



Shot 1: Partial axonometric view of the settlement from above, with the central market and residential homes.

“Re-purposing the conflict border ,western sahara”

Set within the vast expanse of **the Western Sahara**, this project reimagines life along the 2,700 km **long Berm Wall**, an enduring scar of the **Sahrawi conflict**. Designed for the Sahrawi people, it proposes a **prototypical settlement** that **reclaims** the wall as a civic spine, transforming a symbol of **separation** into one of **connection**. Through **3D-printed adobe** and **locally sourced materials**, the project explores how architecture can foster resilience, **adaptability**, and collective identity within a challenging and politically charged landscape.” 50708m2

Typology: Residential Buildings, Unrealized

Conceptual Approach

For centuries, the **Sahrawi people** lived in harmony with the desert, their **culture** defined by movement, oral **tradition**, and the dual life between nomadic tents and **earthen ksour**. This balance was fractured by the construction of **the Berm Wall** between 1980 and 1987 a 2,700 km barrier of **sand and stone** that divided families and confined generations to refugee camps in Algeria for nearly fifty years.

This project **speculates** on a future where the conflict is resolved and the Sahrawi people return to the desert. Rather than removing the wall, an immense and costly act, it seeks to **repurpose** it into an architectural spine of renewal. Using the sand and stone of the Berm, combined with **3D-printed adobe** and **palm wood**, the project explores how these materials can meet and assemble through **innovative construction techniques**.

Five potential nodes are proposed along the wall, From these, one prototype site is developed in detail, examining architecture as a cultural and tectonic act, where the **way materials join**, support, and express themselves becomes a medium for reviving memory and **adaptation** in the Western Sahara.



Old Ksour on a terrained site.



