DESIGN THEORY ANALYSIS

RESPONSIVE AND RESPONSIBLE ARCHITECTURE

CASE STUDIES:

PAREKH HOUSE

SAGE HOUSE

TYE RIVER CABIN

COLLECTION 4

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ARCHITECTURE 330: ARCHITECTURAL DESIGN THEORY FUNDAMENTALS

INTRODUCTION

In this collection, I examine architectural design theory fundamentals with emphasis on proportions and scale, spatial organization, ordering principles, and sustainable building techniques by exploring three case studies: Parekh House in Ahmadabad, India, Sage House in Taos, New Mexico (United States of America), and Tye River Cabin in Skykomish, Washington (United States of America). With the climate change crisis increasing in importance, it is imperative to adapt new technology to principles of passive solar design to minimize wasteful energy consumption and protect the environment from further damage. Of equal importance is architecture's relationship with humanity, and so I explore the above ideas with structural, environmental, psychological, and sociocultural lenses.

The theories discussed in this collection are those presented by Francis Ching in his 2015 book, ***Architecture: Form, Space, and Order*** and Roger Clark and Michael Pause's book, ***Precedents in Architecture: Analytic Diagrams, Formative Ideas, and Partis*** (2012). Sustainability and passive solar design strategies referred to in this collection are from David Bainbridge and Kenneth Haggard's book, ***Passive Solar Architecture: Heating, Cooling, Ventilation, Daylighting, and More Using Natural Flows*** (2011) and Doerr Architecture's video series, "Passive Solar Simplified". I analyze these concepts alongside the ideas proposed by Robert Gifford in his text, ***Environmental Psychology: Principles and Practice***.

THE SITES

PAREK HOUSE - AHMEDABAD, INDIA
SAGE HOUSE - TAOS, NEW MEXICO, UNITED STATES OF AMERICA
AND
TYE RIVER CABIN - SKYKOMISH, WASHINGTON, UNITED STATES OF AMERICA

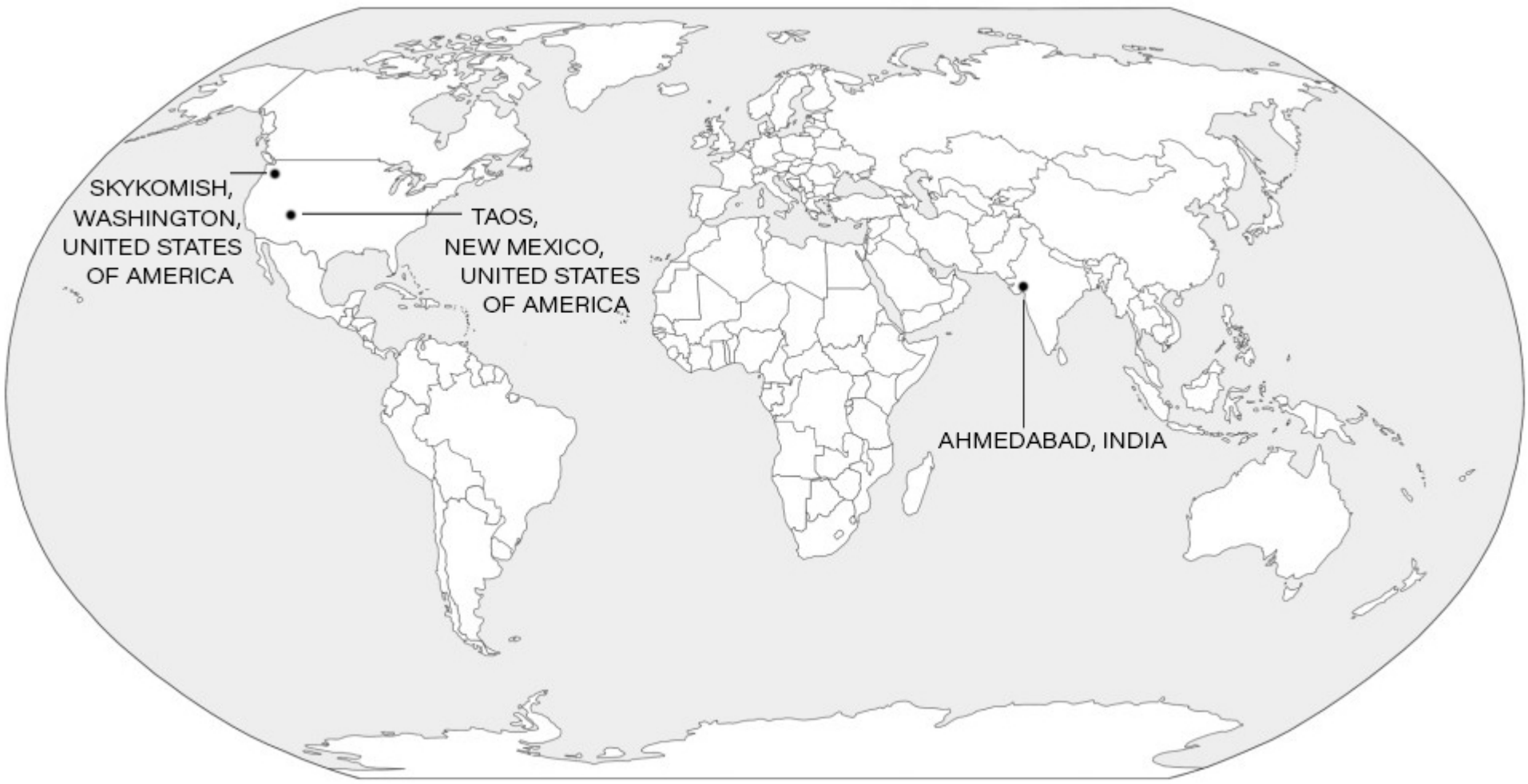

Figure 1: World map depicting the Collection's three case studies. FROM: WaterproofPaper, 2018.

Parekh House is situated in Ahmedabad, India while both Sage House and Tye River Cabin are in the United States of America. These three case studies on two different continents allow for exploration of climate on international and national levels and analysis of varying architectural building techniques.

THE ARCHITECTS

CHARLES CORREA (PAREKH HOUSE)

Charles Correa (1930-2015) was an Indian architect and urban planner best known for his skillful adaptation of modern style to local climates and styles (Encyclopedia Britannica, 2018). He is known for his understanding of the poor, low-cost housing, and traditional architectural methods and local materials (Encyclopedia Britannica, 2018). Correa used low-rise buildings with communal spaces to emphasize the human scale and foster a sense of community and using conceptual influence of Le Corbusier's use of concrete and sharp angles (Encyclopedia Britannica, 2018), which are reflected in the design of Parekh House. He obtained his Master's degree from the Massachusetts Institute of Technology in 1955 and had established his own practice in India by 1958 (Encyclopedia Britannica, 2018).

ANTOINE PREDOCK (SAGE HOUSE)

Based in Albuquerque, New Mexico, Antonine Predock does not view New Mexico as a region but rather a "force that has entered [his] system, a force that is composed of many things" (Predock, 2018). He acknowledges his design response to climactic influence but emphasizes the aura surrounding his architecture within its Chaco Canyon cultural context as "one cannot invoke in one's work" (Predock, 2018). He states that he aims "for the built work to express that initial physical and spiritual impulse" (Predock, 2018). This intentional homage to the cultural and environmental context surrounding Sage House is seen in its design and orientation, as well as the spiritual connection between building and environment.

TOM KUNDIG & KIRSTEN MURRAY (TYE RIVER CABIN)

Tom Kundig and Kirsten Murray are both principals and owners of Olson Kundig, based in Seattle, Washington (Olson Kundig, 2018). In an interview with Patrick Sisson of Curbed, Kundig discusses his reputation for creating modern architecture that reflects its rural landscape without sacrificing warmth by considering cities and natural landscapes: "People make the mistake that the city isn't a natural landscape while it's actually shaped by an array of natural and cultural forces" (Sisson, 2015). Kundig speaks further of context when he states that "architects need to understand they're part of the context of the situation" (Sisson, 2015). This is a profound statement as it acknowledges that the architectural process requires a multifactorial approach of various disciplines and that it is the architect's responsibility to consider all factors and advocate for the most responsible and responsive design. He cites sculptor Harold Balazs as an influence growing up, who used only natural materials and a very experimental design philosophy (Sisson, 2015), which is seen in the innovative construction techniques of Tye River Cabin.

