03 PILOTS

RISING FROM RUINS

Title
Rising from Ruins: Reuse in Ukraine

NTNU
Faculty of Architecture and Design
AAR4990 Master in Architecture
Spring 2025

Students
Anders Gjesdal
Mille Sofie Hals Richardsen

Supervisors
Steffen Wellinger
Stuart Mcleod Salway Dickson

Content of the Folder

This final folder: 03 Pilots combines the theoretical and material work from the previous two folders into three pilot typologies. It is organized into six sections:

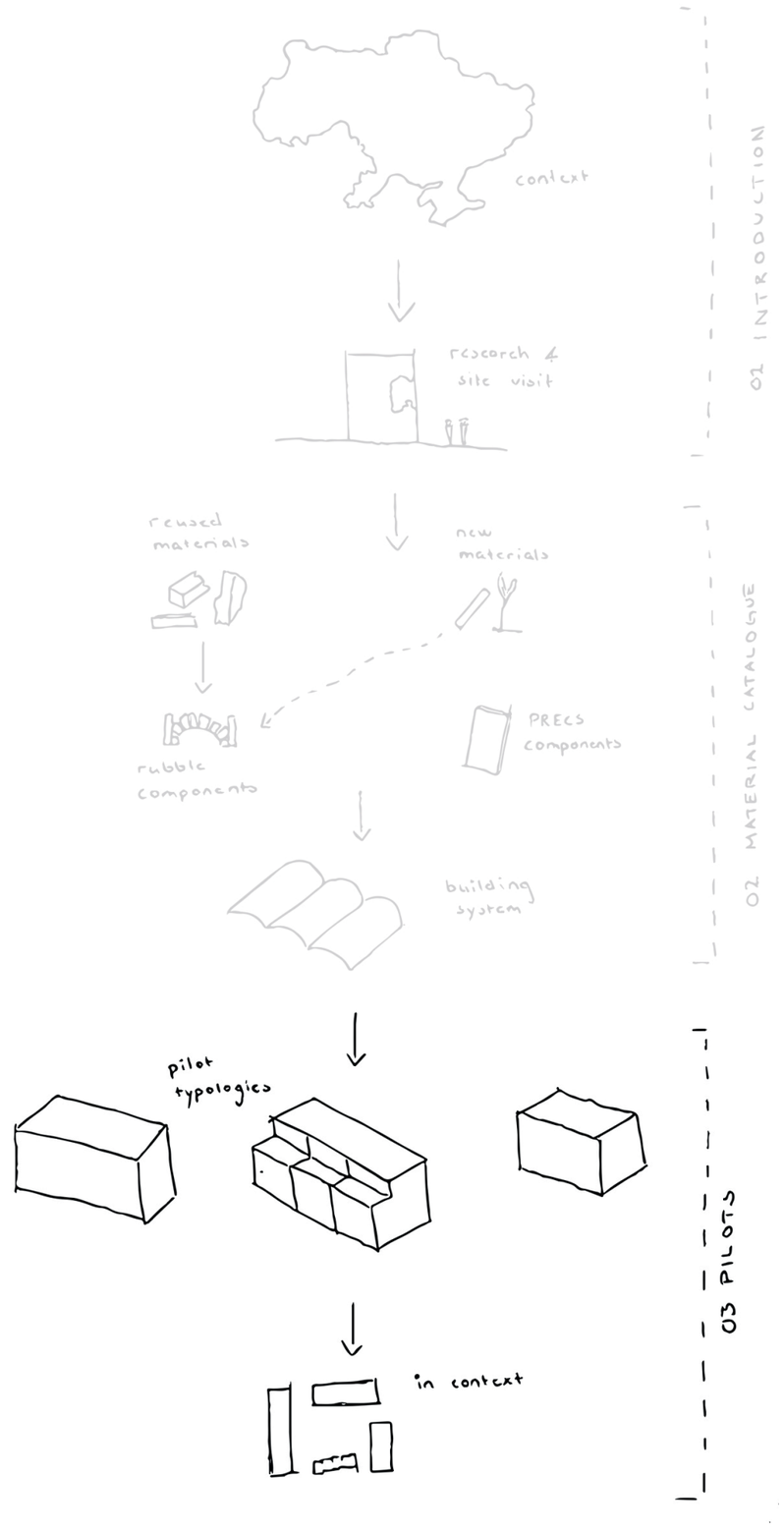
3.1 Concept introduces the core design strategies, derived from the information of folder one and two. It outlines a modular system that responds to the limitations and possibilities of the building system.

3.2 Pilot typologies explores three building typologies, each serving as a prototype. These pilots test the modular system at different scales and with different applications of the building system. Through these pilots we explore the flexibility, construction logic, and spatial qualities of the building system.

3.3 In context places the pilots in a specific area in Irpin, testing how they can function in an urban context. This section examines the broader architectural and cultural implications of the project. It addresses the challenges of designing within limitations from reuse, the role of memory in material reuse, and the relevance of this approach in post-crisis rebuilding.

3.4 Reflections are our thoughts and learnings from working with these pilots.

This folder explores how the theoretical, contextual and material insights from the previous folders can be applied into a reuse-based architectural approach for rebuilding.



3.1 CONCEPT

Introducing the design approach for further design.

Retake on modular systems

Modular and prefabricated building systems can produce both boring and soulless architecture. Learning from the post WW2 soviet housing, where the prefabricated buildings presented a copy paste solution that could be placed anywhere. Apartments were typically small and uniform, reflecting the idea that “one size fits none”.

However, there are some clear benefits to modular building systems. They allow for a pragmatic and efficient approach to architecture, which is often needed for swift rebuilding after a war. They are economically viable due to the reuse of formwork, fast mounting and predictable in planning, all of which are suitable for post-conflict rebuilding. The modules can be combined as wanted, allowing the buildings to be adapted to site conditions, cultural context, and local needs.

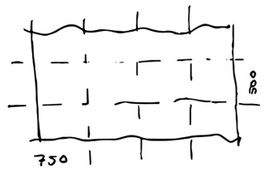
To avoid creating monotonous and disconnected environments, we propose a material-driven, context-sensitive modular system. By responding to the material availability in the specific area, in this case Irpin, we can draw from both a pragmatic and ideological approach to reuse. It allows us to use the surplus of available materials, while at the same time allowing these materials to carry the memory of what was into new structures.

Damaged soviet-era housing in Irpin, Ukraine.

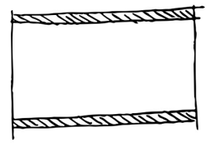
Material Driven Design

The structural logic is derived from limitations set by the available materials. The reused PRECS components from the I-464 building components have clear restrictions, such as a set height from walls and a defined span from available slabs. In order to reuse these to their full potential, we set a structural grid of 3m, and a wall height of 2.5m.