Sand and stone berm wall



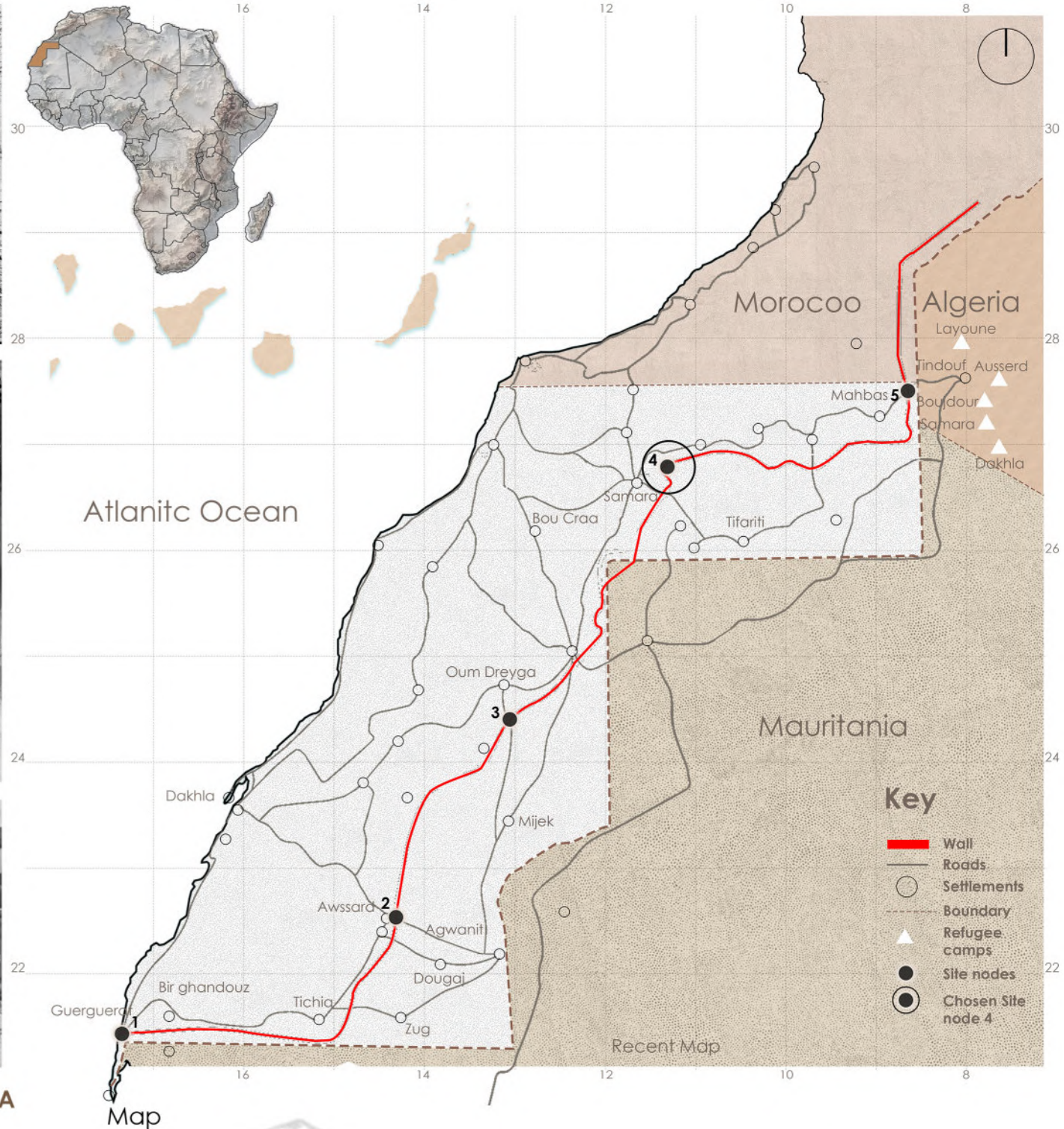
Site satellite view of node 4



Still standing stone in the berm



Still standing stone in the berm



Historical Timeline



1 URBAN ANALYSIS AND EXPANDING

OLD KSOUR BRANCHING AND EXPANSION



Branching out from a main street

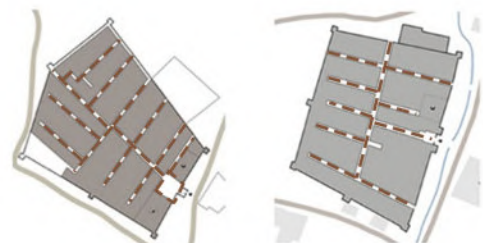
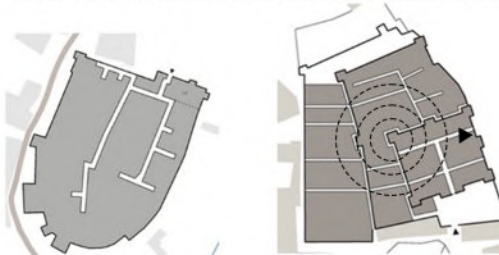
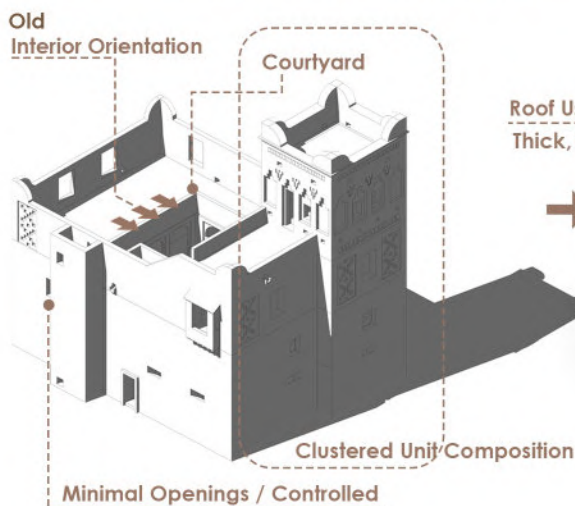


DIAGRAM FROM:
THE KSOUR OF THE MDAGRA OASIS (ER-RACHIDIA, MOROCCO)



Expansion from the center to outward.