Murray is known for her close attention to the habits and patterns of users' behavior, which has influenced her mixed-use and transformative approach to design (Olson Kundig, 2018). Murray cites the importance of designing for the spirit of place (Olson Kundig, 2018), which is evident in how Tye River Cabin's design optimizes its integration with its natural surroundings and microclimate.

PART ONE:
CASE STUDY
DESIGN ANALYSIS

PAREKH HOUSE

CHARLES CORREA, 1967-68

AHMEDABAD, INDIA

Parekh House, located in the residential Cablenagar Township of Kota, Rajasthan, India, is an excellent example of adapting modernism to passive solar design to accommodate Ahmedabad's high temperatures. Correa adopted a low-rise plan to maintain and emphasize human scale for its poor inhabitants and enhance a feeling of community (Encyclopedia Britannica, 2018) for its users and neighbors. Its size was intended to accommodate multi-generational living, as customary in Indian culture. The safety provided by low-rise buildings (Gifford, 2014) was also likely a factor in Correa's design. Parekh House serves as a clear indicator of how climactic, socioeconomic, and cultural factors influence architectural expression. This house, with its passive solar design and durable sustainable materials, was built to last the test of time.

Figure 2: Parekh House context map - Ahmedabad, Kota, India. Sketch by author - October 20, 2018.

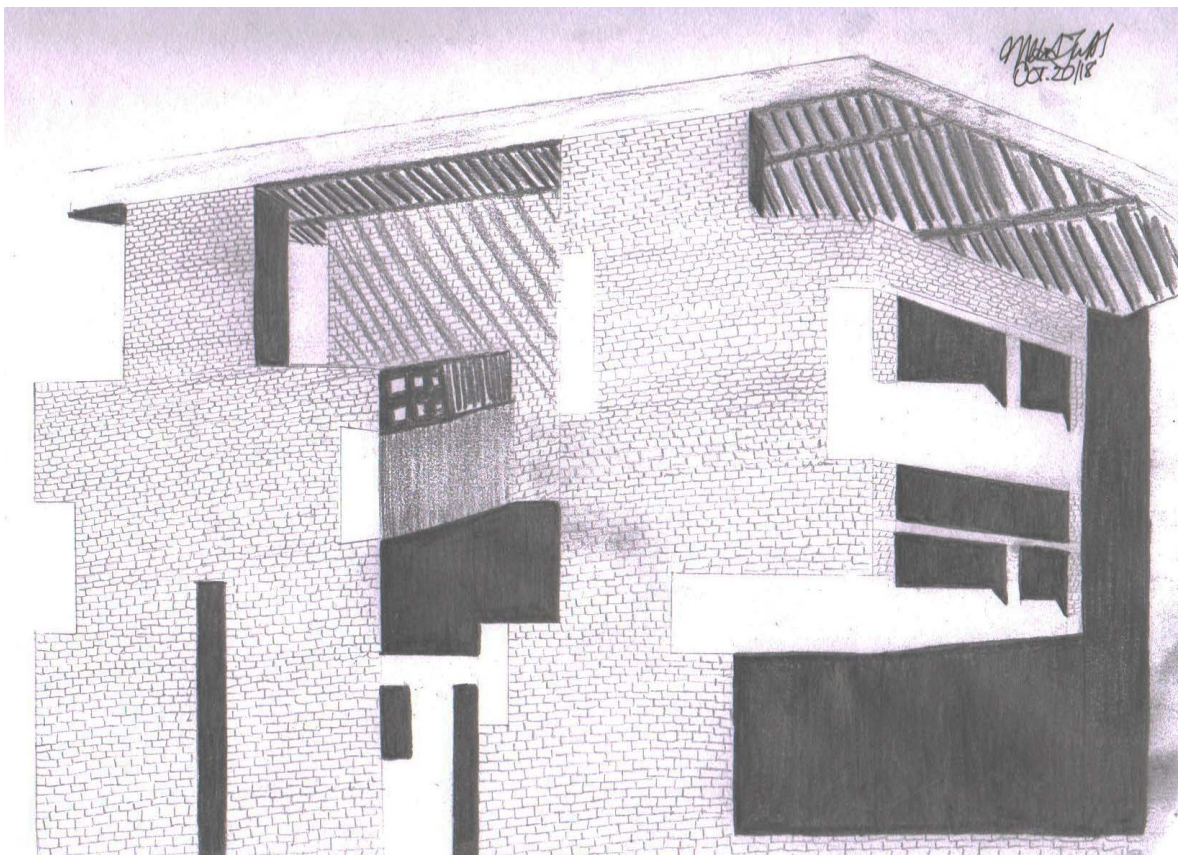

Figure 3: Parekh House 's eastern façade. Sketch by author - October 20, 2018.

This residential home is cubic, linear, and regular in form (Ching, 2015) and composed primarily of brick and concrete. Brick was a bountiful cost-effective local material and the light-colored concrete serves to highlight the voids created by subtractive transformation. Ching discusses in his book how linear buildings have the advantage of enclosing exterior space as well as adapting to environmental conditions (2015). Here, the contrast of the red brick with the white concrete echoes the contrast of the mass and the voids in its design. The white concrete also helps to offset the heavy visual mass of the building; especially on its higher storeys and roof, which is further visually lightened with slats as fenestration directing air downwards towards the house's users and creating shadows for privacy, solar shading, and visual interest.

The rough texture of the brick is juxtaposed against the smooth surfaces of the white concrete, perhaps a nod to the rough life of the urban poor and Charles Correa's desire to integrate some lightness and smoothness into Parekh House's cultural context. Modifi (2007) also cites that rough building surfaces with porosity increase the structure's contact with circulating air and decrease heat gain. Analyzing lines at their smallest scale in this design, the staggered pattern of the laid brick creates the impression of spatial quadrants, much like the various sections of the building. The contrasting geometric shapes of the white concrete balconies and pergola roof create visual indication of exterior space as well as denoting a change in plane because of the change of building material, a concept described by Ching (2015). These spaces defined by white concrete are also hierarchical, as they are composed of unique shapes (as illustrated by the balcony ledge angles), exceptional size (the entire surface area of the ceiling/roof plane) and are strategically placed (to optimize ventilation by southward winds) (Ching, 2015). Brick has low insulative qualities and is an ideal construction material for this building requiring ventilation.

The primary horizontal element defining Parekh House's space is its overhead plane; the roof composed of pergola-like slats to provide shade. The repetitive nature of the slats in the pergola roof allow it to serve as a datum, referencing a concept by Ching (2015) that "if planar or volumetric in form, a datum must have sufficient size, closure, and regularity to be seen as a figure that can embrace or gather together the elements being organized within its field". Despite its dense materials and extensive use of subtractive transformation, its volume is articulated and maintained by its concrete roof spanning the entire building, which helps to retain its balance.

Parekh House has short frontal approaches and recessed entrances. This is likely due to its situation on a residential street and its close proximity to the street. A gate provides some property designation and privacy. The building appears to have an open composite circulation path (Ching, 2015) to facilitate access that terminates in a space (the building's interior). Staircases facilitate interior circulation between levels.

Parallel lines and linear elements are prevalent in the design of Parekh House. As Francis Ching (2015) discusses in his book, linear elements can define a transparent volume of space. This concept is visualized in Figure 4, where the brick columns meet the overhead plane (pergola roof) to enclose the spatial field, also meeting the practical need of structural support. Vertical wall planes also serve as supportive features of the bearing-wall structural system of the Parekh House.