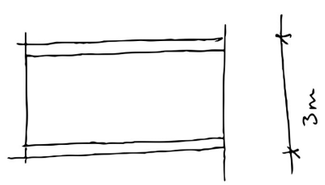
For the rubble components, the system is more flexible and dependent on each component.



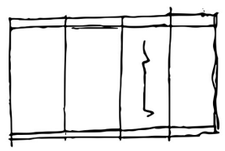
Simple structural grid



Load bearing partition walls



Maximum 3 metre span



Slabs spanning between partition walls

3.2 PILOT TYPOLOGIES

Here, we test our finding from the previous folders through three typologies. We explore the architectural possibilities and limitations of the building system.

Pilots

The three following pilot typologies explore the application of reused components in architectural design. While adaptable to different contexts, the typologies are based on the conditions, rebuilding needs and material availability of Irpin, Ukraine. This exercise serves as a method to investigate how the use of reclaimed materials influences architectural form, structural choices, and construction techniques.

Exterior render.

3.2.1 Lamella

The layout of this first typology can be easily adapted for residential, or office space. In this case, we have designed a semi-public version with a public ground floor, next to the main road in Irpin.

For this in-context exemplification we have chosen to explore slabs using the parallel flat sided concrete vaults, and Large concrete rubble walls. The walls are inspired by the Norwegian architect Erling Viksjø, who integrated large pieces of stone within cast concrete structures . In this typology, the large rubble concrete walls are prefabricated and placed on three main axes: both external wall and the middle axis.

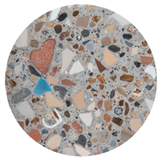
Together with a vertical core, they create the conditions necessary for vaulted cap ceilings to span outwards. Spanning six meters to the external wall, the concrete beams require heavy reinforcements. Between them, concrete rubble barrel vaults and rubble distribution work together with an insulated floor for sound proofing between units.

Long horizontal bonds on the facade, prefabricated balconies from scrap metal are hung on the robust walls.

The foundation uses a rubble aggregate system, using a conventional concrete approach but reducing embodied energy compared to conventional concrete. At the same time, it provides a robust and safe base that can provide the dual function of basement and shelter, a critical requirement for new Ukrainian buildings. The internal vertical core provides direct, internal access from the apartments and public areas to the shelter.

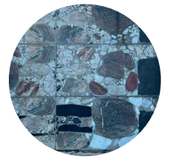
Exterior render.

