



BEYOND TEMPORARINESS

A REVERSE POST-OCCUPANCY INCREMENTAL HOUSING MODEL FOR POST-DISASTER SETTLEMENTS IN BOUMERDÈS, ALGERIA

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ABSTRACT

Temporary housing is widely used as an immediate response to post-disaster displacement, yet prolonged occupation can transform temporary settlements into de facto permanent residential environments. This study investigates the long-term transformation of temporary housing established following the 2003 Boumerdès earthquake in Algeria and explores an alternative approach to their progressive conversion into permanent and adaptable dwellings. Based on field observations, residential surveys, and an analysis of spontaneous transformations, the study identifies recurrent patterns of extension, enclosure, room addition, and appropriation of spaces beyond the original dwelling boundaries. These transformations reveal both residents' capacity to adapt their homes and the limitations of the initial temporary units in terms of space, flexibility, and adaptability. Building on these findings, the research proposes a Reverse Post-Occupancy Incremental Housing Model, developed through a Research through Design approach. The model reverses the conventional incremental housing sequence by introducing an independent structural system around an already occupied temporary dwelling. Its seven-phase process enables the gradual development of permanent residential space, transfer of occupants, and progressive removal of the original unit while preserving the existing plot and infrastructure. The findings suggest that in-situ transformation can provide a context-sensitive alternative to demolition and relocation, extending incremental housing principles to existing and occupied temporary settlements. Beyond its residential function, the model offers a creative urban alternative for improving living conditions and requalifying post-disaster settlements, while further structural, economic, and operational validation remains necessary.

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Introduction

The increasing frequency and intensity of natural disasters over recent decades have become a major challenge for planning, reconstruction, and sustainable development policies. Beyond human and material losses, disasters cause extensive destruction of the built environment and require rehousing strategies capable of addressing both immediate humanitarian needs and the requirements of sustainable reconstruction (United Nations Office for Disaster Risk Reduction, 2015). While the emergency response phase generally addresses the immediate needs of affected populations, the reconstruction phase remains the most complex and prolonged stage of the post-disaster recovery process (Haas et al., 1977; Rouhanizadeh et al., 2019). It requires substantial technical, financial, institutional, and social resources and may extend over several years or even decades, depending on the scale of the disaster, governance capacities, and the socio-economic conditions of the affected territories.

International disaster risk management frameworks generally distinguish several successive phases within the post-disaster recovery process, including relief operations, emergency shelter, recovery, reconstruction, and the sustainable restoration of affected communities (Barakat, 2003; United Nations Office for Disaster Risk Reduction, 2015). Within this continuum, the specialized literature also identifies a sequence of accommodation solutions ranging from emergency shelter to temporary housing and ultimately permanent housing (Johnson, 2007; Quarantelli, 1995). Among these stages, temporary housing plays a strategic role by providing a transition between emergency response and permanent reconstruction. Beyond simply sheltering disaster-affected populations, it provides a living environment that allows communities to remain close to their original surroundings, supports the continuity of economic and social activities, and facilitates the planning and implementation of reconstruction operations (Félix et al., 2013; IFRC, 2013).

The international literature converges on a structural observation: post-disaster temporary housing tends systematically to remain in use far beyond its intended lifespan, regardless of the institutional context or level of development. This observation calls for a reconsideration of temporary housing not merely as a stopgap solution expected to disappear rapidly, but as an unavoidable strategic component of post-disaster response, despite its controversial nature.

The Japanese experience provides one of the most significant illustrations of this phenomenon. Following the 1995 Kobe earthquake, part of the affected population remained in temporary housing five years after the disaster, with the social isolation associated with these settlements being linked to the emergence of *kodokushi*, or solitary death (Bris & Bendito, 2019). Despite Japan's internationally recognized expertise in earthquake risk management, a similar dynamic occurred following the Tōhoku earthquake and tsunami: 958 people were still living in temporary housing in 2023, twelve years after the disaster (The Reconstruction Agency, 2023). In Italy, the official report of the *Struttura Commissariale* confirms a comparable recurrence: eight years after the 2016–2017 earthquakes, 2,789 households were still residing in *soluzioni abitative di emergenza* (SAE). This situation led the authorities themselves to recognize the need to transform this emergency provision into an instrument capable of accommodating the actual timescale of reconstruction (Castelli, 2024).

Beyond institutional shortcomings alone, this prolonged use also results from dynamics driven by the inhabitants themselves. In Chile and Peru, Wagemann ((2017) shows that families extensively transform their prefabricated temporary dwellings (*mediaguas*), sometimes doubling or even tripling their original floor area, despite knowing that they are expected to leave these settlements within a predetermined period. Such spontaneous appropriation reveals that the need for durability and adaptability consistently exceeds the temporal horizon officially assigned to temporary housing, regardless of the context.

