KHOOS: CRAFTING A CONTEMPORARY MATERIAL LANGUAGE FOR THE ARABIAN MASHRABIYA

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ABSTRACT

This paper investigates the potential for *khoos*, a freehand woven process indigenous to the Middle East and North Africa (MENA), to reimagine the design and construction of the *Arabian Mashrabiya*. A culturally and climatically significant feature of domestic Islamic architecture, the *mashrabiya* is a latticed window screen that traditionally formed a threshold between private and public spaces and is part of a natural ventilation system. Historically the space of the disguised female gaze offering clandestine views of public life on the street, or guests in the courtyard, the *mashrabiya* provides privacy while allowing air flow and filtered light. A space in between two realms, carved by kinetic light and the hands of skilled craftspeople.

The decline of the vernacular *mashrabiya* and its substitution within contemporary Arabian architecture and urban design has often reduced it to a superficial, two-dimensional motif pasted onto building façades devoid of purpose, cultural identity, and architectural experience. Beyond the degradation of Arab vernacular architecture, an equally pressing concern lies in the prevalence of contemporary construction across the region that relies on imported, culturally foreign, industrial materials and methods rather than processes of place and people. Originally made from local and imported woods, *mashrabiya* showcased skilled craftsmanship. The industrialization of regional architecture has displaced artisans from the building process, eroding locally rooted, culturally embedded, and ecologically attuned practices of construction. *Khoos*, a material practice native to the MENA region, is both environmentally sensitive and human-centered. Traditionally employed in basketry, its potential extends beyond the fabrication of artifacts to the construction of architectural space. Derived from the date palm tree, *khoos* is locally abundant and harvested during seasonal cycles of regeneration, making the craft a practice grounded in the use of natural, biodegradable byproducts.

Using material investigations conducted with weavers in Upper Egypt and advanced through digital modeling, the paper studies architectural possibilities for reimagining the contemporary artisanal *mashrabiya*. The research leverages and builds on the knowledge of the weaver to propose a new architectural vernacular that explores the application of basket weaving techniques to architectural design. Through hybrid analogue-digital creative production, the paper will demonstrate the versatility and strength of freehand weaving as a technological process capable of creating robust, volumetric, structural form and surfaces that define spatial conditions. As a contemporary reinterpretation of traditional elements of Arab vernacular architecture, the phygital material experiments reinvent the wood screen in the woven language of *khoos*, a practice that respects the land, contributes to cultural heritage, and celebrates artistry of past and present.

KEYWORDS

Indigenous Weaving, Ancestral Technology, Craft-Based Design, Contemporary Mashrabiya, Islamic Architecture

1. INTRODUCTION: CLIMATIC CULTURAL ARCHITECTURE

The *mashrabiya*, a threshold between two worlds – interior and exterior, private and public, cool and hot – and an architectural device symbolic of climatic and cultural Islamic domesticity for centuries. It is easy to be captivated by the intricate wooden latticework of the *mashrabiya*, whose delicate patterns scatter dappled light across floors and walls. Often mistaken as purely ornamental, these finely crafted screens are in fact a sophisticated fusion of form and function. *Mashrabiya* served as one of the earliest architectural strategies for regulating interior temperature and mitigating solar gain in regions of intense sunlight (Architizer Journal 2023). Beyond its practical and artistic purposes, the *mashrabiya's* poetic merit lies in its ability to manufacture a unique architectural experience that preserves cultural identify and achieves sustainability.

Traditional Arab urbanism employed architectural elements like courtyards and *mashrabiyas* to reconcile privacy with climatic efficiency (Bianca 2000, 102). The *mashrabiya*, therefore, emerged as a response to the region's need for climate control, modesty, and artistry in urban housing. Found throughout the Middle East and North Africa (MENA), particularly in Egypt, Iraq, and the Levant, the *mashrabiya* is part of a natural ventilation system in the historic Arabic house (Bianca 2000, 134). The *mashrabiya* works in tandem with the courtyard, basement, and airshaft to create a microclimate within the house that mediates the exclusively hot and dry climate endemic to the Arabian Peninsula (Dabbagh 2023). Originally handmade by skilled craftspeople from turned wood, it evolved from simple latticework into complex geometric and floral patterns that reflect Islamic artistic traditions (El-Habashi 2012, 94–97). Typically projecting from the façade of buildings, they are often supported by corbels and extend over narrow streets, creating shaded corridors in dense urban environments (Fathy 1986, 77–79). The functional ornamentation added tectonic articulation and material differentiation to the simpler, heavier, mudbrick, rammed earth, and stone masonry buildings. In a place where light is abundant, the *mashrabiya* becomes an architectural instrument for its calculated diffusion casting one face outward to the street, while cultivating an entirely different experience within: an intimate, atmospheric interior where daily life quietly unfolds.

Figure 1. Bayt al-Suhaymi. Detail of mashrabiya interior. Source: Museum for Art in Wood.

