

Architecture as Humanitarian Intervention:

Designing and Deploying Resilient Supportive Infrastructure in Post-Disaster Environments

Research Methods for Architects ,ACAA7006
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1. Research Question

What are the principles and strategies employed in the widely considered successful Al-Za'atari refugee camp in Jordan, and how can these be critically applied to inform a prospective supportive infrastructure proposal for the post-conflict reconstruction of the Gaza Strip?

This overarching question is further refined through a set of subsidiary research questions that collectively interrogate the architectural, logistical, technological, and socio-cultural dimensions of post-disaster humanitarian infrastructure:

What are the minimum essential infrastructural components ,including water, power, sanitation, communication, and communal space ,required for a stable post-disaster humanitarian settlement, and how might they be architecturally integrated into modular, deployable units? How can decentralised, off-grid technologies such as solar micro-grids, biomass conversion, and atmospheric water generation be embedded within these units to guarantee operational autonomy irrespective of local grid damage? What key design principles of modularity, lightweight construction, and intuitive joinery enable the rapid deployment and reconfiguration of supportive infrastructure by unskilled labour across diverse geographical and climatic conditions? How can the design of communal infrastructure ,clinics, educational pods, cooking facilities ,incorporate principles of cultural sensitivity to support both immediate survival and longer-term social recovery? And, finally, what supply chain and material sourcing strategies maximise the speed and sustainability of deploying such interventions in conflict-affected or access-restricted environments?

Taken together, these questions reflect a dual concern: first, the extraction of transferable lessons from an established case study; and second, the architectural translation of those lessons into a contextually appropriate and ethically grounded design framework for one of the most politically and physically complex reconstruction contexts of the contemporary era.

2. Aim of the Research

The primary aim of this research is to develop a critical and evidence-based architectural framework for the design and deployment of resilient, community-centred supportive infrastructure in post-disaster and post-conflict environments. In doing so, it seeks to demonstrate that architecture can function as a form of humanitarian intervention ,not merely as shelter provision, but as a strategic instrument for the stabilisation and dignified recovery of displaced communities.

The Gaza Strip offers an acutely urgent and politically charged context for this inquiry. Following protracted conflict, the territory faces one of the most severe post-disaster challenges

in recent global history: the near-total destruction of physical infrastructure, the mass displacement of over two million people, and competing geopolitical visions for reconstruction that range from top-down, externally-financed masterplanning to locally-led, community-driven rebuilding. The scale of human suffering is immense and well-documented. An interview with a humanitarian field worker operating in Gaza through the organisation Human Appeal described an incident in which an infant died overnight due to exposure: the emergency shelter provided could not maintain adequate thermal insulation against the sharp nocturnal temperature drops experienced in the region. This single account crystallises a broader systemic failure, that post-disaster architecture frequently prioritises individual shelter provision over the integrated communal infrastructure necessary for human dignity, health, and security.

Against this backdrop, the research aims to draw lessons from the Al-Za'atari refugee camp in Jordan, a settlement that has, over time, evolved from emergency tented accommodation into a structured, semi-permanent urban environment housing over 76,000 registered Syrian refugees. By critically analysing the spatial, infrastructural, and governance strategies that have shaped Al-Za'atari's relative success, this study intends to identify transferable principles applicable to the prospective reconstruction of Gaza, while remaining attentive to the profound contextual differences between the two settings.

A secondary aim is to develop a conceptual model for a 'Supportive Infrastructure Kit': a modular, rapidly deployable, and context-responsive system of architectural components integrating decentralised power, water purification, sanitation, and essential communal facilities. This model is intended to transcend the Gaza context and serve as a transferable typological contribution to the broader field of humanitarian architecture.

The ultimate aspiration of the research is to position architectural design not as an afterthought to humanitarian logistics, but as a first-response discipline capable of accelerating the transition from emergency relief to sustainable and dignified community recovery.

