
However, existing studies addressing modular and portable systems have primarily focused on emergency shelter applications and refugee camp conditions, with comparatively limited attention given to their role within post-conflict urban reintegration and medium-term recovery processes. Limited research has examined the use of modular tactical urbanism as transitional urban infrastructure capable of integrating temporary housing, healthcare, education, and off-grid support systems within damaged urban neighborhoods (Ksaiby & Ibrahim, 2024; Al-Betawi, 2024).
Accordingly, this study investigates the potential of adaptive modular architectural systems as transitional recovery infrastructure for post-conflict Syrian communities. Unlike previous studies that primarily focus on emergency shelter provision, this research conceptualizes modular systems as multi-functional urban recovery infrastructure capable of supporting housing, healthcare, education, and essential community services during medium-term recovery phases. The study further explores the integration of tactical urbanism principles and off-grid infrastructure systems as part of a resource-conscious and adaptable recovery framework.

1.1 Background

The Syrian conflict, which lasted for approximately thirteen years, resulted in extensive destruction across urban centers, infrastructure systems, and local economies. Following major political developments and changes in territorial control in late 2024, increasing numbers of displaced populations and refugees began returning to their home communities (UNHCR, 2025). However, many returnees encountered heavily damaged urban environments lacking adequate housing, infrastructure, and essential public services.
Previous assessments conducted on Syrian cities such as Aleppo, Homs, and Idlib documented severe damage to urban infrastructure and significant reductions in national service capacity. Among the reported impacts was a major decline in power generation and deterioration in socio-economic indicators, including the Human Development Index (HDI), which returned to levels comparable to previous decades (World Bank, 2017).
The prolonged duration of the conflict has created complex post-conflict recovery challenges that extend beyond physical reconstruction. Many returnees currently reside in temporary or informal shelters due to limited financial capacity and the slow pace of rebuilding processes. In addition, damaged infrastructure and limited access to healthcare, education, and utility services continue to affect the quality of life within returning communities (Taher & Al-Chikh Ali, 2025).
Given these conditions, the need for rapid, adaptable, and resource-efficient architectural interventions has become increasingly important within post-conflict urban recovery strategies. This challenge highlights the importance of exploring modular and deployable systems capable of supporting medium-term urban stabilization while longer-term reconstruction efforts continue.

1.2 Problem Statement and Research Gap

The return of displaced populations to heavily damaged urban environments has generated an urgent demand for shelter and essential community services that exceeds the current pace of permanent reconstruction. While previous studies on portable and modular housing systems have primarily focused on temporary camp-based humanitarian response, limited attention has been given to their potential role within post-conflict urban reintegration and neighborhood recovery.
This limitation reveals a significant research gap regarding the use of modular systems as medium-term urban recovery infrastructure capable of supporting both temporary accommodation and essential community functions. Recent conditions observed in areas such as Idlib and Aleppo demonstrate that many returnees continue to inhabit informal temporary shelters or basic mud-brick structures due to economic hardship and damaged urban infrastructure. In many cases, these settlements experience limited access to healthcare, education, sanitation, and public services. Comparative indicators between 2009 and 2024 further demonstrate the significant deterioration in living conditions and urban service accessibility within post-conflict communities, particularly in relation to education, electricity access, sanitation, clean water availability, and housing quality (Taher & Al-Chikh Ali, 2025). Table 1 compares selected indicators for Aleppo and Idlib in 2009 and 2024, demonstrating substantial deterioration across multiple dimensions of living conditions.

Table 1. Socio-economic and infrastructure indicators in Aleppo and Idlib (Adapted from Taher and Al-Chikh Ali, 2025).

Dimension	Indicator	Aleppo 2009	Aleppo 2024	Idlib 2009	Idlib 2024
Education	Children not completing primary education	1.3%	24%	0.8%	32%
	Children not enrolled in schools	1.8%	14.7%	1.4%	21.2%
Infrastructure	Lack of electricity access	0.01%	3.2%	0.01%	2.9%
	Lack of improved sanitation	0.04%	16.0%	0.01%	11.5%
	Lack of clean drinking water	2.5%	8.2%	1%	5.3%
Housing	Houses built with inadequate materials	2.5%	10.2%	3%	7.8%

There was limited attention given to the deployment of modular systems within public open spaces as temporary service-support infrastructure during medium-term urban recovery. This highlights the need for adaptable architectural strategies capable of supporting neighborhood stabilization while long-term reconstruction efforts continue.
Accordingly, this research investigates the potential of modular tactical urbanism as an adaptable architectural framework for post-conflict urban recovery. The study aims to explore how modular container-based systems can evolve from emergency shelter provision into rapid urban infill and community recovery strategies that support urban stabilization, service accessibility, and resource-efficient reconstruction within damaged urban contexts.