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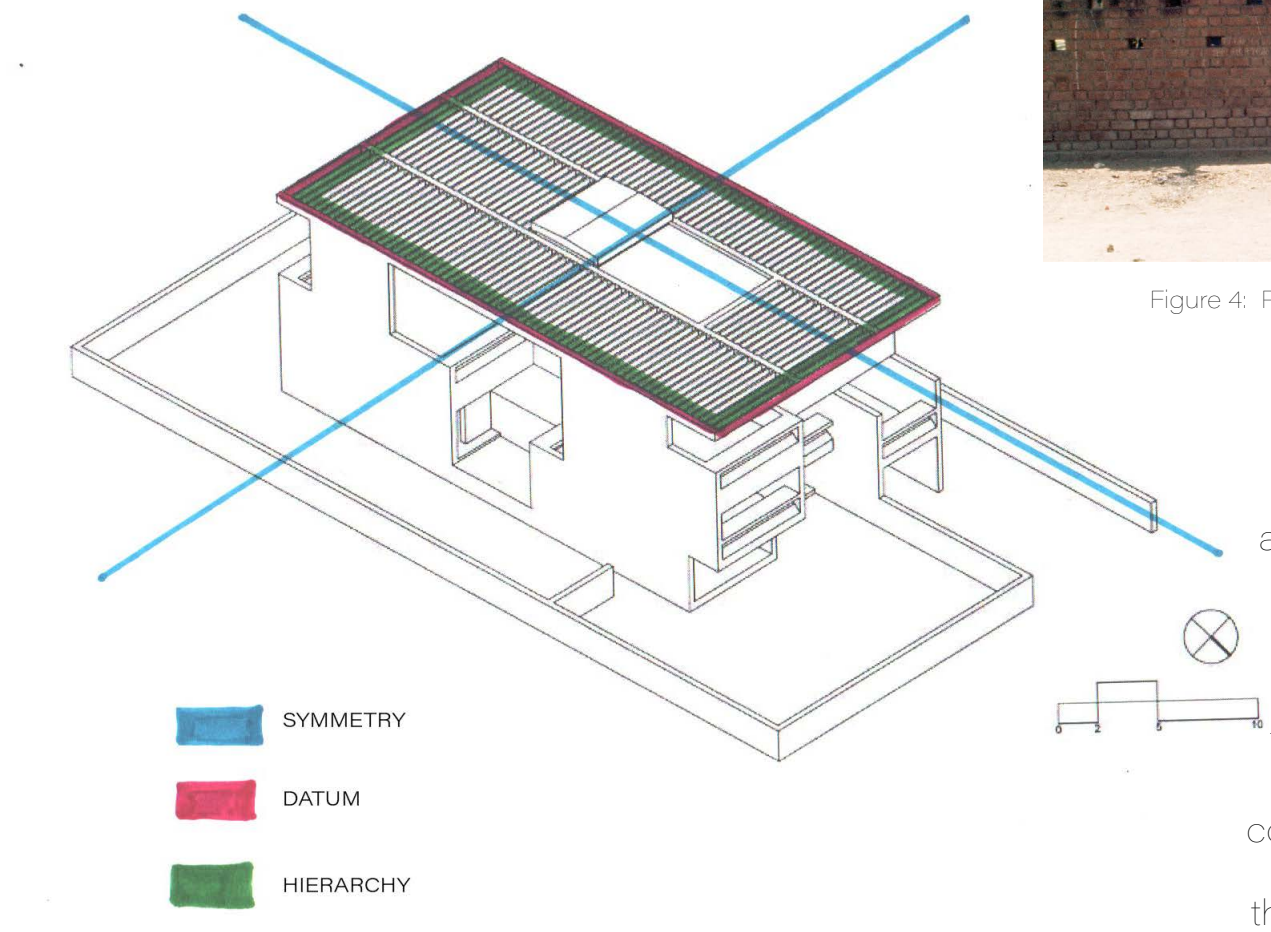

Figure 5: Parekh House: aerial view. FROM: E-Build.In, 2018.

Figure 4: Parekh House: view from the street. FROM: E-Build.In, 2018.

There are copious architectural ordering principles seen in the design of Parekh House. As seen in Figure 5, the building is symmetrical and balanced, with axes running along the width and length of the building around which volumetric elements and spatial fields are arranged.

To create livable spaces, the home is composed of three bays with primarily U-shaped configurations to create interlocking and adjacent spaces: a "summer" section to be used during the daytime to escape the heat, a "winter" section that utilizes outdoor space in the early morning and evenings, and a conjoining service bay for circulation, kitchen space, and washrooms (The Archi Blog, 2011).

Views of the house and surrounding landscape are provided by terraces (barsati). Direct and ambient natural lighting are controlled with the division of space according to time of day (summer and winter sections), fenestration, subtractive transformation, and pergola roof to provide shade and increase impact with the wind (Modifi, 2007).

Trees in the gardens on the east and west facades of the house provide additional shade (Ching, 2015). The most commonly used communal spaces such as the dining and living areas are on ground level, the coolest location, and the bedrooms are at higher elevations to keep warm at night. Of the design strategies for tropical climates outlined by Modifi (2007), Parekh House's introverted building morphology of a courtyard (seen here between the living/dining room and studio) creates a more livable microclimate for its users. This also helps to provide more cooled spaces during the daytime (Modifi, 2007).

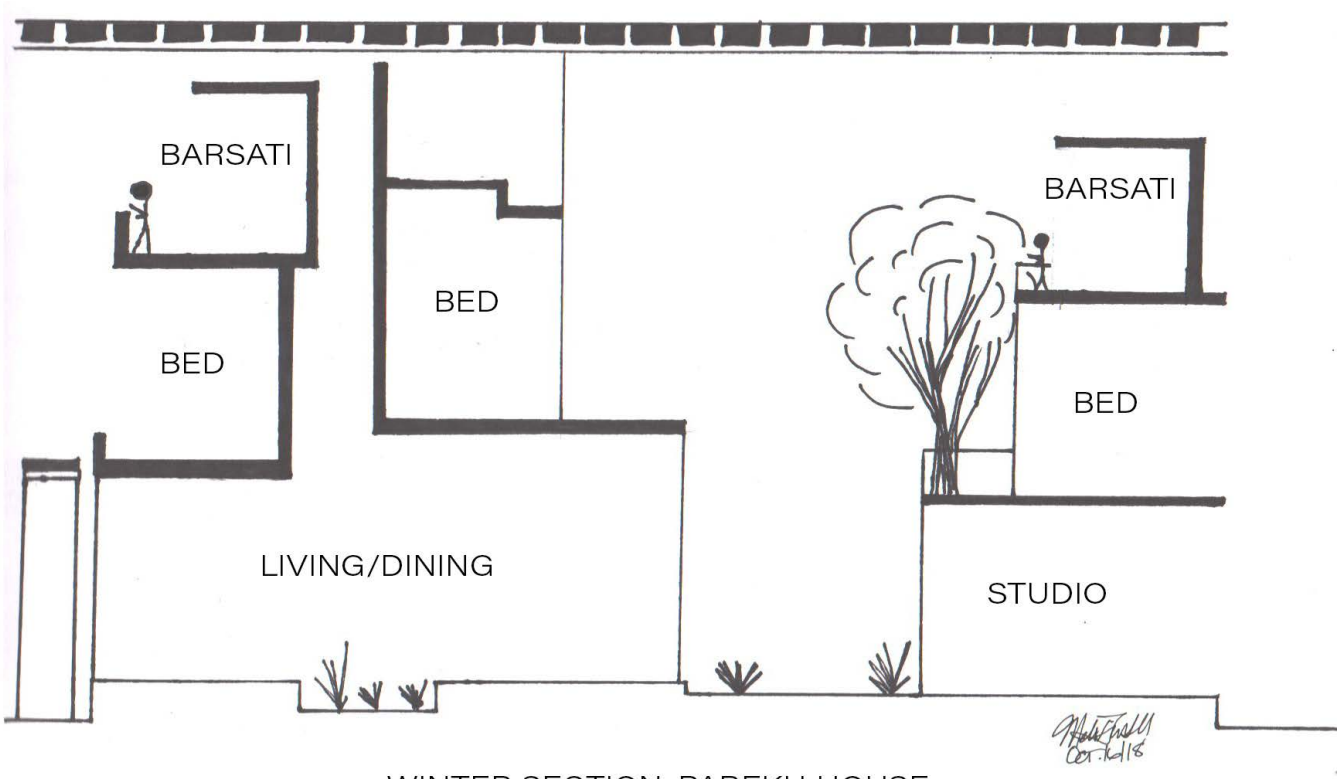

Figure 6: Parekh House: winter section. Sketch by author - October 16, 2018.

