SCOTT BROWNRIGG

INTELLIGENT ARCHITECTURE \ ISSUE SIXTEEN

DESIGN+
RESEARCH
UNIT

RED CLAY

The selection of iA theme colours is rooted in an integration of architectural history and contemporary design trends. This issue's theme colour draws inspiration from the vibrant red illustrations in S. Giedion's seminal work, 'Space, Time and Architecture', and finds its basis in a Pantone swatch, aptly named 'Red Clay'. Creating a visual link to the earthy tones associated with architectural elements throughout human history.

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INTRODUCTION:
Architecture and the wall

The wall is an elemental part of architecture. As S. Giedion alludes to in his seminal book ‘Space, Time and Architecture’ published in 1941, it heralds the introduction of the second phase of human habitation.

Introduced by Director Neil MacOmish, this edition of iA explores the numerous roles a wall can play as part of our built environment, from the practical and prosaic to the philosophical and the poetic.

The wall is an essential part of enclosure, a protection from, and a response to climate. It defines boundary and threshold, often the moment of the separation of or integration of two worlds or environments. Its composition can express culture, hierarchy or inclusion. Its construction can include simple vernacular techniques or complex technologies. Its tectonics can allude to and reinforce architectural concepts – depth, thinness, solidity, lightweight, invisibility and many others. After orientation, it can be said to be the second aspect of climatic modification. It has the ability to make a serious contribution to building performance and sustainability. The wall can be living, decorated/decorative and used to keep people out or bound in.

There are aspects of reflection on what the wall might mean to us individually or collectively. There are investigations into optimising performance – not just those aspects that should be a given i.e. keeping the water out, heat and airtightness, stopping condensation etc., but testing how contemporary construction techniques can validate the spirit of an ideological or architectural proposition.

I use by way of a final example that can be described as an architectural strategy or ‘attitude’, a sketch scheme that uses a historic (ancient) wall as a point of departure for the architectural concept as well as a series of ‘rules’ that establish such an attitude.

> **“The wall defines boundary and threshold, often the moment of the separation of or integration of two worlds or environments. Its composition can express culture, hierarchy or inclusion.”**

Commissioned by the local authority, an idea for a new visitor centre (to replace a tired temporary one) was required for Cardiff Castle.

Part of the most public facing wall is a mid-century rebuild, but there is still on view, the remnants of an original Roman structure. To distinguish between old and new (although the difference is pretty obvious!), a line of red stone defines the original/authentic.

We used this line to articulate an organic form of the new facilities roof – which doesn't touch the castle wall other than by a glazed rooflight or shadow gap. The folded extrusion then turns into a landscape element, exposing more of the Roman wall and creating a grassed external amphitheatre – placed against the south-facing wall and popular with office occupants and tourists alike for social time, picnics and play.

The building is entered over a new formal pool via a curved ramp (inspired, partly by Lubekin and Tecton's famous penguin pool at London Zoo) and reintroducing an element that is also a reference back to the original water moat, rather that the grass one which exists today.

The accumulated effect is a building which is unashamedly contemporary set against the backdrop of an historic monument, whilst also being enigmatic, specific of its place and contextual.

Being partially suppressed below ground, passersby can look down into the reception building, see all the way through to the castle wall and those inside catch a framed and glimpsed view of the city and its people activity.

I hope you enjoy reading everything in this addition of iA, and find it informative and engaging ●

LEFT
Visualiations for a new visitor Centre at Cardiff Castle.

> **“When a wall becomes a metaphorical threshold, it may represent the breaking down of barriers between spaces, ideas and people.”**

RIGHT
The Great Wall of China.
© Usukhbayar Gankhuyag
via Unsplash.

RETROSPECTIVE:
The wall and its symbolism in architecture and society

Here, Project Director Alistair Brierley explores the concept of the wall and how the primary structural element has developed over time to possess deep complexity in terms of structure, role, and metaphorical significance.

In isolation and solitary, a wall may have particular resonance and symbolism in terms of its functionality and purpose, its form and scale, and its materiality. Mythologies and reputation have imbued certain walls with an importance and significance that travels far beyond their construction. The demolished Berlin Wall, the Great Wall of China, or Hadrian’s Wall are all cultural icons of global significance, and represent multi-layered and deep resonance across social, cultural and political borders. By and large the messaging and connotations surrounding the ‘wall’ in this context may be construed as negative. These walls were primarily defensive, divisive, impermeable and physical barriers to human movement. By their nature they have divided societies, blocked communication and created ‘them and us’ scenarios. A wall cannot justify its construction and maintenance without a gradient of some sort, be it economic, political or territorial. The morphology of such walls tend to be linear, extruded and stretched across and through landscapes, towns and cities.

Within the defensive paradigm, the linear wall can curve, bend and fold to create sealed enclosures. This means that rather than a binary separation of two adjacent components or land parcels, the sealed and enclosed entity is performing the same defensive or protective role as its linear counterpart, but in an entirely different way. Whether Carcassonne, Dubrovnik, York or Toledo the walls were built to provide security and safety in uncertain times.

Besides keeping those within its curtilage safe, a wall also holds, retains and incarcerates those within. A prison is designed to be impervious to escape, just as the wall of a dam must contain and hold its huge volumes of retained water. The dam describes the notion of the wall as a separator particularly well. Without the need for some sort of gradient, (be it physical, political, financial or sociological) a wall would not be necessary as there would be no imperative for its construction. This notion of the wall as a divider and marker of different environments can be extrapolated and interpreted in a variety of settings. For the architect, whether designing a retaining wall, or a non-load bearing panelised system supported on a frame, the principles of protection and modification and control of two different environments are similar.

The architectural personality and character of walls are multifold and have been developed to solve and address various performance criteria and requirements throughout centuries. Before the development of frame buildings the wall needed to be loadbearing in its entirety. Often the profile would have been battened to widen at the base to provide the requisite stability, and foundations would have been aligned to pick up the continuum of weight transferred through the masonry construction into the ground. An awareness of Newtonian physics, and the inherent forces applied to any structure means that in engineering terms the wall is actually a vertical cantilever subject to the normal rules of physics. Slenderness ratio (height to width), modularity (brick, stone, rubble or mud) all come into play here, as well as the length of particular sections of a wall. Whether a wall is straight or curved in plan, form will also have a bearing on its structural stability and whether it is built on a slope or on a flat surface. Ground conditions and foundations are also integral to the design of a wall, and whether deep or shallow subterranean support and stability is easily available.

Historically it is interesting to note that Vitruvius, Alberti and Andrea Palladio were more than aware of the practicalities of building, as well as the more academic discipline of proportion, and the use of particular columns

and their associated capitals for specific temples and civic structures. Palladio after all came into architecture via the route of expert stonemasonry, and knew how to optimise materials in specific contexts within the Venetian plain. Within the classical genre of Palladio's work, the wall is often enhanced and provided with additional articulation with the introduction of pilasters, and half and full columns actually separated from the wall itself.

Perhaps most important of all is the use of openings with the surface of the wall itself. Without a wall there can be no openings, and as such these two variables are inextricably conjoined. On the basis that the use of walls in early civilisations were primarily defensive, the use of the void or cut out space was used sparingly. Gateways providing access to fortifications were minimised, and were strengthened with turrets and walkways directly behind the battlements. These were points of vulnerability and had to perform a specific role.

The temples of the ancient world also used very few openings in wall surfaces, largely because the function of the temple, and the worship of particular gods was an introverted and intense experience. An entrance into the chamber was likely to be the only opening within the rectangular container. The single entrance would however have been celebrated and decorated with an applied system of pilasters, lintels and pediments, and the actual surfaces of the walls smooth and clean cut from huge blocks of precisely cut stone. This threshold would have been seen as a portal or threshold from the outside world into that of Venus or Zeus, and was loaded with symbolism. The symmetry of the positioning of this entrance also added to its importance and significance. →


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NOW

FROM LEFT

Section of the Berlin Wall outside the entrance to the train station at Potsdamer Platz © Marie Bellando Mitjans via Unsplash.

A surviving segment of the Berlin Wall by contemporary artist STIK on display at The Migration Museum.

A more contemporary and infamous wall divided Berlin from 1961 until its fall in 1989. It was built to prevent East Germans from fleeing to the west, and stopping the economically disastrous migration of workers. Symbolically it was a potent representation of the Cold War, and ran for 96 miles (27 of those within Berlin. It was in fact two walls that rose between 3.5 and 4.8m high built of reinforced concrete.

I experienced this wall in 1980 whilst undertaking a trip with the Bartlett School of Architecture, and the intensity of the experience remains. As we approached Berlin, the full extent of this construction became apparent - particularly the multiple watchtowers and the death strip complete with tripwire activated machine gun posts and landmines. It was both ominous and sinister and left us all silent and uneasy. Once within the city of Berlin, we crossed from east to west through the legendary checkpoint Charlie on the Friedrichestrasse. It was here, whilst the guards checked our papers and swept our bus for magazines and western food and goods, that the notion of controlled and uncompromising separation became intense.

This is the most politically and symbolic threshold that I have ever passed through, and has helped me to understand the resonance and physical messaging that a wall can communicate. The growing tension as one approached the moment of crossing, followed by the experience of having transitioned through this point felt like a significant decompression, albeit paired with the awareness that we had gone over to the other side in terms of Cold War parlance. Our objective in the east had been to visit the Bauhaus in Dessau, the villas of Schinkel in Potsdam, and the Einstein Tower hidden in the forests close to the border. All of these experiences were enhanced and intensified through the knowledge that we had passed from one world to another, and the anxiety that perhaps we would not get back to the west.

There are other examples of walls or barriers that have been created over time, and the philosophical and ideological positioning remains the same. The wall primarily performs a containing, protective and separating role. This separation is implemented for a wide variety of reasons whether political, territorial, safety, comfort or protection. Protection from external factors, be they climatic or ideological.

When viewed through this lens, the wall becomes imbued with a mythological and symbolic language. The reputation from afar that a wall may engender is well known. The reasons for this are that containment and separation speak of mystery, secrecy and the unknown. The labyrinth in Knossos was formed of a complex arrangement of walls that created a maze of such sophistication that all who entered were at risk of being subsumed and absorbed by its sequential spaces and places. Thus here the configuration and arrangement of individual walls combine to build something mysterious and intangible. In a more contemporary example, the novel The Secret Garden by Frances Hodgson Burnett speaks of the veiled and separated world that exists within a space that is isolated, contained and separate. A key to a single door provides a way in, and subsequently the arrival of spring and the gardens restoration.

So far, this essay has looked back to antiquity as well as the more recent past. The constant theme here has been the solidity and impregnability of the wall. If we move forward in time the wall can be seen performing additional roles in terms of both its construction and symbolism. A wall ceases to be just a physical barrier when it transcends its traditional function and takes on a symbolic or metaphorical significance. In society a wall might no longer be just a partition, but rather a canvas for artistic expression, a conduit for storytelling, or conversely a statement of transparency and openness. When a wall becomes a metaphorical threshold, it may represent the breaking down of barriers between spaces, ideas and people. Walls encapsulate a sense of enclosure and protection defining spaces for introspection and refuge. Such walls may carry historical narratives, reflecting the passage of time, and the →

accompanying layers of human experience that have marked the wall.

A 'wall' based project that has always fascinated me is the Running Fence installation by the artist Christo and Jeanne-Claude. The project involved the construction of a fabric fence that extended for 24.5 miles across Sonoma and Marin counties in California. The purpose of the Running Fence (which was completed in 1976) was primarily artistic and environmental, with its strong interaction and engagement with the surrounding landscape. It followed the contours of the land, crossing hills, meadows and even traversing roads.

The sinuous and winding curves of the installation encouraged us to focus on the transient nature of art as reflected in the natural world. As a temporary structure, its impermanence added to its allure, emphasising the ephemerality of artistic expression, whilst challenging the notion of art and the wall specifically as a permanent fixture. Beyond its aesthetic and environmental considerations, the Running Fence project sparked dialogue about art, nature, and the relationship between human intervention and the landscape.

In complete contrast to the poetic and thoughtful Running Fence project, the wall envisaged and partially constructed by the Trump Administration in 2016 (to create a barrier along the south west border of the US) has been a source of controversy in terms of its symbolism, as well as the social and environmental damage that it has caused. The 8m high tightly spaced steel columns rooted in heavy concrete foundations do not run contiguously, and use already built sections of partially finished wall. Inevitably, besides the divisive and harsh presence of the actual physical barrier, the resonance of its presence encompasses harm to natural habitats and species, water

management and sustainable agriculture, and the undermining of the economies of indigenous native populations and their sacred burial sites.
Perhaps more authentic and imbued with deeper sociological, cultural and economic significance than both the Trump and Christo and Jeanne-Claude projects are the dry stone walls constructed over centuries by farming communities in specific parts of England, in particular Derbyshire and Yorkshire. Seen in other societies across the world it's clear that the building of such a wall requires a meticulous understanding of local geology, climate and the properties of individual stones. The craftsmanship becomes a form of cultural expression with distinct regional styles identifiable. The symbolism and resonance of the Neolithic tomb at Skara Brae in Orkney (blended and built into the earth) is evident and potent, and dates from 3200 BC. Such walls can be found in most parts of the world, and are a key example of how society used local materials and nothing else to improvise, and create systems of enclosure, defence and habitation. The lack of cement, and the skill of the construction involves careful selection of individual stones, and allows for the integration and acceptance of nature in the form of small mammals and reptiles, as well as birds and shrubs and grasses.

As well as the more vernacular and domestic scale of the farming enclosures seen in northern Europe, the dry stone wall reached its most sophisticated and elevated level at Machu Picchu in Peru where the Incas used this form of construction to complete complex and detailed habitable construction.

The consideration of the dry stone wall in society, the multiple roles it has played over millennia, its inherent simplicity and integrity, and its green credentials all bring it into focus as a significant and far reaching version of what we recognise as a wall. It's clear and obvious functionality, its universal adoption across civilisations, and its ubiquitous flexibility all recommend it as a key component of human habitation, occupation, division, shelter and religion. Although not overtly symbolic and sophisticated in its everyday use, it has by stealth become part of our agricultural and ancient civic settlements. It also accepts its environmental and ecological responsibilities to those who encounter and use it. Openings can easily be cut within it, water can flow underneath, birds can nest, and its construction methodology requires nothing but the skill of making the right choices in terms of each and every stone. Everything is integrated, co-ordinated and set in the context of its prevailing landscape, and its specific position within the physical and symbolic places we inhabit.

There can be no succinct or definitive moment of conclusion in the discussion around the wall and its symbolism in architecture. Any particular atmosphere or statement that a wall engenders comes from the human response to its suggested intention. It is difficult to argue against the wall being a neutral or entirely democratic response to its particular role in a specific place in society. We understand that the purely vernacular role of the wall, utilised in the domestic dwelling is to provide shelter and safety. These small scale architectural gestures are however loaded with intense symbolism for their occupants and wider society. By its very nature, the purpose of a wall is to be divisive. The reinforced concrete of the retaining wall of a dam, the protective wall around the medieval city, or the sheltered courtyard within a middle eastern home all create an immediate differential between two environments, and a means of controlling and ameliorating specific conditions, be they physical, philosophical, ideological or political.
The potential variations of the physical wall are almost infinite when one considers immediate context and given performance criteria. This is almost a contradiction for something that is so universal to our daily lives and experience, and only comes into a sharper focus when additional resonance and meaning is applied through the lens of history. Walls that are yet to be built may also carry symbolic weight, and the reasoning and grounds for envisaging such a wall will be grounds for intense debate ●

LEFT
Machu Picchu, Peru © Fabien Moliné via Unsplash.

PURE RESEARCH:
Perspectives on an architectural intervention in a walled garden

Here Director Neil MacOmish explores the relationship between architecture and the wall and the potential for architectural intervention within the bounds of the historic garden walls at Castle Leslie in Monaghan, Ireland.

Architecture within garden walls is difficult to find. It is often architecture as 'background' - an undulation of the wall or an extension of it. Even when the architecture might be new (newer than the wall) or of a contemporary architectural language, it still often dissolves into the background - it becomes the 'architecture of absence'.

However, the organisation and structure of the internal landscape is often architectural itself. Where opportunities for interventions within the enclosure exist, a response to the layout and planting is clearly a contextual opportunity. This initial research looks at the ways in which architecture does or might engage with the walled garden and more particularly, the wall.

We have looked at precedent, but equally undertaken some diagrammatic studies that test architectural strategies and 'attitudes' as to how any proposition at Castle Leslie might respond to the special and significant landscape and environment. The nature of any intervention should take a positive but respectful attitude to the existing fabric. It should be unashamedly contemporary to ensure that it does not compromise the currency of authenticity of the existing buildings and environs.