These converging cases, whether resulting from planning failures or spontaneous forms of resident-driven appropriation, demonstrate the adaptive capacity of affected communities while simultaneously revealing the limitations of temporary rehousing models based on rigid and non-evolutive units. This observation has led part of the research community to turn towards the paradigm of *incremental housing*, theorized as early as the 1970s by Turner (1976) and Habraken (1972). These authors challenged the conventional logic of housing provision by conceiving housing not as a finished product but as a process structured around a durable support that can be progressively appropriated and transformed by its occupants. This paradigm found one of its most influential contemporary formulations in the “half a good house” model developed by the Chilean firm Elemental under the direction of Alejandro Aravena, recipient of the Pritzker Prize in 2016 (Aravena & Iacobelli, 2016); and implemented notably in the post-disaster Villa Verde project. Post-occupancy studies of this project nevertheless indicate that such self-construction dynamics, while demonstrating a sustained capacity for residential resilience, leave open questions regarding the long-term structural and safety implications of transformations undertaken beyond the technical control of the designers (Carrasco & O’Brien, 2022a, 2022b).

Whereas incremental housing is traditionally conceived as a planning strategy that incorporates adaptability from the initial design stage, the application of its principles to existing temporary housing that has been continuously occupied and extensively modified remains largely underexplored. In such situations, interventions no longer consist of supporting the planned evolution of newly constructed housing, but rather of progressively transforming provisional housing that has become permanent while maintaining occupancy, ensuring residents’ safety, and adapting interventions to the technical constraints of the existing structures. This issue remains insufficiently explored in the scientific literature, despite its growing relevance in territories facing the long-term consequences of natural disasters. It therefore raises the question of how the principles of incremental housing can be adapted to support the progressive transformation of a stock of temporary housing that has become permanently occupied.

Algeria provides a particularly representative example of this situation. Following the El Asnam (1980) and Boumerdès (2003) earthquakes (CRAAG, 2026b), large-scale temporary rehousing programmes based on prefabricated units were implemented to provide rapid accommodation for affected populations. Following the El Asnam earthquake, more than 18,300 prefabricated units were constructed. Although designed for limited-term occupancy, these dwellings remained in use for several decades, with their gradual replacement by permanent housing only completed in 2022 (OPGI, 2021 ; Direction du Logement de Chlef, 2022).

The Boumerdès earthquake, in turn, led to the installation of 14,917 prefabricated units distributed across 96 temporary rehousing sites. More than twenty years after the disaster, despite the gradual dismantling process initiated in 2016, 1,645 units were still occupied in 2024 (Wilaya de Boumerdès, 2017). Over time, these dwellings underwent numerous informal transformations intended to respond to changing household needs, revealing both their long-term persistence, their physical deterioration, and the absence of integrated possibilities for future adaptation in their original design. Although the servicing infrastructure remains generally functional, the dwelling units now exhibit an advanced state of deterioration, together with a wide variety of informal extensions and modifications. These adaptations reflect the inadequacy of the initial floor areas, the absence of built-in potential for future expansion, and the need to progressively adapt provisional housing to a use that has become permanent. This situation makes Algerian temporary housing settlements a particularly relevant field for investigating how the principles of incremental housing can be transferred to an existing housing stock that is occupied and has been extensively transformed through residents’ practices.

Beyond residential concerns, the long-term persistence of temporary rehousing sites also raises issues of sustainable spatial planning. In many cases, these settlements were established on land reserves, agricultural land, or areas with significant development potential, and are subsequently

replaced by new housing programmes constructed on different sites (DL Boumerdès, 2021). This reconstruction strategy contributes to urban sprawl and the consumption of additional land resources, thereby encouraging the exploration of alternatives based on the in-situ transformation of existing sites.

Against this background, this article proposes a *Reverse Post-Occupancy Incremental Housing Model*, which transfers the principles of incremental housing to existing temporary dwellings that have been continuously occupied and progressively transformed by their residents. Unlike conventional incremental approaches, which are incorporated from the outset into the design of new housing, the proposed model seeks to progressively transform temporary housing that has become permanent while maintaining household occupancy and making use of existing infrastructure

The model is developed around a lightweight and modular construction system that enables the dwelling to be progressively transformed without requiring the relocation of occupants. Its feasibility is assessed through the case of the temporary rehousing settlements of Boumerdès, based on an analysis of its technical, constructive, and economic feasibility, together with a comparison with conventional strategies relying on the dismantling of existing settlements and reconstruction on new land. Beyond proposing an architectural model, this research contributes to extending the scope of incremental housing by applying its principles to existing temporary dwellings that are already occupied and have undergone long-term transformations. It proposes a conceptual and operational framework for their progressive conversion, combining residential continuity, resilience, optimization of existing infrastructure, and reduced land consumption. In doing so, it opens a new perspective for post-disaster reconstruction policies confronted with the long-term persistence of temporary housing.