The word ***mashrabiya*** (Arabic: مشربية) has an interesting and somewhat debated etymology, rooted in Arabic and tied closely to its original function. Many scholars trace "mashrabiya" to the Arabic root **"sh-r-b,"** which means **"to drink."** The word originally referred to a **niche where drinking water was stored**, typically in **porous clay vessels** that were placed behind wooden screens to keep them cool through evaporation (Dallal 2010, 78). An alternative etymology suggests a link to *"mashrafiya"* from the root "sh-r-f," meaning "to overlook" or "observe." This term highlights the **projection and viewing function** of the window screen (Almurbati 2022; Alothman 2020). A lesser-known interpretation attributes the name to *Macherb*, a

durable hardwood used in traditional screen construction – suggesting material origin in the term's naming (Alothman 2020). As architectural practices evolved, the wooden lattice screen behind which these water jars were placed became a **distinct architectural element** associated with privacy, shade, ventilation, and ornamentation. Over time, the term *mashrabiya* began to refer **not to the act of drinking,** but to the ornamental **wood screen itself** used in homes throughout the Islamic world (Behrens-Abouseif 2008, 135–136). The **linguistic ambiguity**, the richness of the cultural context, and the evolving role of the *mashrabiya* over centuries has led scholars and historians to propose **multiple interpretations of t**he word's **etymology.**

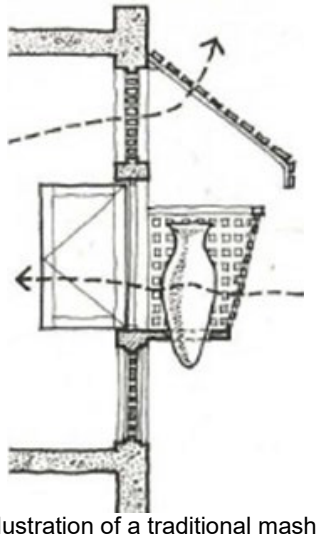

Figure 2. Illustration of a traditional mashrabiya using a clay water jar to cool incoming air. Source: Ashi 2010.

The *mashrabiya* serves multiple interrelated functions within Islamic domestic architecture. In his seminal work on vernacular architecture in hot-arid climates, Egyptian architect Hassan Fathy outlines how the design of the *mashrabiya* evolved to accommodate a range of environmental and social functions. According to Fathy, its patterned wooden screens were meticulously developed to regulate the entry of sunlight, facilitate natural ventilation, lower indoor air temperature, enhance humidity levels, and preserve visual privacy within domestic spaces (Fathy 1986, 85–87). In essence, its primary purpose was as a passive environmental control system responsible for creating comfortable indoor living conditions and, in the process, performed other social and cultural roles. A strategic breakdown of the *mashrabiya's* functions reveals the sophisticated performance of this climate-control device. The projected window screen is situated toward alleyways between buildings as well as the courtyard of the house to enable air to circulate through the apertures in the lattice. Unglazed clay pots filled with drinking water were placed inside the *mashrabiya* to activate evaporative cooling. The porous surface allows water to **slowly seep through** and **evaporate**. The *mashrabiya's* **lattice structure** promotes continuous **cross-ventilation**; airflow enters through the lower part and exits through its upper openings. As the hot, dry air moves across the sweating surface of the pot, it **causes water molecules to evaporate**. An endothermic process, the evaporating water **absorbs heat** from the surrounding air causing it **to cool. In the same moment,** the evaporation draws **heat** from the surface of the clay pot cooling the drinking water. The cooler, moister air continues to **flow inward**, reducing the **temperature and dryness** of the room (Fathy 1986, 77–79, 120–123). In addition to natural ventilation, humidification, and evaporative cooling, the wooden lattice filters sunlight, reducing glare while allowing diffuse natural light creating illuminated interiors without overheating. As a result, the window screen further aids in moderating internal temperatures by providing shade and allowing heat to escape. While fulfilling climatic functions, the latticework also aligns with cultural and religious norms of modesty by enabling women to socially observe life outside the household and remain unseen. The porosity of the lattice balanced large and small interstices to respond to both environmental and social needs—fine mesh at eye level for glare control, wider mesh above for ventilation (Fathy 1986, 77–79). **The *mashrabiya's* design – combining shade, airflow, and evaporative cooling – exemplifies a form of vernacular architecture that enhanced indoor comfort in hot climates before mechanical air conditioning existed, relying instead on passive**

environmental strategies.

Mashrabiya are fabricated out of local and imported wood, a material which can expand and contract in response to the region's intense daytime heat and cool nights in order to perform over centuries. **Hardwoods included beech and oak,** commonly used in higher-end residences due to their strength and resistance to warping. **Softwoods such as pine** were widely employed for their ease of carving and turning. In Egypt, **local pine (al-sanawbar)** was traditionally common due to its affordability and availability (Ragette 2003, 139). The construction of a traditional *mashrabiya* involves **highly skilled woodworking and joinery.** Comprised of thousands of individually lathe-turned components, they are assembled in grids or geometric patterns held within a wooden frame. Frames are modular and allow for flexibility in scale from small window inserts to entire façade screens. Traditional mashrabiyas are built using **mortise-and-tenon joints**, pegs, and interlocking systems – no glue or fasteners. This allows for flexibility, breathability, and ease of repair (The Mashrabiya Project Blog 2023).