1.3 Objectives and Hypotheses

The primary objective of this study is to investigate the potential of modular shipping container systems as adaptable transitional infrastructure for post-conflict urban recovery. Specifically, the research aims to:

- Adapt previously developed modular container units from earlier research (Ksaiby & Ibrahim, 2024), featuring high-performance insulation systems and rapid structural assembly, into a deployment strategy suitable for public open spaces such as parks and school playgrounds.
- Explore the use of public open spaces as temporary deployment sites to reduce the legal, structural, and safety challenges associated with reconstruction near unstable private ruins.
- Evaluate the integration of off-grid infrastructure systems, including greywater reuse for sanitation purposes and solar technologies capable of supporting basic daily energy demands (Maka & Alabid, 2022; Shaikh & Ahammed, 2020).
- Examine the potential role of modular educational and healthcare units in supporting neighborhood stabilization and post-conflict community recovery (Aznar & Tejedor, 2020; Ksaiby & Ibrahim, 2024; Odunlade & Abegunde, 2023).

The study hypothesizes that rapidly deployable modular systems may contribute to improving temporary living conditions for returnees while supporting access to essential community services during the medium-term recovery phase. Furthermore, the integration of modular schools and healthcare facilities within public open spaces would support neighborhood resilience and assist communities during the transition toward long-term reconstruction.

1.4 Significance and Structure of the Paper

This research contributes to ongoing discussions on post-conflict urban recovery by exploring the role of modular tactical urbanism as a rapid and adaptable recovery strategy within damaged urban environments. The proposed framework seeks to provide safer and more dignified temporary living conditions for returnees through the integration of modular housing, educational, and healthcare facilities guided by the humanitarian shelter and settlement planning principles outlined in the Sphere Standards (Sphere Association, 2018).
The significance of the study lies in its investigation of modular systems not only as emergency shelter solutions, but also as transitional urban infrastructure capable of supporting neighborhood stabilization during medium-term recovery phases. By addressing daily spatial and service-related needs, the proposed framework aims to support social resilience, improve access to essential services, and contribute to community recovery processes while permanent reconstruction efforts continue.
In addition, the study highlights the potential role of modular educational and healthcare environments in supporting social continuity, psychological stability, and community functionality within post-conflict settings. Previous studies emphasize that trauma-informed spatial environments can positively influence emotional recovery, perceived safety, and psychological well-being among vulnerable populations affected by crisis and displacement (Desai, 2025).
The remainder of this paper is structured as follows. Section 2 presents the materials, modular system specifications, and human-centered design considerations. Section 3 outlines the proposed deployment strategies, technical configurations, and conceptual site layouts. Section 4 discusses the socio-economic and urban implications of the proposed framework, while Section 5 concludes the study and presents recommendations for future post-conflict recovery strategies.
The originality of this study lies in integrating modular architecture, tactical urbanism, and off-grid infrastructure strategies within a unified post-conflict recovery framework. While previous studies have often examined emergency shelter provision, modular construction, or tactical urban interventions independently, this research proposes a comprehensive approach that addresses housing, healthcare, education, infrastructure resilience, and community recovery simultaneously. The framework development supports Syrian returnees during transitional recovery phases and contributes to broader discussions on adaptable post-conflict urban development.

2. Materials and Methods

This section outlines the methodological framework adopted in the study, including the case-study approach, human-cantered design considerations, modular system specifications, deployment protocols, and comparative evaluation methods used to investigate the proposed post-conflict recovery framework. The methodology combines literature review, contextual analysis, architectural design development, and comparative conceptual evaluation to investigate the potential role of modular systems in supporting temporary urban stabilization and medium-term recovery processes.
The research adopted a design-based case study methodology to investigate the application of modular architectural systems in post-conflict recovery scenarios. The study combines literature review, contextual analysis, and conceptual design development to formulate an adaptable recovery framework for Northern Syria. Figure 1 illustrates the research flowchart adopted in this study.