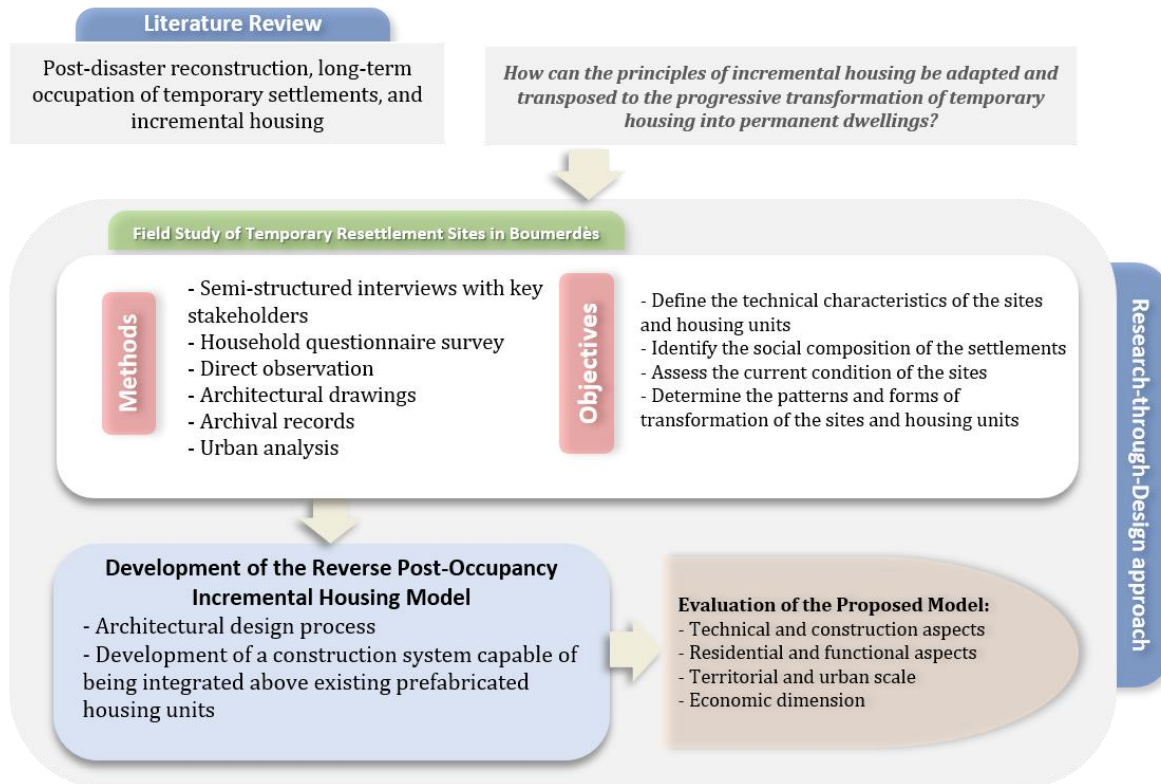
2. Research Framework and Methodology

2.1. Research Framework

This research adopts a Research through Design (RtD) approach, which uses architectural design as a means of knowledge production and as a tool for addressing complex problems (Frayling, 1994; Zimmerman et al., 2018). Rather than relying exclusively on a descriptive approach, this methodology seeks to develop, test, and evaluate an architectural solution addressing a need identified in the literature and confirmed through field observation.

The research framework is based on the hypothesis that the principles of incremental housing, traditionally applied to dwellings designed for future adaptation from the outset, can be transferred to existing temporary housing that has become permanent. This hypothesis challenges the conventional demolition-and-reconstruction logic by exploring a progressive transformation strategy capable of simultaneously ensuring residential continuity, making use of existing infrastructure, and limiting additional land consumption.

The methodological approach is structured around four complementary stages (**Figure 1**). The first stage consists of identifying the research problem through a review of the literature and international experiences of post-disaster reconstruction. The second focuses on field investigation of the temporary rehousing settlements in Boumerdès in order to characterize resident-driven transformations and identify the constraints affecting the existing housing stock. The third stage involves the development of the *Reverse Post-Occupancy Incremental Housing Model*, while the final stage evaluates its feasibility and relevance through comparison with conventional reconstruction strategies.

Figure 1. Methodological Framework of the Research

Source: Own elaboration, 2026

2.2. Case Study

The selected case study concerns the temporary rehousing settlements established following the Boumerdès earthquake of 21 May 2003, which had a magnitude of 6.8 and caused extensive human and material losses in north-central Algeria (CRAAG, 2026a). To rapidly address the rehousing needs of the affected population, the public authorities implemented a large-scale programme comprising 14,917 prefabricated units distributed across 96 sites intended to temporarily accommodate affected households (Wilaya de Boumerdès, 2017).

Designed for occupancy over a limited period of a few years, these units progressively became permanent housing for a proportion of households as a result of delays in the reconstruction of permanent dwellings. Despite the dismantling operations initiated in 2016, 1,645 units were still occupied in 2024, illustrating the long-term persistence of a system initially conceived as transitional.

The selection of this case study is based on several criteria. First, the long duration of occupation makes it possible to observe the long-term effects of the persistence of temporary housing. Second, the numerous transformations undertaken by residents provide valuable evidence of their actual housing adaptation needs. Finally, the continued functionality of existing infrastructure provides a favourable context for exploring in-situ transformation strategies without relocating the affected population.

Figure 2. Location of the Zemmouri study site (Boumerdès, Algeria), settlement layout, and characteristics of the prefabricated temporary dwelling (36 m² typical floor plan on a 100 m² plot).



Source: Archives of the Centre National d'Ingénierie de la Construction ; and Own elaboration, 2026

The field investigations included visits to several temporary rehousing sites, architectural surveys, photographic documentation, and an analysis of modifications introduced by residents. These observations were complemented by an examination of technical and institutional documents relating to the rehousing programme and its subsequent development.