Architecture as:

- Object
- Installation
- Sculpture
- Node
- Landmark
- Temporary Event
- Enigma

Placed in a walled garden, Peak Morison's playful structure marks the centre point of the space. It affords the opportunity for shelter, play and discussion, touching only lightly on exiting fabric and landscape and entirely detached from the garden wall.

Combined with other elements, it could form part of a wider estate 'cultural trail' - a journey not just though the physical environment but also a historical narrative. It could be permanent or temporary and specific.

The arbour has been a typical device for describing route, space and place. It merges structure and landscape and creates a very specific kind of environment. Whilst simple in construction, these can create spaces for occupation and modify local climate in a modest way. All of these elements can contribute to wayfinding and spatial legibility without have to result in reliance on clumsy signage which can often add visual clutter to a special historic environment.

Woven and bound traditional structures have been the inspiration for contemporary interventions within both formal and informal spaces. They can capture a 'sense of place' and generate intrigue, moments of contemplation and potentially assist in as sense of well-being.

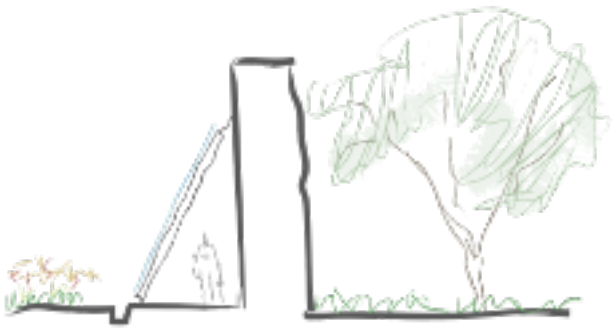
Whatever new spaces or interventions that may be created, the space contained by the wall garden might only be temporary. Landscape and structures may (are likely) to be perceived from within the space. These mid or distant markers can be useful as points of orientation and spatial legibility.

Cool and clearly different architectural responses to the heavy masonry wall articulate both the authentic nature of the original structure and what is new - by example, these lightweight and substantially transparent prisms that have different juxtapositions to the existing. →

LEFT FROM TOP

© The Castle at Castle Leslie Estate, Co. Monaghan, Ireland. www.castleleslie.ie

***'Look! Look! Look!'*, courtesy Heather Peak and Ivan Morison.**

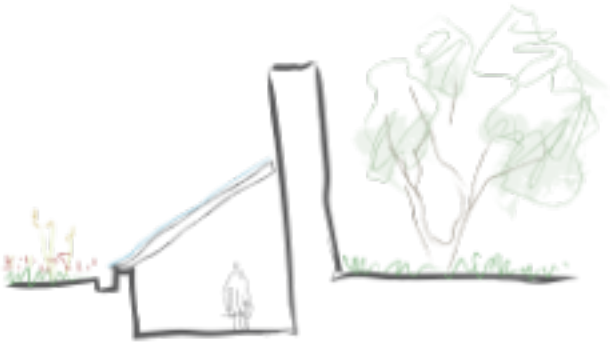


THE WALL + SIMPLE STRUCTURE NO. 1

A lightweight glazed lean-to. Almost conceived as the occupation of a ‘cold-frame’. These were originally created to create warmer environments on south facing walls - additional heating created by the glass panels increase the solar heat on the wall - which later as the temperature and sun decreases, releases heat back into the space, tempering the environment further. This has been developed in the Trombe Wall typology for many passive buildings.

THE WALL + SIMPLE STRUCTURE NO. 2

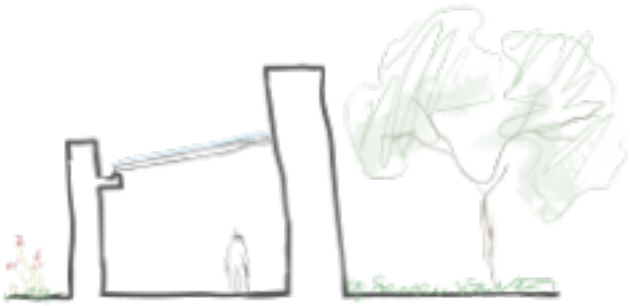
Still lightweight and touching both the wall and ground lightly, the section is slightly more sophisticated and adds another layer to the spatial quality of space created. Structures like these clearly transform into greenhouses and orangeries, using identical passive environmental techniques as simple structure no. 1. The form and configuration can become more elaborate and sophisticated - like the Crossrail Place Roof Garden in London or Gardens by the Bay in Singapore.



THE WALL + CUT SPACE

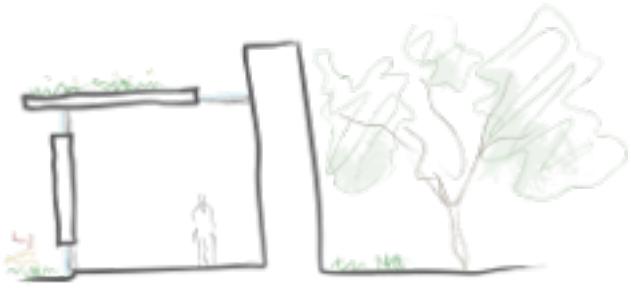
Again, using similar techniques to the previous two strategies, this typology generates a different perspective of the immediate environment. Eye level is now at ground level and one appreciates the place in a slightly different way. It also acts as a potential for archaeological discovery - layers of history and the wall are revealed and can be used to develop a specific narrative around heritage and social structures.

An example of how this type of architectural response might work in the landscape and walled garden is Ahrends Burton and Koralec’s Keeble College intervention at Oxford University within the historic cloister.



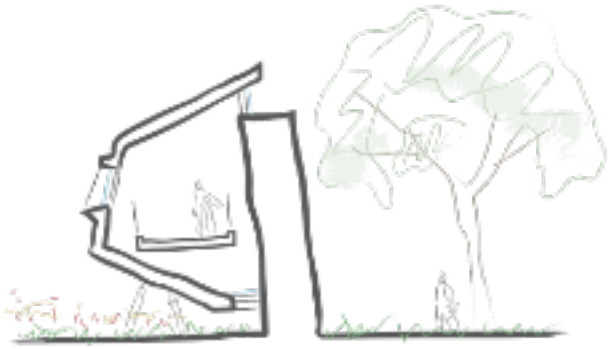
THE WALL + ANOTHER WALL

This typology uses spatial layering or ‘peeling’ to create space that could in elevation be almost invisible or merge into the background. Equally, it could frame and contrast a different type of architectural expression to existing structures. The density of the new wall should probably left unarticulated or at least use a language of openings as ‘punched holes’ with deep recesses and reveals. New layers can be articulated in different ways - heavy, light and transparent or translucent, or even living.



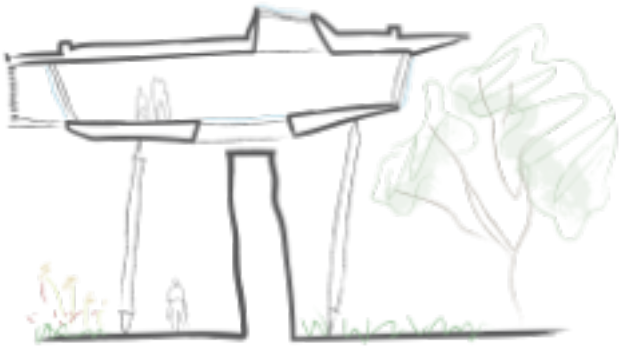
THE WALL + PLANES - HORIZONTAL AND VERTICAL

Partially using familiar techniques to the previous, this typology is perhaps more sophisticated in its manipulation, configuration and response to ‘genius loci’. Only ever touching the existing wall and ground lightly, it has the potential to frame existing views and vistas. Usually, the language is one that represents lightness, but equally can use devices such as grass or sedum roofs, mitigating loss of planting areas and increasing biodiversity.



THE WALL + ARCHITECTURAL ‘PEEKING’

This strategy looks at how interventions might afford opportunities to look outside of the contained space. It also alludes to something of interest or act as a landmark breaking the continuous horizontal line of the wall. By ‘embracing’ the wall structure, it becomes an integral part of it. The potential for different levels can also allow for an experience of the wall and its environs. The wall can become part of a tactile visitor experience.

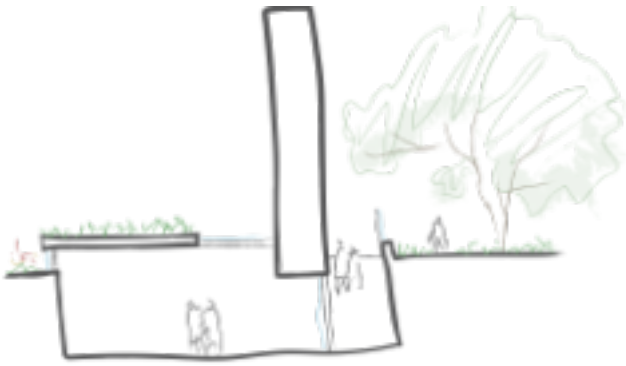


THE WALL + OVER

A typology as a bridge - both physically and as a metaphor. A physical engagement with two separated worlds. Dissolving the ‘barrier’. Minimal contact with the ground, landscape and ‘floating’ above the wall giving an entirely different perspective of it and the wider environment. Alluding to connectivity, route and passage. Crossing a threshold.

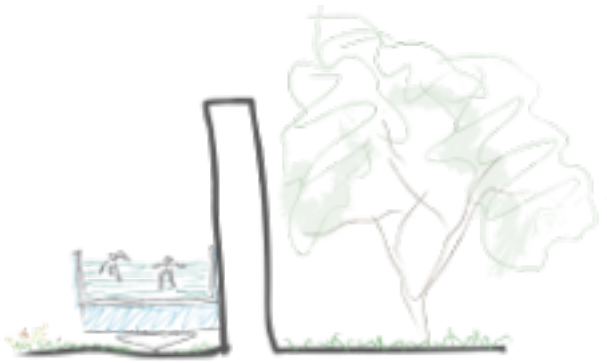
THE WALL + POKING THROUGH

This typology has similar characteristics to the one previous but includes the wall as part of the proposition. In one sense, it remains subservient to any existing structure. It still crosses the ‘existential threshold’ from one world to another and erodes the sense of boundary.



THE WALL + UNDER

A transition that creates an extraordinary experience. A language of form that is seen as land art. Revealing the foundations of the wall, a further and deeper exploration of the layers of history. Spatial contrasts of dark and light - understanding the soil, its structure and benefits.



THE WALL + LEISURE

And finally, not necessarily architecture. Using the walls thermal heat properties to generate a leisure (swimming) experience with the walled garden. Formal swimming, wild swimming and a different type of ‘animated space’ ●

LEFT
Concept sketches by Neil MacOmish.

DESIGN PROCESS:
Net Zero behaviours to break down the invisible wall

Meeting Net Zero targets matters greatly to us all, but even with the best of plans, stayed or outmoded behaviours have the potential to present us with a seemingly impenetrable wall. Here, Edinburgh Studio Principal Alex Donaldson shares insight into our approach to the Early Years Centres pilot programme at St Mary's and Blackridge in Scotland as an example of what can be achieved when behaviours and ambitions align.

Conflicting views, outdated behaviours, and slow and short-sighted decision making too often create behavioural walls that can have a detrimental impact on a project. Leading to key design features, included for the benefit of the end user, wider community or environment to be value engineered out with detrimental impact to programme, cost, environmental performance, and end user satisfaction. Here are the key behaviours that we believe led to the successful design and delivery of our projects at St Mary's and Blackridge.

COMMITMENT

St Mary's and Blackridge were initiated in response to a wider national initiative; the Scottish Government's Early Learning and Childcare (ELC) Expansion Programme which increased the funded ELC entitlement for eligible children from 600 to 1,140 hours a year in August 2021. The main aims of the programme were to help close the poverty-related attainment gap, increase family resilience through improved health and wellbeing, and support parents into work, study or training.

Whilst this direction is commendable, it left the local Scottish authorities who provide such education and childcare services, with a mountain to climb. The current Early Years estate couldn't accommodate this increase in demand and the government required almost immediate implementation.

To meet this demand, local authorities were allocated enhanced funding but had to find space or develop space fast, to spend efficiently and to ensure that any new build, performed to ever more challenging energy, carbon and thermal performance targets. Achieving such ambitions would undoubtedly require commitment, collaboration and collective buy-in from a range of key stakeholders and consultants from the outset.

Fortunately, our client Hub Southeast was a framework partner, determined to deliver quickly, efficiently and strongly compelled by their charter to the government to deliver energy efficient public assets.

COLLABORATION AND CONSULTATION

To best respond to the scale of this procurement, the client conducted a series of workshops collaborating with Scott Brownrigg to form a Territory-wide Early Years Strategic plan. This included a range of sustainable, scalable design models conceived to be efficiently procured and delivered quickly in the southeast of Scotland. West Lothian Council were presented with this strategy and it was established that they would like to develop two Early Years Centres (EYC) as part of a pilot programme, at St.Marys EYC in Bathgate and Blackridge EYC.

With essentially the same spatial and operational brief and layout, our pilot coincided with the emerging market

trend or desire amongst public sector clients to develop a Passivhaus pilot. As West Lothian required a method of scrutinising the relative benefits of adopting a Passivhaus approach, the scene was set, and we were presented with the perfect opportunity to develop a comparison programme. Having already developed a highly performing Optimum Schools model with West Lothian Council in previous years, the model was to be adopted for the traditional prototype which would be directly compared with its Passivhaus twin.

This modest initiative was to present Scott Brownrigg with a series of design and advisory opportunities beyond the norm. In addition to the RIBA stage 2 to 6 Lead Designer role, we utilised an RIBA Stage 2 Requirements Analysis process to prove the functionality, adjacency and operational aspects of the brief, with the findings used to form the basis of our concept design. Involved throughout the process, the client was highly supportive of the design direction for the remainder of our journey. We also worked with the client to provide Passivhaus design services, review the supply chain and construction, and provide post occupation evaluation services.

VISION AND FORESIGHT

It has to be said that during the development of the Optimum and Passivhaus pilot programme we were all driven, observed many positive behaviours, high levels of commitment and support which inspired us all.
The single biggest obstacle we were to face was our perennial foe, affordability, and whilst we didn't let it impede us, we did have to alter course. So, did we take the correct course, and knowing what we know now, would we take the same course again?

When comparing the Optimum to Passivhaus, Passivhaus was more expensive with more sophisticated →

"Conflicting views, outdated behaviours, and slow and short-sighted decision making too often create behavioural walls that can have a detrimental impact on a project."

ABOVE
Still frames from Blackridge Primary School video © RAW Film Productions / Morrison Construction.

elevation components and MEP kit. This differential was to result in two main compromises; Pilot wide Value Engineering of "non-critical" space affecting both Passivhaus and Optimum pilots, and adopting a more complex Passivhaus construction detailing methodology, as this was more affordable.

Our approach for our Passivhaus EYC whilst more cost effective than it's more expensive counterpart was far more complex to detail and deliver. Insisting upon simplicity of structural form is the big learning point for the designer and contractor when engaging with options appraisal exercise. Additionally, Value Engineering out perceived non-critical plant space was to add further complexity.

Things seldom get built properly without the people who are committed to delivery, and to the greatest extent our Optimum School approach for St. Mary passed without incident, largely due to the Framework Tier 1 Contractor's familiarity with the product, positive attitude and commitment.

Blackridge, our Passivhaus pilot was a new prospect for the Tier 1 Contractor, their first Passivhaus delivery. Whilst well prepared, we did encounter many more issues regardless of the contractor's positive attitude and commitment. We therefore question how hard as designers and contractors we collectively insisted upon selecting the easiest to build option. In retrospect, it may have more appropriately supported efficient Passivhaus delivery.

REFLECTION

We entered this exercise knowing what we wanted to achieve but when we reached a behavioural 'wall', did we all react? Of course we did, but translating individual successes into a collective holistic behaviour which better supported the ambition to achieve Net Zero remained our drive. Our client had a vision and was resolved to resist short-termism in favour of a more holistic greener less wasteful future. Key learnings of the project and process from an architect/designer perspective are as follows:

- Know what added value benefits to promote to the client to enable them to secure support – whether this is technical, political or funding.

- Know what benefits to promote to the end-user. Users feel more connected to their energy consumption and carbon commitment. Whilst the Passivhaus pilot at Blackridge has the theoretical edge, St. Mary's EYC, as a result of being involved in this pilot programme have taken control of their more traditional centre, taking great pride in conserving energy where they can.