The widespread use of the mashrabiya declined during the 20th century due to modernization, Western architectural influences, and the rise of air conditioning (Bianca 2000, 130–133). Mashrabiya construction demands precise artisanal knowledge, a skill that is now scarce. Without such craftsmanship, mashrabiyas lose both their cultural value and structural integrity (Almurbati 2022). The rise of industrial production brought more economical, foreign materials and technologies which "made small craft-based manufacturing redundant," leading to the disappearance of both the architectural element and its skilled artisans (Alothman 2021).

Contemporary attempts to revive the *mashrabiya* have, for the most part, failed or result in misuse. Across the Gulf region today, it is common to see ***mashrabiya* motifs applied superficially** to new buildings, often simply stamped onto façades to create the illusion of being "Middle Eastern" without any functional purpose. This practice reduces the *mashrabiya* to surface-level formalism rather than meaningful adaptation. When the *mashrabiya* is applied **without regard to its environmental logic, craftsmanship, or cultural context**, it risks becoming a **stylistic accessory** rather than a sustainable or meaningful feature. Maintaining its essence – functional and poetic – requires attention to **scale, performance, material, and care in deployment**. Successful *mashrabiya* reuse demands **integration of passive climate logic,** not just visual mimicry. The value of the *mashrabiya* lies not in its visual imprint, but in its **fine-grained materiality, climatic responsiveness,** and **cultural adaptability** – elements often overlooked today.

A resurgence in environmentally conscious design and heritage conservation has generated renewed interest in the *mashribiya* exemplified through notable contemporary Islamic architecture that uses it as a cultural model for passive climate control (Bianca 2000, 130–133). The paper looks at a few of these contemporary architects who reinterpret the *mashrabiya* in metal, stone, concrete, and glass. Although the architectural precedents analyzed use primarily industrial materials and technologies, they respect the performative complexities of the *mashrabiya* as a culturally climatic tool and in doing so, inventively adapt the architectural device to support ways that we live today. Building on this momentum, however, in search of artisanal material practices native to the MENA region, the research investigates the potential for freehand weaving to reimagine the design and construction of the *Arabian* Mashrabiya. One such practice is *khoos*, an intergenerational craft still alive today among traditional communities across the Gulf. This coiled basket-weaving technique uses the leaves of the date palm, a tree common in the arid peninsula. Using autoethnographic design research and creative production, the paper revisits the *mashrabiya* through the lens of a regionally informed material approach. Drawing on material explorations conducted with weavers in Upper Egypt and developed through digital modeling, this paper investigates the architectural capacity of khoos in its application to the mashrabiya. The research integrates the embodied knowledge of traditional weavers with

design methodologies to propose a new architectural vernacular that adapts basket weaving techniques for spatial and structural innovation. Through a hybrid analogue-digital design process, the study demonstrates the adaptability of freehand weaving as a technological method for producing robust, volumetric forms and spatial surfaces. As a contemporary reinterpretation of Arab vernacular architectural elements, these "phygital" material experiments reimagine the wooden screen through the woven language of *khoos*, an ecologically grounded practice that honors the land, preserves cultural heritage, and celebrates artisanal craftsmanship across generations.

2. HISTORICAL EXAMPLES OF TRADITIONAL MASHRABIYA

While many traditional *mashrabiya* have disappeared along with the historic urban fabric of Middle Eastern cities, there are notable examples that have survived. Cities such as Cairo, Baghdad, and Jeddah feature numerous historical examples, each reflecting regional adaptations in design and craftsmanship (Behrens-Abouseif 2008, 91–95). These architectural elements embodied both environmental responsiveness and cultural values, playing a critical role in shaping the relationship between private interior life and the public urban fabric (Ragette 2003, 172–176). Two of the best-preserved examples of traditional *mashrabiya* can be found in Cairo, Egypt, in the historic Islamic homes of Bayt al-Suhaymi and Bayt al-Razzaz (Aga Khan Trust for Culture 2011).

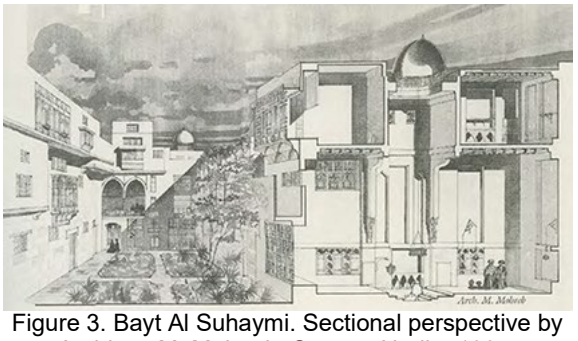

Figure 3. Bayt Al Suhaymi. Sectional perspective by Architect M. Moheeb. Source: Nadim 1997.