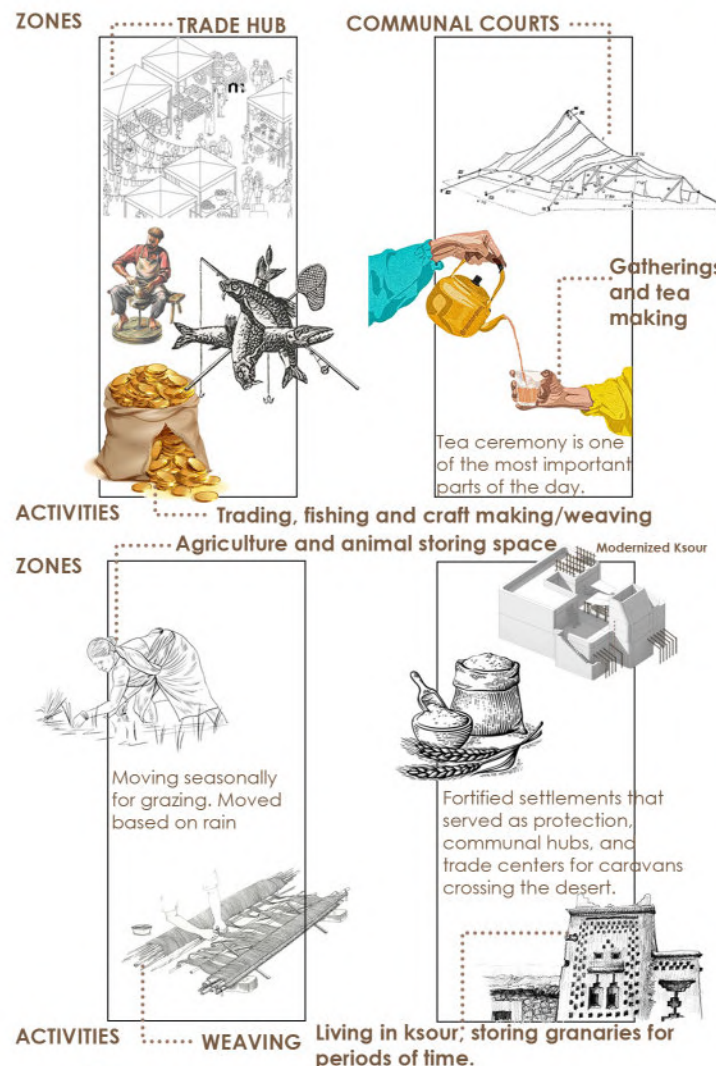
3 ARCHITECTURAL LANGUAGE AND ZONING



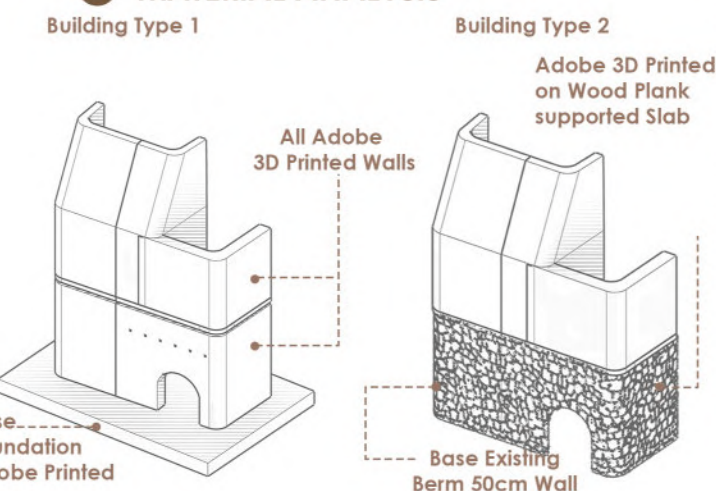
Design Framework

The project unfolds through **four intertwined approaches**. First, an urban analysis traces how **Sahrawi ksour expand** along a **central spine**, where markets and mosques anchor **communal life**, and **residential** paths branch **perpendicularly**. Second, a social and behavioral study maps everyday **patterns of movement, gathering, and exchange**, shaping the project's zoning logic. Third, an exploration of the **architectural language** reinterprets the spatial and tectonic **identity** of the ksour within a **contemporary framework**. Finally, a material investigation speculates on two modes of making, fully 3D-printed adobe or a hybrid system of stone, palm wood, and printed earth, testing how tradition and **innovation** can merge tectonically.

2 SOCIAL AND BEHAVIOUR ANALYSIS



4 MATERIAL ANALYSIS

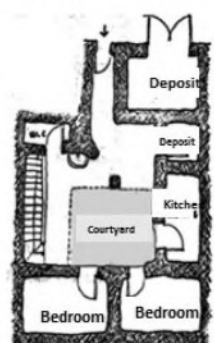


Shot 2: Infront of one of the mixed material units



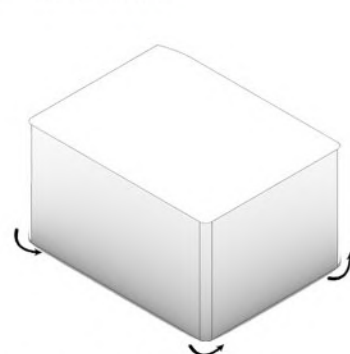
Shot 3: A shot in one of the side streets leading to a communal shaded court and showing the architecture language and feel

Form Generation of a unit

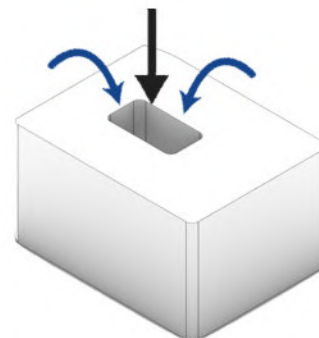


Picture from heritage science research

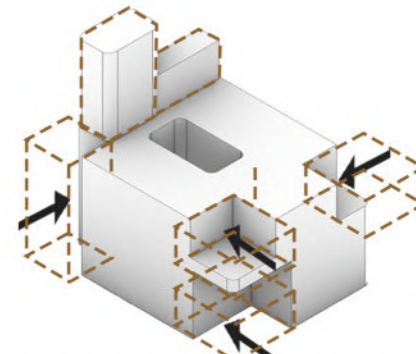
Derived from a traditional ksour ground plan, then adapted for contemporary use.



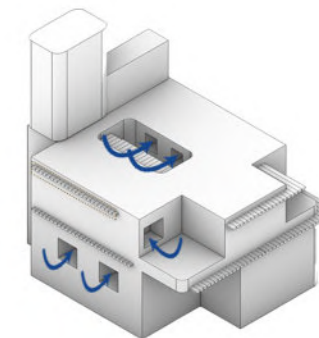
Two-floor, 8.4m-high box with filleted edges for 3D printing.



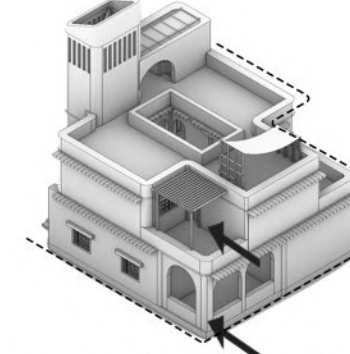
Central courtyard for natural ventilation and sunlight.



Subtractions and additions to create terraces and windcatcher.

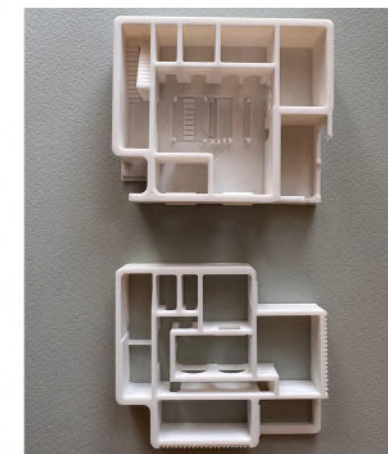


Smaller outward openings and larger inward ones ensure privacy, with palm trunks providing structure and shade.



Final mass of one of the prototypes with designed openings and shading devices.