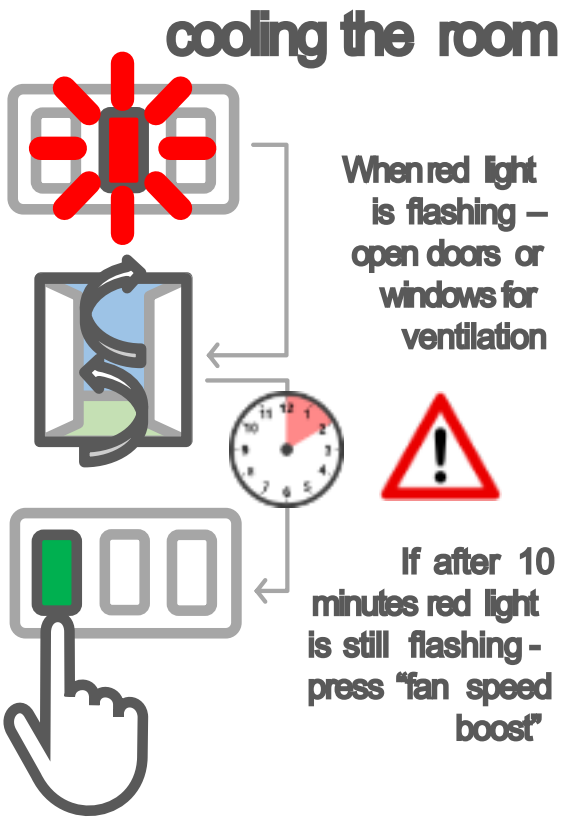
- Insist upon ownership of space. One of the "non-critical" space targets for value engineering was the community room. This is not generally regarded a core education space but mattered greatly in its ability to host a wide range of support activities. Ownership of this space is essential, and as no one agency really occupies it, such spaces can be an easy target for reduction. In post occupation evaluation analysis at St. Mary's, this space demonstrates regular CO/CO_2 build-up pointing towards the fact that it is potentially over utilised, necessitating the more regular opening of windows to purge and incidental energy loss.

- Insist upon investment of time and effort of others. Whilst from conception to completion we were all of one mind as part of our process, we must work harder to ensure that the operational phase of the project is understood, its importance acknowledged and that it is meaningfully resourced from the offset.

- Have courage. When faced with short-termism especially when you know or can gauge that it's going to cause more complex problems for others.

- Be mindful of complacency. We are trained to design logically and when it comes to detailing it pays dividends to follow a process. At University we were taught to follow a simple process to good detailing. Detailing to account for water; insulation; vapour; ease of construction and structure were tutored as a fundamental doctrine. When engaging with Passivhaus this is no different; in fact, it is even more essential.

- Be respectfully persistent and resolute. When viewed through the accountancy prism it is easy to see why we are quick to rush to the conclusion that committing to carbon reduction costs more money. Our experience would suggest that whilst this is true to a degree in the short term, when this investment is viewed over the life of a project, this commitment will save wasteful expenditure for years to come whilst significantly reducing negative impact on the environment ●



ABOVE
A sample of the signage created for the West Lothian schools.
LEFT
Blackridge Primary School © Ian Fleming.

DESIGN PROCESS:
The notion of personal territory

In this article, Project Director and Interior Designer Laurence Orsini explores the perimeters of personal territory and looks at how we can create the same sense of enclosure and degree of privacy when designing without walls.

Open plan layouts are increasingly desirable to workspace building owners and occupiers, primarily for the flexibility they provide in current and future use. But how do we create a sense of enclosure and personal territory in a space without walls?

Fascinated by the notion of personal territory, I decided to explore, map and measure what the smallest version of this space could be for my architectural thesis. At one time, this could have been defined as the space between the cupped hand and face of someone lighting their pipe. Now you might consider interaction with a mobile phone or laptop more relevant. The principals however are very similar; they both temporarily define a very small personal territory between your face and the object. This sense of enclosure is important as it often brings comfort and focus from the distractions that surround us.

As people continue to return to a shared office environment, there is more need than ever to provide a range of spaces that evoke the same sense of belonging, safety, comfort and even delight.

Sensory changes are one of the easiest ways to help define personal territory in a space without walls. Thresholds can be marked by the edge of a rug, contrasting colours, tones or materials, a change of lighting intensity, warmer colour temperatures, even the introduction of a soundscape to name but a few. It is important to create the right balance of these elements to make a space memorable. However this approach is generally reliant on generous proportions.

The challenge for most office environments is that space is at a premium, which only pushes areas of personal territory closer together. While this works well in spaces like coffee shops, adding to a buzzy atmosphere; offices usually require a greater variety of spaces to suit different interactions. It is this factor that drives the need for some kind of physical separation. Walls of course still have their place within offices environments, providing necessary private spaces for confidential discussions or noisy teleconferencing. However the idea that there has to be a choice between cellular enclosed spaces, made up of physical walls, or vast open plan areas has long been replaced by an array of possibilities.

ABOVE
Eltham Palace's grand entrance hall © Jacinta Verdegaal, Urban Pixxels.

ABOVE
The space between a pipe and its user © Dave Herring via Unsplash.
The space between a phone and its user © Andrea Piacquadio.

The degrees of separation and ratio of open versus solid can become a tuneable device to allow spaces to be located comfortably next to each other. The notion of creating a division that still allows views through to the neighbouring spaces is well established with many ways to create this boundary without blocking views to the outside or internal vistas. There is nothing new in this approach, as in the Middle Eastern tradition of Mashrabiya screens (right) made up of intricate patterns infused with meaning dates back to the 12th century. This technique creates the notion of a wall while also allowing partial views beyond, with a magical layering of light and shadows cast by the filigree patterns.

Designers can now choose from a range of modern equivalents of these perforated screens, providing endless possibilities to create defined spaces that reinforce feelings of safety and ownership. Nowadays different territories can be defined by slatted timber walls, suspended acoustic poles, open grid structures planted with greenery, or open pavilions that create a room without shutting out the rest of the office. Many of these now have the added benefit of a 'Lego' like expandability so can be assembled and disassembled to create relocatable special areas of personal territory. You could therefore consider a workspace to be a theatrical stage, set with different elements of division that can be brought into play.

In choosing from this myriad of possibilities, one must ask the following. What is the function of the space? Who will use the space? What feelings do we want the space to evoke? →

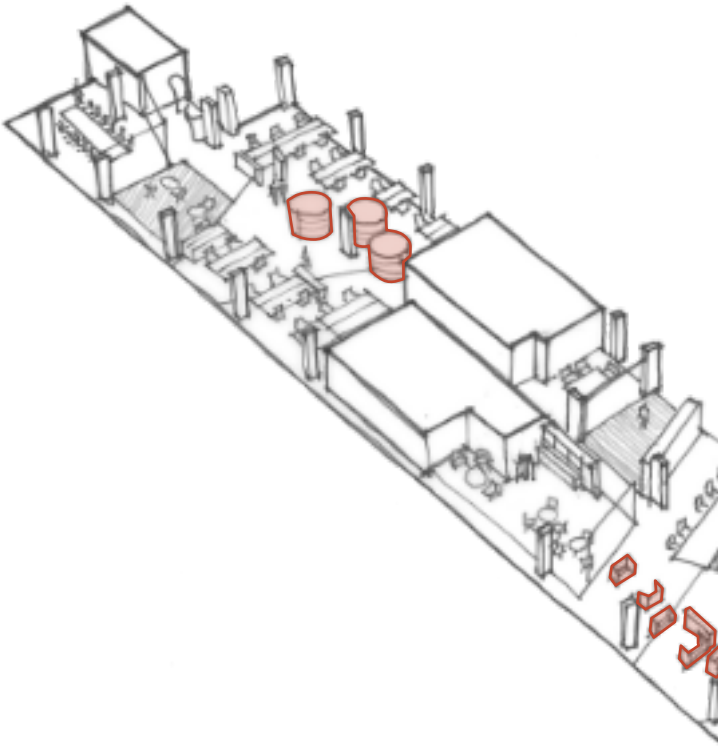
RIGHT
Mashrabiya screen at Roshn Headquarters © 2022 copyright pierre zabbal. All rights reserved.

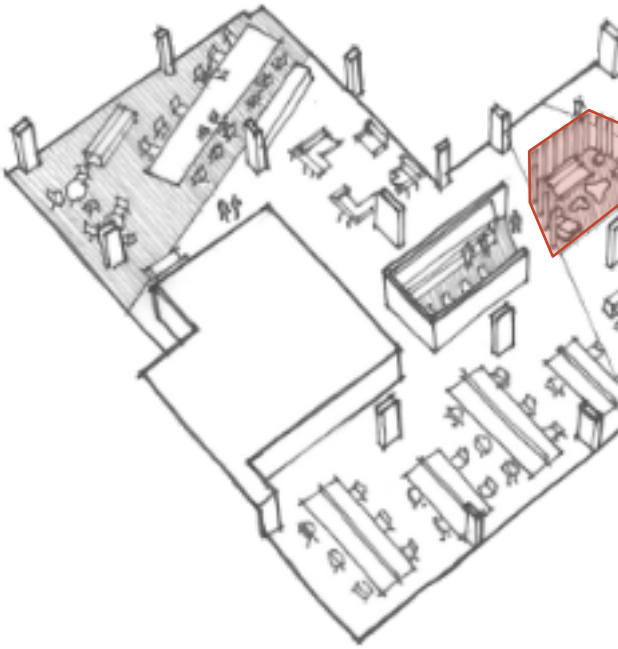
Loose furniture can also play a part when considering spaces without walls; incorporating high backed furniture, for example, can immediately create a sense of personal territory when placed in the right location. Orientation also becomes significant. A single arm chair with a high back facing a window with a good view, in an angled positioned with its back to the rest of the office becomes an important personal haven that sends a message to others 'I want to be alone for a moment'. Whereas the same high back chair positioned near circulation routes will likely remain empty because the context is uncomfortable and people will feel too exposed.

The same significance of location and orientation can be applied to open booths creating a 'non-walled' territory for groups of 4-6 people, but here the successful placement of these booths almost works in reverse. This types of semi-enclosed space works best when they are located close to circulation routes or 'gathering spaces'. Where they can offer the possibility of an impromptu informal meetings. These booths have become a phenomenon in themselves and are arguably one of the most popular destinations in most offices environments, demonstrating that conversation benefits from more open enclaves.

Another factor that enables the removal of walls while creating a feeling of territory is the creation of shaped enclosures. These become landmarks within the office landscape and identify themselves as safe havens for people to retreat to. With careful placement and sensitive use of materials with acoustic treatment, these spaces provide a place for a quiet or concentrated one-to-one discussions. Their shape helps to create an unspoken threshold that once crossed engenders a change of mind-set and emotions that can lead to a different outcome to that of a formal meeting room behind walls and a closed door.

Therefore whilst acknowledging the need for some confidential spaces that require fixed walls and a door, the above principles reinforce a 'loose fit' approach to office design, allowing personal and group territories to be defined in other ways. The numerous benefits to designing without walls provide organisations with a far more adaptable workplace able to respond to their ever change business needs. By focusing on creating a range of territories to suit a variety of individuals, bringing diversity to a workplace, provides opportunity to create and reinforce a sense of corporate identity. This also improves knowledge share, innovation and ultimately create spaces that people want to be in ●





CENTRE

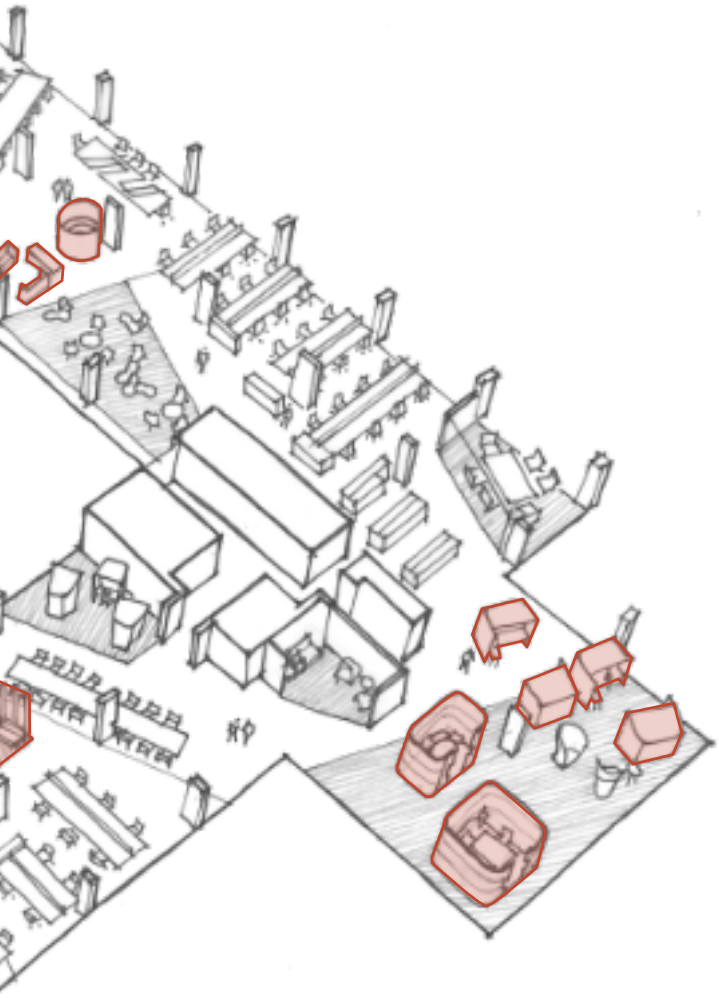
Sketch floor plan illustrating the variety of spaces available in a 'loose fit' office design.

RIGHT

Suspended acoustic poles and high back chairs create a sense of enclosure © Adam Grzesik.

Close vicinity of personal and group territories © David Churchill.

Semi open booths © Philip Durrant.



PURE RESEARCH:
The sustainable wall

Here, Project Director Olga Mikhaleva and Sustainability Designer & Co-ordinator Neva Beskonakli explore strategies to reduce embodied carbon in the external wall build-up for residential buildings and material and choices as a critical step towards sustainable construction practices.

Nearly 40% of the world's energy-related carbon emissions are attributable to the construction sector. In the UK the construction industry is responsible for 49% of carbon emissions out of which 22% is attributed to the domestic use. To prevent further climate and ecological degradation, a change in construction and design industry is imperative. With the focus not only on the operational energy of buildings but also the embodied carbon present in construction materials and processes.

The construction process relies on the utilisation of various materials and products, all of which must be mined or cultivated, processed at a manufacturing site, crafted into usable products, and ultimately transported to building sites. These stages invariably produce greenhouse gases, contributing significantly (between 30% to 70%) to the overall carbon emissions throughout a building's life. Embodied carbon refers to the total greenhouse gas emissions associated with the life cycle of building materials, including extraction, production, transportation, and disposal. The shift toward using less carbon-intensive and more regenerative materials from natural cycles that capture and store carbon is a pivotal strategy for reducing the carbon footprint.

Traditional concrete frame residential buildings with façade walls constructed of Steel Framing System (SFS) wall build-up with brick cladding is a staple of UK residential construction, widespread and used by most of the contractors, known for its durability, aesthetics, and thermal properties. However, it has various negative carbon effects that are important to consider in the context of sustainable construction practices.

RESOURCE EXTRACTION:
The extraction of raw materials required for steel and bricks is resource-intensive. The mining activities for iron ore and coal necessary for steel production, and clay extraction for bricks, lead to habitat destruction and land degradation, which can contribute indirectly to increased CO2 levels by reducing the earth's natural carbon sinks.

MANUFACTURING IMPACT:
The production of steel for the framing system is energy-intensive, requiring significant amounts of energy, mostly from fossil fuels, to convert these raw materials into steel. This process generates considerable amounts of carbon dioxide (CO2).

TRANSPORTATION EMISSIONS:
Transportation emissions: Both the steel framing components and the brick cladding materials are heavy and dense, resulting in higher energy use for transportation, which, in turn, increases the carbon emissions associated with their distribution from the place of manufacture to the construction site.

BRICKS:
Similar to steel, brick production is carbon-intensive. Bricks are made from clay that is fired in kilns at high temperatures for a prolonged period, and the process can emit substantial amounts of CO2, especially if the kilns are powered by fossil fuels.