2.3. Development of the Reverse Post-Occupancy Incremental Housing Model

The proposed model is based on the transfer of incremental housing principles to a context different from that for which they were originally developed. Whereas conventional incremental approaches anticipate future adaptability from the initial design stage, the present research considers temporary housing that has already been constructed, occupied for many years, and extensively modified by its residents. The *Reverse Post-Occupancy Incremental Housing Model* is based on a progressive transformation strategy that allows households to remain in their dwellings throughout the construction process. The principle consists of introducing a new structural system independent of the existing prefabricated unit, capable of progressively accommodating new living spaces before the original structure is dismantled.

This approach reverses the conventional logic of incremental housing. Transformation no longer begins with a newly constructed core intended to be expanded over time, but rather with an existing

temporary dwelling that is progressively converted into permanent housing. Residential continuity constitutes a central principle of the approach, making it possible to avoid temporary relocation while reducing the extent of demolition operations.

To address requirements related to rapid construction, modularity, and adaptability, the model combines a lightweight steel frame with prefabricated components that can be integrated with commonly available local materials. The system also offers potential for innovation in partitioning and finishing elements, which can be adapted to locally available resources and construction techniques.

2.4. Evaluation Methodology

The proposed model is evaluated through a multicriteria and comparative approach aimed at assessing its relevance in relation to the constraints identified in the temporary housing settlements of Boumerdès and to the principles of progressive post-disaster housing transformation. The objective is to identify its potential, limitations, and the conditions required for its implementation.

Four dimensions are considered: technical and constructive, residential and functional, territorial and urban, and economic and operational. The first examines the independent structural system and the construction phasing; the second assesses changes in the spatial and functional capacity of the dwelling; the third considers transformation within the existing plot and the reuse of existing infrastructure; and the fourth draws on available data concerning dismantling costs, existing infrastructure, and the indicative cost of the proposed structural system.

The analysis draws on field observations, documented spontaneous transformations, project drawings, the seven-stage construction sequence, and available economic data. The results are discussed in relation to the principles of incremental housing and post-disaster reconstruction. The assessment remains exploratory, as definitive validation of the model would require detailed structural, economic, and operational studies, together with full-scale experimental implementation.

3. Results

3.1. Diagnosis of Transformations in Temporary Housing Units

Field observations conducted in the temporary rehousing settlements of Boumerdès reveal a significant gap between the initial design assumptions and the patterns of use that have developed over the past two decades. Conceived as a transitional accommodation solution, the prefabricated units have progressively become permanent housing for a proportion of households. This long-term occupation has resulted in the gradual adaptation of the dwellings, their outdoor spaces, and their relationship with the public realm.

The field analysis reveals several recurring forms of transformation. The first concerns the expansion of living space, particularly through the addition of bedrooms and the construction of supplementary volumes. The second involves the transformation of outdoor spaces, notably through the enclosure or roofing of courtyards and the extension of domestic functions, such as kitchens, into areas that were initially unbuilt. The third concerns the modification of the interface between the dwelling and the public realm through the creation or reinforcement of fences, alterations to entrances, and, in some cases, the appropriation of sidewalks or spaces extending beyond the original plot boundaries. Finally, some cases show the emergence of spontaneous and unplanned constructions carried out progressively in response to changing household needs.

Figure 3. Typology of spontaneous transformations observed in temporary housing units in Boumerdès

Source: Own elaboration, 2023

Figure 3 illustrates this diversity, ranging from dwellings that have retained their original configuration to situations characterized by the addition of rooms, expansion of the built footprint, enclosure of outdoor spaces, and progressive appropriation of peripheral areas. These transformations reveal an incremental process of adaptation in which the initial dwelling functions less as a final state than as a starting configuration that can be modified according to occupants' needs and resources.

These interventions therefore demonstrate a significant capacity for household appropriation and adaptation, while simultaneously revealing the limitations of the original housing provision in terms of floor area, flexibility, and capacity for future adaptation. Spontaneous transformation thus appears to be a response to needs that were not accommodated by the original configuration, rather than merely an aesthetic modification of the dwelling. This interpretation is consistent with Turner's approach, which views housing as a process capable of evolving in response to occupants' changing needs rather than as a definitively completed product.

Another important finding concerns the settlement scale. Although the dwelling units have undergone substantial transformations in some cases, the collective infrastructure (including roads, utility networks, and the overall spatial organization of the settlements) remains generally functional. The issue therefore does not necessarily lie in the complete obsolescence of the rehousing sites, but primarily in the progressive inadequacy of the dwelling units for uses that have become permanent. This situation creates an opportunity for a targeted transformation strategy that preserves and makes use of existing infrastructure while progressively upgrading the residential units.

This distinction between the settlement, which retains functional value, and the dwelling, which is progressively reaching its limits of adaptability, constitutes a key finding for the subsequent stages of the research. It supports an approach based not on the systematic demolition of the

existing settlement and relocation of households, but on the progressive transformation of dwellings on their original sites.