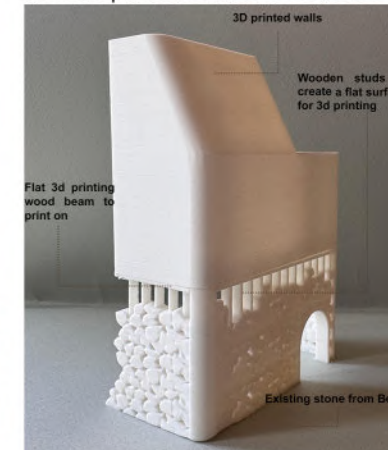
The process began by studying traditional ksour plans, identifying key features like **courtyards**, towers, and **inward-facing** openings. 3D models and **full-scale 3D prints** tested how Berm stone, palm wood, and printed adobe could be integrated. Corners were filleted to 0.5m to **optimize printability**, structure, and material connection. These experiments guided the development of modular, repeatable residential prototypes rooted in tradition and contemporary fabrication.



Printing Floors separately, some parts were broken.



Testing how openings were printed and thicknesses.

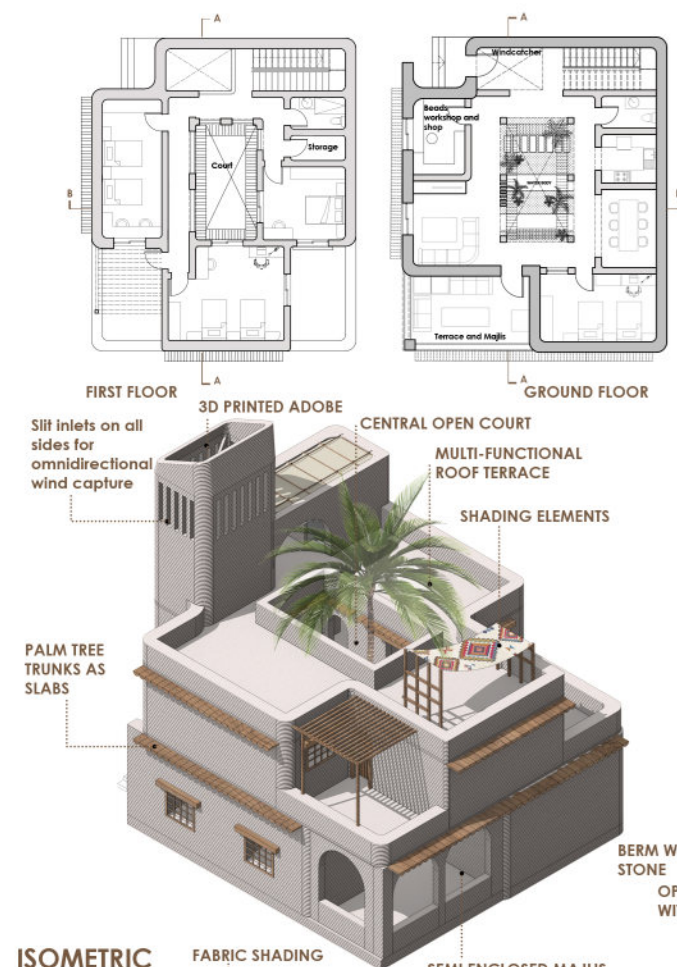


Initial trial of testing material connections

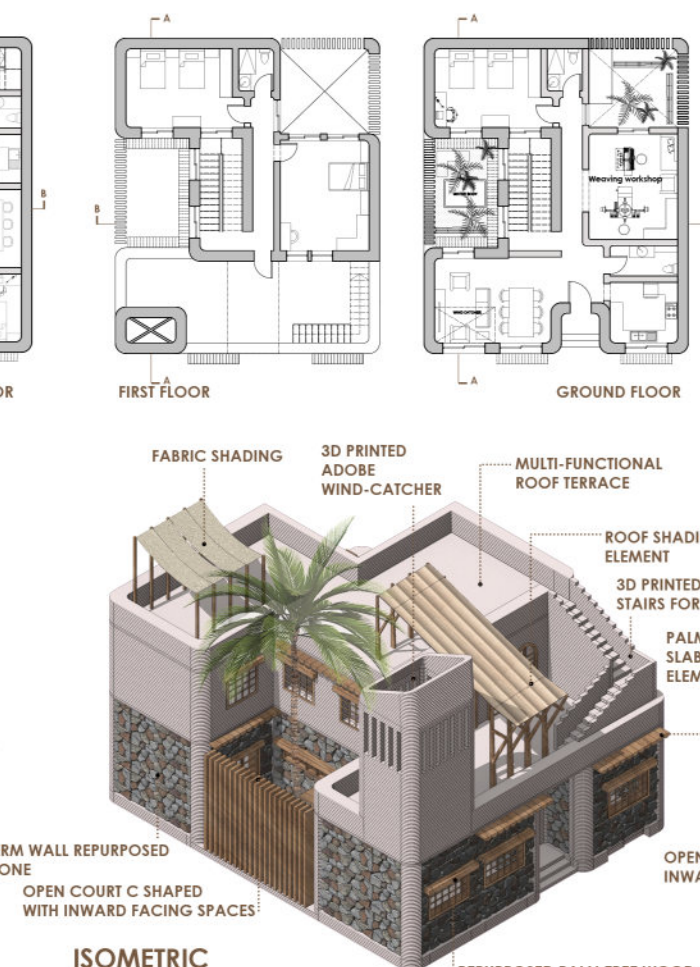


Printing a unit as a whole to mimic on site printing.