SAGE HOUSE

ANTOINE PREDOCK, 2008

TAOS, NEW MEXICO, UNITED STATES OF AMERICA

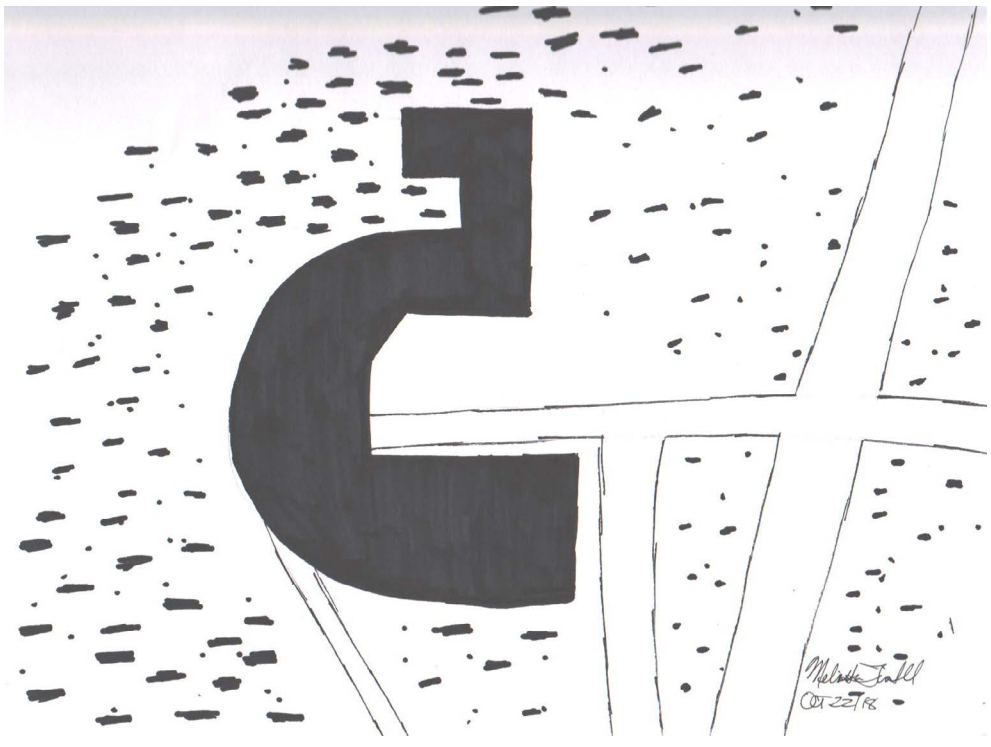

Figure 7: Sage House's site plan.. Sketch by author - October 22, 2018.

The arc shape helps to offset the southwestern winds (Predock, 2018) and provide the best mountain and landscape views for its inhabitants. The small linear and arc configurations utilizing maximum fenestration allows for an unobstructed panoramic view of the mountainous landscape. The linear-shaped portions are hierarchical by shape and placement (Ching, 2015) as they differ from the dominant arc shape and are placed on either end of the arc for the best views in the living quarters.

Antoine Predock's Sage House is positioned in Taos, New Mexico between the Sangre de Cristo Mountains and blankets of sagebrush (Predock, 2018), giving the house its name. The home houses an internal courtyard, orchard, and earthen berm (Predock, 2018). Interiorly, the central spaces are organized around the courtyard for outdoor entertaining (Predock, 2018). The bedroom wing captures views of the Truchas Peaks and the master bedroom opens onto another private courtyard (Predock, 2018). The private residence is of an irregular arc form with two linear segments and natural colors of beige, rust, and white, mimicking the surrounding vegetation and the snow-capped mountains and minimizing the building's visual mass.

Upon analysis of an aerial view of the site, the Sage House has two approaches for automobile traffic: one frontal and one oblique by means of straight linear paths. These are in the form of unpaved roads. These approaches are likely also to be used by pedestrian traffic, though pedestrians are also able to approach the building through undefined composite paths in the surrounding desert, as there is only sand and low-lying vegetation within its immediate vicinity. There appear to be several entrances that are flush with the exterior vertical planes, which may be deliberately obscured (Ching, 2015) for reasons of design cohesion and privacy. These paths pass by the building's spaces as well as terminate within them (as with entrances and garage).

Figure 8: Sage House, surrounded by mountains and sagebrush. FROM: Predock, 2018.

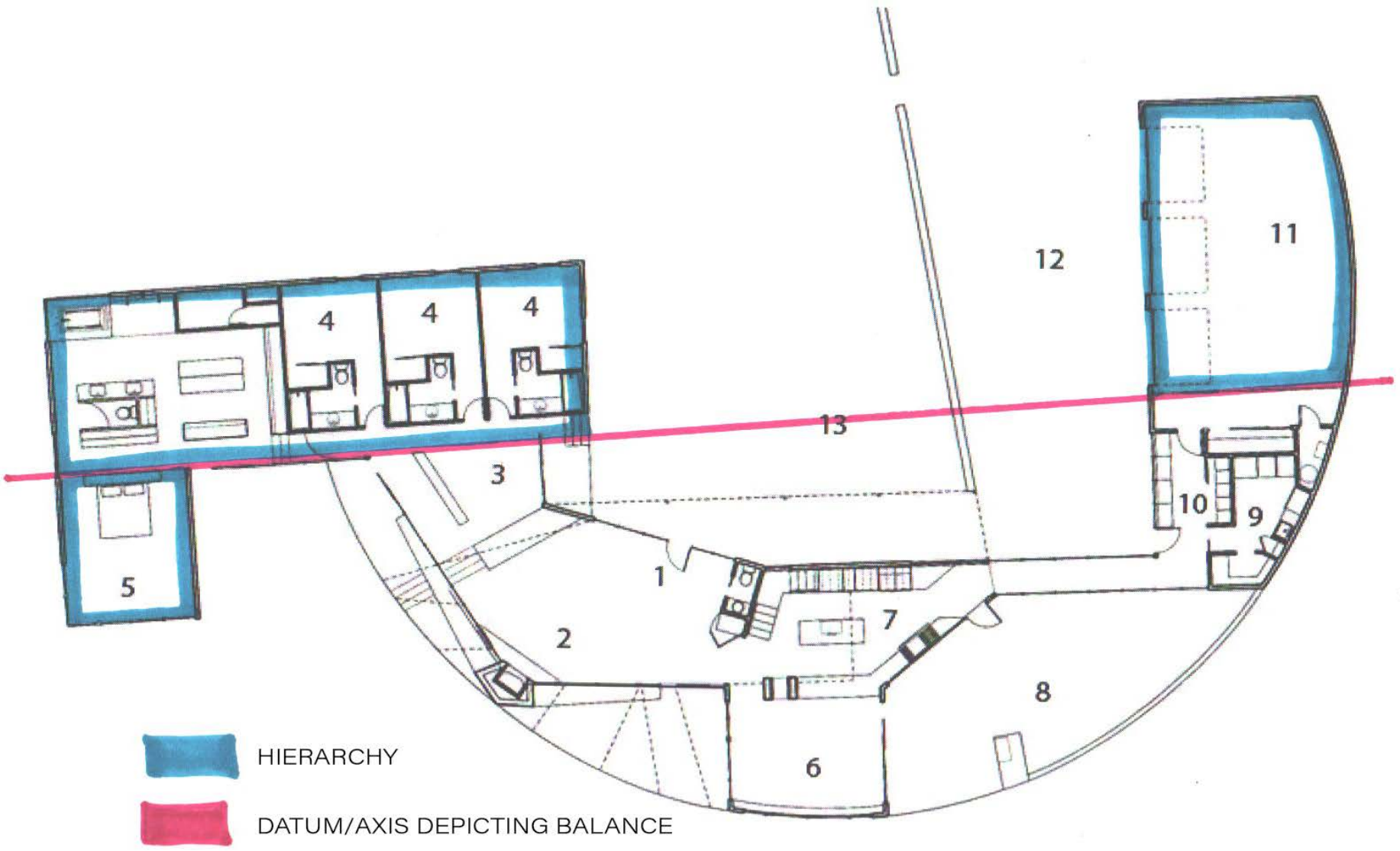

Figure 9: Sage House's floor plan. FROM: Architectural Digest, 2018.