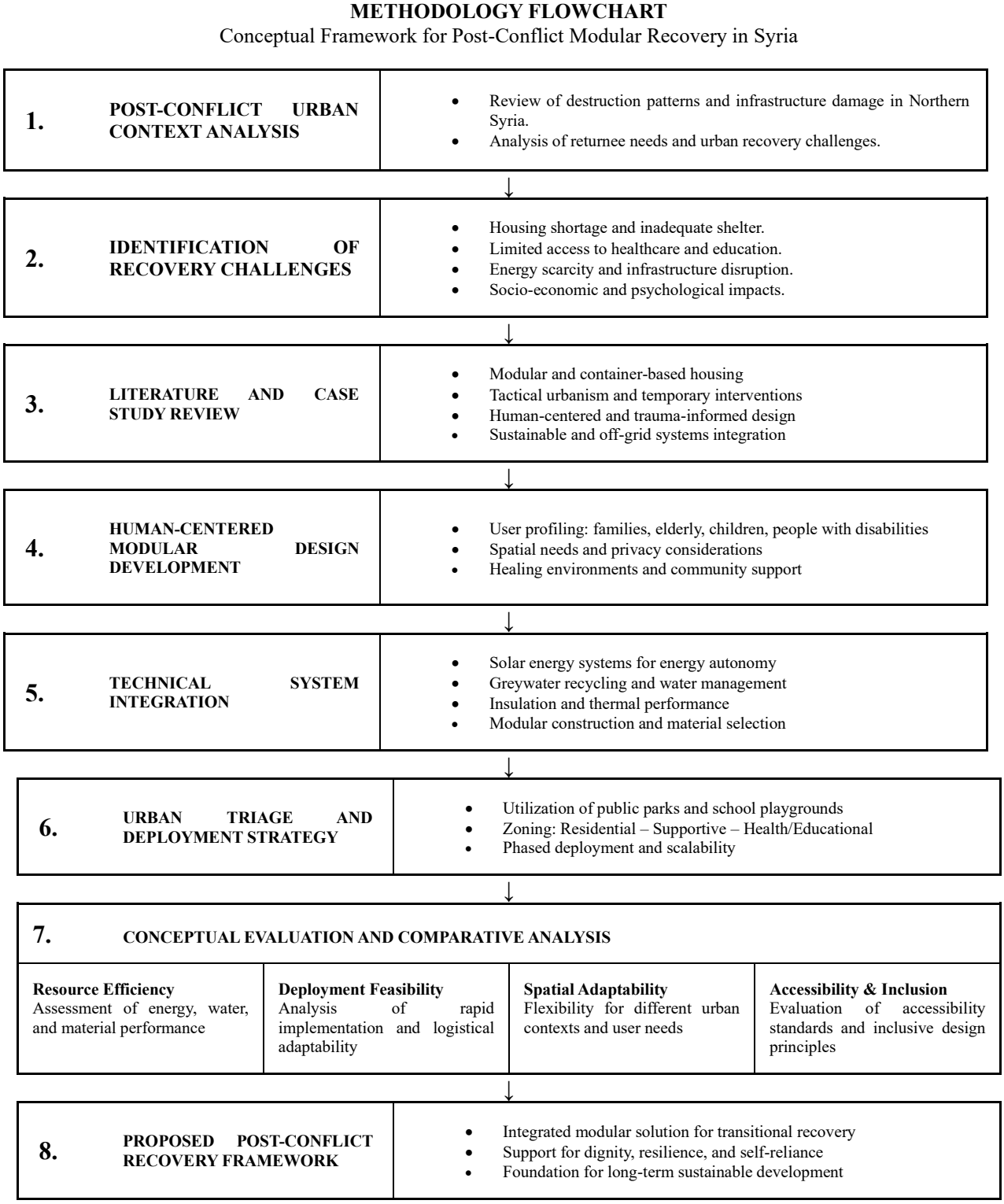

Figure 1. Methodology Flowchart (Developed by the Authors).

2.1 Study Design and Setting

This study adopts a case-study methodology using the Idlib region as a representative example of post-conflict urban conditions in Syria. Northwestern Syria, particularly Idlib and Aleppo governorates, continues to experience severe socio-economic deterioration, infrastructure damage, displacement, and multidimensional poverty resulting from prolonged conflict conditions (Taher & Al-Chikh Ali, 2025; World Bank, 2017). The research combines qualitative architectural design approaches with basic quantitative evaluation methods to investigate the potential role of modular systems in supporting post-conflict urban stabilization and medium-term recovery processes.