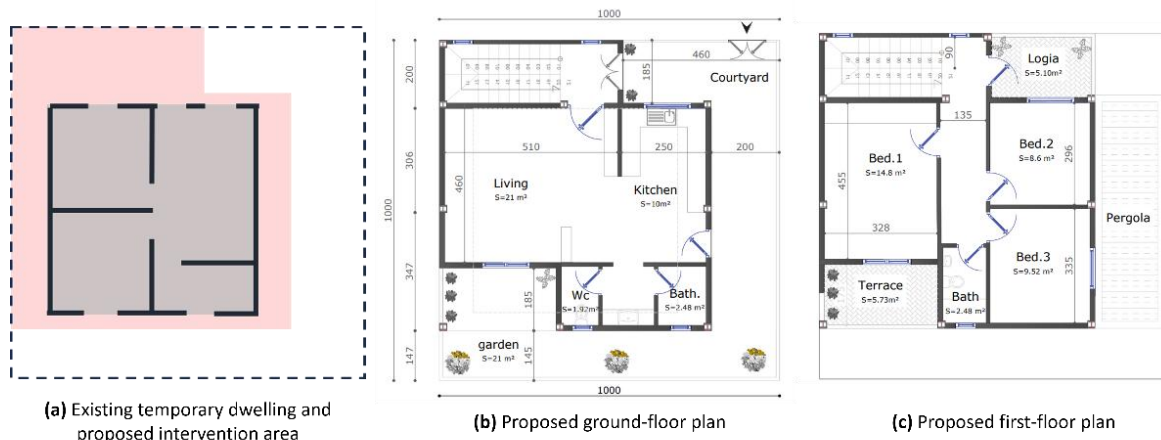
3.2. Presentation of the Reverse Post-Occupancy Incremental Housing Model

Based on the diagnosis of spontaneous transformations observed in the temporary rehousing settlements of Boumerdès, an adaptive architectural model was developed to address the growing mismatch between the original configuration of the prefabricated units and households' residential needs after several years of occupation. Referred to as the *Reverse Post-Occupancy Incremental Housing Model*, the model transfers the principles of incremental housing to a specific situation: that of an existing temporary dwelling that has already been constructed, occupied, and progressively transformed by its residents.

Unlike conventional incremental housing approaches, which anticipate future expansion from the initial design stage, the proposed approach intervenes after a prolonged period of occupation. It therefore seeks to progressively transform an existing temporary dwelling into permanent housing while keeping households on their original plots and minimizing disruption to their occupancy. The model is based on an independent structural system that enables additional residential spaces to be developed around and above the existing unit before the latter is progressively dismantled and the ground floor is subsequently reconfigured.

The spatial translation of this approach is presented in **Figure 4**, which relates the footprint of the initial temporary dwelling to the proposed ground- and first-floor organization. The project develops a two-storey residential configuration. The ground floor comprises a 21 m² living room, a 10 m² kitchen, a 1.92 m² toilet, and a 2.48 m² bathroom. The explicitly identified room areas amount to approximately 35.4 m² on this level. The first floor comprises three bedrooms measuring 14.8 m², 8.6 m², and 9.52 m², respectively, together with a 2.48 m² bathroom, resulting in approximately 35.4 m² of identified room areas.

Figure 4. Site implantation and spatial organization of the proposed Reverse Post-Occupancy Incremental Housing Model: (a) existing temporary dwelling and proposed intervention area, (b) ground-floor plan, and (c) first-floor plan.



Criteria	Plot area (m ²)	Initial built-up area (m ²)	Number of floors	Living area m ²	Number of rooms	Terrace (m ²)	Exterior Area (m ²)
Existing temporary unit	100	36	01	35,5	02	/	64
Proposed incremental model	100	57,07	02	100,22	3	18,20	36,58

Source: Own elaboration, 2026

Based on these values, the cumulative internal floor area of the designated spaces reaches approximately 70.8 m², excluding circulation areas. Compared with the initial area of 35.5 m² adopted for the temporary housing unit, this configuration represents a theoretical increase of 35.4 m². This comparison is interpreted as an indicator of the increase in the dwelling's spatial capacity.

Beyond the increase in internal capacity, the proposal incorporates several outdoor spaces, including a 21 m² garden at ground-floor level, a 5.73 m² terrace, and a 5.10 m² loggia on the upper floor. These spaces contribute to diversifying residential uses and strengthening the relationship between the dwelling and its immediate surroundings. Their inclusion in the assessment should nevertheless remain distinct from that of internal habitable floor areas.

The final configuration of the model, presented in **Figure 5**, translates this spatial transformation into a two-storey architectural expression. The elevation, axonometric, and urban integration views illustrate the proposed volume and its relationship with the public realm. The street-level perspective, in particular, makes it possible to understand the project both as a transformation of the individual dwelling and as an intervention capable of contributing to the gradual evolution of the site's built environment.

Figure 5. Final architectural configuration of the proposed Reverse Post-Occupancy Incremental Housing Model: (a) elevation, (b) axonometric view, and (c) street-level integration.