15.1 Parallell flat sided
rubble vaulted roof



11. Terrazzo cladding

10. Large rubble blocks

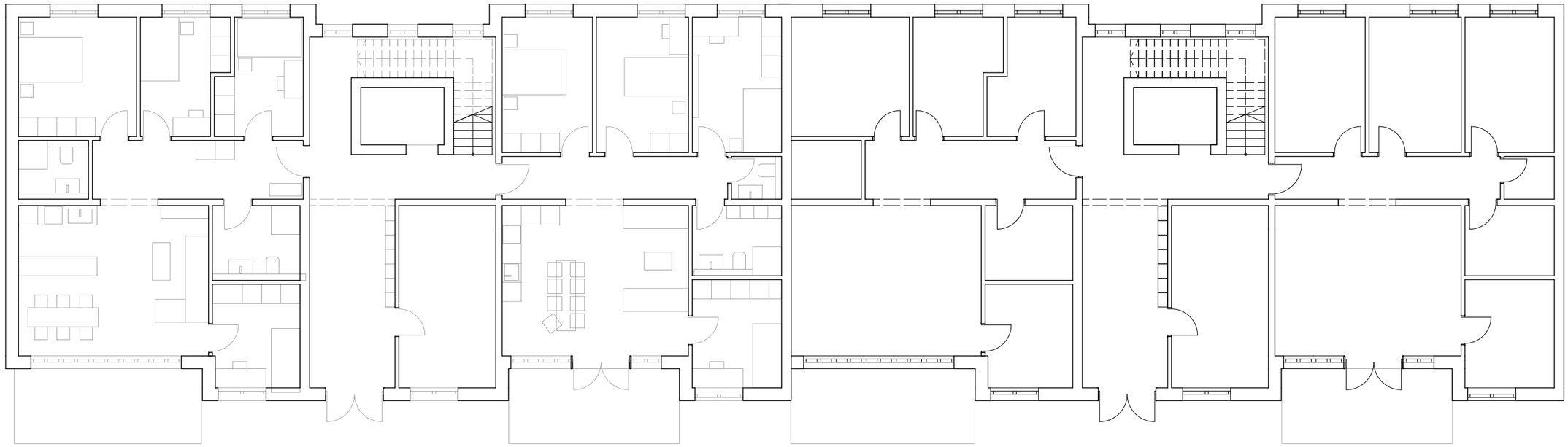


10. Large rubble concrete
walls (load bearing)

15.1 Parallel flat sided
rubble vaulted roof

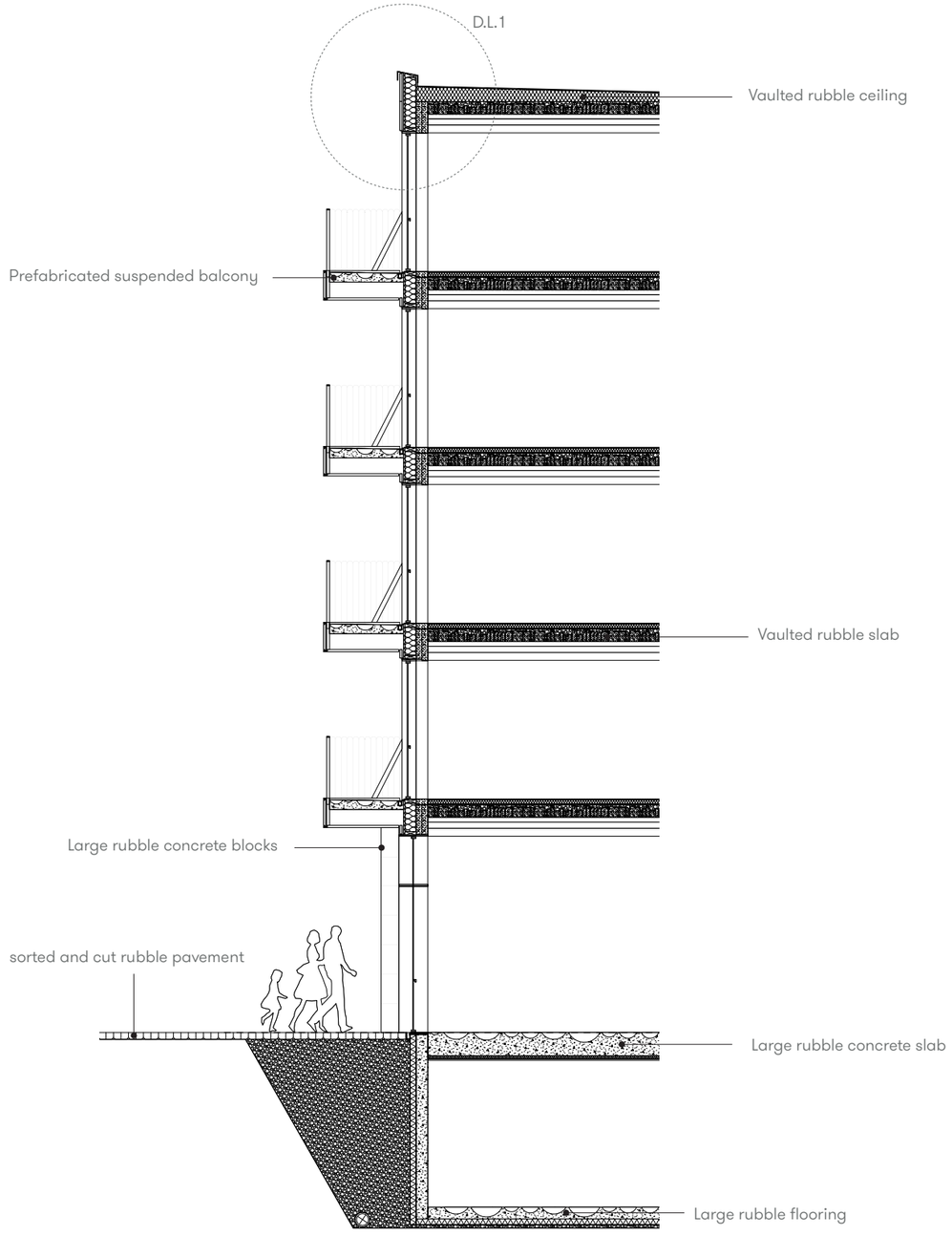
7. Rubble aggregate foundation

Repeatable module



Lamella floorplan | M 1:100

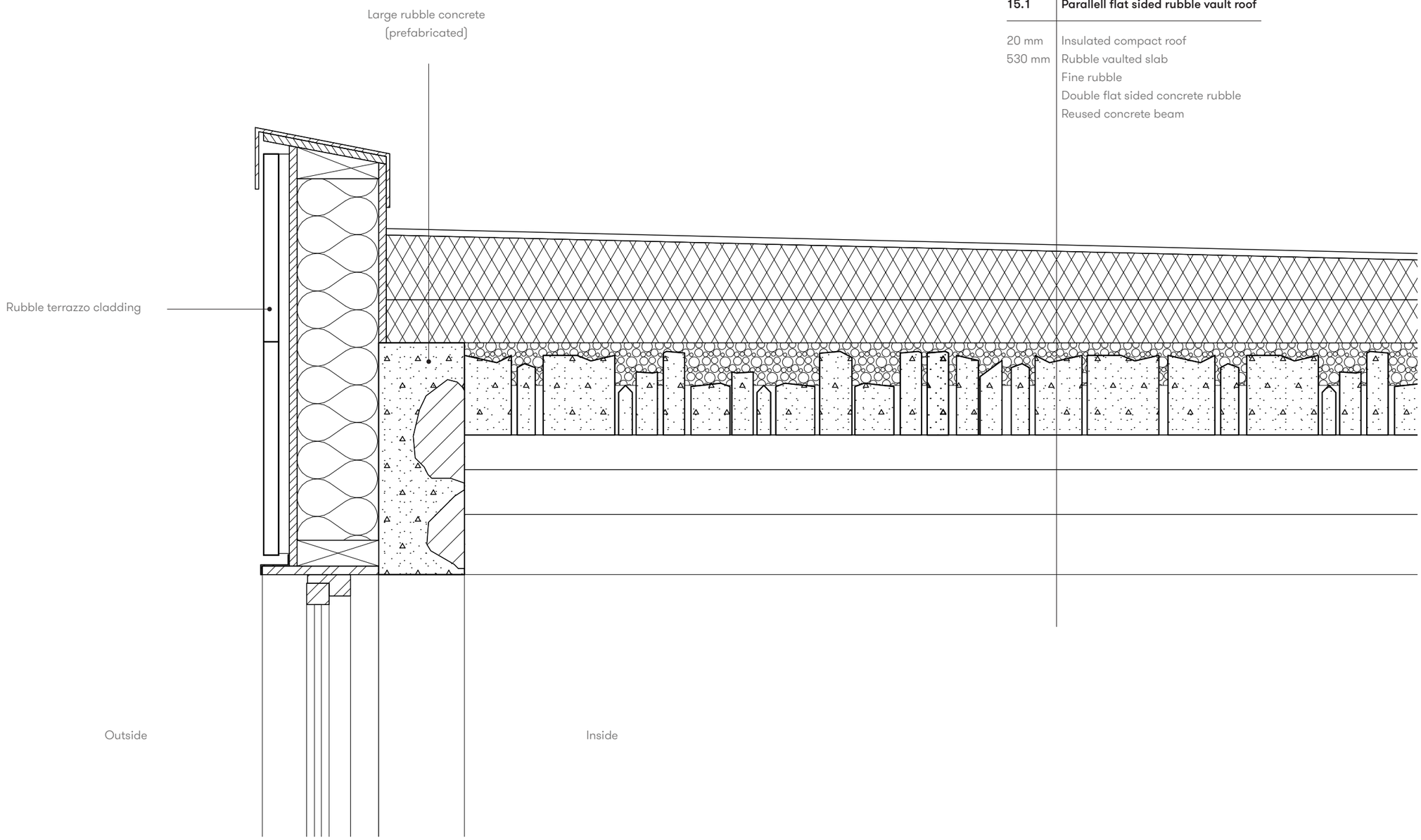
1 5m



1 5m

Lamella facade elevation and section | M 1:100

15.1	**Parallell flat sided rubble vault roof**
20 mm	Insulated compact roof
530 mm	Rubble vaulted slab
	Fine rubble
	Double flat sided concrete rubble
	Reused concrete beam



0.25 0.5m

D.L.1 | Lamella detail 1 | M 1:10

3.2.2 Row House

The second pilot typology proposes a low and dense rebuilding strategy aimed at efficient post-war densification. Lower structures are faster and easier to construct, making them suitable for urgent rebuilding efforts. They are also better suited to accommodate reused materials, which often come with structural uncertainties.

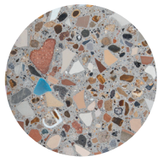
The internal load-bearing walls use a single leaf rubble masonry system, acting as a partition between units. This reduces the need for openings and we assume that these walls have similar acoustic and fire-resistance properties as regular concrete. The design is adaptable to one, two, or a maximum of three stories, set by the structural limits of the single leaf masonry walls.