It also focuses on tactical urbanism strategies through the temporary utilization of public open spaces, including parks and school playgrounds, as deployment sites for modular housing and community-support clusters. Tactical and flexible urban interventions have been explored increasingly in post-conflict and high-density urban environments due to their adaptability and rapid implementation potential (Odunlade & Abegunde, 2023; Al-Betawi, 2024; Stanley, 2017).

These spaces were selected due to their relative accessibility, spatial availability, and reduced exposure to the legal and structural challenges associated with reconstruction near unstable private ruins.

2.2 Target Users and Human-Cantered Design

The target users of the proposed framework include returnees and internally displaced people (IDPs) affected by post-conflict displacement conditions. Recent reports indicate increasing discussions surrounding voluntary repatriation and return movements among Syrian refugees despite continuing instability and infrastructural limitations (UNHCR, 2025). Previous studies have highlighted the prevalence of psychological stress and post-traumatic stress disorder (PTSD) among refugee and displaced populations, particularly among individuals exposed to prolonged conflict conditions and unstable living environments (Blackmore et al., 2020; Handiso et al., 2023).

To address these conditions, the study adopts a Human-Centered Design approach emphasizing safety, accessibility, adaptability, and psychological comfort. The proposed design strategy aligns with trauma-informed architectural principles that prioritize emotional well-being, environmental stability, and healing-oriented spatial experiences within vulnerable user groups (Desai, 2025). The modular unit development aims to accommodate different family sizes, including households of 2, 4, 6, and 8 individuals. Accessibility considerations include integrated ramps and non-slip surfaces to support elderly users and individuals with disabilities.

In addition, the design incorporates natural lighting, cross-ventilation, and family-oriented spatial layouts intended to support healthier indoor environments and improve the sense of privacy, dignity, and social belonging within temporary living conditions. Flexible and transformable spatial approaches are considered to maximize functionality within compact living environments (Kronenburg, 2005; Schmidt III & Austin, 2016; Chu, 2012).

2.3 Materials and Technical Specifications

The proposed framework utilizes standard ISO shipping containers due to their structural durability, modular adaptability, portability, and rapid deployment potential. Container-based architectural systems have increasingly been explored within humanitarian and emergency-response contexts due to their scalability and construction efficiency (Aznar & Tejedor, 2020; Radwan, 2015). The wall assembly system consists of a 100 mm container deck, 30 mm spray foam insulation, 50 mm polyisocyanurate (PIR) insulation, and 12 mm gypsum board to improve thermal performance and indoor environmental conditions.

To address limitations in local infrastructure and energy supply, the units integrate off-grid support systems including rooftop solar technologies and greywater reuse strategies. Each unit incorporates a six-panel solar array with seasonal tilt adjustments intended to support estimated daily energy demands. Solar photovoltaic systems are viable off-grid energy solutions capable of supporting partial residential energy independence under suitable climatic conditions (Maka & Alabid, 2022; Shaikh & Ahammed, 2020).

In addition, greywater treatment is proposed for non-potable applications such as toilet flushing, consistent with humanitarian water-management principles and minimum living standards outlined in the Sphere Handbook (Sphere Association, 2018). These systems aim to support more stable and resource-efficient temporary living environments compared to informal settlements and emergency tent-based conditions.

2.4 Procedures and Design Protocols

The modular units were designed using a compact daily-life spatial model in which foldable and transformable furniture systems allow multiple interior functions within limited floor areas. This approach supports spatial adaptability while maintaining basic residential functions within the modular units (Kronenburg, 2005; Schmidt III & Austin, 2016; Chu, 2012).

The structural assembly process is designed to support rapid deployment through prefabricated modular construction methods, followed by interior fit-out procedures and on-site installation phases. Previous studies have highlighted the ability of modular construction systems to reduce construction durations and improve deployment efficiency compared to conventional building approaches (Zohourian et al., 2024; Subramanya et al., 2020).

Healthcare units were designed as adaptable modules capable of supporting different temporary medical functions through modifications to internal layouts and equipment configurations. Previous studies have demonstrated the feasibility of converting shipping containers into temporary healthcare environments and emergency-response facilities (Aznar & Tejedor, 2020). Proposed deployment protocols prioritize locations with sufficient street accessibility for transportation and installation requirements, as well as adequate external space for water storage and waste-management systems.