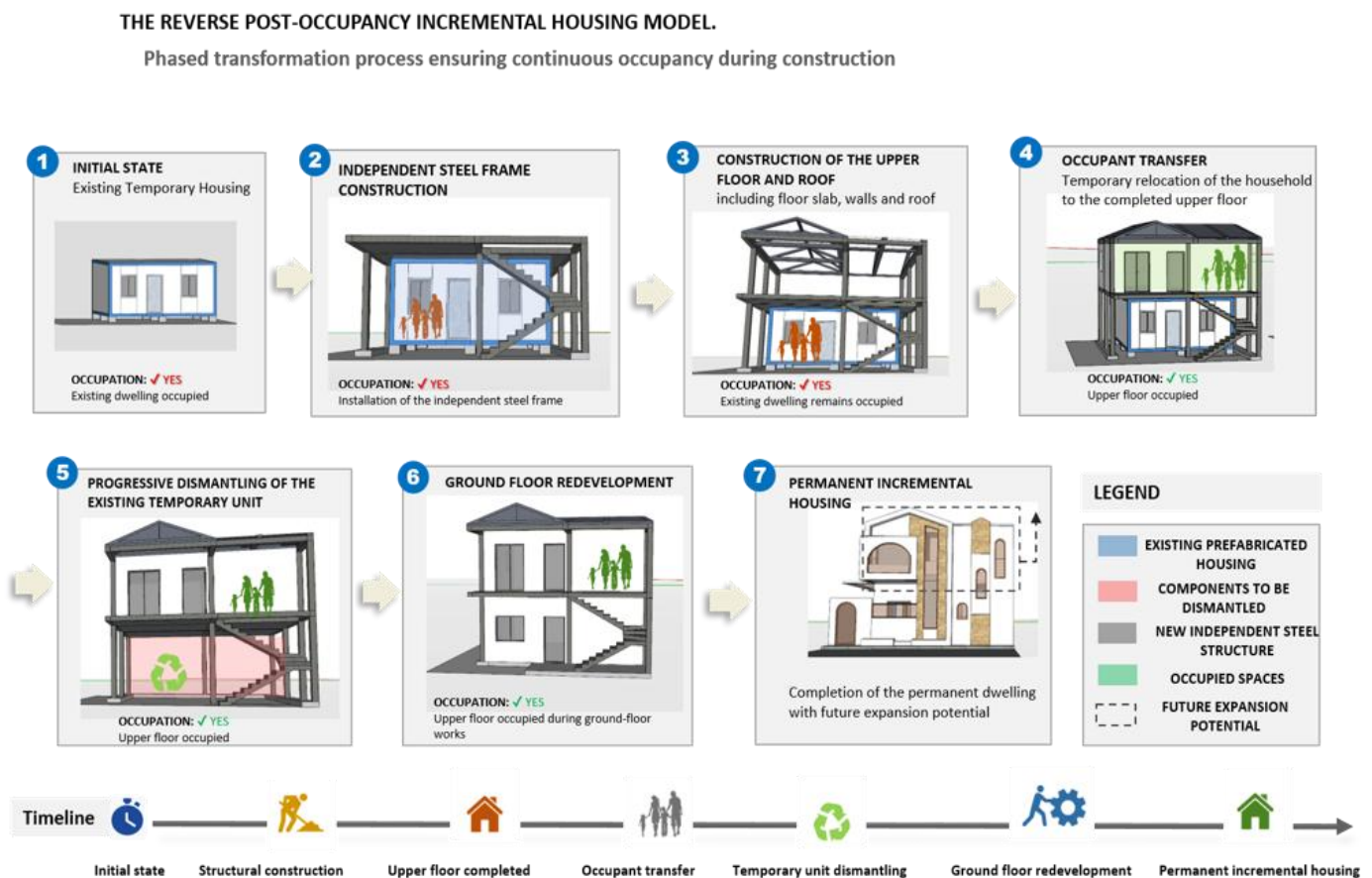
Source: Own elaboration, 2026

The model also retains potential for further adaptation according to household needs and the possibilities offered by the construction system. The proposal should therefore be understood as an adaptive architectural configuration whose actual performance in terms of structural safety, cost, construction time, and durability requires further technical and comparative assessment.

3.3. Phased Transformation Process

The proposed model is translated into a transformation process organized into seven successive phases, with the primary objective of ensuring residential continuity throughout the transition from existing temporary housing to permanent housing. The sequence, presented in **Figure 6**, integrates the construction of the new structural system, the progressive development of habitable spaces, the relocation of occupants within the dwelling, and the dismantling of the original prefabricated unit.

Figure 6. Phased transformation process maintaining residential continuity throughout the transformation.



Source: Own elaboration, 2026

The process begins with the initial condition of the dwelling, which remains occupied at the start of the intervention. This first phase establishes the baseline condition from which the transformation is developed. The second phase consists of installing an independent steel structural frame designed to support the future built spaces while minimizing intervention on the still-functional temporary unit.

Once the structural frame has been installed, the third phase involves the construction of the upper floor and its roof. The floor slab, walls, and roof are progressively completed while the existing dwelling continues to provide residential accommodation. This temporary coexistence of the two construction systems makes it possible to postpone the dismantling of the prefabricated unit until a new habitable space is available.

The fourth phase begins when the upper floor has been sufficiently completed to accommodate the occupants. The household is then transferred to this newly completed space, progressively freeing the lower level and allowing construction to continue without requiring external temporary rehousing. Residential continuity is therefore achieved by keeping the household within its original plot rather than by preserving the initial dwelling throughout the entire construction process.