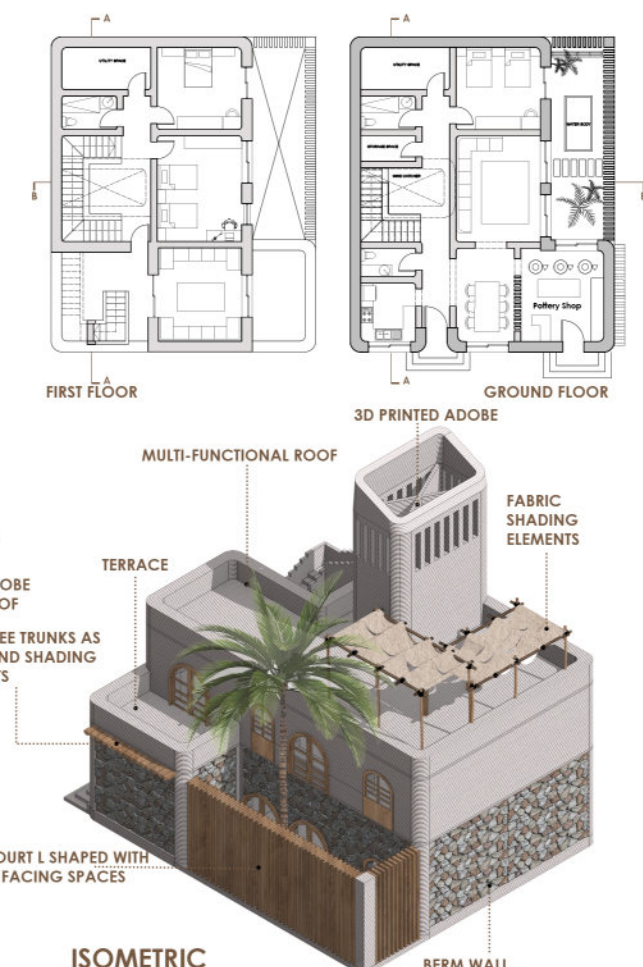
PROTOTYPE TYPOLOGY 1 CENTRAL COURT ALL 3D PRINTED



PROTOTYPE TYPOLOGY 2&4 C-SHAPED COURT MIXED MATERIAL



PROTOTYPE TYPOLOGY 5&3 STONE L SHAPED COURT MIXED MATERIAL



Residential Prototypes

Before defining the settlement, **six residential prototypes** were developed for **adaptable, repeatable** units enabling faster construction (three shown here). Each explores variations in courtyard form, rectangular, L-, U-, or C-shaped, and in materiality, shifting from **stone-heavy** hybrids **near the Berm Wall** to **fully 3D-printed adobe** houses farther away. Palm wood slabs bridge between printed walls, blending local craft with new technology.

Some homes **integrate workshops** or **small stores**, allowing women to **sustain crafts** like pottery, weaving, or beadwork. Shops open to the exterior, while workshops remain inward-facing for privacy. Roofs serve as social terraces for sitting, drying, and gathering.

These prototypes merge **cultural continuity** with innovation, testing how **material, behavior**, and tectonics can shape a **resilient Sahrawi** domestic life.



Shot 4: Inside prototype typology 1 with central courtyard

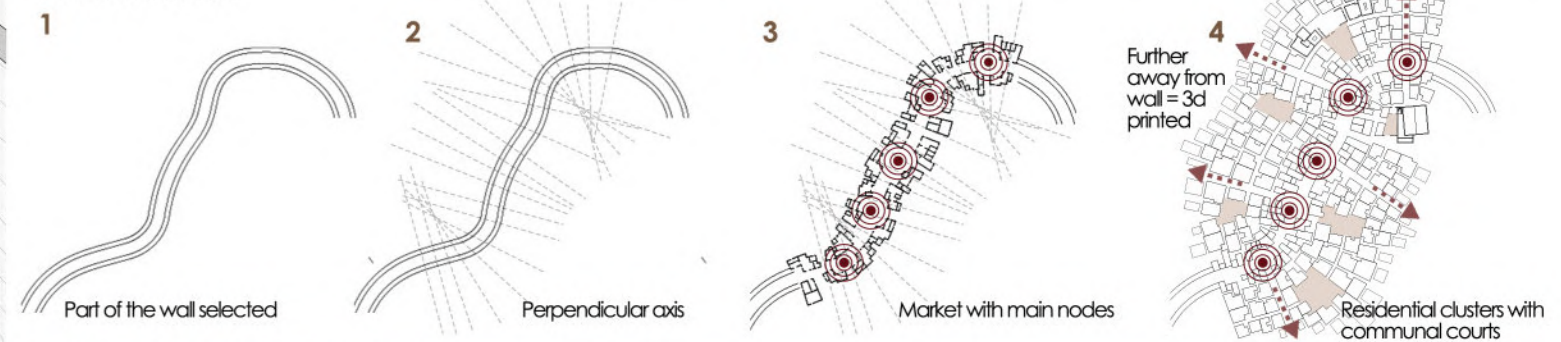


Master Plan: Growth from the spine

The **market** anchors the **central spine**, located along the Berm Wall where the two lines converge. This **dense communal hub** is the heart of activity, built using **leftover standing stone** from the wall, giving its walls a bent, **non-perpendicular** geometry that follows the Berm's local orientation. The combination of reclaimed stone and 3D-printed adobe creates a **hybrid material**, linking past and present.