The slabs are reclaimed brick vaults, spanning six meters over the living areas. They make the rubble visible in the ceiling, creating a distinct, vaulted space while combining reused war rubble with new, light wood.

In this case, the typology is designed without a basement. Bomb shelter provisions are instead integrated into the lamella typology, ensuring safety requirements are met while optimizing material and energy use. Instead, a gabion foundation is used.

The cladding is a combination of terrazzo plates and reused rubble bricks. Since the bricks usually break near the middle, an English bond is used, allowing for the reuse of both whole and chipped bricks. Both the bricks and the terrazzo plates are subtle ways of reusing remnants of war. They are not necessarily readable as spolia, but still carry a history and memory from its previous use.

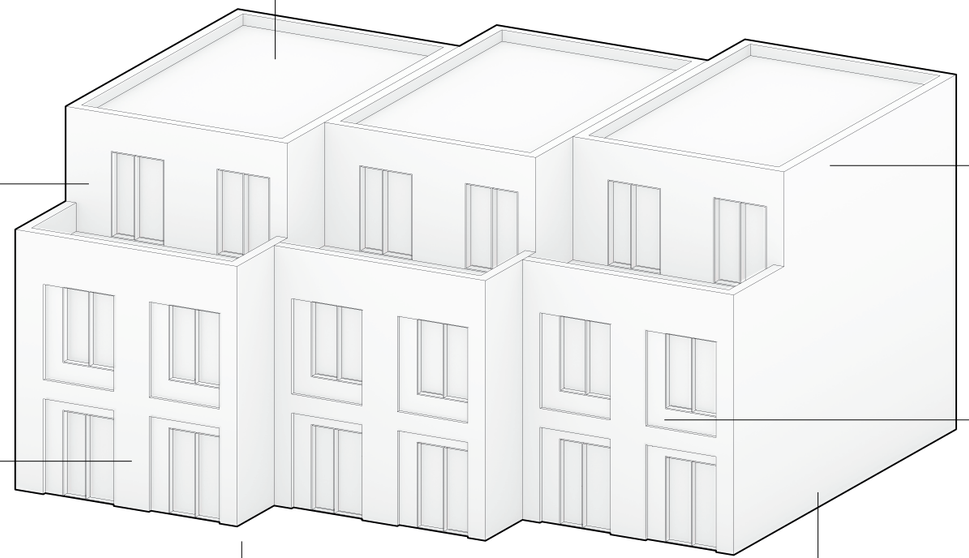
15.3 Reclaimed brick
vaulted slab



11. Terrazzo cladding

9. Masonry brick cladding

6. Rubble gabion line foundation

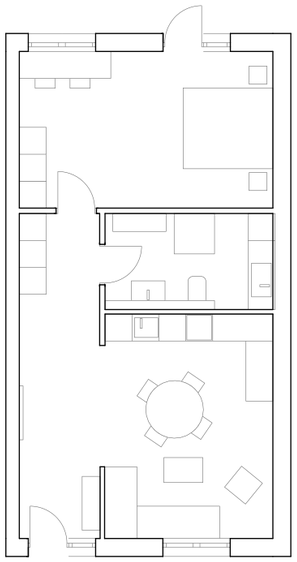


15.3 Reclaimed brick
vaulted slab

9. Masonry brick cladding

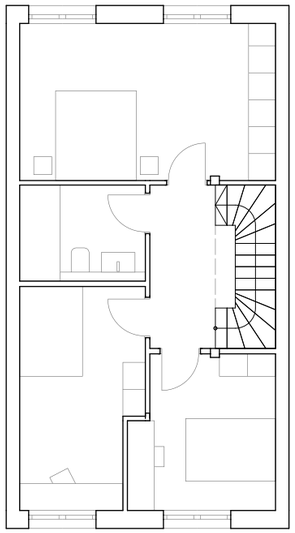