Following the transfer, the fifth phase involves the progressive dismantling of the prefabricated unit. This operation is undertaken only after a functional part of the new dwelling has been completed. It must be carried out under previously verified technical and safety conditions to avoid compromising the stability of the new structure or the occupancy conditions of the upper floor.

The sixth phase consists of redeveloping the ground floor after the temporary unit has been removed. The spaces are then completed and organized to accommodate the permanent functions of the dwelling, while the household continues to occupy the upper floor. This stage marks the transition from the temporary coexistence of the two construction systems to a residential configuration based entirely on the new structure.

Finally, the seventh phase results in the completed incremental permanent dwelling. All planned spaces are completed, while the construction system retains potential for future adaptation according to household needs and technical possibilities. The proposed sequence thus establishes a gradual transition from temporary housing to a new residential configuration by combining prior construction, occupant transfer, dismantling of the existing unit, and redevelopment of the dwelling.

The incremental character of the model therefore lies not only in the possibility of adapting the spatial configuration over time, but also in the phased organization of its implementation. However, the actual feasibility of each phase will depend on structural assessments, site conditions, required permits, and appropriate mechanisms for supporting and coordinating the households throughout the transformation process.

3.4. Evaluation of the Proposed Model

The proposed model is evaluated across four complementary dimensions: technical and constructive, residential and functional, territorial and urban, and economic and operational. The assessment is based on a comparison of spatial configurations, an analysis of the transformation process, and the available data regarding implementation conditions. At this stage, the evaluation provides an indicative assessment of the model's performance and does not replace the detailed technical and economic studies required for its implementation.

From a *technical and constructive perspective*, the model relies on an independent structural system that enables the new spaces to be progressively constructed while temporarily maintaining the existing unit. This arrangement facilitates phased construction and limits intervention on the occupied dwelling. Structural feasibility must nevertheless be confirmed through detailed design studies, particularly with regard to foundations, connections, load-bearing conditions, and the interaction between the new and existing elements. Seismic verification must also be carried out in accordance with the applicable regulatory requirements, particularly those established by RPA 2024 for the seismic zone concerned ([Centre National de Recherche Appliquée en Génie Parasismique CGS, 2024](#)). The use of a conventional and technically established construction system therefore represents a favourable condition, but does not eliminate the need for regulatory design, calculation, and inspection procedures.

From a *residential and functional perspective*, the proposal directly addresses the deficiencies revealed by the spontaneous transformations observed in Boumerdès. **Figure 4** illustrates the

transition from the 36 m² reference temporary unit to a two-storey configuration, with approximately 35.4 m² of identified internal spaces on each level, resulting in approximately 70.8 m² of cumulative identified internal floor area. The model thus accommodates a living room, kitchen, sanitary facilities, and three bedrooms, while also providing complementary outdoor spaces. Beyond the increase in spatial capacity, its principal advantage lies in the possibility of transferring occupants to the upper floor before dismantling the temporary unit, thereby enabling progressive transformation without systematically requiring intermediate rehousing.

At the *territorial and urban scale*, the model prioritizes in-situ transformation and the retention of the existing plot and infrastructure. This strategy makes it possible to preserve the proximity relationships established by households while avoiding the systematic development of new land for rehousing. **Figure 5** illustrates the architectural expression of the model and its integration within an existing residential sequence. The territorial relevance of this approach nevertheless depends on the condition of existing utility networks and roads, land tenure conditions, and the capacity of the proposed building volume to integrate appropriately into the existing urban fabric.

From an *economic perspective*, the available data on post-earthquake prefabricated housing provide useful orders of magnitude for comparison. According to the Algerian Centre for Construction Engineering (2010), approximately 79% of the prefabricated units cannot be dismantled and relocated. For recoverable units, dismantling costs are estimated at DZD 607,388 per unit (approximately USD 8,436), representing nearly 84% of the initial construction and installation cost. This figure highlights the economic burden associated with a demolition-and-reconstruction strategy.

For comparison, the cost of a collective housing unit under the Algerian rent-to-own programme is estimated at DZD 60,000/m² (approximately USD 448.94/m²), to which approximately DZD 650,000 per dwelling (USD 4,863.50) is added for external infrastructure and servicing (*voiries et réseaux divers*, VRD), together with potential state assistance of up to DZD 700,000 per household. In the Boumerdès sites under consideration, the existing servicing infrastructure remains functional, which could allow the reconstruction of these networks to be avoided under an in-situ transformation strategy.

For the proposed model, the estimated cost of the steel structure including finishing works ranges between DZD 65,000 and 75,000/m² (approximately USD 486–561/m²). Although this estimate remains partial, it points to potential economic advantages associated with avoiding intermediate rehousing, retaining existing servicing infrastructure, and making use of an already serviced plot. However, these figures do not allow an unequivocal claim of overall economic superiority for the proposed model.

Overall, the evaluation highlights a strong correspondence between the constraints identified through the diagnosis and the architectural principles incorporated into the proposed model. The approach combines progressive transformation of temporary housing, increased spatial capacity, and the retention of households within their original settlement. Its technical, economic, and operational performance nevertheless requires further validation through additional studies, particularly regarding structural verification, detailed cost estimation, construction scheduling, and assessment of actual occupancy conditions.