2.5 Data Analysis and Recovery Framework

The study utilizes conceptual quantitative estimations and comparative architectural analysis to evaluate the proposed modular framework. Evaluation criteria include energy support potential, spatial adaptability, deployment feasibility, accessibility considerations, and the integration of essential community services within temporary recovery environments.

The proposed framework follows a stabilization-oriented recovery approach in which the provision of temporary housing and community-support infrastructure is a crucial step toward improving living conditions during medium-term recovery phases. The integration of modular educational and healthcare facilities within public open spaces intends to support neighborhood functionality, service accessibility, and social continuity while permanent reconstruction efforts continue (Ksaiby & Ibrahim, 2024).

Rather than functioning solely as emergency shelters, the proposed modular systems are explored as transitional urban recovery infrastructure capable of supporting adaptable and resource-efficient post-conflict recovery strategies.

3. Results

This section presents the conceptual and technical outcomes of the proposed modular recovery framework, including urban deployment strategies, resource-support systems, and spatial design considerations. The results are organized according to the proposed urban triage logic, technical performance estimations, and human-cantered architectural responses intended to support post-conflict stabilization and medium-term recovery processes.

3.1 Urban Triage and Deployment Logic

The proposed recovery framework applies a triage-based urban deployment strategy to address varying levels of post-conflict urban damage. Based on the relationship between infrastructure conditions, structural integrity, and residential usability, four primary recovery zones were conceptually identified to guide the deployment of modular interventions.

Table 2. Deployment Zones (Developed by the Authors).

DEPLOYMENT ZONES			
ZONE	**CONDITION**	**PRIMARY INTERVENTION**	**GOAL**
ZONE A	High Integrity / Low Services	**SOCIAL CORE:** Modular Schools & Clinics	Restore essential services and reinforce community resilience
ZONE B	Low Integrity / Functional Grid	**RESIDENTIAL:** Units placed near plots for clearing	Support returnees and enable step-by-step reconstruction.
ZONE C	Total Destruction	**MODULAR NEIGHBORHOODS:** Full clusters on public land	Provide immediate shelter and re-establish community fabric.
ZONE D	Functioning Areas	**LOGISTICAL HUBS:** Storage and coordination	Ensure efficient operations and supply distribution.

Table 2 presents the proposed urban triage framework used to classify post-conflict conditions according to structural integrity and infrastructure functionality. Based on this classification, four recovery zones were identified to guide the deployment of modular interventions.

- Zone A (Structural Integrity High / Services Low):
  - Priority is given to modular educational and healthcare facilities intended to support the reactivation of neighborhood social infrastructure and essential community services.
- Zone B (Structural Integrity Low / Infrastructure Functional):
  - Priority is given to temporary residential clusters positioned near damaged residential areas, allowing returnees to remain close to their properties during debris removal and rebuilding processes.
- Zone C (Severe or Total Destruction):
  - This zone proposes the deployment of larger modular neighborhood clusters within open public spaces such as parks and playgrounds to support temporary housing and centralized service provision.
- Zone D (Functioning Areas):
  - Areas with relatively stable infrastructure and services are proposed as logistical support zones for storage, coordination, and resource distribution activities.

This zoning logic demonstrates the potential role of modular tactical urbanism as an adaptable response framework capable of addressing varying post-conflict urban conditions (Al-Betawi, 2024; Kawther & Hassan, 2022).

3.2 Technical and Resource Autonomy

The proposed modular framework integrates off-grid support systems intended to reduce dependence on damaged national infrastructure networks during medium-term recovery phases.

- Energy Support:
  - Conceptual energy estimations suggest that the proposed six-panel solar array could support basic daily electrical needs (Maka & Alabid, 2022; Shaikh & Ahammed, 2020).
- Water Management:
  - The integration of greywater reuse systems for non-potable applications, such as toilet flushing, intends to reduce pressure on damaged municipal water infrastructure and improve local resource efficiency (Shaikh & Ahammed, 2020; Sphere Association, 2018).
- Rapid Deployment Potential:
  - The modular structural system is designed to support rapid assembly and deployment processes compared to conventional reconstruction timelines. Prefabricated modular construction methods have been shown to improve construction efficiency and reduce project durations, making them suitable for temporary recovery applications in post-conflict environments (Zohourian et al., 2024; Subramanya et al., 2020).

Overall, these technical strategies demonstrate the potential of modular systems to support temporary urban stabilization through adaptable and resource-conscious infrastructure approaches.