From the spine, residential prototypes **branch perpendicularly**, forming clusters that reflect **kinship and social proximity**. Courtyard typologies vary, L-, U-, or C-shaped, producing **diverse cluster arrangements**. Between clusters, **communal courts** serve specific functions, storytelling, shared kitchens, and social gathering, reviving traditional Sahrawi **culture** and encouraging **interaction**.

Material distribution responds to location: homes closest to the market and wall incorporate more stone, while units farther out transition to lighter, fully 3D-printed adobe, balancing structural logic, resource use, and connectivity across the settlement.



Preserving culture

Sahrawi culture is largely oral, passed down through **conversation, storytelling**, music, poetry, and shared rituals, as Hassaniya is rarely written. Recognizing this intangible heritage, the settlement is designed with **social gathering points** at every scale. Private courtyards provide **intimate family spaces**, while larger **communal courts** between clusters act as vibrant nodes where neighbors meet, share tea, tell stories, teach crafts, and celebrate together.

These courts are carefully placed to ensure that daily life **encourages interaction**, revives collective memory, and **strengthens intergenerational bonds**. By embedding social life into the layout, the project ensures that culture is not only remembered but **actively lived** and experienced every day, while allowing the community to reflect on the past and **adapt for the future**.



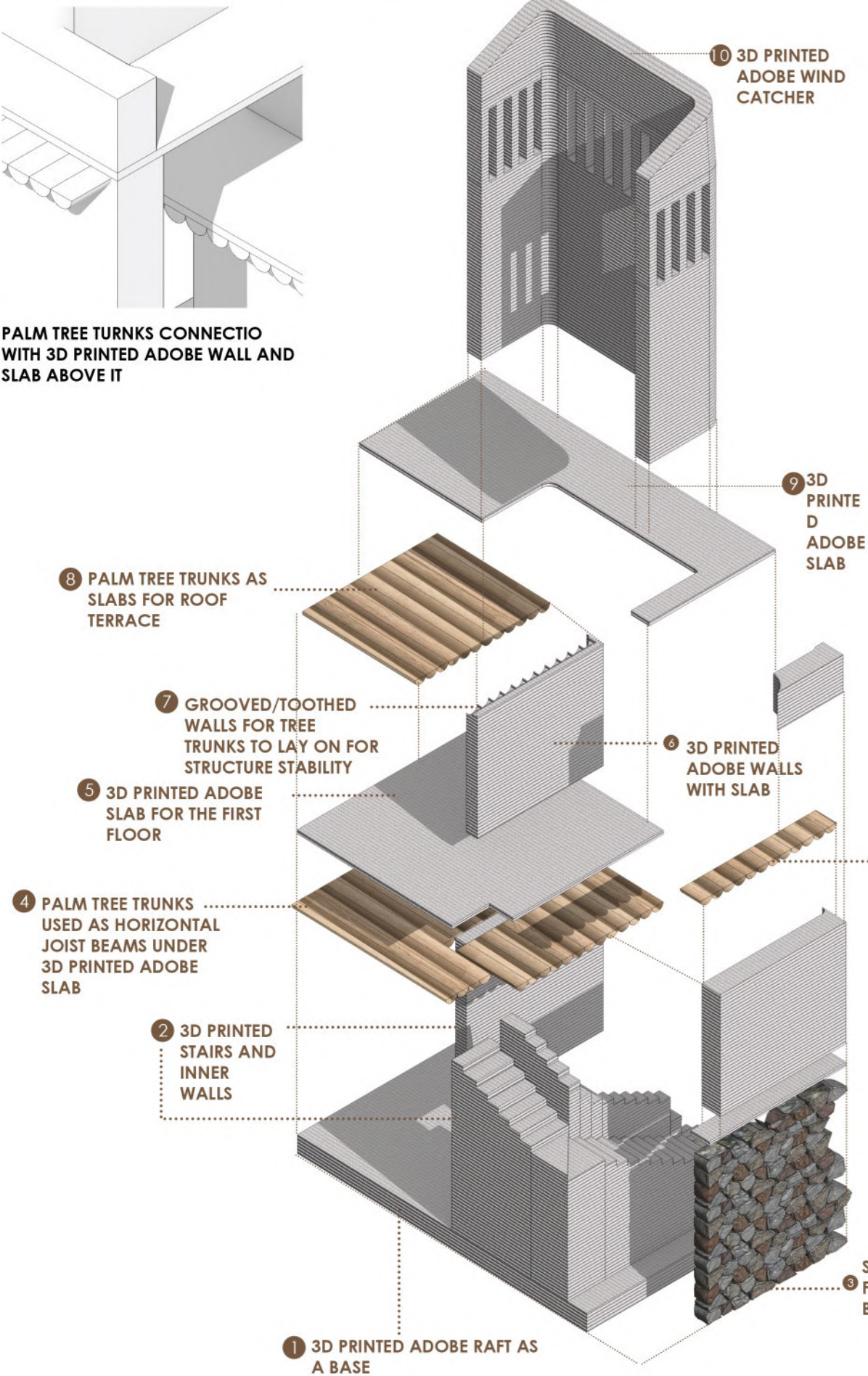
Shot 6: Shot in the storytelling communal court, where all generations can sit down and interact.