Bayt al-Suhaymi, a 17th-century Ottoman-era residence in Cairo's historic Darb al-Asfar district, features some of the most refined and elaborate examples of traditional *mashrabiya*. Built in 1648 and expanded in the 18th century, the house has 30 rooms within its three stories organized around a central courtyard ("*sahn*") with segregated public spaces ("*salamlik*") for gatherings, from which women were generally excluded, and private quarters ("*haramlik*") that housed family life, primarily occupied by women, children, and domestic staff ("Bayt al-Suhaymi" 2025). Bayt al-Razzaz, a grand residential complex in historic Cairo dating back to the Mamluk and early Ottoman periods, stands as one of the most comprehensive surviving examples of a traditional Islamic residence and showcases several well-preserved examples of *mashrabiya*. Composed of two separate houses, one built in the 15th century and the other traced back to the ninth century, the houses were adjoined in the late 18th century to create a sprawling four-story palatial residence of 190 rooms ("Bayt al-Razzaz" 2025). The layout of the complex is organized around two courtyards, concealed behind a modest street façade that understates the scale of the private house. Similar to Bayt al-Suhaymi, and typical of Islamic domesticity, rooms have distinct private and public functions securing privacy for women within the *haramlik* (private quarters) while allowing discreet outward views (Behrens-Abouseif 2008, 96). Their placement signals a clear spatial hierarchy: public-facing façades balance visibility with seclusion, whereas courtyard-facing screens maintain intimacy and light (Ragette 2003, 177–179). Climatic adaptations transcend typical utilitarian designations of the various rooms of traditional Islamic houses as activities are moved from one room to another according to the time of day and the seasons (Ragette 2003, 177–179).

Figure 4. Bayt Al Razzaz. Exterior and interior views. Source: ARCHNET

The *mashrabiya* in Bayt al-Suhaymi and Bayt al-Razzaz fill almost every window, at every scale whether overlooking the busy street, or facing the serene and private courtyard (The Mashrabiya Project Blog 2023). These wooden lattice screens project outward from the building's upper stories, allowing women to observe street activity without being seen, while also regulating light and ventilation (Behrens-Abouseif 2008, 95–97). Their elevated placement on upper floors allows for cross-ventilation, a strategy especially effective in Cairo's arid environment. The craftsmanship of the *mashrabiya* in Bayt al-Suhaymi and Bayt al-Razzaz is notable for its intricate geometric patterns and modular wooden components, which exemplify the high level of artisanal skill in Mamluk and Ottoman Cairo (Ragette 2003, 178–181). The ***mashrabiya*** are characterized by their dense *turned woodwork*—crafted from local hardwoods such as beech or acacia—assembled into geometric and vegetal patterns that produce a delicate perforated screen (Ragette 2003, 178–181). Artistic and symbolic expression is embedded in the *mashrabiya's* motifs that often reference **Islamic aesthetic principles,** such as balance, repetition, and unity, and their complex wooden grids create dynamic patterns of **light and shadow** that animate interior spaces throughout the day. The scale and richness of the *mashrabiya* at Bayt al-Suhaymi and Bayt al-Razzaz reflect the social prestige of its original owners and the architectural sophistication of the period (Bianca 2000, 136–140). Functionally, the *mashrabiya* served climatic, social, and aesthetic purposes creating shaded zones, enhancing airflow, and maintaining visual privacy in accordance with Islamic cultural norms (Grabar 1983, 46). Today, these examples offer scholars and conservationists a tangible record of how **vernacular technologies** were seamlessly integrated with cultural values and environmental intelligence. They remain a vital reference for contemporary reinterpretations of traditional Arab architectural elements (AlSayyad 1992, 37–38).

3. CONTEMPORARY INTERPRETATIONS OF MASHRABIYA

In contemporary architecture, the mashrabiya is being revived as a sustainable design strategy for climate control and daylight modulation (Othman 2016, 1–7). A number of projects in the MENA region and worldwide have reimagined the architectural expression of the mashrabiya in contemporary contexts that go beyond its traditional application to single-family, private residential buildings. These architectural precedents take an inventive, reintegrative approach to the cultural lattice that reconsiders the variety of ways in which space is inhabited, the materials – new and old – used to make it, and the methods of construction used to build it.

Mashrabiya House, completed in 2011 by the Palestinian office, Senan Architects, reenvisions a mashrabiya using local stone and masons from Jerusalem, Israel (Abdelqader 2023). In this contemporary reinterpretation, the carved wood screen is envisioned as a porous stone facade that envelopes the building (ArchDaily 2011). In doing so, the stone mashrabiya can serve multiple residential units of an apartment complex. Although a heavy material, the masonry envelope achieves lightness and permeability due to the irregular positioning of the stone blocks which leave gaps resulting in a playful composition of small and large openings (ArchDaily 2011). Privacy is maintained by the careful arrangement of the openings while allowing views from the interior out. Similar to a traditional mashrabiya which makes a projection from the building face, Senan's Mashrabiya House treats the stone façade as a second skin forming a cavity between the inner and outer

envelope of the building. The interstitial space permits chimney-like ventilation while the second skin of the climate-responsive façade with pixelated openings filters and deflects solar gain, as well as ensures a constant flow of fresh air (Khamui, Kaźmierczak, and Kulig 2023, 4–14). Passive cooling is further enhanced by the stone's thermal mass which absorbs the sun's heat during the day and releases it during the cool Jerusalem nights. The shaded, aerated space between the double-skin façade extends domestic living by creating a comfortable, habitable environment that is both interior and exterior.