Two-thirds of this irregularly-shaped home are shaped like an arc and the other third contains rectangular shapes. It is composed of primarily glass and light-colored stucco and metal. Its textured stucco and smooth light-colored metal reflect the textures of the vegetation and snow covering the mountains, further echoed by the sloped roof. These light-colored building materials create the illusion of a light building mass (Ching, 2015), suggesting the building was lightly placed within the mountainous landscape with its camouflaged colors. Predock developed corners and edges with the building's vertical planes to define its form, an idea proposed by Ching (2015). If we apply Clark and Pause's (2012) descriptions of plans to section or elevation relationships, the relationship of Sage House is analogous, since the aerial and elevation perspectives of the building show a change in form which resembles but is not equivalent to the rest of the structure. This is best shown in Figure 9; the rectangular form at far left resembles the partially rectangular form of the semicircle at far right, resulting in an analogous perspective when visualized by section.

Figure 10: Sage House; view from garage entrance. FROM: Predock, 2018.

While its form is irregular, asymmetrical, and composed of an arc, rectangle, and square, it is balanced in visual weight, as depicted in Figure 9. Also seen in Figure 9 is the datum around which its space is arranged. Repetition can be seen in the arrangement of fenestration with many identically-sized windows as well as windows varying in size after undergoing transformation, best visualized in Figure 10.

Of its horizontal elements, Sage House's design uses overhead and base planes to define its space. Predock likely used low-lying horizontal elements to emphasize the house's integration into its landscape and not to detract from it. Most of the house's base planes are level with the earth, though there are elevated base planes seen at the garage entrance, as shown in Figure 10. Applying another of Ching's theories, elevating a portion of a base plane creates a specific domain within a building's spatial context by interrupting the flow of space across its surface (2015). According to Ching, because the planes and edges of and surrounding the elevated base plane do not change in form, texture, or color, the spatial field maintains its visual congruence with the rest of the building while remaining as a designated plateau (2015). Predock used vertical elements consisting of columns, posts, and window panes to help define Sage House's space.

Figure 11: Sage House. FROM: Predock, 2018.

Figure 12: Sage House's patio. FROM: Predock, 2018.

While linear components are few in Predock's design, their use is intentional and dramatic. The sloped overhead plane as seen in Figure 11 mimics the angles of the mountains in its backdrop and creates a sense of falling and integrating into the vegetation below while defining the building's space. The repetition of the window-walls in this plane also serve to create visual inertia (Ching, 2015), further emphasized by the graduating slope of the overhead plane. The vertical window panes seen throughout the home anchor the building within its environmental context and help define its volume and articulate its form. Conversely, the curvilinear arc shape softens the harsher elements of its exterior and environment. As Francis Ching discusses in his book, circular forms possess centrality (2015). The semi-circle (arc) is configured to incorporate and focus on the surrounding landscape as part of its form, acting as a unifying element. The linear slats of the pergola roof depicted in Figure 12 provide shade for the patio and immediate interior space as well as juxtapose the semicircular patio shape with the linearity of the shadows.

Openings are seen within planes, corners, and between planes (Ching, 2015). To maximize views of the surrounding landscape to provide a soothing natural aesthetic for the building's users, Predock used excessive glass. The plane closest to the viewer's perspective in Figure 11 has openings centered within its vertical plane, which creates a contrast between the glass and the surrounding stucco. According to Ching, this design theory serves to stabilize the opening and arrange the surrounding elements (2015).

Depicted at the far left of Figure 11 and in Figure 13, the architect also utilized openings at corners. According to Ching (2015), this arrangement provides a diagonal orientation and is used to brighten interior space and optimize views. It is likely that Predock chose to open such large surface areas of these planes to naturally illuminate the interior living space while providing over 180^0 views for its inhabitants.

The fenestration here erodes the integrity of the plane and creates implied angles of space, allowing the spatial field to extend beyond its enclosing planes and into the landscape, as outlined by Ching's theory (2015). This method allows for better blending of interior and exterior space and daylighting (Doerr, 2010) because of its low degree of enclosure (Ching, 2015).

Figure 13: Sage House's corner femestration. FROM: Architectural Digest, 2018.

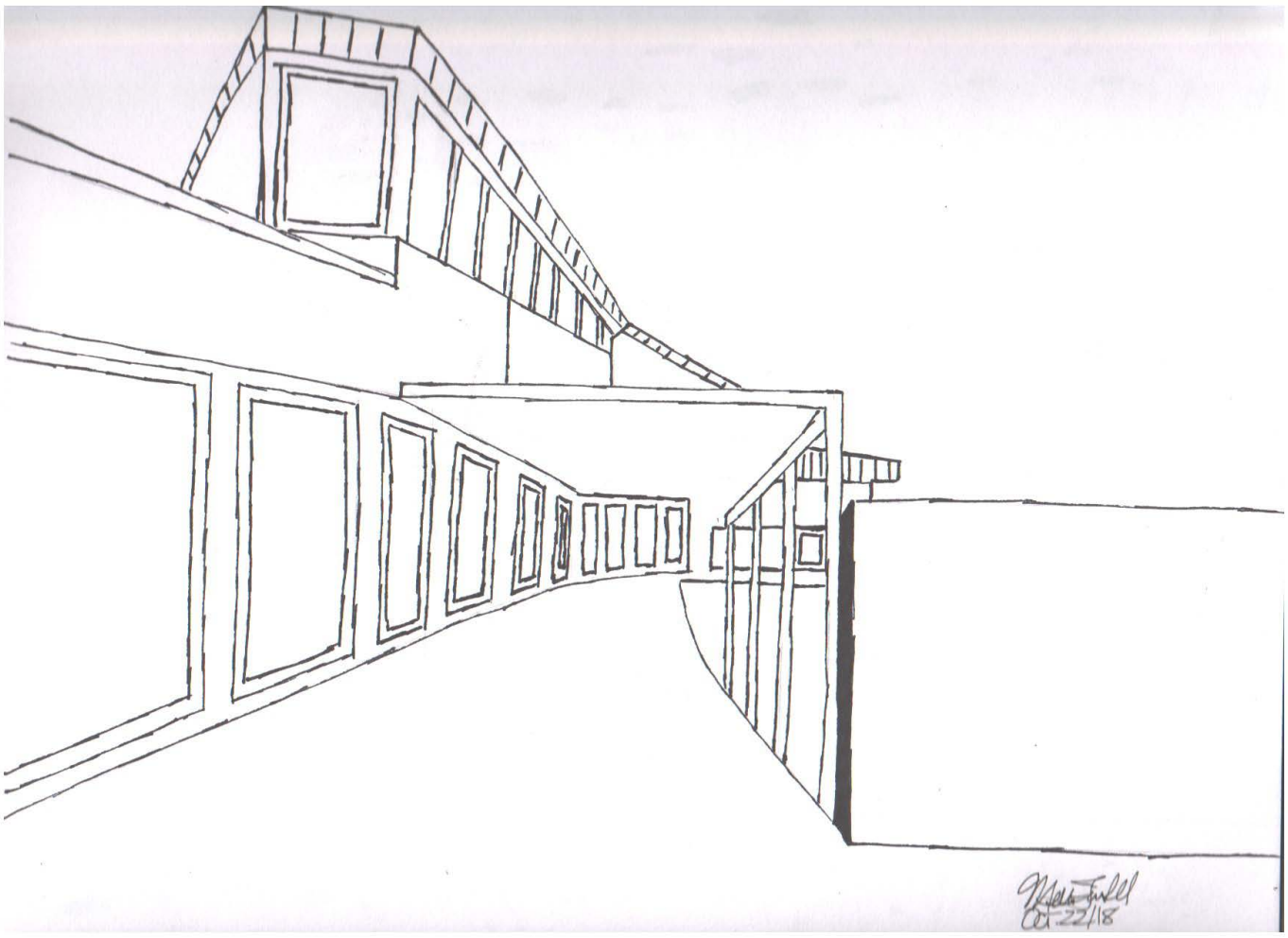

Figure 14: Sage House's exterior space and fenestration. Sketch by author - October 22, 2018.