3. Strategy for Conducting the Research

The overarching research strategy is qualitative and design-led, situated within an interpretivist philosophical framework. As Creswell (2018) argues, qualitative research is appropriate when the aim is to explore complex social phenomena within their real-world contexts, particularly where existing theory is insufficient or inadequate. The intersecting crises of disaster, displacement, and reconstruction resist quantitative reduction and demand the kind of contextual, critical, and generative inquiry that qualitative strategies support.

The research adopts a comparative case study strategy as its primary mode of inquiry. Groat and Wang (2013) identify the case study as one of the most appropriate research strategies in architectural research precisely because it allows the researcher to investigate a phenomenon in depth within its specific context, and to draw out design-relevant insights that may be transferred or tested elsewhere. The Al-Za'atari refugee camp in Jordan will serve as the primary case study, selected on the basis of its widely acknowledged relative success as a managed, evolving humanitarian settlement. Its spatial and infrastructural development over time offers a rich analytical resource from which to extract architectural principles.

This primary case will be set in dialogue with an analysis of the competing reconstruction proposals currently in circulation for the Gaza Strip. Two principal frameworks are examined: the externally-led 'Board of Peace' masterplan, associated with the United States administration and first presented at the World Economic Forum in January 2026; and the Palestinian-led 'Phoenix Plan,' developed by a consortium of Palestinian architects and

municipal planners. The critical comparison of these two frameworks offers a productive lens through which to examine the political economy of post-disaster reconstruction and the extent to which architectural strategies can either reinforce or contest existing power structures.

In accordance with the logic of design-based research, a mode that Knight (2008) describes as particularly generative in applied and practice-oriented disciplines, the comparative analysis will feed directly into a design development phase. This phase will involve the iterative development of a conceptual architectural typology for the Supportive Infrastructure Kit, assessed against the principles and failures identified through the case study analysis. The design proposals will be evaluated through environmental performance simulation using architectural software tools, enabling assessment of thermal, structural, and logistical performance under extreme conditions.

The research strategy is also partly informed by a constructivist ontology, recognising that knowledge about built environments and their human consequences is not value-neutral, but is produced within specific political, economic, and cultural contexts. This is particularly pertinent when researching a site of ongoing geopolitical contestation such as the Gaza Strip. The researcher is therefore committed to maintaining critical reflexivity throughout the inquiry, and to foregrounding the agency and expertise of local communities and practitioners wherever the evidence base permits.

4. Methodology

The methodology is structured across three interconnected phases, each corresponding to a distinct dimension of the research questions: critical analysis, design development, and contextual application.

Phase One: Analytical and Comparative Research

The first phase comprises a comprehensive literature review and a comparative case study analysis. The literature review will canvass scholarly, professional, and policy literature across multiple intersecting domains: humanitarian architecture; disaster-resilient design; sustainable and low-embodied-energy materials; passive climate control; decentralised energy systems; and the emerging field of post-conflict urban reconstruction. The review will be critically rather than descriptively structured, with the aim of identifying key theoretical frameworks, contested positions, and evidential gaps relevant to the research question.

The case study of Al-Za'atari will draw on published academic analyses, UNHCR reports and camp planning documentation, journalistic investigations, and, where feasible, testimony from professionals with direct experience of the camp's design and governance. The analysis will be organised around a typological framework assessing: spatial organisation and urban morphology; infrastructure provision (power, water, sanitation); governance and community agency; material and construction strategy; and adaptability over time. The findings will then be set in structured critical dialogue with the two competing Gaza reconstruction proposals, enabling a comparative mapping of values, assumptions, and likely architectural and social outcomes.

Phase Two: Design Development and Performance Assessment

The second phase is design-based in character. Building on the principles extracted in Phase One, this phase will develop a conceptual architectural typology for a modular Supportive Infrastructure Kit. The design process will be iterative and tested against a defined set of

performance criteria: thermal performance across the range of climatic conditions characteristic of the Eastern Mediterranean; structural resilience to wind and seismic stress; logistical transportability within standard shipping container dimensions; and cultural appropriateness within the Palestinian context.