The Masdar Institute of Science and Technology, also a multi-unit residential project however, part of a larger mixed-use public-private cluster of buildings in a research campus. Completed in 2010, it was the first building to be finished in the broader Masdar City master plan, an urban quarter in Abu Dhabi powered entirely by solar energy, which aimed to create a sustainable, zero-carbon urban environment. The design was led by Foster + Partners, and the institute serves as both an academic institution and a demonstration of innovative sustainable architecture in a desert climate. At the Masdar Institute, traditional mashrabiya-inspired elements are modernized through a context-sensitive architectural approach. The residential buildings feature perforated façades made of glass-reinforced concrete, tinted with local sand to harmonize with the desert surroundings and minimize maintenance (Foster + Partners 2025). These perforated elements, derived from Islamic geometric motifs, provide shade, privacy, and thermal comfort, acting as self-shading devices on street-facing elevations and balconies (Foster + Partners 2025). This contemporary adaptation maintains the core functions of the traditional mashrabiya – modulating light, enhancing airflow, and ensuring privacy – while contributing to energy efficiency and passive cooling (Foster + Partners 2025). The screens are part of a broader design strategy that incorporates vernacular Arab principles, such as shaded courtyards, narrow pedestrian streets, and closely spaced, undulating balconies to increase air circulation through stack effect and optimized solar performance enhancing thermal comfort between housing units (Foster + Partners 2025). This architectural strategy reflects Masdar City's goal of sustainable urban living grounded in regional traditions.

In 1987, Ateliers Jean Nouvel, in collaboration with Architecture-Studio, reconceive the traditional mashrabiya as a mechanized, high-tech daylight system on the south-facing façade of the Institut du Monde Arabe (IMA) (Winstanley 2011). A cultural institution in Paris, France, the IMA is a center for promoting understanding and appreciation of Arab culture, history, and civilization. Inspired by the geometry of Islamic latticework, the project incorporates several hundred motor-controlled diaphragms (photo-sensors) that automatically open and close to modulate natural light based on solar intensity (Schielke 2014). Similar to a camera, the responsive metallic brise-soleil calibrates the aperture of the ocular devices and in doing so produces fluid squares, circles, and octagonal shapes transforming the quality of interior space along with the exterior appearance of the façade (Winstanley 2011). Although the system eschews the strengthening of airflow typical of traditional mashrabiya, it functions effectively as a dynamic shading device, reducing solar gain while producing visually engaging patterns of light and shadow in response to daily rotations and shifting sunlight (Winstanley 2011). Unlike other architectural precedents that employ a contemporary iteration of the mashrabiya, the IMA is not situated in a hot, arid climate and its design necessitates the accommodation of environmental challenges other than daylight regulation. Significant for its time, the IMA has become a catalyst for wider discussions on the conservation and modern adaptation of historical architectural traditions, serving as a platform for engaging with evolving interpretations of cultural heritage in contemporary architectural practice.

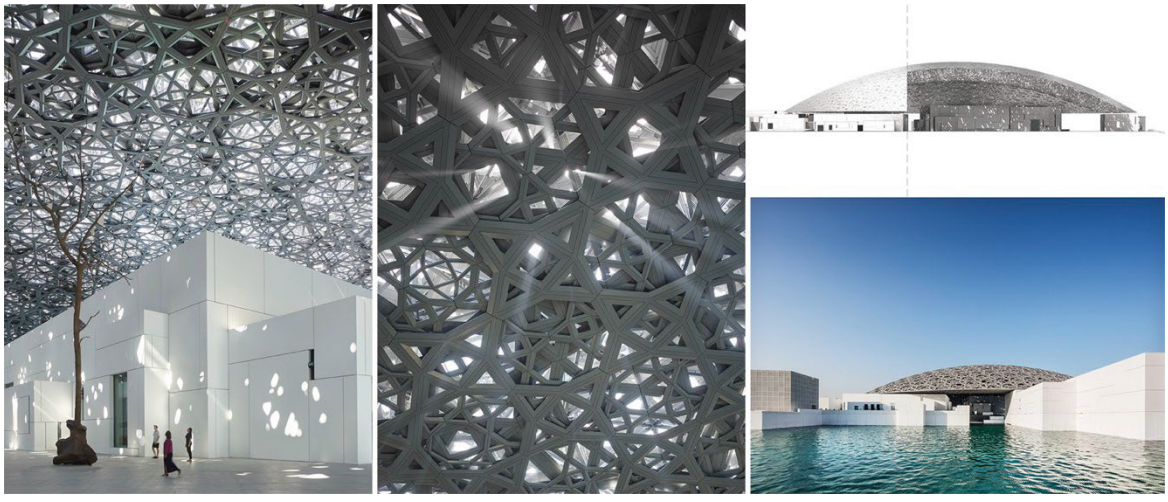

Figure 5. The Louvre Abu Dhabi, Ateliers Jean Nouvel, 2017. Source : Ateliers Jean Nouvel