The lower-level fenestration provides direct and diffuse ambient lighting for the interior space while the openings closer to the overhead planes offer diffuse ambient lighting. Predock used slot windows in private areas for lighting and mountain views (Predock, 2018). Many of the openings are parallel to allow for visual continuity (Ching, 2015); the viewer can see through the building's volume to the landscape.

Figure 15: Visual (landscape) and material (concrete) continuity of Sage House. FROM: Predock, 2018.

TYE RIVER CABIN

TOM KUNDIG & KIRSTEN MURRAY, 2006

SKYKOMISH, WASHINGTON, UNITED STATES OF AMERICA

Deep in the woodland of Skykomish, Washington lies Tye River Cabin designed by Tom Kundig and Kirsten Murray of Olson Kundig. The lush forest surrounding this private retreat offers the perfect backdrop and presents a design challenge of creating a building that honors its gorgeous natural landscape while facilitating modern amenities in a small space of a remote location. With Mother Nature as its landscape architect providing enviable forest views, Tye River Cabin's warm wood interior and concrete chimney and foundation echo the naturality of the surrounding trees and boulders.

Its position within its landscape on an elevated plane establishes the cabin as a retreat from surrounding activity and a location of prominence; ideas proposed by Ching (2015). Its elevated position also allows its users to be more engaged with the surrounding landscape and provides a better sensory experience. This small square building is regular in nature and surrounds a central concrete chimney/fireplace that melds with its concrete foundation, creating a centralized spatial orientation (Ching, 2015). The fireplace and chimney structure also establish hierarchy by placement; an application of a theory discussed by Ching (2015). This hierarchy is created by the central placement of the fireplace/chimney to designate it as the most important compositional element within the structure (Ching, 2015).

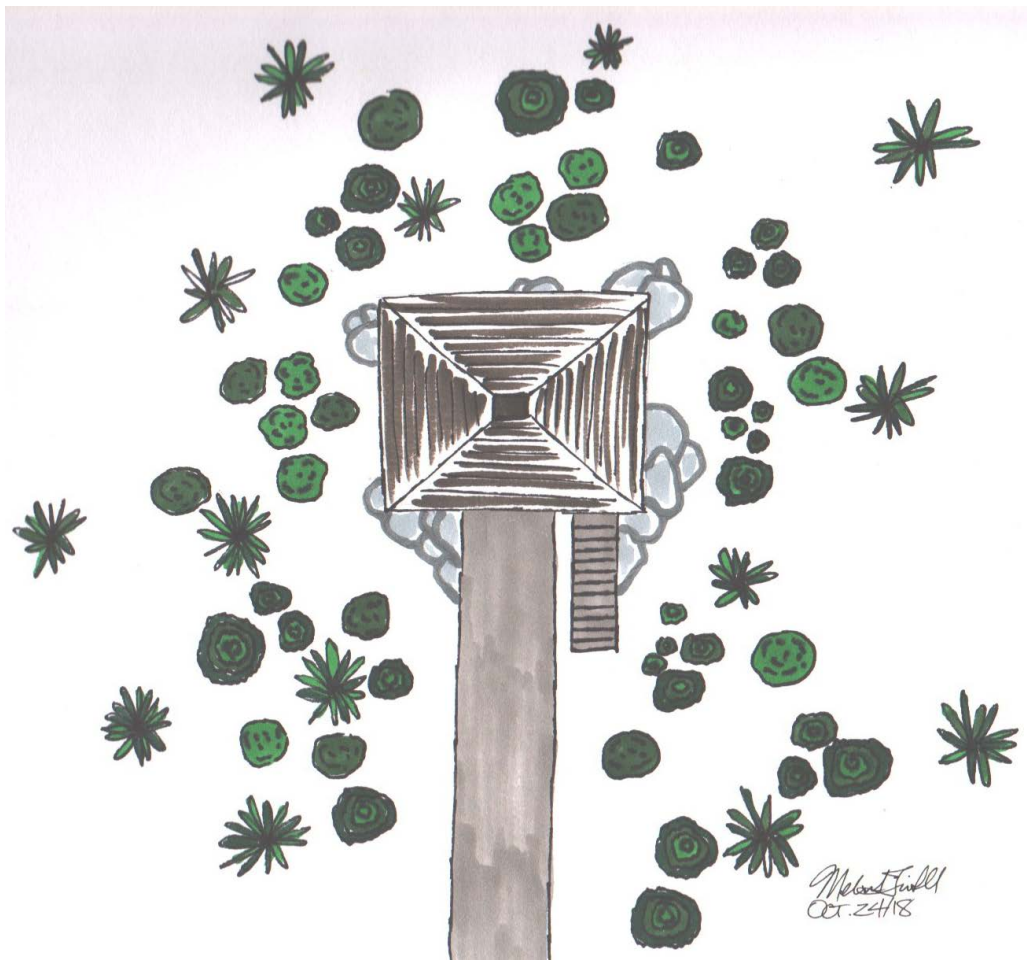

Figure 16: Tye River Cabin's site plan. Sketch by author - October 24, 2018.

Figure 17: Tye River Cabin. FROM: Olson Kundig, 2018.

Figure 18: Tye River Cabin's main entrance. FROM: Olson Kundig, 2018.

Figure 19: Tye River Cabin's pedestrian stair entrance. FROM: Olson Kundig, 2018.

Linear elements seen within the design of Tye River Cabin are seen in the metal roof slats, window/door frames, and wood paneling beneath the roof's overhang. The chimney is the predominant vertical element defining the building's position on the landscape. According to Ching's theory (2015), this is because it establishes a point on the ground plane and makes it visible in space. Interiorly, linearity is continued beneath the roof overhang with the wood paneling and the ceiling beams.

Its massing is symmetrical and balanced. The cabin is composed of light-colored concrete, dark-colored steel, varying colors of wood, and glass, which unite to create a modern cabin dwelling. The opposing textures of smooth concrete and steel amidst different grains of wood is representative of the merging of modern amenities with natural materials. The volume is fully enclosed with four vertical planes, but the use of glass serves to weaken the integrity of the planes and integrate the natural surroundings with the interior space. The overhead (roof) plane extends beyond the vertical and base planes to create a canopy effect, echoing the forest canopy surrounding it and providing sheltered exterior space. The base plane is elevated on top of the terrain; positioned to create a separate domain within the landscape (Ching, 2015). The wood exterior blends into the surrounding trees' and the concrete chimney mimics the light-colored sky above. The predominant use of wood and concrete provides a rawness and earthiness. The exaggerated roof overhang allows for solar shading (Doerr, 2010) and movement around the cabin in inclement weather. Considering Clark and Pause's (2012) descriptions of plans to section or elevation relationships, the relationship of Tye River Cabin is proportional because the basic square plan view undergoes a dimensional change to a similar form but different proportion when viewed by section or elevation.

According to Ching's explanation of approaches and entrances, the cabin has primarily a frontal approach, though because of its position within the terrain, there are undefined oblique and spiral approaches through the vegetation (2015). The cabin's door entrance is flush with its vertical plane and is likely deliberately hidden; a design theory suggested by Ching (2015). This design ambiguity is likely intended to facilitate cohesion between the interior space and natural environment, as not to draw attention to this functional building element. Upon analysis of this site using Ching's ideas of path-space relationships, the cabin's paths pass by spaces (the undefined composite paths surrounding the cabin) as well as terminate in a space (the concrete path leading towards the entrance) (Ching, 2015). The exterior and interior circulation paths are open on all sides (Ching, 2015).