Environmental performance simulation tools, including solar radiation and thermal analysis software, will be employed to assess and refine the designs quantitatively. Material specifications will be evaluated with reference to their embodied energy, durability, supply chain accessibility, and potential for local sourcing or adaptation, a particular consideration in the context of Gaza's border restrictions. The Phoenix Plan's proposal for the on-site recycling of war debris into new building materials will be critically examined as a potential source of material innovation in this regard.

Phase Three: Contextual Application and Validation

The third phase tests the Supportive Infrastructure Kit design against two distinct deployment scenarios: a sudden-onset natural disaster scenario and the prolonged, conflict-driven displacement of the Gaza context specifically. This dual-scenario application tests the flexibility and transferability of the design across different scales and timelines of crisis, validating the research's claim to broader disciplinary relevance beyond its primary case.

Fellows (2008) emphasises the importance in built environment research of aligning methodological choices rigorously with research objectives, and of maintaining transparency about the assumptions and limitations embedded in each method. In accordance with this principle, the methodology described here acknowledges its dependence on secondary data for the Gaza context, given the practical impossibility of primary fieldwork in the current conditions, and its reliance on simulation modelling rather than constructed prototypes for performance assessment. These are recognised limitations that will be explicitly addressed in the final report.

5. Literature Review

5.1 The Architecture of Humanitarian Intervention

The scholarly literature on humanitarian architecture has expanded significantly in the twenty-first century, driven by the increasing frequency and scale of both natural disasters and conflict-driven displacement crises. A foundational distinction in the field, articulated by researchers including Kronenburg (2008), is between the provision of individual emergency shelter and the design of collective infrastructural systems. The former has historically dominated humanitarian response, with organisations such as the UNHCR prioritising the rapid distribution of prefabricated or tent-based individual shelters. The latter, the design of water systems, sanitation networks, communal kitchens, medical facilities, and public space, has received comparatively less architectural attention despite its decisive importance for community stability and health outcomes.

Davis and Alexander (2016) draw a critical distinction between 'relief' and 'recovery,' arguing that the architectural profession has been slow to engage with the full temporal arc of post-disaster community reconstruction. Too frequently, architectural intervention ends at the emergency phase, leaving the more complex and politically contested process of recovery to be managed through bureaucratic and logistical means rather than design. The research proposed here positions itself explicitly within this gap, arguing that a more proactive and holistic architectural engagement with the recovery phase is both possible and necessary.

Charlesworth (2014) offers a critical overview of the historical evolution of humanitarian architecture, noting the profession's recurring tendency towards technological solutionism: the assumption that a well-designed, universally applicable prefabricated shelter can resolve crises that are, at root, political and social in character. This critique is directly relevant to the research's interest in the competing reconstruction frameworks for Gaza, where the risk of imposing external design solutions over local knowledge and agency is particularly acute.

5.2 Al-Za'atari: An Evolving Model of Managed Settlement

Al-Za'atari refugee camp in Jordan, established in July 2012 to receive Syrian refugees displaced by the civil war, has become one of the most studied humanitarian settlements in recent decades. What distinguishes it within the literature is not simply its scale, at its peak, it housed over 150,000 people, making it Jordan's fourth-largest city, but the degree to which it has evolved organically from emergency provision into a structured, if informal, urban environment.

Scholars including Ledwith (2014) and Sanyal (2017) have documented the camp's spatial evolution, noting how residents progressively transformed standardised UNHCR caravan units, replacing them with brick extensions, informal street-front commercial premises, and community gathering spaces, in a process that effectively constitutes a form of bottom-up urban planning. This self-organisation, often carried out in defiance of camp management regulations, reveals the inadequacy of top-down planning approaches and the critical importance of designing flexibility and agency into post-disaster settlements from the outset.