4. Discussion

The results show that the prolonged occupation of the temporary housing units in Boumerdès has progressively transformed their initial status as transitional accommodation into that of long-term housing. The extensions, room additions, enclosure of outdoor spaces, and appropriation of surrounding areas observed in the field reflect both households' adaptation to changing needs and the limitations of the original configuration in terms of floor area, flexibility, and adaptability. These findings are consistent with studies highlighting that temporary housing may undergo substantial

transformations when occupation extends beyond the period initially anticipated (Félix et al., 2013; Wagemann, 2017)

In this context, the *Reverse Post-Occupancy Incremental Housing Model* proposes a reversal of the conventional incremental housing logic. Whereas incremental housing is generally designed from the outset to accommodate future extensions, the proposed model intervenes in a temporary dwelling that has already been constructed, occupied, and appropriated for several years. Its main contribution therefore lies in combining progressive transformation, residential continuity, and reuse of the existing site. The seven-phase sequence presented in **Figure 6** organizes this transition from the initial temporary unit to permanent housing by combining the construction of an independent structural system, the development of the upper floor, occupant transfer, progressive dismantling of the existing unit, and redevelopment of the ground floor.

The spatial comparison presented in **Figure 4** confirms the model's potential to improve residential conditions. Starting from an initial 36 m² unit, the proposal develops a two-storey configuration with approximately 35.4 m² of identified internal spaces per level, resulting in approximately 70.8 m² of cumulative identified internal floor area. This configuration makes it possible to accommodate three bedrooms, a living room, a kitchen, and sanitary facilities, while retaining complementary outdoor spaces. The model thus provides a direct response to the spontaneous extensions observed in the studied settlements by replacing largely unplanned transformations with a framework for anticipated architectural adaptation. The increase in floor area should nevertheless be interpreted as a spatial indicator rather than as definitive validation of the regulatory habitable floor area.

From a technical perspective, the independent structural system constitutes a central component of the strategy, as it allows the new construction to be structurally separated from the still-occupied temporary unit. This arrangement facilitates phased implementation and helps minimize disruption to the residents' living conditions. However, continuous occupancy remains dependent on site safety, the effective habitability of the upper floor, and the coordination of the different construction phases. Likewise, structural feasibility and seismic resistance must be confirmed through detailed design studies and the applicable regulatory procedures, particularly with regard to the requirements of RPA 2024.

At the urban scale, in-situ transformation makes it possible to retain an already occupied plot and make use of existing infrastructure. The preservation of roads and utility networks, where they remain functional, represents a potential advantage over strategies based on relocation and the development of a new settlement site. **Figure 5** further demonstrates that the proposed intervention can be integrated into a coherent residential sequence while introducing an architectural expression distinct from that of the original prefabricated units.

Finally, the economic analysis provides an initial indication of the model's potential relevance. The historical dismantling cost of recoverable units, estimated at approximately DZD 607,388 per dwelling, together with the continued availability of existing servicing infrastructure, constitutes a favourable factor for an in-situ transformation strategy. At the same time, the estimated cost of the steel structure with finishing, ranging from DZD 65,000 to 75,000/m², represents a significant investment that must be considered in relation to the potential savings associated with retaining the existing site and limiting the need for intermediate rehousing. These data do not, however, support a definitive conclusion regarding the economic superiority of the proposed model, as a comprehensive assessment would need to incorporate foundation works, design studies, dismantling, redevelopment, construction duration, and other associated costs.

Overall, the findings suggest that in-situ incremental transformation may constitute a relevant alternative to demolition-and-reconstruction strategies in certain post-disaster housing contexts. The contribution of the proposed model lies less in providing a standardized solution than in establishing a context-sensitive transformation framework grounded in observed residential

practices and in the possibility of keeping households within their existing settlement. Its full validation nevertheless requires further structural, economic, and operational investigations.

5. Conclusion

The results show that the prolonged occupation of temporary housing in Boumerdès has progressively challenged its transitional nature. The spontaneous transformations observed demonstrate households' capacity for adaptation, while also revealing the limitations of housing initially designed for short-term occupancy.

The *Reverse Post-Occupancy Incremental Housing Model* proposes a response to this situation by progressively transforming already occupied temporary housing into permanent and adaptable housing. Its seven-phase process involves the installation of an independent structural system, the construction of an additional level, the transfer of occupants, followed by the dismantling and reconfiguration of the existing temporary unit. This approach aims to minimize disruption to occupancy and avoid the systematic need for intermediate rehousing.

In spatial terms, the model enables the initial configuration of approximately 36 m² to evolve into nearly 70.8 m² of identified internal spaces distributed over two levels, including three bedrooms. The technical, residential, territorial, and economic assessment also highlights the potential value of in-situ transformation, allowing the existing plot and infrastructure to be retained while progressively improving housing conditions. Beyond its residential dimension, the model represents a creative and innovative urban alternative that could improve residents' living conditions while contributing to the gradual requalification of the urban image of sites initially conceived as temporary settlements.

This research therefore proposes a context-sensitive approach to post-disaster reconstruction, prioritizing the transformation and valorization of existing assets rather than their systematic replacement. However, further structural, economic, and operational studies, together with full-scale experimentation, are required to confirm the model's feasibility and its transferability to other post-disaster contexts.

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