3.3 Human-Centered Design Outcomes and Modular Scalability

The proposed architectural framework emphasizes spatial dignity, adaptability, and social interaction as important considerations within post-conflict recovery environments.

- Spatial Stability and Privacy:
  - The provision of private and secure living environments intends to support psychological comfort and improve residential stability for displaced populations affected by prolonged conflict conditions (Desai, 2025; Blackmore et al., 2020).
- Community-Oriented Site Layouts:
  - The proposed arrangement of modular units in clustered configurations rather than isolated linear rows aims to encourage social interaction and shared communal spaces through the integration of internal courtyards and gathering areas.
- Scalability and Adaptability:
  - The modular units were conceptually designed as expandable building blocks capable of both horizontal and vertical growth. This allows the framework to accommodate different family sizes and changing spatial needs while supporting higher-density living within limited urban footprints (Kronenburg, 2005; Schmidt III & Austin, 2016; Chu, 2012).
- Vertical Expansion Strategy:
  - Vertical stacking concepts supported by integrated stair systems improve land-use efficiency and support adaptable neighborhood growth within constrained post-conflict urban environments.

These findings highlight the potential role of modular systems as adaptable recovery infrastructure capable of supporting both physical and social stabilization processes during transitional recovery phases.

4. Discussion

This section discusses the broader architectural, socio-economic, and urban implications of the proposed modular recovery framework in relation to post-conflict conditions in Northern Syria. The discussion interprets the findings through the lens of poverty reduction, infrastructure accessibility, transitional recovery, and neighborhood stabilization while acknowledging the practical limitations and challenges associated with modular deployment strategies.

4.1 Interpretation of Findings: Addressing Urban Poverty Drivers

The findings of this study correspond with previously identified socio-economic challenges associated with post-conflict conditions in Northern Syria. Recent studies on multidimensional poverty have highlighted the significant influence of limited access to healthcare, education, sanitation, and adequate housing on overall living conditions within displaced and conflict-affected communities. (Taher & Al-Chikh Ali, 2025; World Bank, 2017).

Within this context, the proposed modular framework is intended to support temporary access to essential services through the integration of educational, healthcare, and residential modules within damaged urban environments (Taher & Al-Chikh Ali, 2025; Kawther & Hassan, 2022).

Rather than functioning solely as emergency shelter, the proposed system is conceptually positioned as transitional urban support infrastructure capable of assisting neighborhood stabilization during medium-term recovery phases (Al-Betawi, 2024).

The findings suggest that improving access to basic services and spatially stable living environments may contribute to reducing some of the socio-spatial pressures associated with prolonged displacement and informal settlement conditions.

4.2 Comparison: Limitations of Traditional Shelter Systems

Previous studies on displacement conditions have identified the limitations of temporary makeshift shelters, particularly regarding thermal performance, sanitation integration, durability, and access to basic infrastructure services (Sphere Association, 2018; Shelter Projects, 2020).

The findings of this study suggest that repurposed shipping containers may provide a more adaptable and structurally stable alternative within post-conflict urban environments. In comparison to tents and temporary mud-brick structures, modular container systems allow greater integration of off-grid infrastructure systems, including insulation layers, solar technologies, and greywater reuse applications.

In addition, the proposed insulated wall assembly system plans to support improved indoor environmental conditions compared to many informal temporary shelters currently observed in damaged urban regions. While the proposed framework does not replace permanent reconstruction, it may provide a more stable transitional environment capable of supporting temporary urban recovery processes (Boafo et al., 2016).

4.3 Addressing Limitations: Logistics and Long-Term Transitional Conditions

The study acknowledges several practical and operational challenges associated with modular deployment strategies in post-conflict urban settings.

- Logistical Constraints:
  - Transporting modular units through heavily damaged urban environments presents significant accessibility challenges. To address this limitation, the study proposes a primary access strategy prioritizing deployment near arterial roads and accessible public open spaces. In addition, modular units may be partially prefabricated and assembled on-site in locations where large transportation vehicles and heavy machinery have limited accessibility (World Bank, 2017; Zohourian et al., 2024; Subramanya et al., 2020).

- Long-Term Transitional Conditions:
    - The study recognizes the sensitivity of prolonged temporary living conditions among populations displaced for extended periods. Within this context, the proposed framework aims to provide more stable and resource-supported temporary environments compared to emergency tent-based settlements through the integration of off-grid services, thermal insulation, and community-support infrastructure.