6. Single leaf masonry
partition wall

1

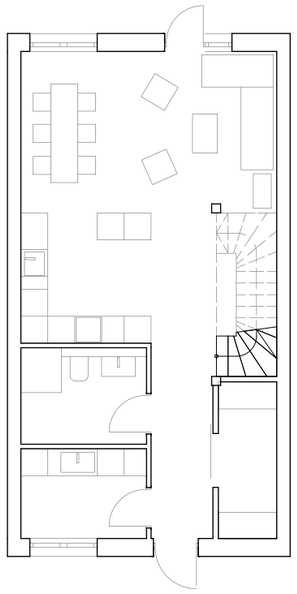


Ground floor

2

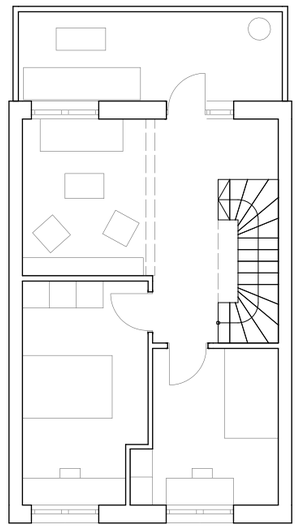


Ground floor

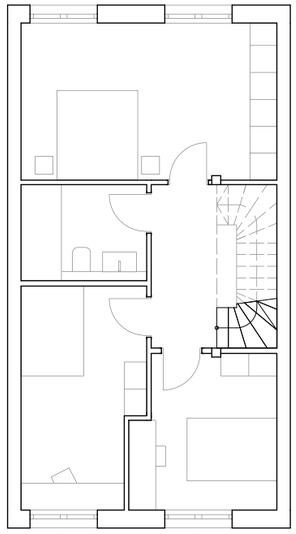


First floor

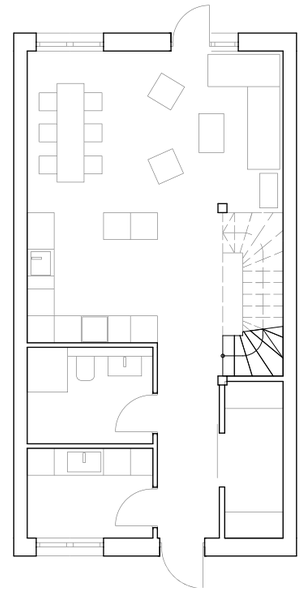
3



Ground floor



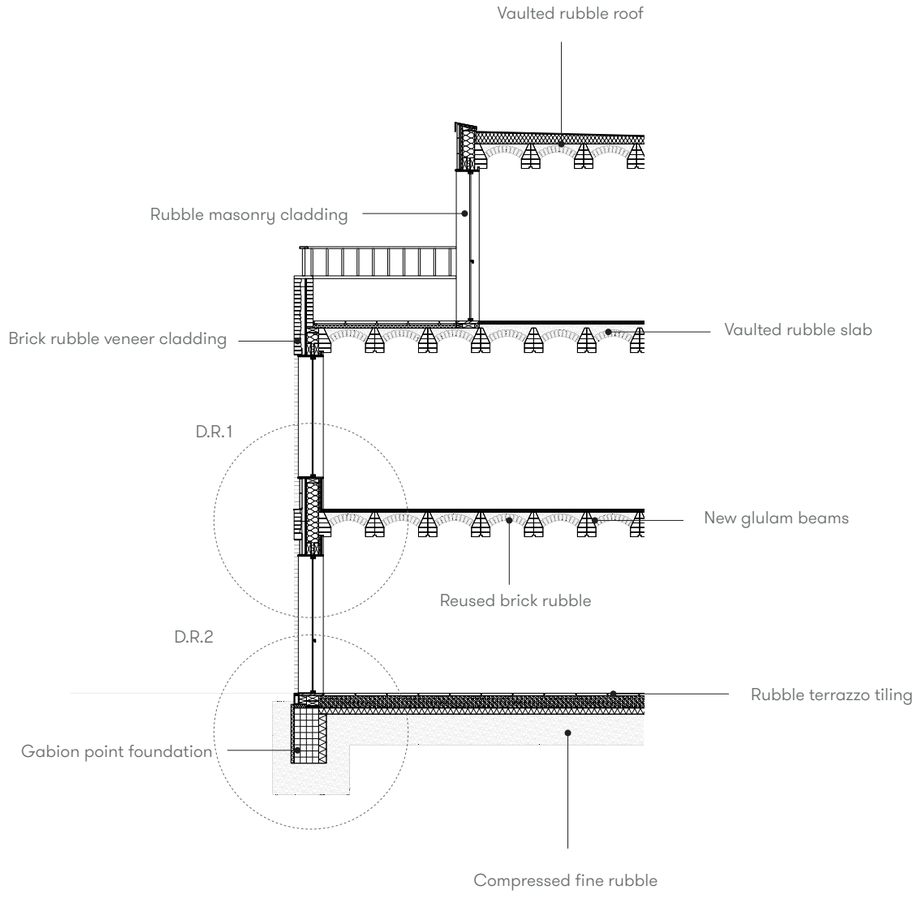
First floor



Second floor

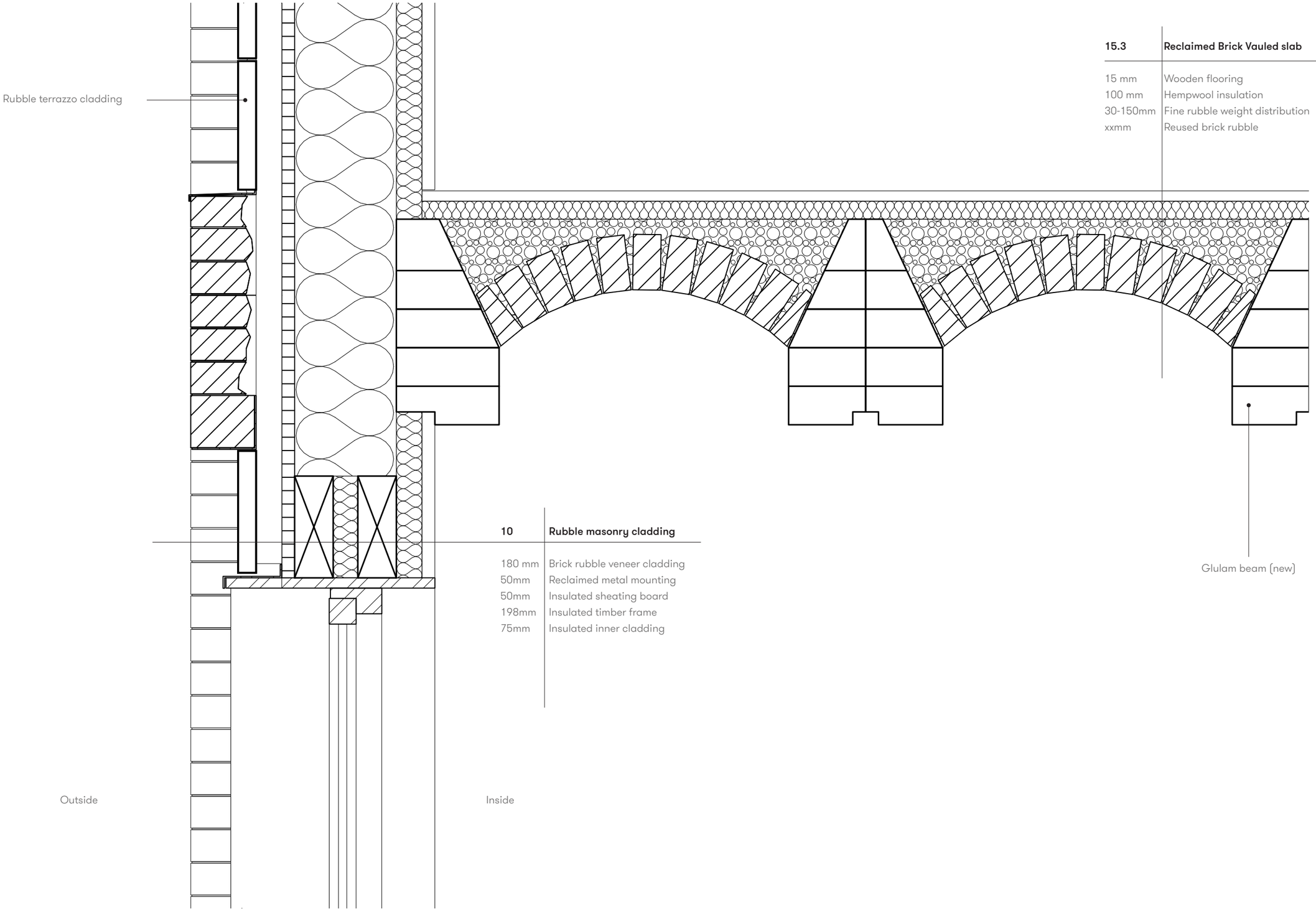
Row House floorplan | M 1:100

1 5m



Row House facade elevation and section | M 1:100

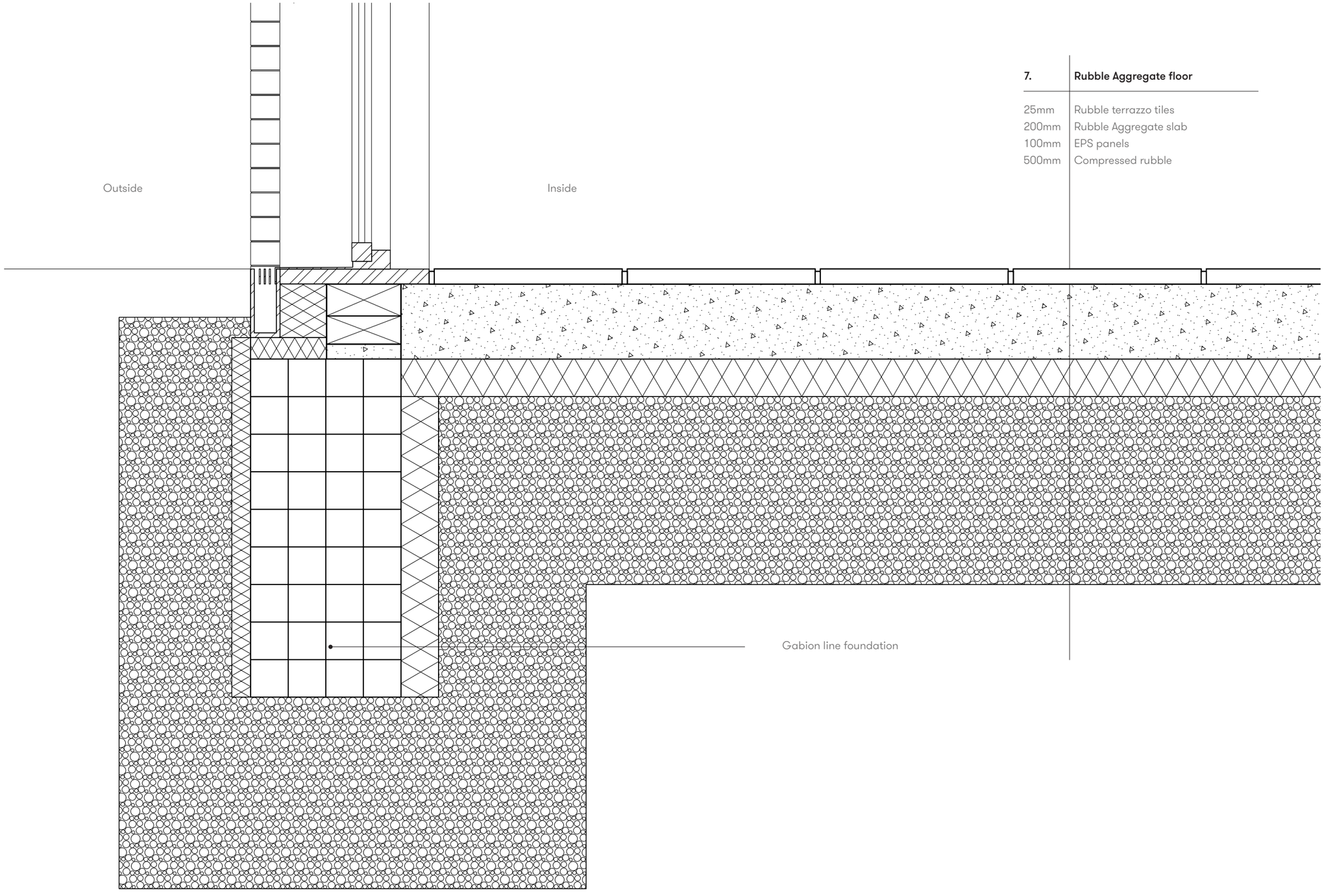
1 5m



10	Rubble masonry cladding
180 mm	Brick rubble veneer cladding
50mm	Reclaimed metal mounting
50mm	Insulated sheating board
198mm	Insulated timber frame
75mm	Insulated inner cladding

15.3	Reclaimed Brick Vauled slab
15 mm	Wooden flooring
100 mm	Hempwool insulation
30-150mm	Fine rubble weight distribution
xxmm	Reused brick rubble

0.25 0.5m



7.	Rubble Aggregate floor
25mm	Rubble terrazzo tiles
200mm	Rubble Aggregate slab
100mm	EPS panels
500mm	Compressed rubble

0.5 1m

3.2.3 Gallery House