Longitudinal section

Architectural Tectonics

RESIDENTIAL UNITS MATERIAL CONNECTION

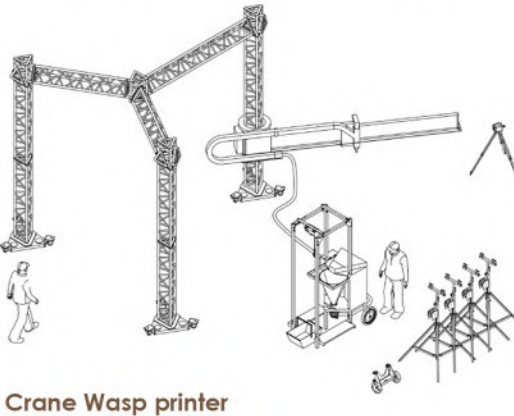
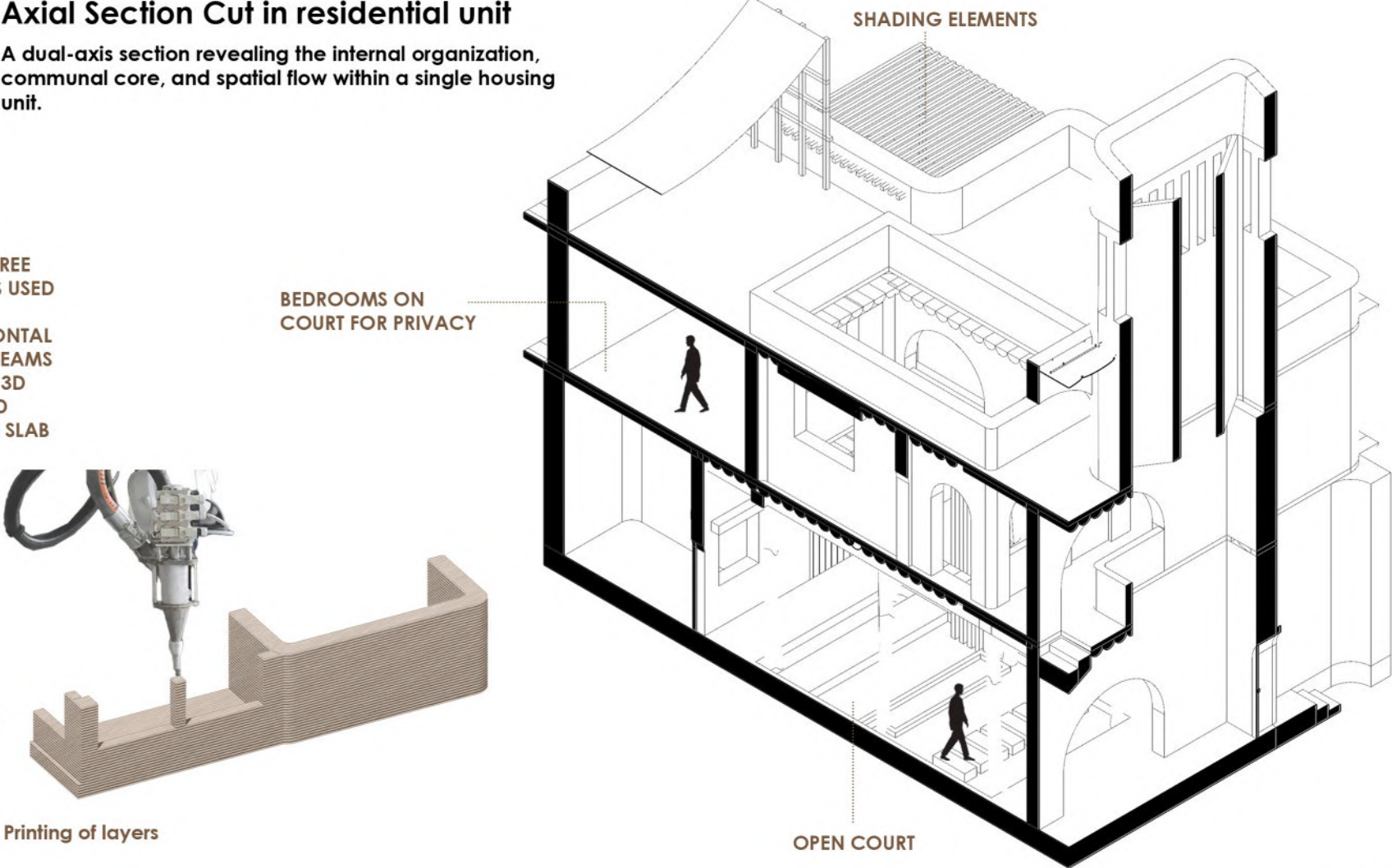


The 3D-printed adobe used in this project is composed entirely of materials **sourced** from the surrounding Saharan context—primarily **sand, clay-rich soil, and water**, with optional natural fibers such as **palm or straw for reinforcement**. The ideal mixture ratio is approximately 30% clay, 65% sand, and 5% fiber or binder, optimized to ensure structural integrity, plasticity, and crack resistance during printing and drying. Once mixed into a paste-like consistency, the material is fed into a **large-scale 3D printing machine** that extrudes the **adobe layer by layer (building in compression)**, allowing for curved walls, variable thicknesses, and embedded cavities. This method enables **fast, low-waste construction**, and produces thermally efficient walls that respond to the climate and material culture of the region.