In another public project and cultural insititution constructed 30 years later (2017) in Abu Dhabi, Ateliers Jean Nouvel realized the redesign of the vernacular Arab screen as a monumental, perforated steel dome shading the entire collection of open and enclosed exhibition spaces of The Louvre Abu Dhabi. The dome, itself a prominent symbol of Arab architecture, undergoes a dramatic shift from tradition as it merges with the reinvented mashrabiya. The luminous canopy is imaginative in its transformation of the vertical window screen into a horizontal roof element without becoming a flat translation (Schielke 2014). The steel mashrabiya is composed of an eight-layered lattice that intersects to create unique patterns through which natural light and air filter, illuminating and cooling spaces below. To appreciate the intricacy of the steel latticework and its experiential impact, Islamic patterns are repeated at different sizes and angles in each of the eight superimposed layers (ArchDaily 2017). This means that light rays must penetrate, and be carved by, the eight layers before entering the space. The layers produce a dynamic “rain of light” effect as sunlight passes through approximately 7,850 star-shaped perforations (Nouvel 2025). Functionally, the dome provides shade, thermal buffering, and passive cooling, echoing the environmental role the mashrabiyas has historically played in traditional Middle Eastern architecture (Nouvel 2025). Resting on four concealed supports, the dome appears to float above the museum complex, forming a microclimate beneath that protects both visitors and artworks from the intense desert heat (Thorpe 2017). The result is a museum composed of cinematic meandering indoor and outdoor spaces, reminiscent of ancient Arab urbanism, made possible by a climate-controlling veil in the sky.

4. KHOOS: REGIONAL HANDWOVEN TECHNOLOGY

Weaving is an ancestral technology practiced by cultures all over the world. The rich diversity of woven processes is shaped by the interplay of geography, ecology, and cultural traditions. This research centers on indigenous freehand weaving – to one of the earliest and most elemental forms of construction technologies – precisely because of its simplicity and ecological integrity. Practiced without the need for equipment, freehand weaving relies solely on the body, using locally available, unprocessed plant fibers that are abundant, inexpensive, renewable, and biodegradable. In this method, form emerges directly through the act of weaving, resulting in inherently three-dimensional outcomes where process and product are inseparable. Rooted in the ecological rhythms of place, these ancient techniques require minimal resources, leaving no environmental footprint

and remaining widely accessible across diverse communities. The spatial logic of freehand weaving – its capacity to produce form, structure, volume, and surface from a single material system through a single additive process – offers a compelling framework for sustainable architectural exploration.

Khoos is the craft of weaving dried palm fronds in a variety of techniques which are practiced widely across the Middle East and North Africa (Vine 1986, 43–47). The process is rooted in Bedouin and coastal communities and is closely tied to the date palm, a tree central to life and sustenance in arid desert environments. Palm frond weaving has been traditionally used to make functional and decorative objects such as baskets and mats. In 2022, the knowledge, skills, traditions, and practices of date palm were inscribed on the UNESCO representative list of intangible cultural heritage (UNESCO n.d.). Over generations, the technique evolved from domestic utility to cultural craftsmanship and, more recently, artistic expression.

The relegation of khoos to decorative cultural heritage has diminished its recognition as a material technology with potential relevance to contemporary modes of living.

The main material in khoos weaving is the fronds of the date palm tree, which are harvested seasonally, particularly during pruning cycles in late spring and summer (Rice 1994, 123–126). Fronds are dried to naturally preserve the leaves and then soaked before weaving to increase pliability. The fronds are split, and strips are bundled and sorted by thickness or color. Khoos weaving is done freehand without a loom. Artisans use coiling, plaiting, or twining techniques, depending on the object being produced. The research focuses on a coiled basketry technique specific to Upper Egypt that uses dried rice and oath grasses in combination with palm fronds to improve structural integrity. The process entails coiling split palm leaves around a core of rice grass or oat grass through an additive technique, wherein the palm strips are interlaced over and under the layered core.

Figure 6. Material experimentation and prototyping with khoos in collaboration with weaver, Laila Mohammed Saeed. Source: Tania Ursomarzo