The camp's infrastructural development is particularly instructive. The installation of a large-scale solar energy system by UNHCR, in partnership with the German development agency GIZ, significantly improved quality of life and reduced the camp's dependence on expensive and polluting diesel generation. The Champs-Élysées, the camp's main commercial street, demonstrates how communal economic activity can organically emerge when populations are provided with even minimal spatial and infrastructural stability. These observations lend empirical weight to the research's hypothesis that decentralised energy provision and the design of productive communal space are critical determinants of settlement stability and community recovery.

5.3 Competing Visions for Gaza's Reconstruction

The literature on post-conflict urban reconstruction provides a well-established theoretical framework for understanding the competing reconstruction proposals currently in circulation for Gaza. Architects and urban scholars including Vale and Campanella (2005) have demonstrated that decisions made in the immediate post-disaster window, about land tenure, spatial organisation, infrastructure investment, and governance structures, tend to lock in patterns of inequality and exclusion that persist for decades. This makes the choice between competing reconstruction frameworks a matter of profound long-term consequence.

The 'Board of Peace' proposal, presented at the World Economic Forum in January 2026, represents a model of large-scale, externally-financed reconstruction oriented towards economic liberalisation and touristic development. Its vision of high-rise residential and commercial towers, a coastal 'Gaza Riviera,' a new seaport and airport, and a transition to a free-market economic model draws heavily on the Gulf States development model, particularly Dubai. Within the scholarly literature, this approach aligns with what Roy (2005) has termed 'planning by exception': the suspension of ordinary planning norms and community consultation in favour of rapid, investor-led spatial transformation. Critics of this model point

to its erasure of existing spatial memories, the displacement of pre-existing communities from prime sites, and its dependence on sustained external political and financial commitment that may prove unreliable over time.

In contrast, the Palestinian-led Phoenix Plan, developed by a consortium of local architects and municipal professionals, prioritises social fabric, local agency, and cultural continuity. Its explicit rejection of the tabula rasa approach is theoretically grounded in a substantial body of post-disaster reconstruction scholarship. Barakat (2003), for instance, argues that sustainable reconstruction must be built upon existing community networks, local knowledge, and a commitment to land tenure security rather than wholesale spatial reinvention. The Phoenix Plan's proposal for a circular economy of construction, recycling the millions of tonnes of war debris into new building materials to circumvent border restrictions on imported goods, represents a particularly innovative and contextually responsive design strategy that merits detailed architectural investigation.

5.4 Modular Infrastructure and Decentralised Technologies

A growing body of research in architectural technology and engineering supports the case for modular, decentralised infrastructure systems in humanitarian settings. The concept of containerised or flat-pack modular systems deployable within standard logistics frameworks has attracted significant attention since the 2004 Indian Ocean tsunami and the 2010 Haiti earthquake, both of which exposed severe inadequacies in conventional relief logistics. Researchers including Opdyke et al. (2017) have identified the key performance criteria for such systems: transportability within standard shipping containers, assembly by unskilled labour using simple joinery, climatic adaptability, and long-term durability.

The integration of off-grid energy and water systems is particularly significant for conflict-affected contexts where grid infrastructure may be destroyed or politically controlled. The rapid reduction in the cost of photovoltaic solar technology has made solar micro-grids an increasingly viable option for post-disaster settlements. Atmospheric water generation, the extraction of potable water from ambient air humidity, represents an emerging technology with particular potential in the Eastern Mediterranean climate, where humidity levels can support meaningful generation rates even in periods of water infrastructure collapse.

6. Pilot Study

The pilot study is designed to test both the methodological approach and the emergent analytical framework prior to the main research phase. It is structured around a comparative desktop analysis of three distinct post-disaster architectural responses, selected to represent a range of contexts, scales, and strategic approaches: the Al-Za'atari refugee camp (Jordan, 2012–present); the Elemental half-house programme in Quinta Monroy, Chile (2004); and the UNHCR Better Shelter initiative (global deployment, 2015–present).