COMPONENT	PERCENTAGE BY WEIGHT	SOURCE/NOTES
CLAY	40-4	Local wadi clay — provides plasticity and cohesion (IAAC & WASP verified)
SAND/AGGR	20-3	Nearby dune or crushed stone — adds bulk and reduces shrinkage
WATER	10-1	From wells/reservoirs/ nearby cities — adjusted to achieve workable
NATURAL	10-1	Chopped palm straw, rice husk — for crack resistance and tensile reinforcement
LIME	5-10	Stabilizer for durability (used in WASP's Gaia project)
TOTAL	100	Mix adjusted slightly based on humidity and printing nozzle specs

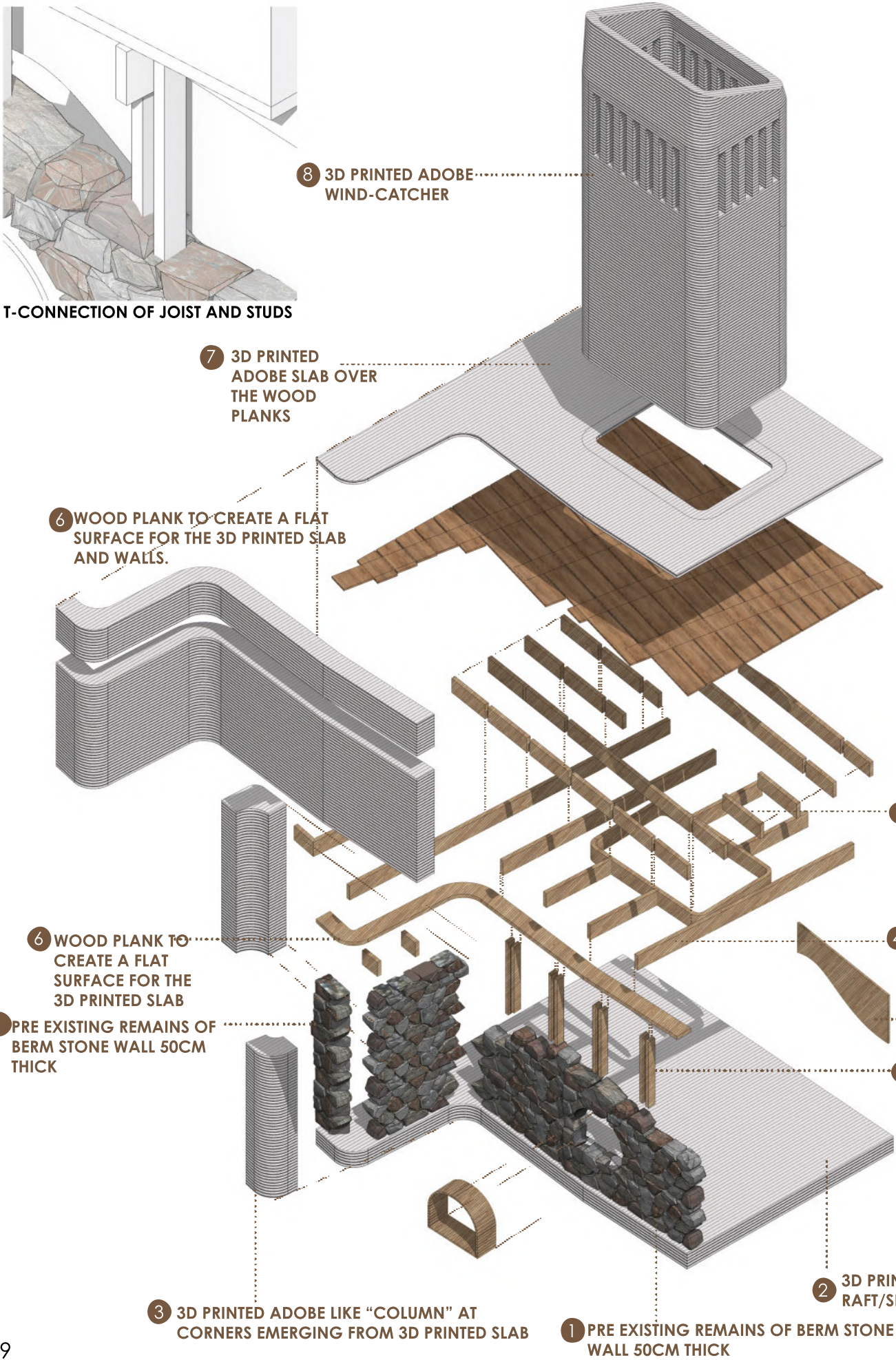
Axial Section Cut in residential unit

A dual-axis section revealing the internal organization, communal core, and spatial flow within a single housing unit.



Architectural Tectonics

MARKET HYBRID MATERIAL CONNECTION



The **hybrid tectonic system** of the market explores how 3D-printed adobe, reclaimed Berm stone, and palm wood coexist structurally and materially. The remaining Berm stone wall, roughly 50 cm thick, acts as a grounding base, its irregular surface serving as both a memory of division and a foundation for renewal. Above it, wood planks and joists form a **flat structural layer**, bridging between the roughness of stone and the precision of 3D-printed adobe slabs and columns. These printed elements rise to form walls and wind catchers that enhance **natural ventilation** within the market. Each layer expresses a distinct logic: **stone anchors** the past, wood mediates and stabilizes, and adobe embodies the future through digital craftsmanship. Together, they create a **unified connection** between traditional material wisdom and contemporary fabrication, revealing a new architectural language rooted in continuity and tectonic honesty.



Axial Section Cut in market unit

A dual-axis section revealing the internal organization, communal core, and spatial flow within a single market unit.