These findings highlight the importance of balancing rapid deployment needs with longer-term urban recovery considerations in post-conflict environments.

4.4 Implications: Potential Social and Economic Recovery

The proposed framework demonstrates the potential role of modular tactical urbanism in supporting transitional neighborhood recovery processes through the integration of temporary housing and community-support infrastructure during medium-term recovery periods. In addition, the localized assembly and adaptation of modular systems may create opportunities for temporary employment, technical training, and small-scale reconstruction activities within affected communities (Ksaiby & Ibrahim, 2024; World Bank, 2017).

Furthermore, the integration of modular schools and healthcare facilities within public open spaces may support continuity of education and community services while permanent reconstruction efforts continue. These implications position modular systems not only as temporary shelters, but also as adaptable transitional infrastructure capable of supporting medium-term urban stabilization strategies. Figure 2 presents the System Lifecycle Diagram of the proposed modular recovery framework, illustrating the progression from rapid deployment and temporary service provision to long-term urban recovery and reconstruction.

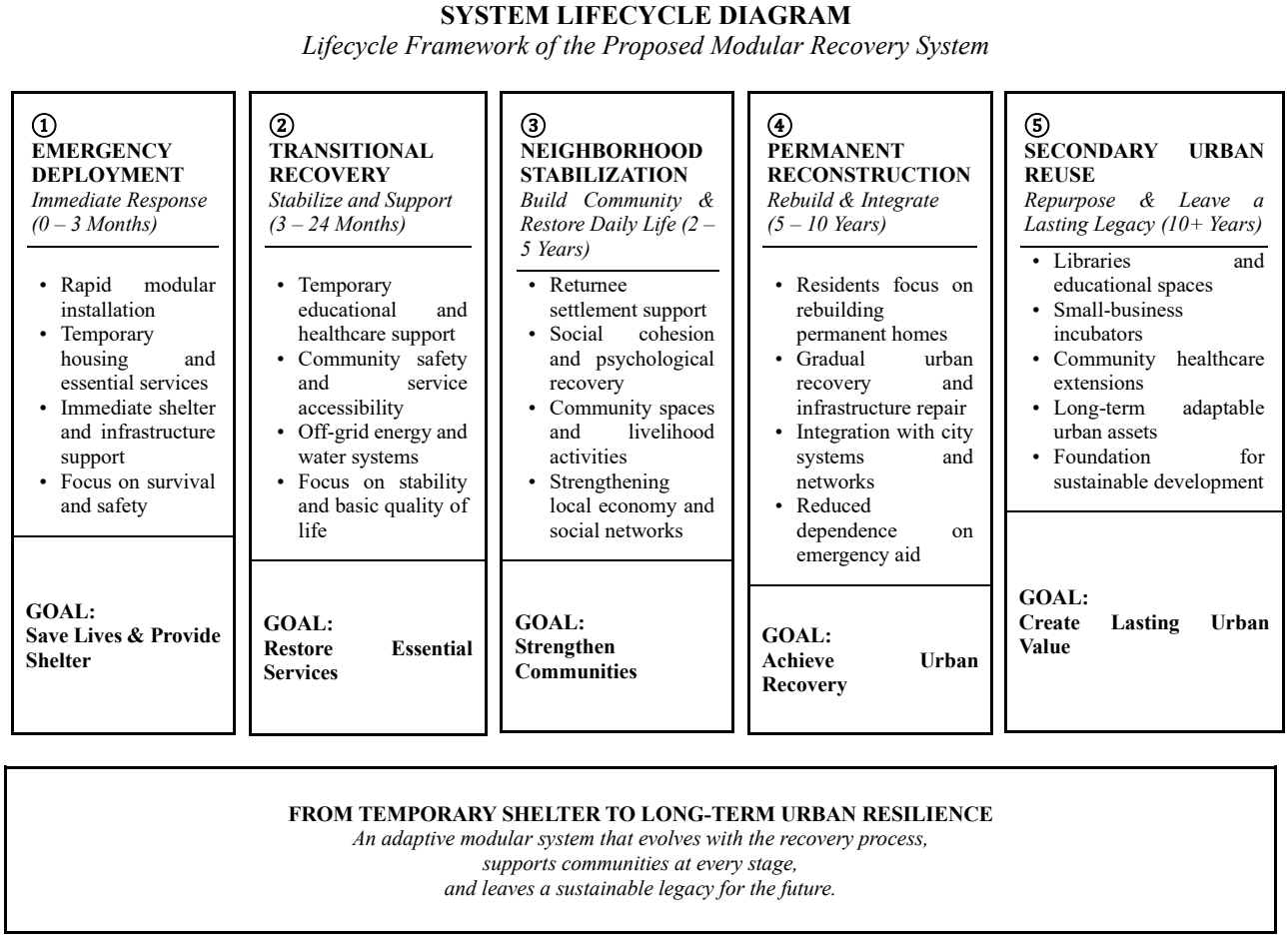

Figure 2. Methodology Flowchart (Developed by the Authors).

5. Conclusions

This section summarizes the main findings of the study and discusses the broader implications of modular tactical urbanism within post-conflict recovery contexts. It also outlines the practical limitations of the proposed framework and identifies future research directions related to adaptable modular recovery systems and long-term urban resilience strategies.

5.1 Summary of Key Findings

This study explored the potential of repurposed shipping containers as adaptable modular systems capable of supporting temporary urban recovery processes within post-conflict environments. The findings suggest that modular container-based interventions provide a rapid and resource-conscious alternative for temporary housing and community-support infrastructure during medium-term reconstruction phases (Aznar & Tejedor, 2020; Ksaiby & Ibrahim, 2024).

The proposed framework demonstrated how public open spaces, including parks and school playgrounds, could function as temporary deployment zones for modular residential, educational, and healthcare units. This strategy avoids some of the immediate structural and legal constraints associated with heavily damaged private properties, allowing for immediate intervention.

Furthermore, the integration of off-grid systems, including solar technologies and greywater reuse strategies, demonstrated the potential to support basic infrastructure needs in areas with severely compromised utility networks (Maka & Alabid, 2022; Shaikh & Ahammed, 2020; Sphere Association, 2018).

These findings suggest that modular systems may contribute to improved temporary living conditions and neighborhood stabilization during transitional recovery periods.

5.2 Implications for Future Urban Resilience