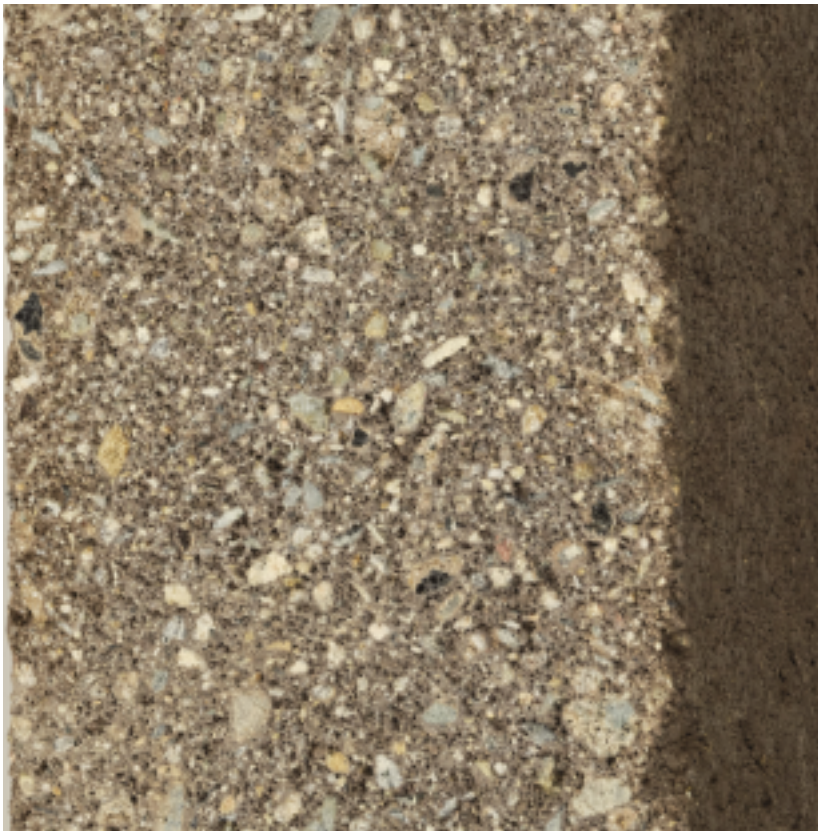
LIFECYCLE:
From a lifecycle perspective, while steel can be recyclable, the repeated melting and reforming require energy, often from carbon-emitting sources. Moreover, if the steel is not recycled, its carbon impact is much more significant. Similar for bricks, if the materials are not recycled or reused, they end up in landfills.

To reduce embodied carbon, it's essential to consider alternative materials with a lower environmental impact.

SUSTAINABLY HARVESTED TIMBER:
Wood is a renewable resource and can act as a carbon sink if sourced from sustainably managed forests. Examples include cross-laminated timber (CLT), laminated veneer lumber (LVL), and glue-laminated timber (glulam).

BIO-BASED MATERIALS:
These materials are made from renewable resources and typically have low embodied carbon. Examples include straw bale, hemp, rammed earth, and compressed earth blocks.

RECYCLED MATERIALS:
Using recycled or upcycled materials can significantly reduce the embodied carbon as it eliminates the need for new resource extraction and production. →



TOP

Biobased lining © Savolit Plus, Skanda Acoustics Ltd.

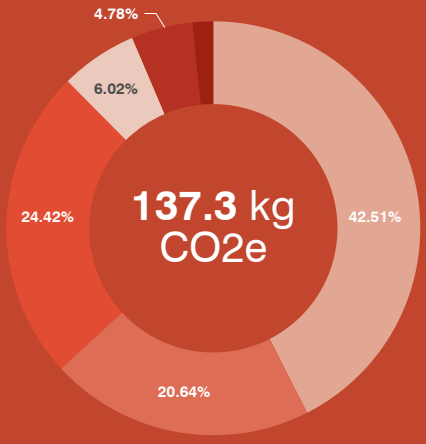
MIDDLE

Cross-laminated timber © Scott Brownrigg

LEFT

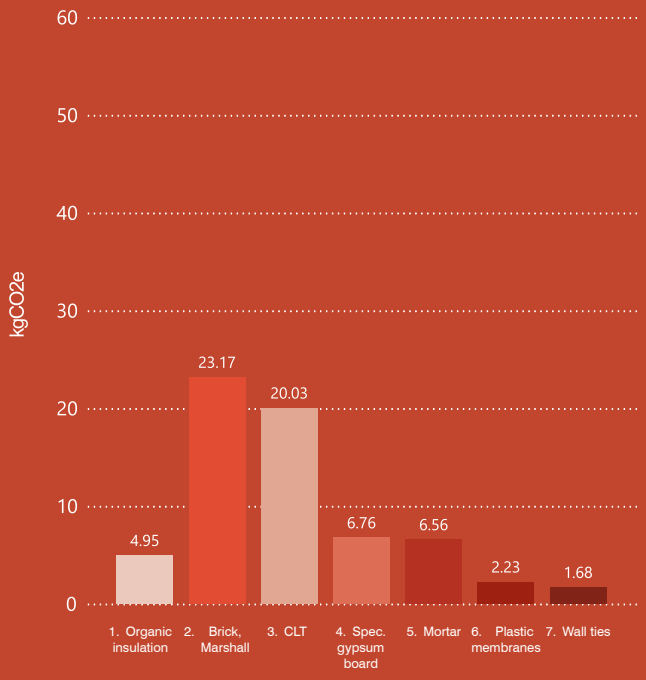
Earth terrazzo © Orca Living

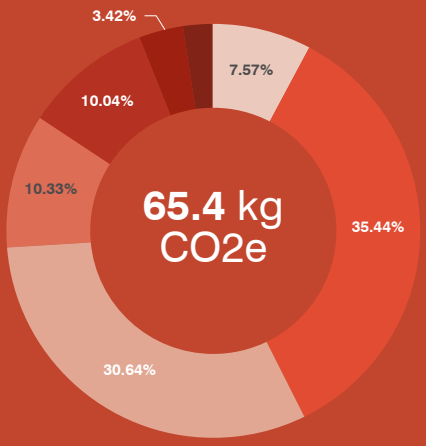
STEEL FRAMING SYSTEMS CONSTRUCTION:



1. Rock wool insulation
2. Brick, Marshall
3. Structural steel and wall ties
4. Regular gypsum board
5. Mortar
6. Plastic membranes

CROSS-LAMINATED TIMBER CONSTRUCTION:





1. Organic insulation
2. Brick, Stone Cycling
3. CLT
4. Speciality gypsum board
5. Mortar
6. Plastic membranes
7. Wall ties

One of the examples combining the above strategies is SIP (Structural Insulated Panel) made from CLT (Cross-Laminated Timber) and hemp insulation combines the structural strength of CLT with the natural insulation properties of hemp. The panel's outer layers are composed of CLT, which is made by cross-laminating layers of solid wood lumber. It provides dimensional stability and distributes loads evenly, offering robust structural support.

The core of the panel is filled with hemp insulation, which is derived from the fibrous core of the hemp plant. Hemp is a sustainable, rapidly renewable resource with excellent insulation properties. Both CLT and hemp are renewable resources. The wood in CLT naturally sequesters carbon dioxide during the tree's growth cycle. Similarly, hemp also captures CO2 as it grows, making the combined SIP panel a carbon-negative product in its raw form. Hemp has a high thermal resistance and can effectively regulate temperature and humidity within a building, reducing the need for mechanical heating and cooling. Hemp insulation is biodegradable at the end of its life cycle, reducing landfill waste.

Recycled-content bricks, is an alternative to traditional clay bricks, as they are manufactured using a significant proportion of reclaimed or crushed brick material. Recycled bricks are obtained from construction and demolition waste, renovation projects, or discarded bricks from manufacturing processes. The collected bricks are cleaned, sorted, and crushed into small particles. The formed bricks are air-dried or cured in a controlled environment to remove moisture and gain strength. recycled-content bricks reduce the demand for raw materials like clay, which can help preserve natural resources and reduce the environmental impacts associated with extraction and transportation.

CARBON DATA AND COMPARISON:

To effectively reduce embodied carbon in the wall build up, it's crucial to have a reliable carbon data for each material. Life Cycle Assessments (LCAs) provide this data, detailing the emissions associated with each stage of a material's life. For instance, while the upfront carbon of timber might be low, considerations must be made for its treatment, longevity, and end-of-life disposal.

Comparing the traditional construction with reduced carbon alternatives involves looking at the whole wall build-up, including insulation, air gaps, and finishes. Each component's carbon impact is considered to understand the overall benefit. The analysis demonstrates that the build-up significantly reduces embodied carbon comparing to the traditional build up while providing same u-values and thermal comfort and keeping the aesthetic of the building the same.

Reducing embodied carbon in construction requires not just technical solutions but also supportive policies and industry standards. Although the methods and technology for creating and building with bio-based materials are in place, the larger scale systems and support structures needed to adopt these on a wide scale are still lacking.

LEFT
Carbon dioxide data of SFS and CLT construction techniques.

The path to widespread implementation of these practices in the UK faces several obstacles:

PUBLIC PERCEPTION AND MARKET DEMAND:

There is a need for greater public & client awareness and demand for sustainable buildings. Without consumer demand, the industry may not feel compelled to change its practices.

INDUSTRY RESISTANCE TO CHANGE:

The construction industry relies on established methods and materials. There is a resistance to adopting new technologies and materials due to familiarity with existing practices, perceived risks, established supply chains and contractors or lack of knowledge.

SUPPLY CHAIN AND MANUFACTURING LIMITATION:

The availability of these materials can be limited, posing logistical challenges. The supply chain for sustainable materials is not as developed as for traditional materials. This lead to challenges in sourcing and increased carbon footprint due to transportation from distant locations, increasing cost and making them less accessible for many projects.

TECHNICAL CHALLENGES:

Some low-carbon materials may not yet match the performance characteristics of traditional materials in terms of strength, durability, or ease of use. This can lead to concerns about the longevity and maintenance of new building methods from insurance companies and regulators.

REGULATORY AND POLICY CONSTRAINTS:

Current building regulations and restricting policies for timber use do not adequately support or incentivize the use of low-carbon materials. Without regulatory push or financial incentives, the adoption of sustainable practices is hindered.

Through embracing alternative materials, utilising carbon data, and learning from successful case studies, this will inevitably lead to creating more sustainable buildings. The shift requires collaboration among architects, engineers, material suppliers, and policymakers. The UK government and construction industry should support the change through incentives for low-carbon materials and more substantial investment in research and development of sustainable materials and practices.

This shift is not just about technical solutions but also about changing mindsets and building a supportive ecosystem for sustainable construction ●

> **“ [Living walls] can go beyond decoration; serving as functional elements that can redefine the purposes of walls in architecture. They act as a living installation to form a building's physical boundary, providing additional layers that seek to enhance the overall environmental performance. ”**

DETAIL:

The sustainable promise of intensive living walls

Living walls serve as functional elements that can redefine the purposes of walls in architecture, providing additional layers that seek to enhance the overall environmental performance.

Here, Architect Jack Williamson looks to demystify the complexities surrounding living walls and shed light on aspects that might pose challenges in interpretation and application.

In the evolving landscape of sustainable architecture, living walls have emerged as a vibrant and eco-conscious design feature. There is a long history to living walls, from ivy naturally growing on a brick façade to intensive man-made systems requiring a large amount of fabrication and maintenance. This article navigates through the diverse systems and applications of living walls, exploring their environmental, economic, and societal benefits.

Living walls take various forms, with three main types standing out: intensive systems with hydroponic and soil-based modules, pocket planters using fabric or plastic pots, and wire mesh/trellis systems. These walls can go beyond decoration; serving as functional elements that can redefine the purposes of walls in architecture. They act as a living installation to form a building's physical boundary, providing additional layers that seek to enhance the overall environmental performance.

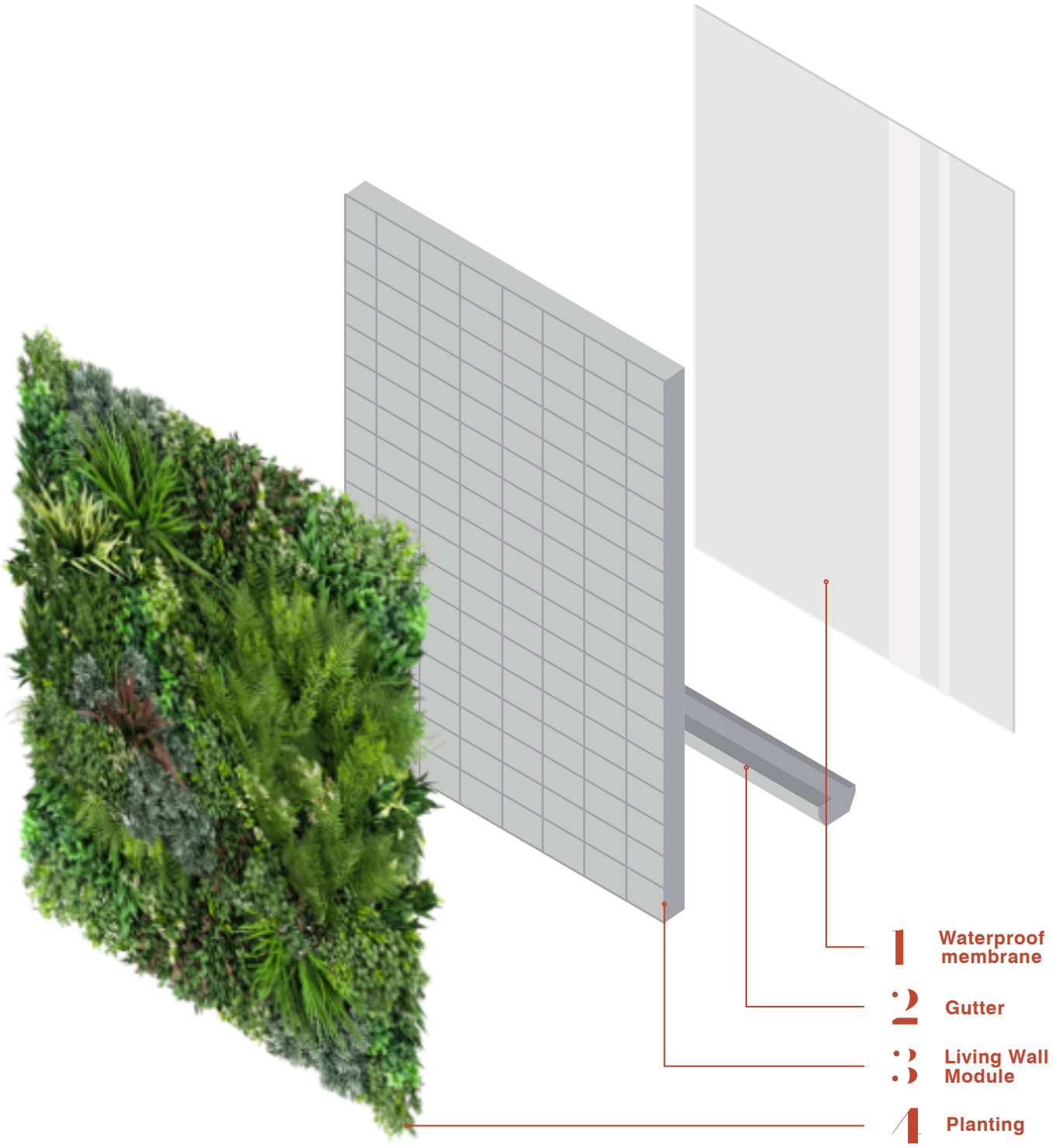
Beyond aesthetic appeal, manufacturers of living walls promote a range of benefits associated with these systems, which often include the following:

- Air purification; offering the ability to filter pollutants from the air, generate oxygen, and absorb particulate matter, promoting cleaner and healthier air quality.
- Carbon sequestration; actively absorbing CO2, contributing to carbon sequestration, and playing a role in mitigating the impacts of climate change.
- Façade life span extension; acting as a protective shield against acid rain and the harmful effects of ultraviolet rays, significantly extending the lifespan of a building's façade.
- Noise reduction; serving as noise absorbers, deflecting and diminishing ambient noise, creating a quieter and more serene atmosphere.
- Ambient temperature reduction; acting as natural insulation, regulating internal temperatures and mitigating the urban heat island effect, thus contributing to a more energy-efficient building.
- Biodiversity increase; by introducing diverse planting and creating habitats for insects and birds, living walls can foster a stronger ecosystem, promoting biodiversity within urban spaces.
- Positive effect on wellbeing: living walls have been associated with positive effects on mental wellbeing, offering a connection to nature in urban settings.
- Increase social interaction; offering the potential to serve as focal points, encouraging social interaction and creating a sense of community in shared spaces.
- Labour productivity increase; with stress-reducing qualities that translate into increased labour productivity, making them valuable additions to workplace environments.