The gallery house explores the potential of using PRECS (Piecewise Reuse of Extracted Concrete Structures) from the I-464 housing system extensively. Through this typology we reinterpret the original system to create a new modular architectural language. This approach tests how the reused components from the I-464 buildings can define both structure, form and memory.

A key aspect of the concept is the material's expression. The reused elements can be left raw, showcasing their patina and history as architectural spolia. Alternatively, surfaces can be painted or coated, offering a deliberate aesthetic contrast to the often monotonous grey appearance of the donor buildings. This latter allows for both continuity through the use of the material, but with a reinterpretation of material memory.

The room height is directly defined by the dimensions of the reclaimed wall components, at 2.5 meters after accounting for expected loss from the dismantling.

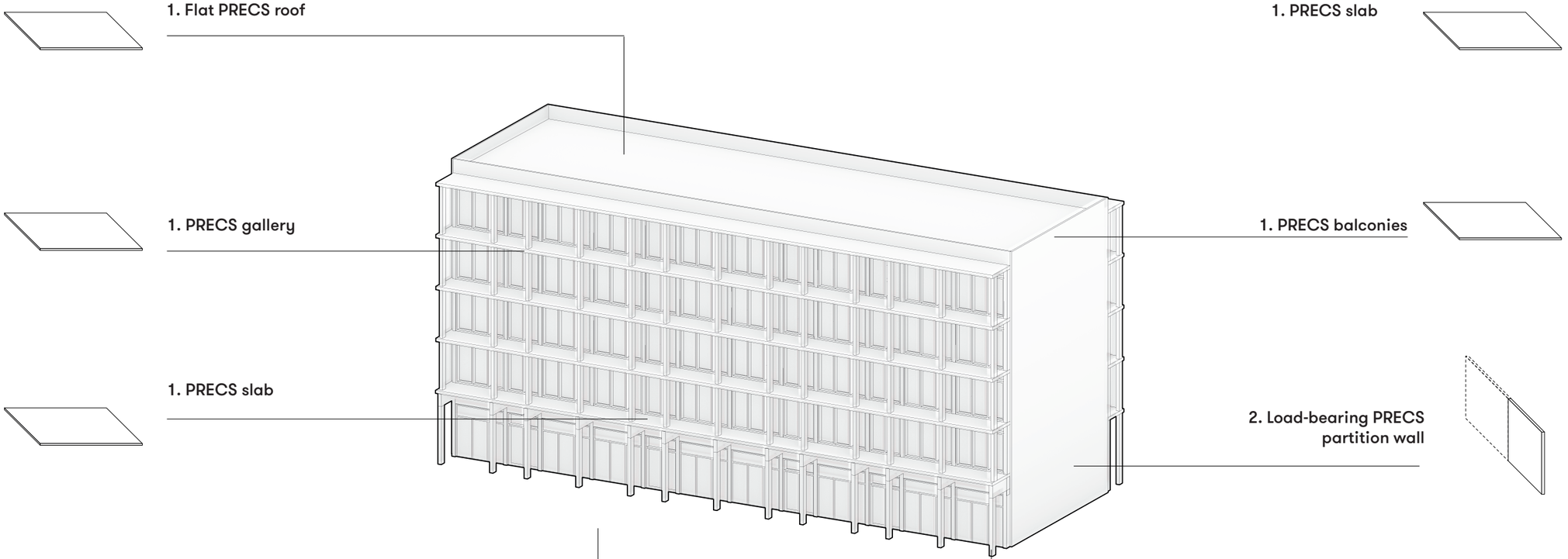
Balconies and galleries are made from load bearing PRECS walls and slabs. The width of the rooms are limited to three meters, allowing the PRECS slab to span between load bearing walls. This way, the slab can be reused to its full structural capacity, aligning with the principles of the Delft ladder.