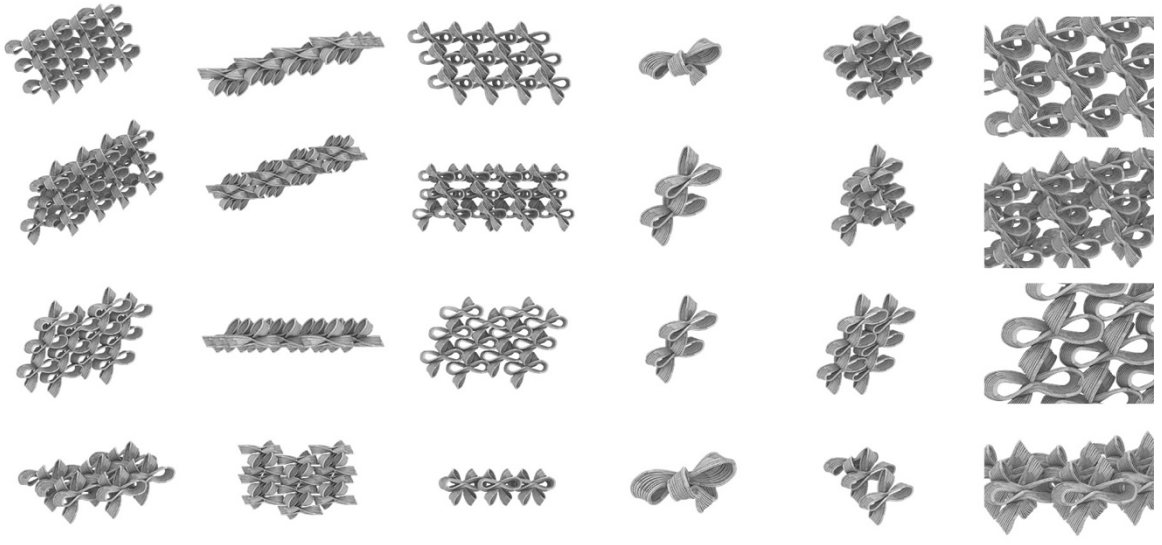

Figure 7. Digital translation and evolution of handwoven samples in three-dimensional model to study modular spatial assemblies. Source: Tania Ursomarzo

The three-dimensional form emerges progressively during the act of weaving, with structure and geometry defined in tandem with fabrication. The weave may be tight and structural (for containers) or loose and open (for ventilation or shading). Complex patterns and geometric motifs are possible to achieve with khoos weaving.

Khoos holds both cultural and ecological significance as a sustainable and climate-responsive craft. Made from the biodegradable waste of date palms, its harvest supports natural cycles without harming the trees. As a low-tech, locally rooted practice, *khoos* requires no machinery, making it both environmentally conscious and broadly accessible. It also embodies intergenerational knowledge, traditionally passed down through women in many Gulf communities, and serves as a vital link to cultural heritage. Woven palm fronds naturally provide ventilation and shade, making *khoos* an ideal material for hot, arid climates and for use architecturally.

5. MATERIAL EXPLORATIONS WITH WEAVERS

Material collaborations with an inter-generational family of indigenous weavers from Upper Egypt explore the application of basket weaving techniques to architectural design. Design is used as an investigative tool to cultivate the freehand woven process of khoos in its potential to produce spatial manifestations. The protagonist of the hands-on research and matriarch of the family is experienced weaver, Laila Mohammed Saeed, who specializes in Upper Egypt khoos weaving, one of the oldest types of hand weaving from Northern Africa. Originating from a long traditional lineage of khoos weavers, Laila started learning khoos at the age of four from her mother and has transmitted the practice to her three daughters. Methodologically, the research is conducted through an episodic cycle of material experimentation, critical reflection, and creative production, with both analogue and digital tools employed to document, analyze, and develop the work. Phases of hands-on experimentation to understand the formal and structural behaviour of khoos as a technological process are followed by phases of iterative refinements and digital translations of selected woven samples into three-dimensional models. These models are further evolved digitally to create modular, structural systems, or construction typologies,

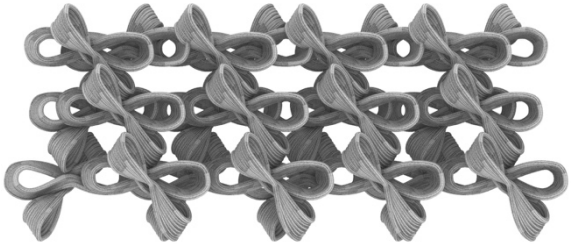

Figure 8. Detail of a digitally evolved prototype exploring a modular spatial assembly.
Source: Tania Ursomarzo

that explore associations, aggregations, and assemblies capable of defining space. The prototypes developed demonstrate the adaptability and structural capacity of khoos as a technological method for producing robust, volumetric forms and spatial surfaces that could be advanced as both modular and in-situ building systems. The hybrid analogue-digital workflow enabled a rigorous exploration of how indigenous handcraft can enter into dialogue with contemporary design technologies to imagine new approaches to architecture and construction.

6. REIMAGINING THE MASHRABIYA THROUGH KHOOS

By advancing woven handcraft into the domain of spatial design, new economic opportunities arise that simultaneously expand the role of the artisan. The craftsperson traditionally engaged in producing baskets and small-scale artifacts could also participate in the construction of architectural elements and environments. In this expanded capacity, the artisan operates as a specialized fabricator, collaborating with designers, architects, and builders across multiple scales. Reframing woven processes as technology rather than product redefines craft as a versatile, contemporary method of making. Culturally, positioning weaving as a modern construction technique enables the emergence of a regionally rooted architectural language – one that integrates heritage practices into contemporary modes of production with relevance across diverse design contexts.

To explore these possibilities, a series of prototypes – developed through material experimentation with *khoos* and advanced through digital modeling – were employed to examine its application in the schematic design of the mashrabiya. As an initial study, the traditional wood screen of a Cairene house was substituted with *khoos*, serving as a first step toward understanding its performance as a vernacular element. Each woven prototype, through its distinct formal articulation and assembly, generated a unique spatial language and porosity, producing varying experiential thresholds between interior and exterior space. The patterning and perforation of the woven *mashrabiya* emerge from the prototypes' modular composition and the way units interact when multiplied, echoing the assembly logic of traditional wooden screens. Dynamic, atmospheric, and inherently three-dimensional, the *khoos* screen modulates light and shadow within and through its spatial depth, transmitting intricate patterns that transform the architectural interior while articulating fine details. This enhanced interface between inside and out fosters an experiential condition in which indoor life remains visually and atmospherically engaged with the outdoors.