While positive, these promoted benefits can, in reality, be difficult to harness with some more easily achieved, and substantiated, than others. Understanding technical aspect such as plant quantity, pre-grown options, installation safety, and maintenance access is both crucial and key. For this article, we will primarily focus on intensive systems due to the wealth of information obtained from recent projects. →

BELOW

A purpose-built steel frame can be used to serve as a biodiverse sound barrier or site divider.



Intensive systems, whether hydroponic or soil-based, can offer unique advantages although incorporating living walls into architectural designs demands careful consideration. A typical buildup includes primary structure, waterproofing layer, fixing rails, irrigation pipes, drainage, living wall modules, and planting. Living Walls come in modules of circa 500mm squared, pre-populated with plants. Generally, the full weight of these products is circa 75kg/m2 (saturated). Factors like maintenance strategy, plant selection, irrigation, rainwater harvesting, fire rating, weight, and heat trapping are critical elements, are best developed in collaboration with a specialist supplier.

One significant aspect often overlooked is the smart specification of plants. Different plant species bring diverse environmental benefits, contributing to the overall functionality of the living wall. For instance, some plants are highly effective at air purification, others for particulate matter capture, and some for biodiversity and habitats.

Regarding air quality the key factors considered are the amount of particulate matter trapped and the amount carbon dioxide captured, and oxygen produced through photosynthesis. As mentioned above these figures relate very much to plant species chosen, but also location and size. For one of our projects the amount of particulate matter trapped was the key criteria to improve the local area. As such, through placing a large section of living wall, with the right plants, by a very busy road ensured the living wall has the potential to act as its most effective. For some comparative studies below are some very high-level figures for the potential benefits of a 1000 square meter living wall. With some analysis this wall could provide the below annually. This has been based on information provided to us by suppliers at an early stage:

Carbon sequestration is an interesting point when it comes to living wall. It is incredibly difficult to find out the relevant information on the amount of embodied carbon these systems use. Particularly when you look at the increased structural requirements of the building to facilitate the modules. Again, a very high-level analysis shows that a 1000 square meter living wall is the equivalent to planting around 50 medium sized trees and would extract around 195kg of carbon annually.

Water consumption should also be considered, along with the potential for rainwater harvesting which is recommended by most suppliers. This does add additional complications, and further plant space requirements for a living wall. Whilst rainwater is generally better for plants, and the irrigation system as it reduces the frequency with which the irrigation pipelines need to be flushed, it does incur further capital cost and it is challenging to take from green roofs or any area treated with salts. One square meter of living wall will consume roughly 1l of water per day through either mains or harvested. This of course fluctuates seasonally as well as aspect.

A critical examination of the financial implications of living walls is essential. The initial investment might raise eyebrows, but the long-term benefits can often outweigh the costs. The lifespan extension of the building's façade is a noteworthy advantage, protecting it from the corrosive effects of acid rain and ultraviolet rays. Additionally, the reduced need for artificial cooling and heating can result in substantial energy savings. For reference initial cost estimates may hover around £800 per square meter.

Maintenance plays a pivotal role in ensuring the sustained functionality of living walls. A well-defined strategy is crucial, encompassing factors such as regular

TRAP **1.3 TONNES** OF **PM10** ANNUALLY

The equivalent to 21 million kilometres or 1740 cars per annum (particulate matter).

CAPTURE **2.3 TONNES** OF **CO_2** ANNUALLY

The equivalent to removing the CO2 emissions from 1 and a half cars per annum. Scott Brownrigg's calculated carbon emission in 2022 was 987 tCO2e. To offset our emissions the living wall would need to be **over 400,000 m²!**

RELEASE **1.8 TONNES** OF **OXYGEN**

inspections, irrigation management, and plant health monitoring. Implementing a thoughtful maintenance plan not only preserves the aesthetic appeal of the living wall but also enhances its overall effectiveness in terms of air purification, noise reduction, and temperature regulation. These can be quite rigorous depending on the size, location and aspect of the living wall. A well-considered access strategy for the whole building can help limit the amount of time operatives are required on site to maintain the living wall. Annual maintenance costs might range from £100-200 per square meter. Without a rigorous maintenance strategy, a living wall can very quickly turn into a mass of roots and provide zero benefits. There are a lot of horror stories out there. If you look back into history a living wall that dies can only leave behind the original façade. In this instance it leaves behind a substrate not designed to be viewed independently.

In conclusion, this exploration of intensive living wall systems, highlights a system that whilst complicated and expansive has the potential to assist in some key sustainable drivers of our built environment. Living walls, often dismissed as decorative elements, emerge as components that can contribute to the wellbeing of occupants and the health of the planet.

As architects and designers delve into the intricate details of living walls, they find themselves at the intersection of aesthetics and functionality. The multifaceted benefits, ranging from air purification and noise reduction to biodiversity enhancement and temperature regulation, showcase the versatility of these green installations. The initial investment and maintenance considerations become minor hurdles in the face of the potential long-term gains in energy efficiency, environmental sustainability, and the overall quality of life within built environments.

However, the living wall industry have some way to go in order to ensure data is available to ensure both client and designers can make truly informed choices, and to avoid the potential use of these living walls as a tool for greenwashing. Combined with more accurate data and information, living installations have the potential to become catalysts for positive change, shaping the way we perceive and interact with our built environment ●

BELOW
Data Centre design by Scott Brownrigg.

DESIGN PROCESS:
Architectural expression and the wall

In this article, Project Director Alistair Brierley outlines the processes and the technical and symbolic influences investigated and implemented during design iterations of a new terminal building in Saudi Arabia.

PART 1: ARCHITECTURAL EXPRESSION & THE WALL

An architectural proposal for a terminal building in Saudi Arabia saw the development of three separate iterations of the external envelope for a similar plan form and passenger processing operation. This article outlines the processes and the technical and symbolic influences investigated and implemented into a detailed design investigation at the conceptual stage of the process. The value systems and criteria that spelt success for one particular iteration over another covered a range of variables that were distilled into a chosen solution. Each rendition of the terminal building design needed to demonstrate inherently different approaches to the 'wall' within the design formula and architectural vocabulary adopted.

For a building or a construction to go beyond the essential use of materials, an added ingredient or alchemy is required to turn it into significant and resonant architecture. The essential spirit of a place (genius loci), its inherent personality and multiple characteristics requires the architect to respond and echo back these parameters in a synthesis of form and function. This process should render the object, the experience of using it, and its contribution to townscape and the surrounding landscape inevitable.

As in any building the Ha'il terminal houses a very particular set of briefing requirements needed to facilitate its operation, maintenance and legibility for the passenger. Air terminals by their nature and context are low buildings with large relatively simple floorplates, often rectangular and symmetrical. The walls that enclose the terminal or processor are very long and repetitive, and are experienced in different adjacency contexts for the passenger. The airside elevation and the landside elevation have almost polarised functionality, whilst the side elevations are largely secondary and shorter than the other two.

Climate plays a key role in the design of the terminal wall, particularly in extremely hot climates such as Saudi Arabia. The external envelope must seek to mitigate heat gain and reduce the cost of cooling the interior spaces. Low sun tends to be the most significant factor to manage in the construction and design of the walls, as glare and the discomfort from this can have a negative impact on the user experience. The orientation of airside and landside is critical here, as these tend to be the longer elevations. It is often the case that landside (where passengers are dropped off and arrive) has more opportunity for shelter from the elements, as in most terminal design there will be a wide drop off road and zone for departures with the arrivals level below this sheltered from direct solar glare.

Conversely the airside configuration tends to be more exposed, as shading can only be provided through the projecting air bridges and gates, a cantilevered eaves detail and external brise soleil integrated into the external envelope. Internally, directly behind this façade the lounges and waiting areas will be laid out overlooking the apron and the runways.

The fifth elevation, or roof of the terminal is the largest single surface in the volumetric composition and will often have roof lights integrated into its surface. The point being made here is that without the roof the walls are rendered meaningless and vice versa. This then poses the question; - when does a wall become a roof or vice versa and what are

the co dependencies between the two components of the external envelope and what happens at their intersection? Within the local context of Ha'il, besides solar control the walls of the terminal building need to be designed to be earthquake resistant, reject and deflect windblown sand, and to manage infrequent but heavy rainfall and wind, and the effect this may have on accumulated sand. As such, although stability is paramount, there must be a degree of flex in the integrity of the wall, and its relationship with the ground and its adjacent surfaces. A frame building is by far and away the most likely scenario for a contemporary terminal building, with regular column grids spaced along the full array of the elevation. The primary columns are likely to be separated from the external envelope and used to mount and support secondary lattices of beams, columns and bracing that hold the chosen system of cladding panels in place. Stability will be gained from primary beams that connect the columns at their heads where there is a tying together with the structural system of the roof. It is often the case that the cladding system will be hung from this primary beam, and stabilized and held within brackets and fixings that tie and bind everything together. Another important ingredient in the formula of this wall typology are the transoms and mullions that provide a perpendicular rigidity to the system. Depending on the varying degrees of transparency required, and the size and orientation of cladding modules, the formula for the wall needs to be evaluated and become an optimised system for separating the outside from the inside, and offering an elegant and responsive solution to all the variables in play.

A good example of this is the pier element of the terminal building that we designed in Medina. Having used the form and iconography of the palm tree (as the key symbolic gesture within the architectural proposals) the design went on to use the active fractal geometries of the palm leaf in the plan configuration of the airside pier.

As opposed to enclosing the airside pier elevations with a straight line geometry, this surface was articulated into a gentle zig zag form. This configuration created two distinct angles that worked together to control the glare from low level sun penetration, and to offer a sequence of open and closed panels. The closed panels were entirely opaque whilst the open fully glazed from floor to soffit. This allowed for a distinct and progressive variation of views and daylight entering the spaces within the pier whilst controlling and enhancing passenger experience and comfort. It also meant that the arrivals and departures experiences were entirely individual, as walking in one direction would open up views to the 'apron', whilst walking in the other would close off the airside views and open those up on the landside.

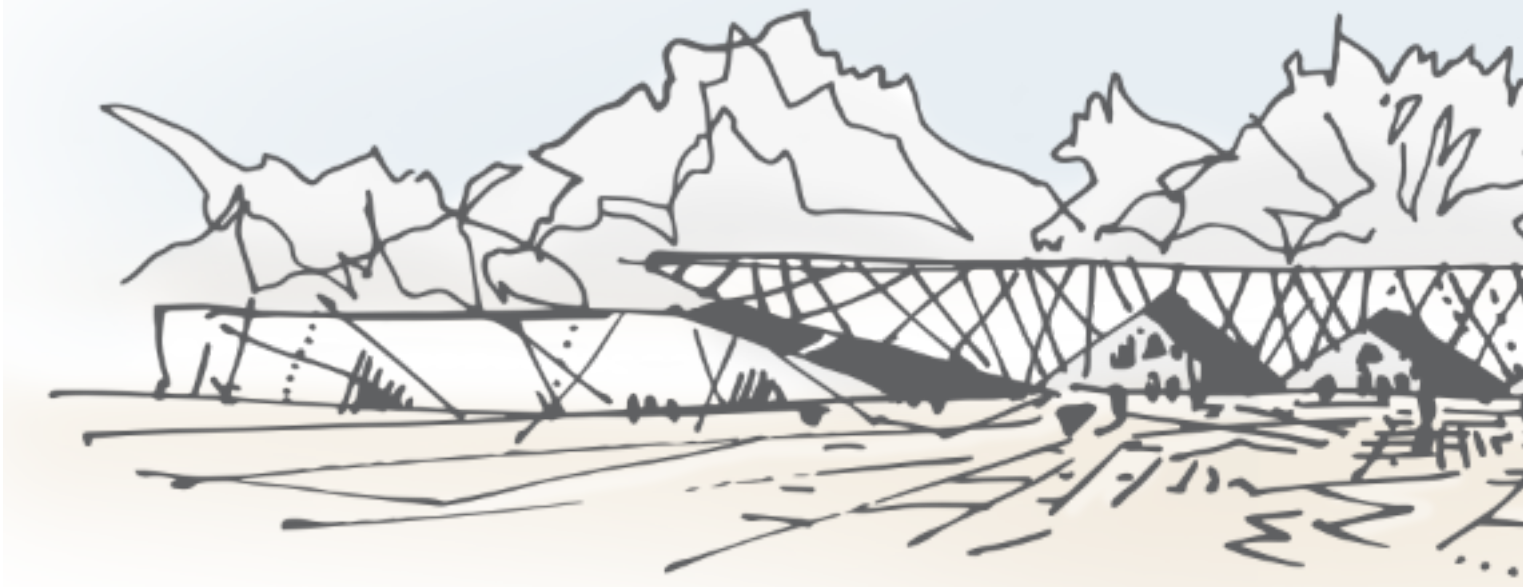
The example of the pier at Medina has been used in this narrative as an introduction of our design response and methodology at the outset of the process and how it is eventually delivered and operated. The three themes that were investigated at the conceptual stage of our thinking for Ha'il will in time follow the same process, but at this stage our response to the 'wall' at the conceptual stage of design is explained on the following page. →

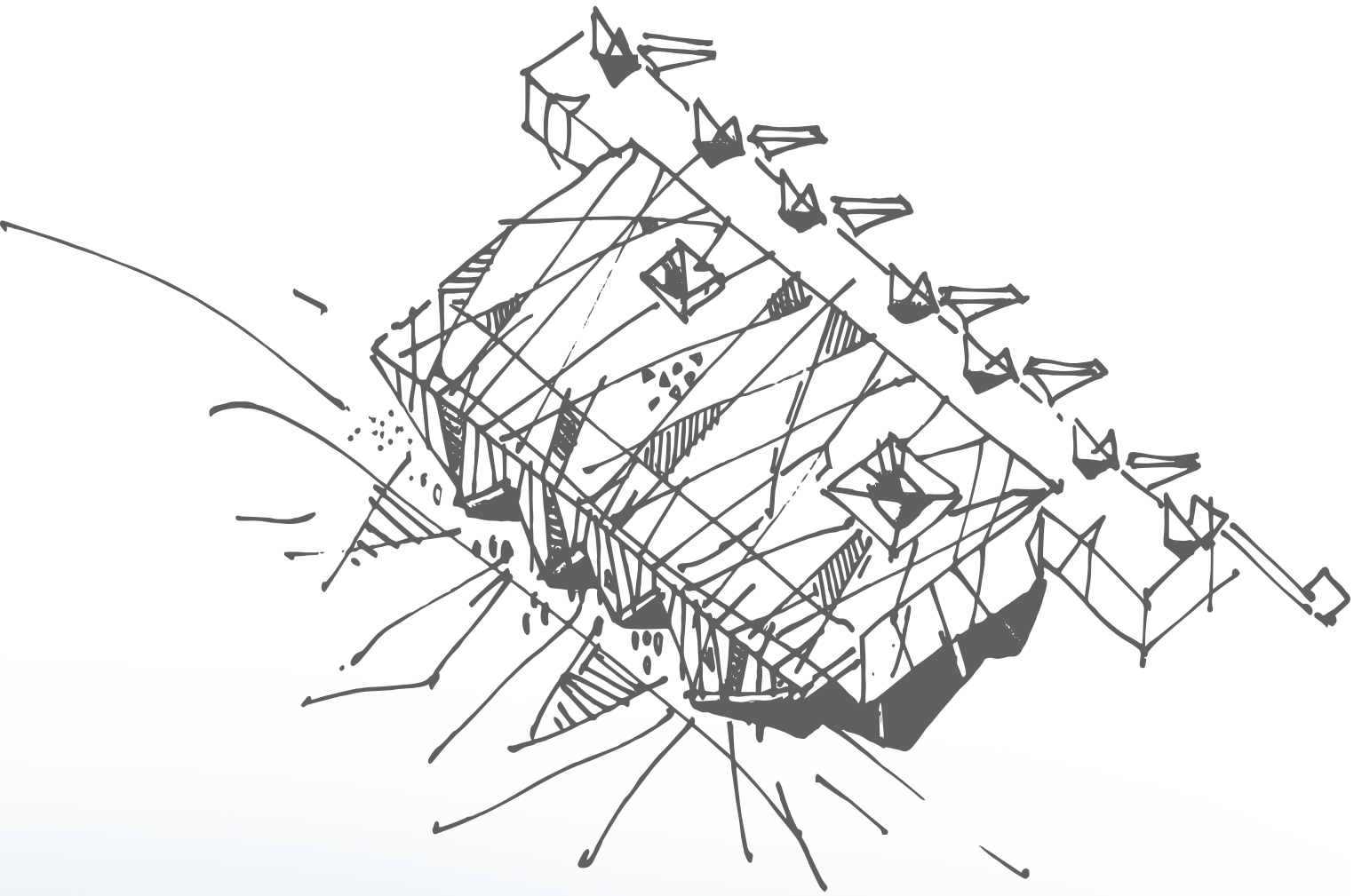
ABOVE
Medina Airport, Saudi Arabia, designed by Scott Brownrigg.