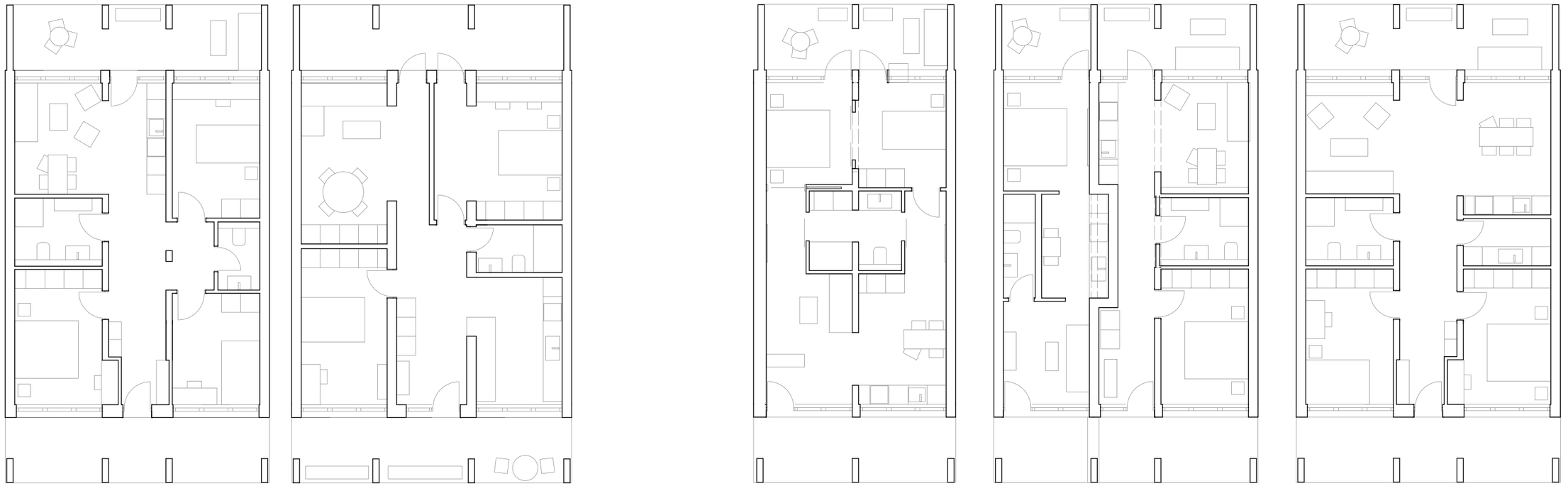
The roof is flat PRECS panels, which also serve as roof terraces.

Given the uncertainties inherent in reused materials, the PRECS components are consequently overdimensioned (laid double) to ensure adequate structural performance while retaining the reused identity of the building fabric.

The typology is organized in a north-south orientation, optimizing daylight access, passive solar control, and natural ventilation across the gallery spaces and residential units.

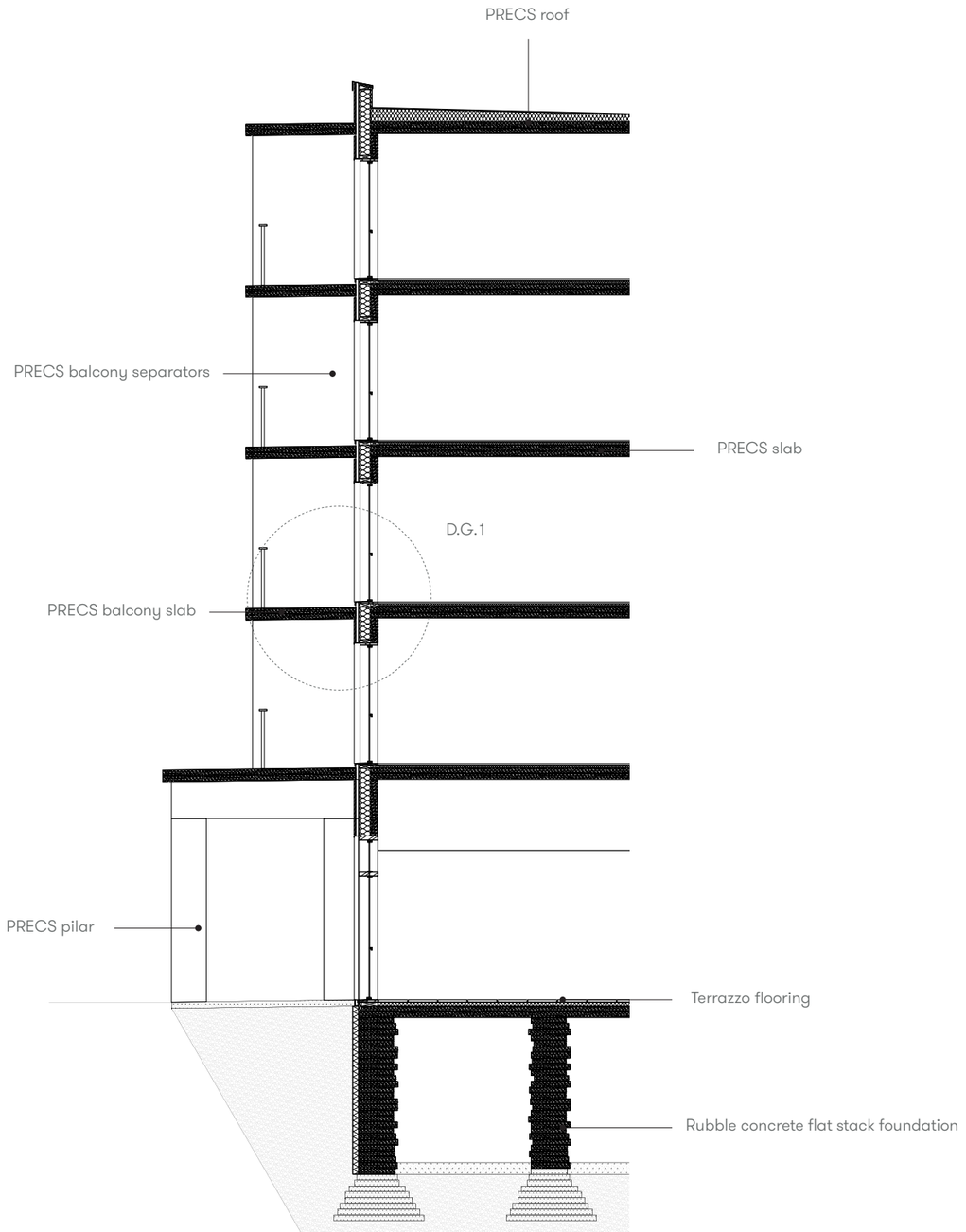
[x]Grangeot, Upcycling concrete rubble.