As discussed earlier, the material of the *mashrabiya* is integral to its climatic function. Like the shaped and patterned wood of traditional screens, *khoos* – composed of woven natural palm fronds – possesses inherent properties that support humidification and cooling. The porosity of the *khoos* screen

Figure 9. Application of a woven prototype to a mashrabiya. Simulated exterior (left) and interior (right) views. Source: Tania Ursomarzo

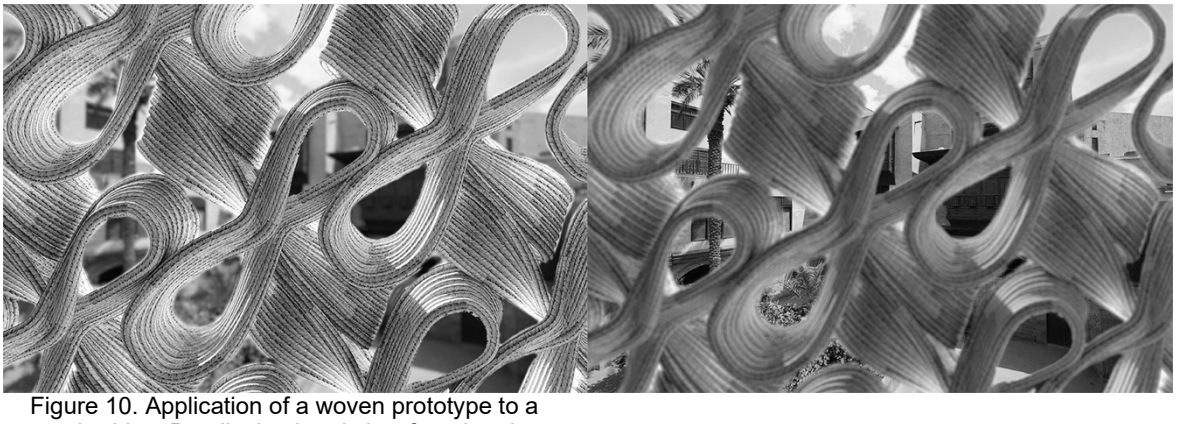

Figure 10. Application of a woven prototype to a mashrabiya. Detail: simulated view from interior looking *at* mashrabiya (left) and *through* mashrabiya (right) to exterior. Source: Tania Ursomarzo

can be calibrated to meet multiple functional needs by adjusting both the configuration of its woven modules and the density of the weave itself. A *mashrabiya* constructed with *khoos* thus can function as a microclimatic device for the architectural interior filtering light, air, and sight lines simultaneously. There is another notable parallel between wood and *khoos mashrabiya*: just as traditional wooden screens were assembled without nails, relying on the precision of skilled craftsmanship, *khoos* weaving similarly depends on interlocking techniques that produce structural integrity without mechanical fasteners, a minimalistic and delicate approach to construction absent in modern high-tech *mashrabiyas*.

The reinterpretation of the *mashrabiya* in *khoos* situates a climatic architectural element within a revitalized Arabian craft process. This approach preserves the functional and cultural heritage of the traditional screen while opening new possibilities for its formal expression. Beyond evoking vernacular precedent, the *khoos mashrabiya* prototypes explore strategies that align cultural continuity with contemporary design agendas of sustainability. Translating a traditional craft into an architectural application demonstrates *khoos'* adaptability as a material technology capable of mediating between past and present, culture and climate, heritage and innovation.

7. REFLECTIONS

While the traditional mashrabiya of turned wood remains an exceptionally beautiful element of Arab vernacular architecture, its enduring significance lies in its role as environmentally responsive architecture – an aspect that is increasingly pertinent in light of contemporary environmental concerns and the need to build responsibly in the harsh climates of the MENA region. Preserving the mashrabiya in contemporary architecture is therefore not about replicating the past, but about adapting it – materially, culturally, socially, and economically – to the realities of the present. The survival of vernacular architecture depends on its capacity to evolve in response to the ways we live, create, and address present-day challenges. This requires reconceptualizing material culture to address current environmental, social, and economic conditions, ensuring that tradition is preserved through inventive transformation.

As the urgency of the environmental crisis grows, it becomes increasingly important to consider alternative modes of design and production. This includes learning from ancestral practices: finding ways to reinterpret traditional material processes for contemporary application, particularly in the face of the accelerating loss of cultural heritage. Traditional technologies are inherently rooted in environmentally sensitive processes and locally sourced materials, making them valuable precedents for a sustainable architectural future. A forward-looking approach to sustainability must therefore integrate lessons from the past while innovating for the future.

The mashrabiya exemplifies how traditional Islamic architecture harmonized beauty, function, and social values. It remains a model for environmentally responsive design and continues to inform modern architectural thinking. In an era marked by climate change and cultural homogenization, revisiting the mashrabiya offers important lessons in sustainable building and cultural identity. Its reimagining through khoos presents an opportunity to revive the mashrabiya in a culturally grounded material practice, one that sustains heritage while advancing climate-adaptive architecture.

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