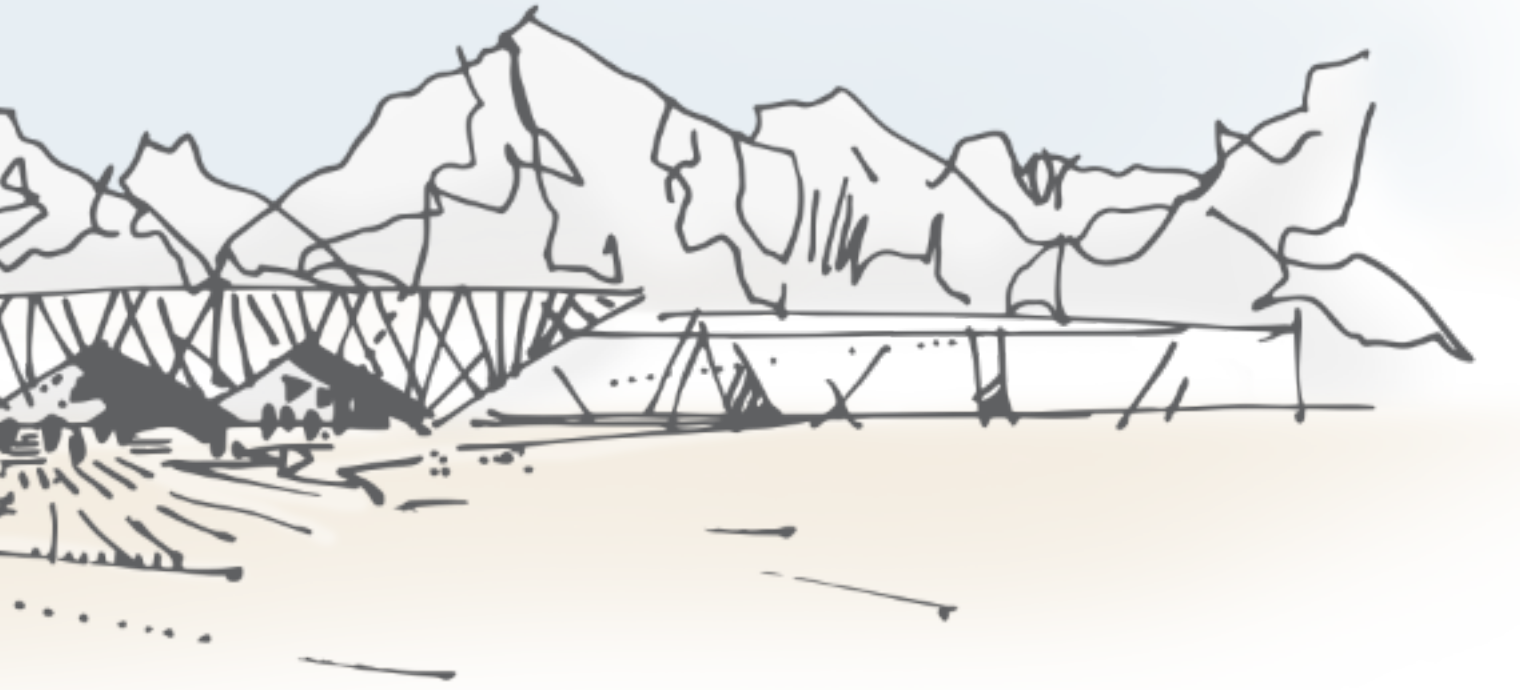
THEME 1: AL-JABAL / THE MOUNTAIN

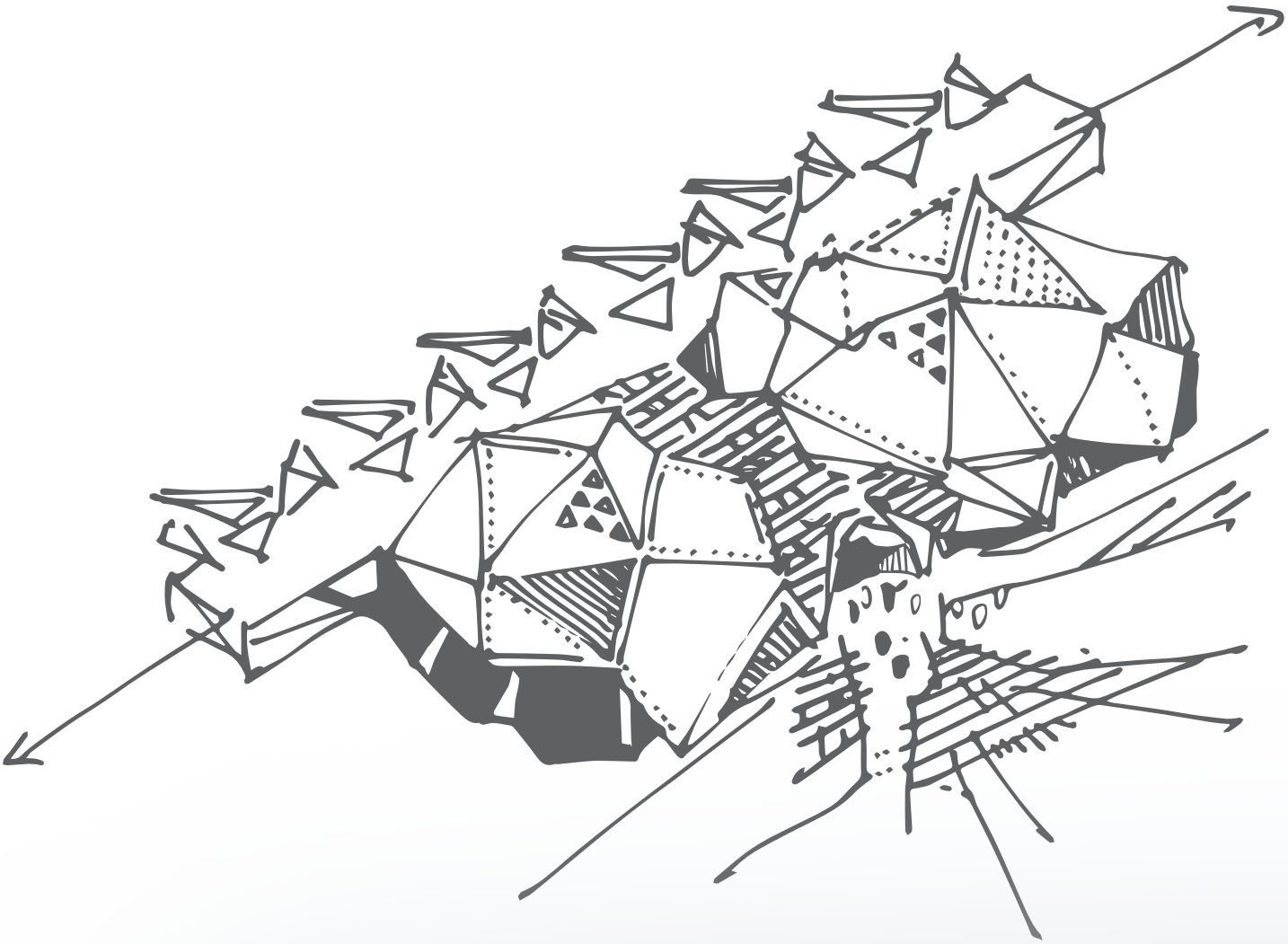
The mountain range that rises at the edge of the city represents a wall of enormous height and significance. This physical barrier, with its serrated peaks and valleys provided the prompts and inspiration for this iteration of the terminal building wall. Moving beyond the literary interpretation, the landside 'drop- off' portico is partially enclosed and protected by a sequence of angled openings cut within the vertical wall plane. The surfaces of this triangulated super loggia are inscribed with vector driven angled incisions, that besides providing texture and rhythm to the composition, help to provide legible and active structural legibility that talks to the fractal geometries of the mountain range. There is a specific dialogue set up within the composition of this wall that sees triangulated openings carved into the vertical wall of the built enclosure. The architectural metaphor speaks of the geological context, and the activity of spaces carved out and silhouetted against the sky only in an inverted form. The vertical plane of the wall folds through 90 degrees at the point of transition to the roof with exactly the same architectural expression extending over the terminal to the airside apron, where the roof folds back down into a serrated vertical elevation. This wall has an inherent thickness of 900mm, and an active and asymmetric play on solidity, translucency and transparency. The asymmetry is an important geometric move here, and is deliberately implied in order to activate the static symmetry often found in a drop off portico, and a more honest reflection of the circulation and programme of the functionality within the terminal building. There is also a simplicity in this architectural solution that does not require the use of complex three dimensional geometry for construction. →

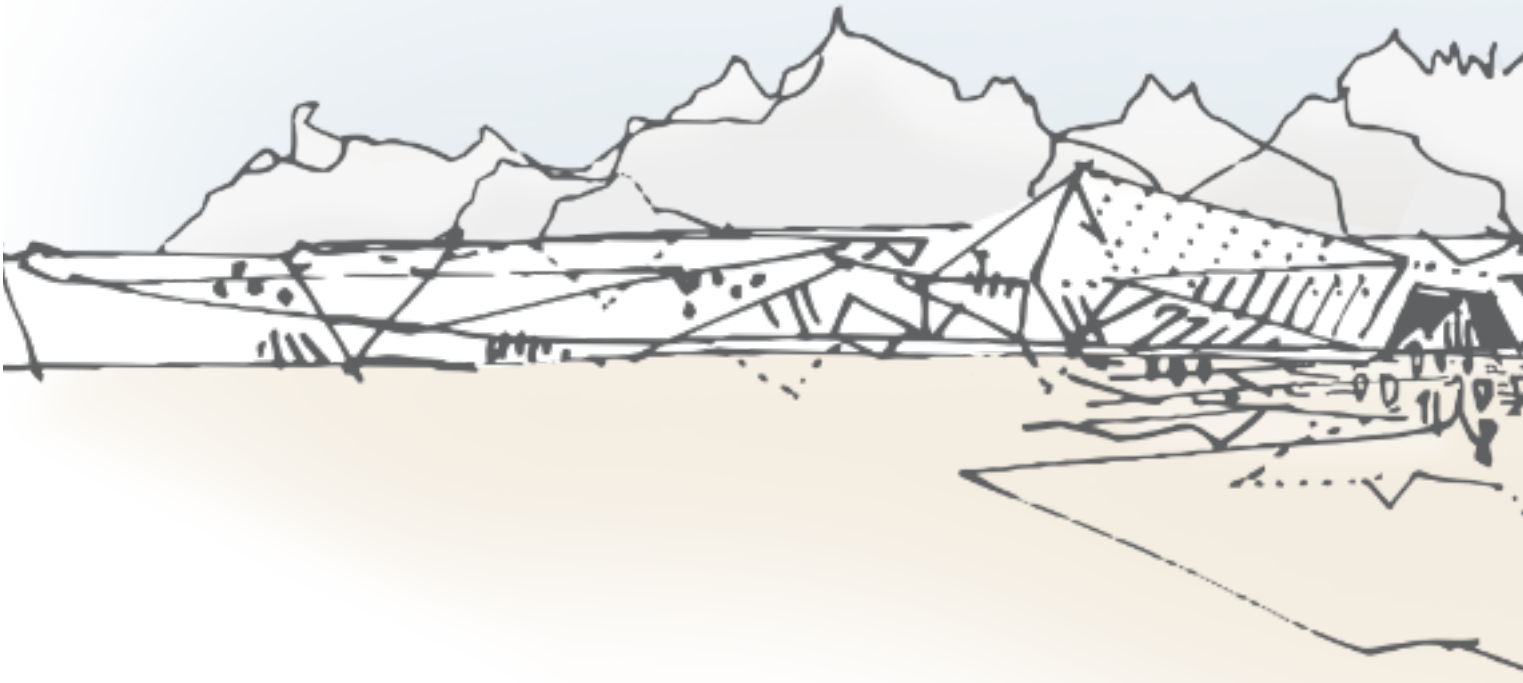
RIGHT AND BELOW
Concept sketches of Ha'il Airport, inspired by landscape, by Alistair Brierley.











THEME 2: AL-WADI / THE VALLEY

As a further reflection and response to the physical context, and the natural terrain, this interpretation of the wall was inspired by the history of the city of Ha'il, and its important role as a staging post for 'caravans' moving valuable goods and merchandise from east to west. For any traveller moving through mountainous terrain, the line of least resistance, or valley would be the optimum choice. Within this design ethos there are no exactly vertical walls, and no perpendicular relationships. A series of folded planes and facets intersect to create an active and fractal volume. Walls and roofs become almost the same thing, whereby it is only a specific angle in terms of the ground plain that could quantify and define where a wall ends and the roof begins. The architectural metaphor offers a lowering of the roof between raised volumes to either side, defining and identifying a pathway or route. From within, this experience is all about the dynamism and connection of wall and roof surfaces as the rise and fall, fold and fracture are used to represent an architectural landscape redolent of mountainous terrain. Degrees of solidity and permeability are expressed and used to control and define spaces within the terminal building, and to offer specific views to the outside world. →

LEFT AND BELOW
Concept sketches of Ha'il Airport, inspired by historic movement of goods, by Alistair Brierley.

THEME 3: AL-KALAA / THE FORT

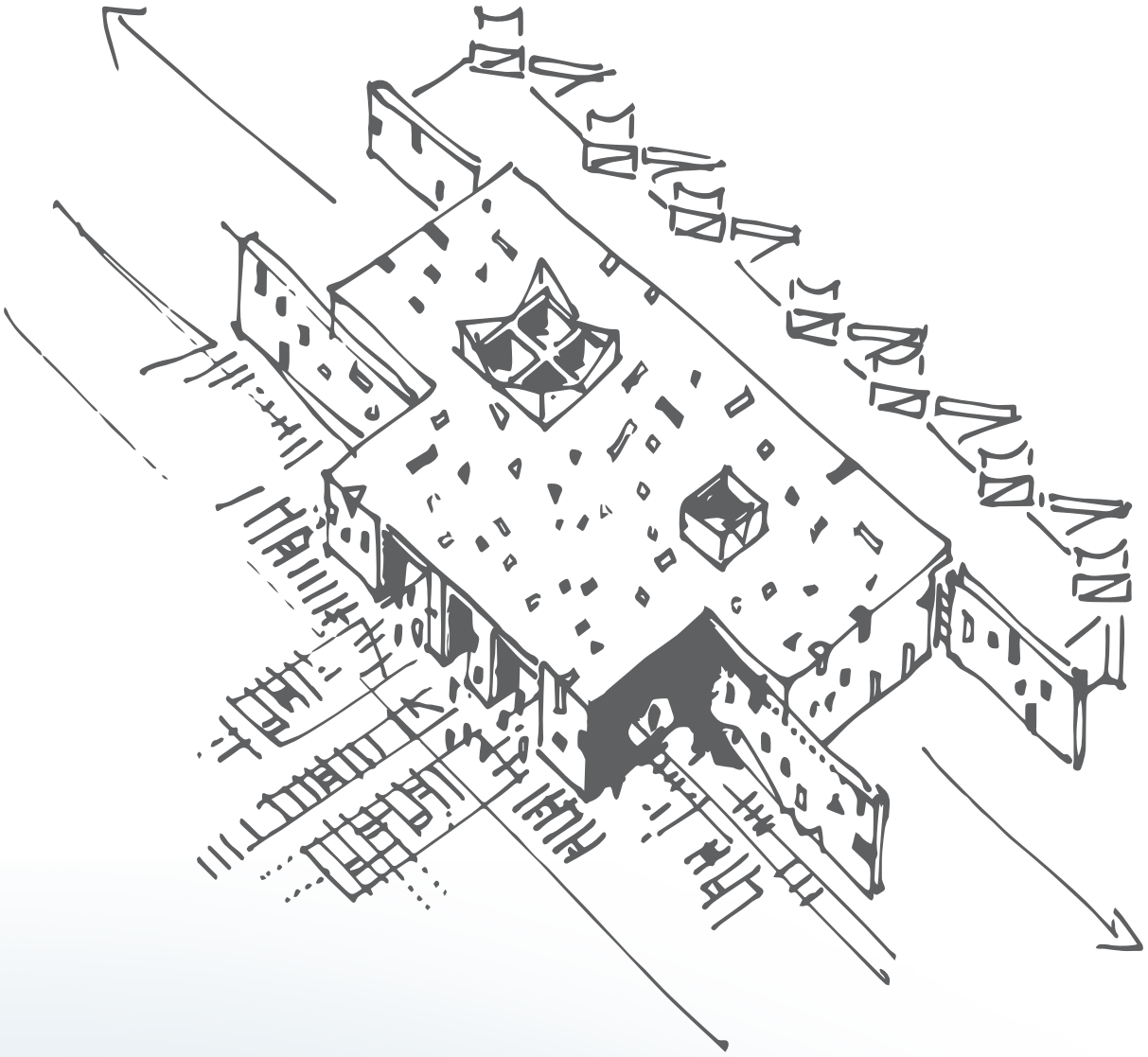
The final theme that was explored referenced the vernacular and traditional forms used in the city of Ha'il, and in particular the civic buildings. Monolithic construction predominates in the region, and stone and sand were used to produce thick protective shelter from the harsh climate, in particular the sun and the wind. Defensive strategies also meant that gateways and entrances, although celebrated were kept simple, abstracted and relatively minimal. The beauty of such walls becomes evident under bright sunlight, particularly in the morning and evening when shadows become more defined and clear.