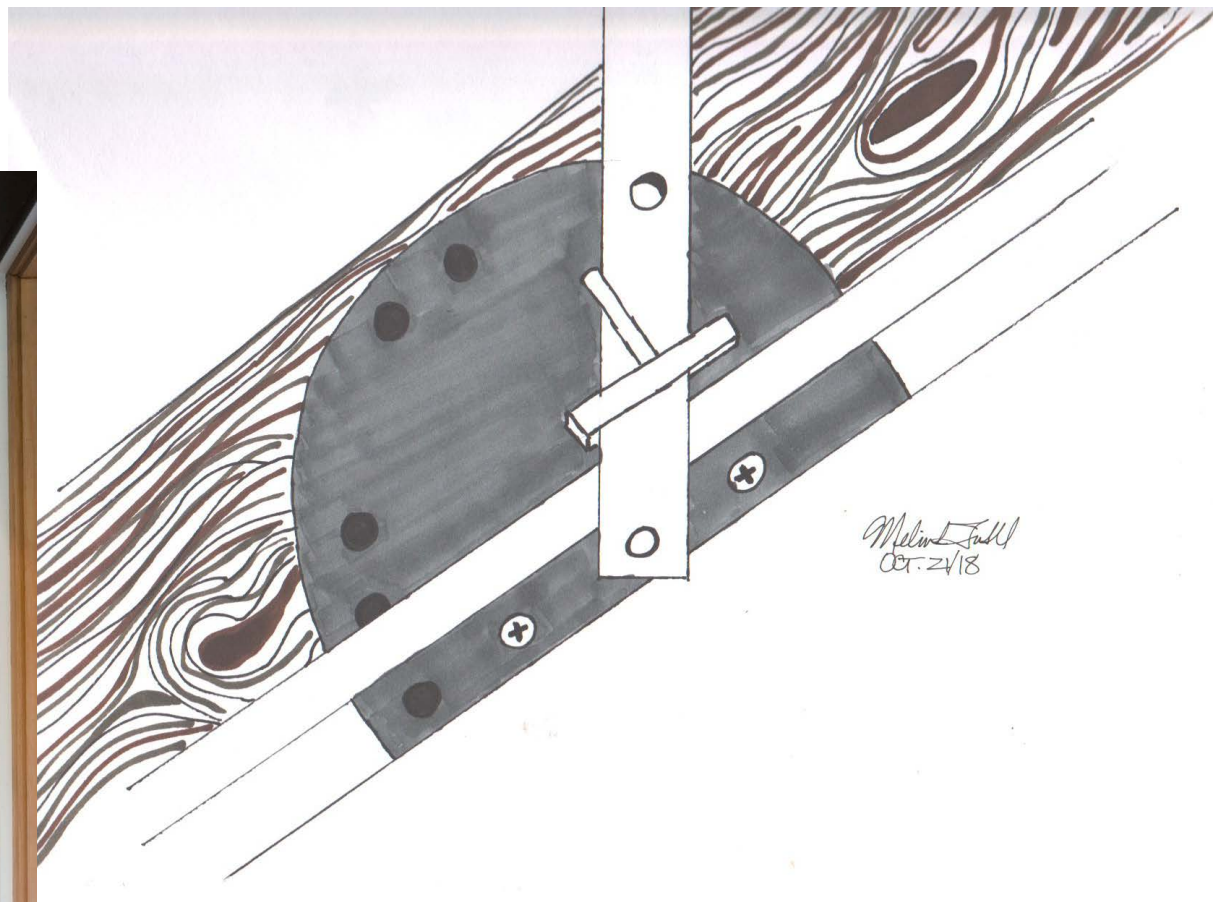

Figure 20 (above): Tye River Cabin's pivoting door hardware. Sketch by author - October 21, 2018.

Figure 21 (above): Concrete fireplace, wooden beam ceilings, pivoting doors, and expansive forest views. FROM: Olson Kundig, 2018.

Figure 22: View of concrete fireplace, living area, and pivoting doors. FROM: Olson Kundig, 2018.

The glass in the pivoting doors that compose all four sides is enclosed by wooden frames, serving to maintain the cabin's visual warmth while depicting the landscape as framed artwork from a viewer's interior and exterior perspective. The framing also helps to define edges and corners, as suggested in Ching's theory of vertical linear elements (2015). The doors pivot to allow unobstructed views of both the exterior landscape and interior design features, such as the fireplace, which is an integral design and heating element. As these pivoting doors create open corners, this design coincides with Ching's theory of openings creating diagonal orientation and opportunity for natural lighting (Ching, 2015). This fenestration allows mostly diffuse ambient lighting (Ching, 2015), as the oversized roof plane likely blocks most direct sunlight. Track, spot, and fireplace lighting supplement the natural lighting within the cabin's interior.

PART TWO:
CASE STUDY
COMPARISON

SPACE, STRUCTURE, AND ENCLOSURE

Of the three case studies' similarities, all have square or rectangular shapes in their design, with only one being irregular in shape (Sage House). This linearity serves practical function for orderly and equal division of space, while Sage House's arc shape offsets desert winds and provides expansive views for indoor living and outdoor entertaining. All the houses utilize colors, textures, and scale to integrate successfully into the physical elements of their landscape by means of biomimicry (Bainbridge & Haggard, 2011).

Consideration of human scale is obvious in the design of all three buildings, with Parekh House's innumerable balconies and low-rise design, Sage House's low-rise design with consideration of outdoor space, and Tye River Cabin's small and cozy square spatial organization surrounding a fireplace. The visible architectural elements of the three homes vary in proportion, establishing importance: the modular element of the laid brick in Parekh House and its concrete reinforcement; the sand-colored stucco, white-colored steel, and reflective glass of Sage House; and the concrete foundation, wood-paneled and beamed interior, and steel roof of Tye River Cabin.

Fenestration is used excessively in all three homes but through completely different methods. Parekh House uses subtractive transformation and spatial voids for its fenestration whereas Sage House and Tye River Cabin use windows and pivoting/sliding doors to illuminate and provide views.

The houses differ in spatial relationships and organizations, likely because their functions are so vast:

SPATIAL ORGANIZATION			
ORGANIZATION	**PAREKH HOUSE**	**SAGE HOUSE**	**TYE RIVER CABIN**
CENTRALIZED			X
LINEAR	X	X	
RADIAL		X	
CLUSTERED		X	
GRID			

SPATIAL RELATIONSHIPS			
RELATIONSHIP	**PAREKH HOUSE**	**SAGE HOUSE**	**TYE RIVER CABIN**
SPACE WITHIN A SPACE	X	X	
INTERLOCKING SPACE		X	X
ADJACENT SPACE	X	X	X
SPACE LINKED BY A COMMON SPACE	X	X	X

Figure 23 (above): Case study spatial organizations and relationships. Chart by author - October 28, 2018.

Figure 24 (above): Non-exhaustive diagram of spatial relationship examples in Sage House's design. FROM: Architectural Digest, 2018.

MOVEMENT IN SPACE-TIME

Parekh House is situated on a busy residential street in the densely populated Ahmedabad, India, and retains some privacy with a gate and recessed entrance. It has a short frontal approach because of its close proximity to the street; a location which experiences significant sounds and smells of urban life. Conversely, Sage House and Tye River Cabin have remote desert and forest locations. Sage House has unpaved roads surrounding it and Tye River Cabin has a concrete paved road, though they both have prolonged sequence of approach to allow for greater appreciation of the surrounding scenery and the sounds and smells of nature within their environmental context. Both Sage House and Tye River Cabin have entrances that are flush with their vertical exterior planes to provide visual continuity and emphasize privacy through ambiguity.

CONTEXT

The microclimate of Ahmedabad sees a significant amount of sun throughout the year; between 10 hours and 43 minutes to 13 hours and 33 minutes (Weatherspark, 2018). The cloudy wet season lasts from mid-June to mid-September with the chance of precipitation ranging from 23% to 45% with an average rainfall of at least 0.5 inches (Weatherspark, 2018). The windiest portion of the year lasts for about four months, from April 25 to August 21, with average wind speeds of more than 8.4 miles per hour but reaching 11.8 miles per hour and blowing west for seven months of the year (Weatherspark, 2018). Correa utilized subtractive form to offset the heat (reaching as high as 106^{0}F) and humidity of Ahmedabad that is oppressive for six months of the year (Weatherspark, 2018) and use its southwestward winds for ventilation by orienting the house facing east and west (The Archi Blog, 2011) and using fenestration to direct airflow.