1. Flat PRECS roof
1. PRECS gallery
1. PRECS slab
1. PRECS slab
14. Flat stack foundation
1. PRECS slab
1. PRECS balconies
2. Load-bearing PRECS partition wall
2. PRECS columns



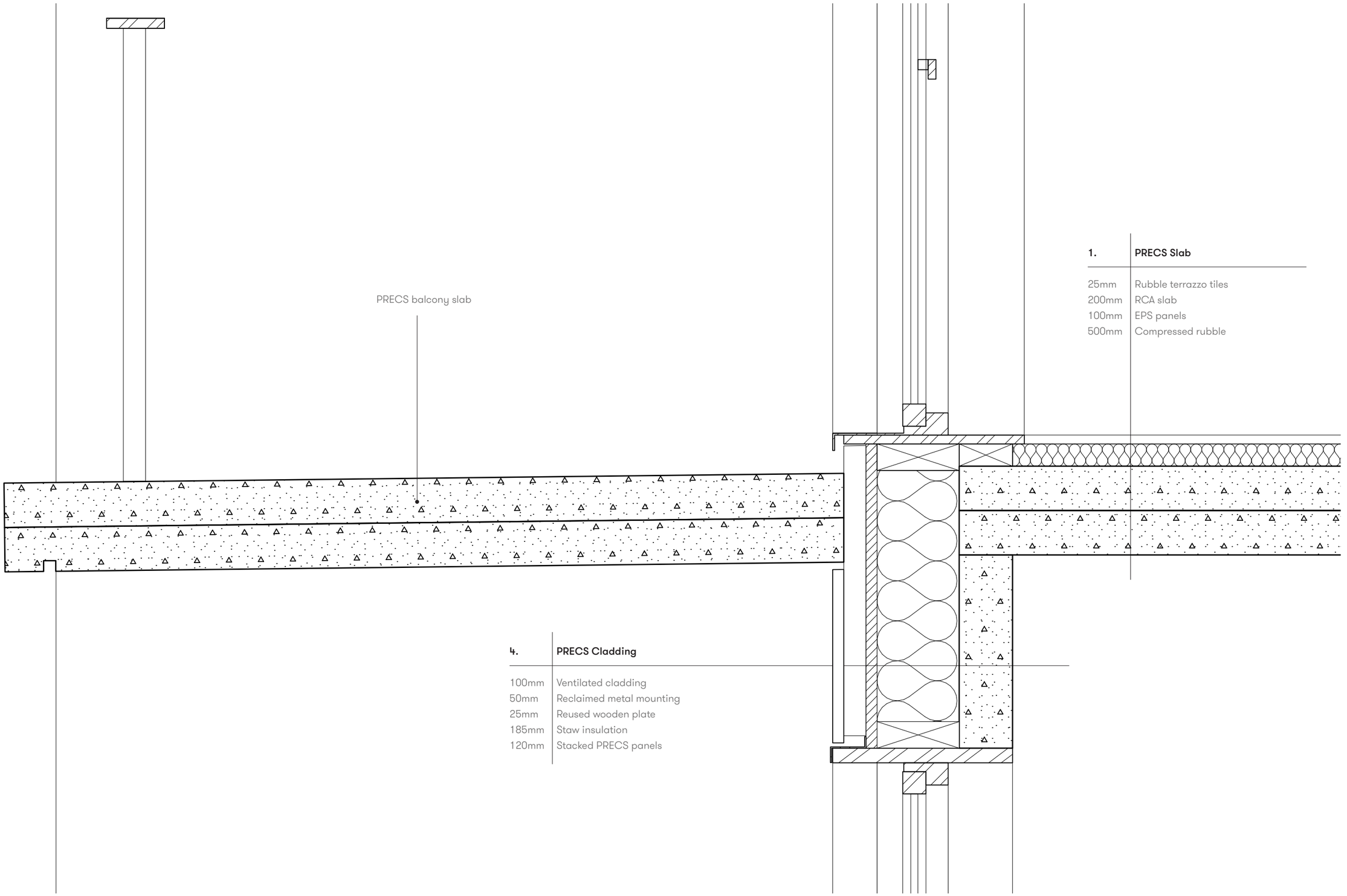
Gallery House floorplan | M 1:100

1 5m



1 5m

Gallery House facade elevation and section | M 1:100



1.	PRECS Slab
25mm	Rubble terrazzo tiles
200mm	RCA slab
100mm	EPS panels
500mm	Compressed rubble

4.	PRECS Cladding
100mm	Ventilated cladding
50mm	Reclaimed metal mounting
25mm	Reused wooden plate
185mm	Staw insulation
120mm	Stacked PRECS panels

0.25 0.5m

D.G.1 | Gallery House detail 1 | M 1:10

3.3 SITUATION

The three typologies are placed together, creating a residential courtyard in Irpin, Ukraine.

Hromada of Irpin

Scale A4: 1:110.000

1 5km

Situation

The pilot typologies are tested on a specific site, to demonstrate their applicability in real rebuilding scenarios. The area in Irpin, Ukraine, was chosen due to its extensive war damage and urgent reconstruction needs.

The area also reflects the dual demand for rebuilding and increased densification due to anticipated population growth and internally displaced people (IDPs).

Buildings with severe damage

Myru st.

Lamella

Public functions

Lamella

Gallery house

Semi-private courtyard

Vulytsya Shchaslyva

Soborna st.

Row houses

Public functions

Private gardens

1 5m

Myru st.

Title
Rising from Ruins: Rebuilding in Ukraine

Students
Anders Gjesdal
Mille Sofie Hals Richardsen