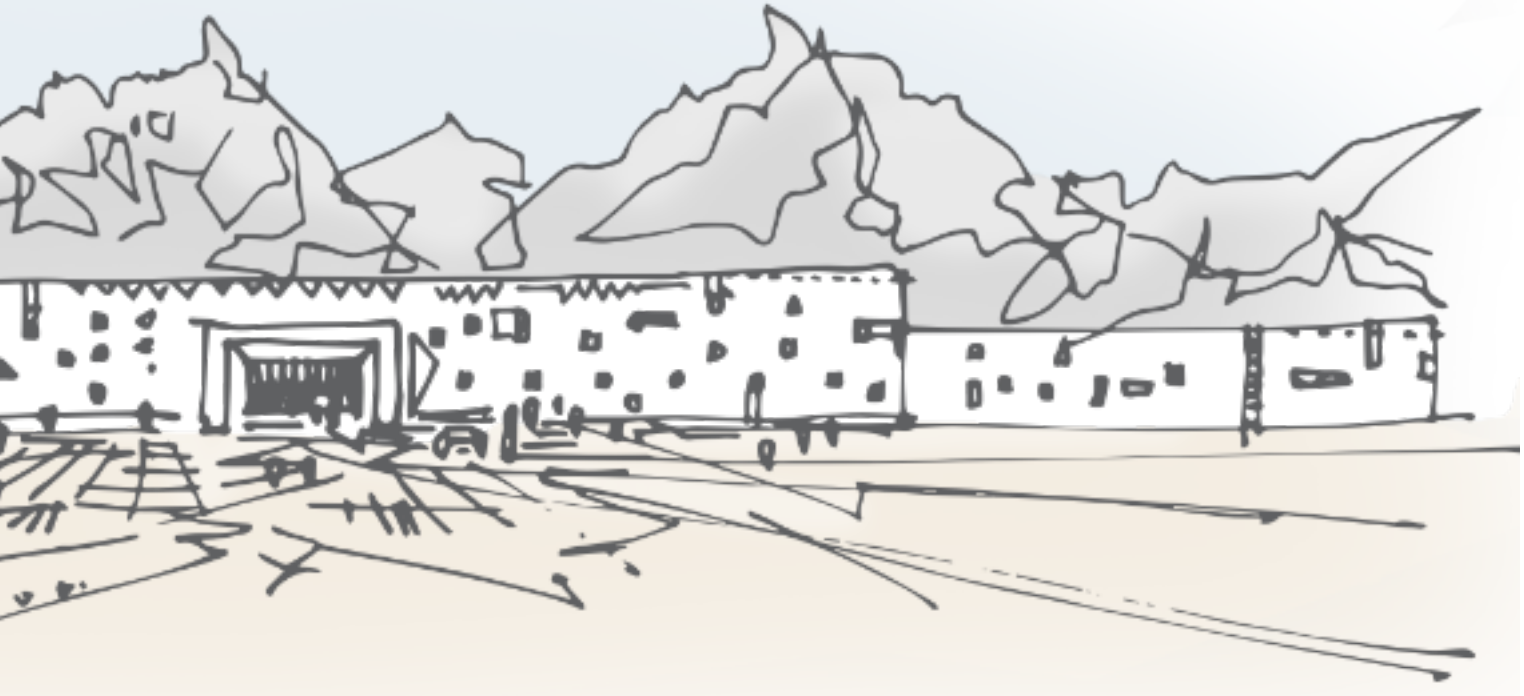
The walls in effect have become thick solid planes with openings incised within their surfaces. The depth of the reveal becomes important within this language, and thickness becomes an expression for the importance of a particular wall within the visual coding of a building. As such the walls that drop down to enclose and protect the drop off and arrivals zone are at least 750mm deep, with the reveal playing an important role in terms of recognising moments of transition in the passenger journey through from landside to airside.

This formula is flexible in terms of the size of openings that are required in terms of filtering light into the terminal concourses, and a range of modular sizes have been used herein effect the wall surfaces are perforated to provide intense moments of natural light scattered and grouped into particular configurations. Because of the relatively plastic nature of these walls, sizes and shapes of openings can be easily varied, and reveals can be angled to provide more directional illumination. In terms of overall building enclosure the roof construction and language follow the same formula as the walls, and are simply folded through ninety degrees to provide horizontal shelter and enclosure. Once again carefully positioned perforations allow the passage of daylight through to the spaces within, and all surfaces are homogenous in their materiality.

The proposals for the new terminal building in Ha'il demonstrate the variety of wall systems and aesthetics that were investigated at the conceptual stage of the design process. The chosen design narrative should aim to extract and define the sense of place and character of a region, its history and its people. All three renditions of architectural expression and their physical, symbolic and practical aspects have validity and resonance, but one must be chosen to anchor and identify the personality of the terminal building within its specific context. In this instance the inspiration that came from the traditional built form of regional civic architecture was chosen as the direction of travel for this particular airport, and its important role as a threshold and gateway to and from the region ●

RIGHT AND BELOW
Concept sketches of Ha'il Airport, inspired by local vernacular, by Alistair Brierley.





PART 2: REINFORCING CONTRASTS
THE DUALITY OF THE WALL

Here, Project Director Alistair Brierley explores the duality of the wall; how clearly expressed contrasts can be used to enhance functionality, manipulate views, and influence perception of place.

When first visiting Venice and the Veneto as a student, amongst many others I was struck by one particular building, The Doges Palace. This enormous seemingly monolithic construction is remarkable for the celebration and visibility of its two primary walls and the open space around them. Apart from the significant and large scale spaces of St Marks, much of Venice exists in a finer grained model. Of course the enormous palazzos that line the Grand Canal are 'super-sized' and powerful, but they always fragment and layer their walls into a series of surfaces and planes that carve out loggias and shaded spaces that overlook the water. They are clearly visible to passing vaporettos and other water borne transport, but the views are contained by the width and curvature of the canal itself, and are best seen as a sequence of almost conjoined blocks that first appear in oblique view, and then as they become closer a moment of pure elevation may be seen, before passing on into a diminishing perspective projection.

The remarkable difference that may be seen in the discrete and clearly identifiable block of the Doges Palace is its clear visibility, and specific attitude to its context. It adopts a polarised attitude to, on the one hand its solid and monolithic planes, and on the other the delicate filigree and tracery of its loggias and colonnades at the base. These clearly expressed contrasts were carried out as a means of describing the inner functionality of the palace, as well as making a statement to the outside world, referencing its status and importance in the wider cityscape.

What is remarkable is the abstracted simplicity (and concurrent complexity) adopted and described via the combinations of macro and micro components, and the complexities and tensions that are set up within the chosen architectural vocabulary. The fine and delicate tracery of the lattice work that provides a filter into the two sided cloister, and the remarkably 'modern' primary corner detail, is the perfect foil for the enormous plane of rotated chequerboard brickwork that has been used to face the deep and heavy wall construction of the insular upper level spaces .The key architectural device in play here is the use of a shifted grid of tonal brickwork that renders the visual effect of the surface 'skin deep', more like a carpet or a rug that could be rolled up and applied elsewhere. The use of this patterning suggests weightlessness and pliability. The few gothic arched openings that are cut into this surface express the actual depth and weight of this wall, with their extremely deep reveals. At odds with this tension, between the simple and the complex, the deep and the shallow, and the heavy and light, the corner of the quadrangle facing the Grand Canal offers an abrupt change of architectural language. The cohesion and lateral spread of the 'magic carpet' surface, floating above the filigree of the tightly spaced gothic arches does not turn through ninety degrees and progress inland. Instead an entirely different rhythm, pace and language is suddenly adopted, and the multiple splits in personality of the volume are once again in play.

The combination is eclectic, and amalgamates elements of Byzantine, Moorish and Gothic influences which results in a rich yet occasionally disjointed narrative. The contrasts of the simple and the abstracted, and the complex, intricate and embellished almost reach breaking point in terms of the tensions that are set up within the composition. The precise mathematical rules of Palladio and Alberti have been deconstructed and put together in challenging and unusual combinations. This is an example of what Robert Venturi referred to in his book Complexity and Contradiction, and goes beyond the pattern books referencing the golden section, and later Le Corbusier's Traces Regulateurs.

Since that first trip to Venice, I have worked on a range of building typologies, across a spectrum of locations, and have applied assimilated knowledge to the range of variables that inform our decisions as architects in the contextual attitudes and construction of buildings in particular their external envelope. Airports, commercial office space, residential dwellings, schools and even data centres all require built enclosure to contain and protect the spaces within, whilst allowing a meaningful dialogue with the outside world. Generically the commonality in terms of relevant variables, is the human occupant and user of these places. From the 'inside out', this speaks of scale, comfort, requisite

protection and degrees of natural lighting. From the ‘outside in’ the appearance and personality of the wall is central to the proposals and how it relates and responds to context.

By way of illustrating some of the key characteristics of walls that the Scott Brownrigg team has worked on, a synopsis of some built projects are discussed here. Starting with the pier at Medina Airport in Saudi Arabia, a finely balanced and calibrated response to specific performance criteria can be seen. This is an elongated double height space, with departing passengers occupying lounge and associated gate spaces at the lower level, and arriving passengers passing above on a suspended bridge at first floor level. Orientation and views over the apron to the runways and awaiting aircraft are essential in a pier, but this requirement for transparency needs to be balanced with potential solar gain, glare and passenger comfort. The answer was found by articulating the plan form of the vertical walls into a sequence of gentle zig zags responding in particular to low solar trajectory. This undulation in the plan form added stability to the structure, but most importantly allowed for the use of a measured sequence of solid to transparent wall panels. The ‘on off’ rhythm of solid to transparent recognises the pace of the ambulant passenger, and provides a variety of closed and open and light and dark spaces.As a consequence of this the views to the outside world are revealed or concealed depending on the direction of travel when searching for the correct gate.

The final components of this wall composition can be seen in the external brise soleil which descend from the eaves level and taper downwards to represent the structure and form of the palm leaf. This functional device is there to deflect solar glare and heat, whilst establishing the theme of the palm tree as the inspiration for the architectural expression and language of the overall building.

> **“Airports, commercial office space, residential dwellings, schools and even data centres all require built enclosure to contain and protect the spaces within, whilst allowing a meaningful dialogue with the outside world.”**

The National Centre that was completed in Milton Keynes for Network Rail introduced a sequence of wall typologies into the external envelope formula to allow the building to function on a low energy budget using passiv techniques and natural cross ventilation. The orientation and disposition of the 4 conjoined office blocks were also angled and spaced specifically to exploit and use the prevailing wind direction and orientation to aid the ambient thermal control systems. There are some similarities with Medina here in terms of cladding systems, proportion, texture and responsive crafted components. In terms of orientation there are three different wall typologies and build-ups that are →

BELOW
Doge’s Palace in Venice © AussieActive via Unsplash.

arranged and synchronised to optimise performance whilst using a stripped down series of classical principles that are scrambled and blended to offer a highly responsive and integrated system of walls. Formally it is worth noting that this remains the only significant building within the Milton Keynes orthogonal grid system that defies this geometry, and settles on the periphery of the urban layout at a dynamic angle that adds a degree of positive tension to its adjoining streets and buildings.

Moving into an entirely different physical environment, the wall systems that were developed for our Chancery Lane building (within its conservation led context) were carefully developed to offer a positive contribution to this historic part of Mid-Town, poised between the open spaces of Lincolns Inn Fields in Camden, and the western fringes of the City of London to the east. The 10 000sq feet of commercial office space needed to be configured and stitched together to incorporate retained and new facades. The primary retained façade on Chancery Lane dated from the early nineteenth century, and provided frontage to a rabbit warren of legal chambers at the rear. A classical formula of expressed architraves, pilasters and columns was capped by a classic mansard (double storey) punctuated by a row of tightly spaced and expressive chimneys. The remainder of the original brick clad chambers accommodation was demolished, along with the other secondary elevations to the sides and the rear. This meant that a stitching together of architectural vocabularies was necessary, with key moments of tension and intersection where historic met contemporary. Although a frame building, just like both Medina and Network Rail, it was necessary to adopt a more overtly monolithic and crafted sequence of bays within the elevations by introducing significant texture and depth. The ‘machine’ aesthetic of Medina gave way here to a more crafted and tactile palette, with the primary lattice work of the layered elevations being made of faience or ceramic components. These were not two dimensional tiled modules, rather a whole system of profiled and glazed components that sat proud of the inner watertight glazed skin of the built enclosure.

With a building such as Chancery Lane issues of form and function, consistency and logic come into play. The ten floors of working environments within experience an internal and an external world via the permeability of the built

enclosure, and the control of natural daylight within the spaces. The historic and immediate responsibilities of the external walls to adjoining buildings and context dictate that the four primary walls here cannot be ubiquitous and homogenous in terms of their character and configuration. Once we apply issues of orientation, overlooking, thermal performance, light pollution and relative depths of floorplates these need to be added to the mix. Spread of flame, party walls and the spaces in between adjacent walls all come into play here with the optimum result answering a complex and wide ranging set of variables.

Another building that exists within the historic fabric of the City of London is Adelaide House. In 1924, at the time of its construction, it was the tallest building in the City, and the first steel frame building. Scott Brownrigg are near to completing a sensitive refurbishment and fit out of the entire Grade II Listed building, and have enjoyed the responsibility of breathing new life and technology into the simple rectilinear plan geometry. The office space within is enclosed by a sophisticated and multi-layered façade system, who's Art Deco style derived some of its architectural character from Egyptian references popular at the time, after the recent discovery of Tutankhamen's tomb.

Despite some abstracted decorative elements, this inherently 'modernist' building uses a sophisticated formula within the articulation of its wall build-ups and their layering. The key characteristic is the implicit depth of the walls and the way vertical piers (or pilasters) form the primary →

LEFT
Orthogonal grid system at Network Rail's National Centre © ARCHIMAGE.

BELOW
Retrofit of 28 Chancery Lane © Hundven-Clements Photography.

> **“By their very nature walls have dual personalities in the sense that they must be both introverted and extroverted at the same time.”**

component of the overall composition. There is a tactile three dimensional quality to the two primary walls of Adelaide House, which works well in both close up and long views. A classical temple declaring a base, a middle and a top,and the introduction of frame construction has freed the architects from an overtly load bearing formula, and subtle and complex games are played at the corners, particularly with the punctuation and fragmentation of the primary cornice, and the asymmetries that are incorporated. A granite base to the composition suggests permanence and solidity, whilst a very light grey faience has been used for the majority of the elevations beneath the main cornice line. The level above the main cornice line is not part of the original composition.

Between the heavily modelled ceramic piers the spandrels express precisely modelled rosettes within the ceramic modules (which in the spirit of progress and the inherent modernity of the building) incorporate flues for ventilation and cooling. This avant garde building from the early 1920s and now a century old is remarkable for the sophistication of the wall systems employed. These have stood the test of time, and express a coherent and entirely holistic approach to the technical and aesthetic performance of the external envelope and built enclosure.