The findings of this study suggest that post-conflict reconstruction may benefit from approaches that combine rapid deployment, adaptability, and resource-conscious infrastructure strategies (Kawther & Hassan, 2022).

Within this context, modular tactical urbanism may offer an intermediate recovery framework capable of supporting temporary urban functionality while long-term reconstruction efforts continue (Odunlade & Abegunde, 2023; World Bank, 2017).

The proposed framework also highlights the potential role of modular educational and healthcare facilities in supporting continuity of essential community services during recovery phases. For planners and decision-makers, the study presents a conceptual approach that may assist in accelerating temporary service accessibility and neighborhood stabilization within damaged urban environments.

Although developed within the context of Northern Syria, the broader framework may also provide relevant insights for post-disaster and post-conflict recovery strategies in other regions facing large-scale infrastructure disruption and displacement conditions (Kawther & Hassan, 2022).

5.3 Limitations and Cultural Considerations

Several practical limitations affecting the proposed framework should be recognized in future applications and research. The feasibility of large-scale modular deployment depends on factors including material availability, transportation accessibility, logistical coordination, and local infrastructure conditions.

In addition, the transition from traditional construction systems toward modular industrialized housing may present social and cultural acceptance challenges within some communities. While the proposed insulation and environmental systems aim to improve indoor comfort and resource efficiency, long-term acceptance may require community participation, public engagement, and further demonstration of durability and adaptability over time (Kronenburg, 2005; Schmidt III & Austin, 2016; Chu, 2012; Radwan, 2015).

5.4 Recommendations for Future Research and Long-Term Urban Integration

Future research should further investigate the long-term integration of modular systems within evolving post-conflict urban environments. Rather than functioning solely as temporary shelters, modular units may also be explored as adaptable urban assets capable of supporting secondary community functions following permanent reconstruction phases. Potential future applications could include neighborhood libraries, small-scale business incubators, educational support facilities, and temporary healthcare extensions. In addition, future studies may investigate the feasibility of localized modular manufacturing and assembly industries capable of supporting employment opportunities and technical capacity-building within post-conflict recovery contexts (Ksaiby & Ibrahim, 2024; World Bank, 2017).

The authors recommend further technical research regarding thermal performance optimization, infrastructure integration, scalability, and long-term urban adaptability of modular systems in different climatic and socio-economic conditions.

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