These three cases were selected on the basis of their contrasting approaches to the tension between top-down standardisation and bottom-up adaptability. Al-Za'atari illustrates the emergence of complexity and community agency within a nominally standardised system. Elemental's Quinta Monroy project is an acknowledged landmark in participatory social housing design, providing half a completed dwelling and leaving the remainder for residents to complete over time according to their own needs and resources, a strategy that has been influential in humanitarian architecture discourse. The Better Shelter programme, by contrast, represents a more conventional top-down approach to the standardised manufacture and global distribution of an improved emergency shelter unit.

The pilot analysis applies a consistent evaluative framework to all three cases, assessing each against six dimensions: infrastructural integration (the degree to which shelter provision is integrated with water, power, sanitation, and communal systems); spatial adaptability (the capacity of the built form to be modified by residents over time); logistical efficiency (transport volume, assembly time, and required skill level); climatic performance (thermal, structural, and environmental appropriateness); cultural responsiveness (degree of community consultation and incorporation of local spatial practices); and long-term durability and transition to permanence.

Preliminary findings from the pilot analysis indicate that infrastructural integration and spatial adaptability are consistently the weakest dimensions across all three cases, lending empirical support to the research's core hypothesis. The Better Shelter unit, while representing a significant improvement over standard UNHCR tents in terms of thermal performance and structural resilience, provides no integrated infrastructural systems and limited scope for spatial adaptation. Al-Za'atari's relative success, the pilot analysis suggests, derives precisely from its residents' capacity to appropriate and modify space in ways that the initial planning framework did not anticipate or facilitate. The Elemental model offers the most theoretically productive precedent for the design phase of the main research, suggesting that the intentional provision of incomplete but adaptable infrastructure, a spatial 'scaffold' rather than a finished product, may be the most effective architectural strategy for post-disaster recovery contexts.

The pilot study has also tested the feasibility and productivity of applying environmental performance simulation tools to the assessment of comparable shelter typologies. Using Autodesk Insight for solar and thermal analysis, a comparative thermal performance assessment of the Better Shelter unit, a standard UNHCR caravan (the primary unit type used at Al-Za'atari), and a conceptual modular unit based on the research's emerging design principles has been completed for a simulated Eastern Mediterranean climate. The results indicate that the research's proposed integration of phase-change materials within wall panels can reduce internal temperature fluctuation by a significant margin relative to the baseline UNHCR caravan unit, a finding directly relevant to the infant mortality incident described in the introduction to this report. These preliminary simulation results will inform the material specification process in Phase Two of the main research.

The pilot study has confirmed the appropriateness of the comparative case study methodology and the evaluative framework developed for the main research phase. It has also identified a number of refinements required: in particular, the need for a more systematic and reproducible protocol for assessing cultural responsiveness, given the qualitative and politically contested nature of this dimension. A structured protocol drawing on the approach recommended by Groat and Wang (2013) for the analysis of built environment's social meanings will be developed and piloted in consultation with the module team prior to the main research phase.

7. Conclusion

This research report has set out the foundations of an inquiry into architectural practice as humanitarian intervention. The research question, focusing on the transferable lessons of the Al-Za'atari refugee camp for the prospective reconstruction of the Gaza Strip, provides a rigorous and contextually grounded framework for investigation. The research aims, to develop both a critical analytical understanding of post-disaster infrastructure strategies and a generative design typology in the form of a Supportive Infrastructure Kit, are clearly delineated and mutually reinforcing.

The methodology, combining comparative case study analysis with design-based research and environmental performance simulation, is appropriate to the dual analytical and generative aims of the study. The pilot study has validated this approach and yielded preliminary findings that both confirm the research's central hypothesis and refine the investigative framework for the main research phase.

The urgency of the humanitarian context within which this research is situated cannot be overstated. As competing visions for Gaza's reconstruction are debated in global political fora, the choices made now about spatial organisation, infrastructure investment, and the degree of local agency afforded to displaced communities will shape the lives of millions of people for generations. This research positions architectural design, its principles, its methods, and its ethical commitments, as an indispensable contributor to those choices.

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