All walls are constructed with a purpose and specific role in mind. They are integral to our everyday lives and fundamentally universal. We all have personal experience of a range of walls, some ubiquitous, some rare and unusual, and some entirely unique to ourselves and our experiences. Whether it is the time of day, the season or our own circumstances, (shared or otherwise) walls have resonance and personality for each and every one of us. By their very nature, walls have dual personalities in the sense that they must be both introverted and extroverted at the same time. Without a wall or barrier there can be no inside or outside. This is never a gradual filter from one mood to another. It is a sudden and abrupt division defining two different worlds. The external treatment, contextual response and language of power that a wall can imbue was first revealed to me in Venice facing the external elevations of the Doges Palace. What struck me most here was that this was a wall of polarities and contradictions. Besides the tensions and compositional juxtapositions, what was most memorable was the delicate and finely articulated geometric design of the pastel shades of the facing bricks used on the primary backdrop to the composition. The trick here was to render a heavy, defensive and monolithic structure light as a feather resembling more a finely woven carpet or rug that fundamentally appeared weightless and planar. It could have been rolled up and carried off such was its delicacy ●

RIGHT
Retrofit of Adelaide House
© Scott Brownrigg.

DESIGN PROCESS:
The Intelligent Wall

New technologies are allowing us to create digital representation of walls which will pave the way for more efficient operation and maintenance of buildings in the future. Join Director of Digital Development Ana Matic as she takes a look at some of the key concepts and uses cases across the industry.

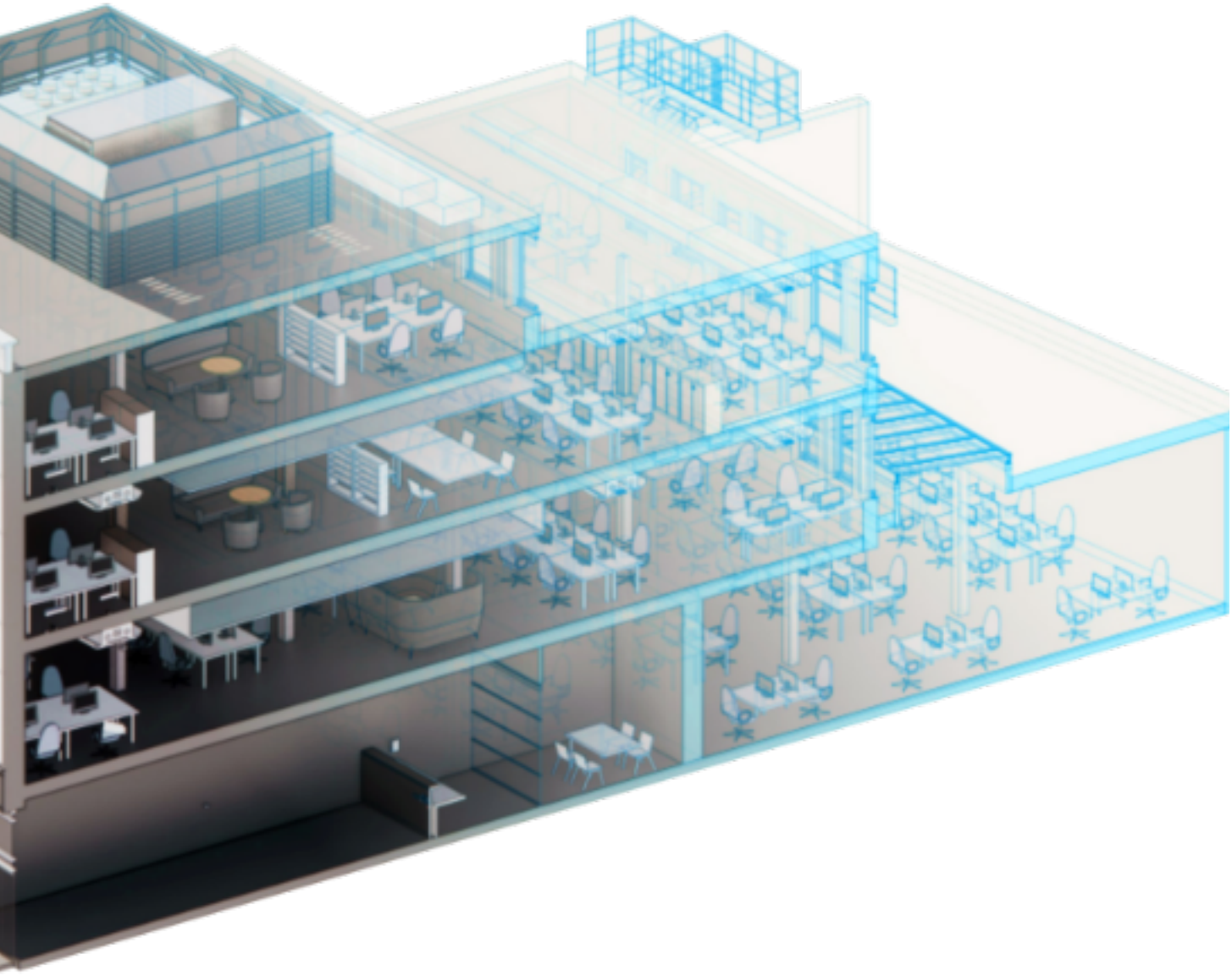
As architects, the way we design in our everyday work increasingly deals with digital concepts of building elements rather than the actual, physical materials and elements themselves. This applies to walls and all other elements which help us create, erect, finish and protect structures. Our understanding of the project is firstly created inside the digital model which is used to test, coordinate and make all key decisions about the project for a long time before the physical counterpart starts to take shape on site.

We create, specify and coordinate from the inception of a design through to the delivery of a project on site by using digital representation of walls and their intrinsic parts. This way, the walls we draw (or, more likely, model) live with us for a long time, gradually becoming more defined into a realistic representation of their physical counterparts. With the advance of information modelling, today's digital walls carry a significant amount of information which is periodically extracted for coordination, quantification, and planning / scheduling of construction (and later) maintenance tasks. With the arrival of digital twin technologies, we anticipate continuing 'digital life' of the walls to enable efficient future operation and maintenance of buildings. To better understand the concepts behind the parallel existence of digital and physical wall, lets have a look at some of the key concepts and uses cases across the industry.

INTELLIGENT WALLS - SYSTEMS, PARTS + PRODUCTS:

The contemporary design of buildings understand walls as part of 'systems' which further break down into layers and parts, usually understood as 'products'. This is grounded in the way we model walls and their intrinsic elements but also because of the way we specify all component parts of buildings. The technical language which has developed around this way of designing captures the spirit of traditional concepts of construction and building. However, many of them have a very new digital meaning – embedded in our professional language.

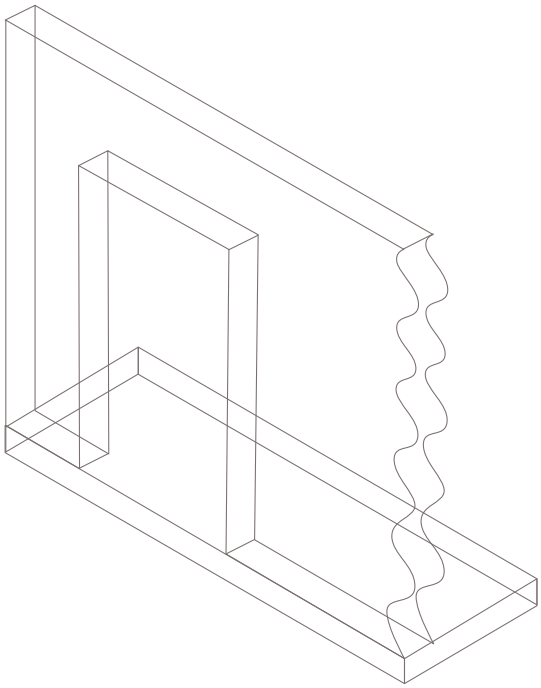
Like other basic model elements, walls are pre-determined instances of a system 'family' of objects which represent standard varieties of physical walls and their shape, function, composition, layering, thickness, and finishes.

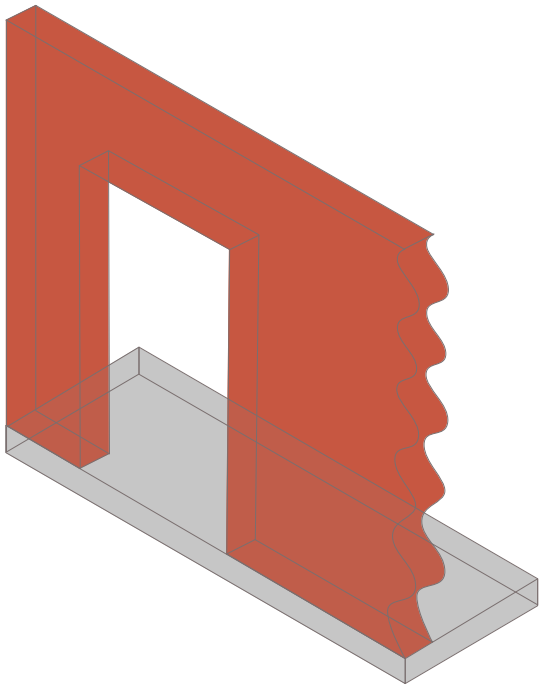


ABOVE
A digital twin of our London studio.

Windows and doors are ‘hosted’ by the walls; walls are ‘built’ on their ‘hosting’ levels and can be restricted or attached to other building elements to limit their height, shape, and form but to also enable them to be automatically updated if those elements change. Layered ‘compound’ walls consist of multiple vertical layers which can be edited individually and given properties (material / thermal / acoustic) which create a composite performance of the wall.

Digital wall systems are required to work and create a ‘whole’ just like their physical counterparts to provide sufficient separation between spaces (fire, acoustic, security) as well as perform their primary function of thermal separation and solar / visual transparency. Digital walls create digital rooms and together with them – digital spaces carry (or again – ‘host’) all other building elements, equipment, and mechanical systems. →





‘I AM JUST A BASIC WALL’:

Gradual digitising of architecture, construction and the operation of buildings is driving creation of industry standards in the way we name and codify walls. The intention is to enable all disciplines involved in the design, manufacture, and construction to have digital continuity from inception through to operational phase of the project. This process is in its early stages yet and in terms of data, we are still creating a lot of wastage. Most recent changes brought about by the Building Safety Act in UK will however have a positive effect on improving our ability to track, convert and understand data as it moves through the stages of the project. The idea of the Golden Thread of Information from design inception through to ‘in-use’ stage of the project and with ability to ‘plug-into’ larger eco-systems of digital twins in the future as city, regional and national digital twins become a mainstream.

INTELLIGENT WALLS - LEVEL OF DEVELOPMENT

Digital wall development is an industry standard that defines how the wall geometry and the associated wall information develops in terms of refinement during the project progress. As design develops and the specification of each element becomes clearer, and as other discipline’s packages develop with more detail – the digital wall gains more knowledge about itself, it’s parts and materials, layers and finishes and junctions with other building elements.

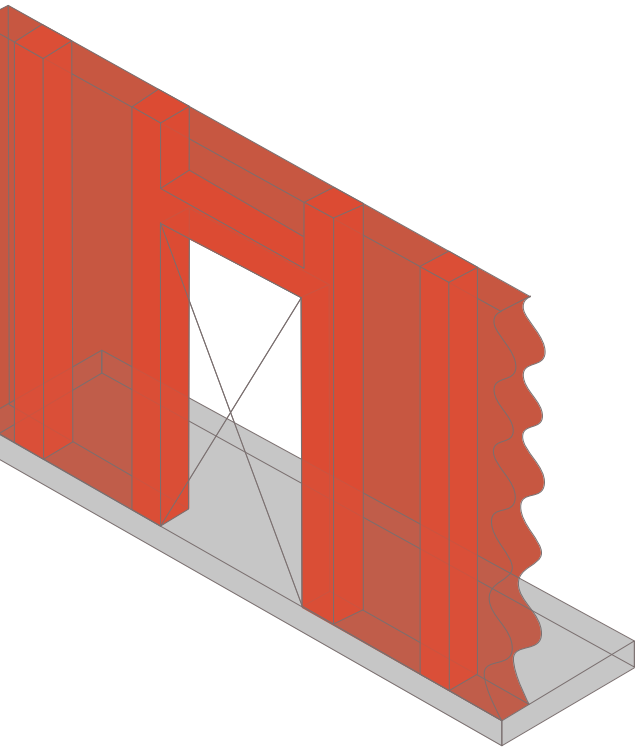
One of the most wide-spread standards for the relevant ‘Level of Detail’ for digital representation of elements is the BIM Forum’s LOD table. Its popularity comes from the simple diagrammatic understanding of the design progress – observed through simplified diagrams which are updated and published every year to keep up with the changes in trends and industry advancements. Thus we adopt the new ways of thinking about relevant level of design development and the language which codifies how we work together.

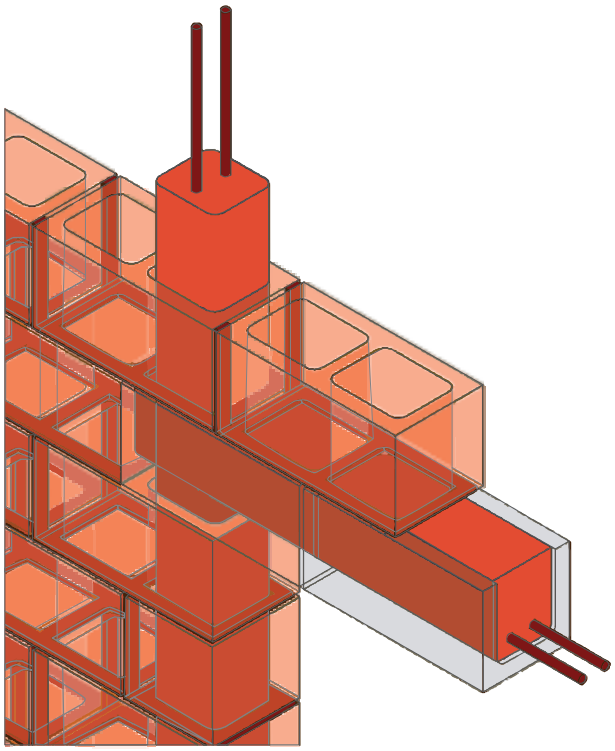
DIGITAL WALL TWIN

The Golden Thread of Information promoted by the recent Building Safety Act [BSA] refers to an accurate and up-to-date information being available throughout the design, construction and most importantly, operational cycle of the building. This information must be simple, clear and accessible for the building owners, managers and occupiers with ability to curate the data delivered for different groups but also keep the data up to date.

Fully developed asset digital twin encompasses all key building assets, including doors, walls, windows, mechanical and electrical equipment, and fire safety equipment, which are connected to key asset information required for their maintenance and day-to-day operation. Real-time data is inputted to identify any potential issues, faults as well as any significant changes over time.

Using digital twins to run, maintain and actively support the ‘in-use’ life of the building will extend the life of the ‘digital wall’ to continue co-existing with its physical counterparts. The level of detail and development of the digital wall will depend on the type of the building and the physical walls function. Key, walls with fire-separating properties will need to be maintained regularly with specific focus on their intrinsic, movable parts (doors / screens etc). Complex buildings which are highly dependent on their fire and security systems to operate successfully are already





ABOVE
Digitisation of walls enables us to design in greater detail at earlier stages of a project.

running sophisticated digital twin systems which monitor, update and self-regulate – needing only periodic active checking from the management team.

Operational digital twins provide an active connection to the physical asset commonly focusing on achieving greater energy efficiencies and better user comfort across all connected spaces. Learning from the manufacturing and transport industries, built environment digital twins are increasingly developing relevant 'ontologies' to track, control and predict certain building user behaviours and seasonal which affect the buildings. Ability to utilise the digital twin to also test proposed building alterations is becoming essential for commercial landlords and owner-occupiers. In the context of the golden thread and maintaining the Building Safety Act requirements – building ontologies can be used to identify key future risks and opportunities to predict those or react fast if required. Specifically pertinent for large estates (healthcare, higher education and residential) and in High Rise Buildings [HRBs] with seasonal changes in habitation (student housing, hospitality).

CONCLUSION

From the initial 'Basic Wall' used to create concept design of a building through to the 'basic wall' required for the future digital twin of the facility – digital continuity with minimum wastage would be a preferable future for both designers and the owners / users of the buildings. Architects can lead and benefit from understanding this progress and embracing potential of future closer relationships between physical and digital worlds ●

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