Conversely, Taos, New Mexico experiences warm summers and snowy cold winters with year-round temperatures varying from 12^{0}F to 84^{0}F (Weatherspark, 2018). Its climate is mostly dry with its dry season lasting 9.7 months; from September 10 to July 1 (Weatherspark, 2018). The highest chance of precipitation is seen between July 1 and September 10, ranging from 24% to 40%, and snow falls between mid-December to mid-February (Weatherspark, 2018). The least amount of sun is seen mid-December with an average of 9 hours and 40 minutes whereas mid-June sees about 14 hours and 39 minutes (Weatherspark, 2018). Taos' windiest part of the year lasts about five months, from mid-January to mid-June, with wind speeds of about 7 miles per hour on average (Weatherspark, 2018). The slower seven months see an average wind speed of about 5 miles per hour (Weatherspark, 2018). Predock's arc design with mostly windows offsets the winds and allows unobstructed views of the surrounding landscape year-round, providing optimal sensory experience of the building.

Skykomish, Washington sees average yearly temperatures ranging from 26^{0}F to 58^{0}F (Areavibes, 2018). The winter months (from November to March) see the most precipitation, ranging from 11.1" to 14.5" (Areavibes, 2018). Year-round wind speeds average at 6 miles per hour and reach a maximum of 12 miles per hour (Areavibes, 2018). Skykomish has predominantly sun 153 days of the year (Areavibes, 2018). The cooler weather, pivoting openings, and elevated position of Tye River Cabin allow for maximum sensory experience of the surrounding forest, as these factors allow for the melding of the sights, sounds, and breezes of the microclimate.

TECHNOLOGY

As Bainbridge and Haggard (2011) explain in their book, passive sustainable architecture is the result of the production, use, and efficiency of energy at the building site. Because of Parekh House's location close to the equator and year-round high temperatures, solar control is of utmost concern, so brick and concrete were used because of their low insulative and thermal properties (Bainbridge & Haggard, 2011). Parekh House also has a low degree of enclosure due to the copious subtractive transformation and openings in its design. Bainbridge and Haggard (2011) recommend horizontal overhangs on the side facing the equator to combat solar radiation, so I suspect the façade with the most surface area of brick is facing the equator (south). While I cannot find detailed information regarding Sage House's and Tye River Cabin's specific geographic locations, with the climates in Taos and Skykomish, solar control is less of a concern, and both homes use wood for heating and have a high degree of enclosure.

In terms of health, safety, and welfare, Parekh House is a multigenerational home built for social connection and low to the ground to maintain a sense of community and safety (Gifford, 2014 & Encyclopedia Britannica, 2018). Sage House is similarly designed for social connection with its expansive kitchen and entertaining area designed to extend outdoors (Predock, 2018). Tye River Cabin is the most secluded of the three, as it was intended to be an isolated private retreat for rest and relaxation.

Thomas Doerr of Doerr Architecture recommends direct gain and indirect/isolated gain systems, thermal mass, solar shading, varying glass types, ventilation and convection, room arrangement, and daylighting to utilize and deflect the sun's energy (Doerr, 2010). Because Parekh House is located in a tropical climate, Correa used Doerr's ideas of ventilation and convection to bring the cool night air into the home through cross-ventilation, with the understanding that hot air rises. The brick walls provide ventilation and permit circulatory airflow throughout the entire building, and the terraces allow hot air to escape while cool air is blown in.

Sage House and Tye River Cabin are located in cooler microclimates of the United States, and benefit from applications of direct gain and indirect/isolated solar gain systems with thermal mass, room arrangement, and daylighting. Because both homes have so many windows, the solar energy goes through its connectors to the absorbers (walls, floors, concrete fireplaces), and heat the rest of the building (Doerr, 2010). The concrete fireplaces of both homes use both thermal energy (wood-burning) and solar energy (direct lighting) for an indirect/isolated gain system (Doerr, 2010). Tye River Cabin's overhanging roof allows direct lighting during the colder winter months when the sun is low and protects the interior from overheating during the summer months (Doerr, 2010). Sage House utilizes clearstory windows to assist with daylighting while minimizing glare (Doerr, 2010), and the pivoting glass doors of Tye River Cabin allow for 360^{0} of controllable ventilation. Tye River Cabin also has concrete walls to warm its rooms through thermal conduction; similarly seen in Sage House with its concrete and tile flooring (Doerr, 2010).

Figure 25: Tye River Cabin's concrete walls.
FROM: Olson Kundig, 2018.

PROGRAM

The three houses differ tremendously in their function: low-income housing for the urban poor (Parekh House), a sizable house complete with outdoor entertaining space for a chef (Sage House), and a cabin retreat for a small family (Tye River Cabin). The latter two likely had larger budgets than Parkeh House, which allowed for more customization and luxuries such as the hardware and technology for pivoting doors and the extra expenses associated with remote locations, such as acquisition of water.

In his book, ***Environmental Psychology: Principles and Practice*** (2014), Robert Gifford discusses concepts that contribute to user preference. For example, according to the prospect-refuge theory, Gifford asserts that because of evolutionary ideas, people prefer environments in open and closed areas, such as savannas and forests, as the open areas allow for prospect (evaluating for danger) and closed areas allow for refuge (retreating for safety). These preferences are reflected in the sites of Taos, New Mexico and Skykomish, Washington; the Ahmedabad property is low-income housing for the urban poor, so this site was likely determined for economic reasons rather than personal fondness.

Gifford also speaks of affective appraisal of environments and the impact of the built environment on its users' emotions and how humans apply meaning to place through four processes: place attachment, ideological communication, personal communication, and purpose. Human needs, aspirations, and sociocultural and economic factors and requirements are communicated through bond, function, personal meaning, and a building's significance through philosophical, architectural, historical or political concepts help strengthen its relationship with its human users (Gifford, 2014). In the design and position of Parekh House, I suspect its user satisfaction is somewhat neutral because of its economic and political reasons for construction, though likely offset by its community and family-oriented design. Because personal preferences were likely the determining factors in the site and design of Sage House and Tye River Cabin, I suspect their user satisfaction is quite high.

Gifford also cites environmental control, social density, and spatial density as contributing factors to user satisfaction. Bay & Ong (2006) similarly suggest that satisfactory environments provide predictability, normalcy within accepted conditions, thermal variety, and adequate control. The owners of Sage House and Tye River Cabin can control their environment (window openings, pivoting doors, and fireplaces) whereas the inhabitants of Parekh House do not have the ability to control their environment so much as change their position within it (moving between "summer" and "winter" sections). The open design of the Parekh House allows for a more socially dense social situation because of the amount of exterior spaces to offer more even distribution of people and personal space. Sage House is similarly large in size to accommodate higher social density for its intended function of entertaining guests. Tye River Cabin is a spatially dense configuration not intended for high social density.

OBSERVATIONS AND CONCLUSION

Studying these three case studies with architectural responsibility and responsiveness in mind, I found myself wanting to know more about the structural systems of each and how their designs could best integrate active solar design. I also found myself wanting to know about the neighborhoods and building's users to determine what they like and dislike about the buildings and what they may have changed. Instead of viewing architecture as only housing or shelter, in my practice, I want to portray architecture as a vessel to improve physical and mental health by honoring the varying needs of its human users.

What I found so enlightening about this analysis is how technology has evolved to the point of relying on mechanical systems for heating and cooling with little consideration of carbon and energy output when the healthiest and cleanest designs are modifications to vernacular architectural concepts. Vernacular architecture evolved to meet very basic needs and from what I have observed in my first year studying architecture, interest in technology has steered architecture and its related fields away from basic techniques that respond to natural conditions. Rather than adopting a symbiotic relationship with the earth, designing to utilize the climate and natural forces, it seems that most newly constructed homes have a one-sided parasitic relationship. Learning that buildings use 40% of American energy and the sun provides our planet with more than 10,000 times the energy we currently use (Doerr, 2010), it is clear that architects and designers must harness this clean free sustainable power through every possible method.

This course has completely altered my understanding of good design and passive solar architecture and I look forward to learning more so I can contribute to net zero energy building and try to mitigate some of the environmental damage caused by irresponsible architecture. I have been inspired to install photovoltaic paneling on my house and am currently working with Energy Efficiency Alberta through the application process. As an architecture student, it is my responsibility to set an example for sustainable, responsible, and responsive design.

WORKS CITED

ARCHITECTURAL DIGEST (2018). NATURAL WONDER.
RETRIEVED FROM: HTTPS://WWW.ARCHITECTURALDIGEST.COM/GALLERY/NATURAL-WONDER-SLIDESHOW#SLIDE=4

AREAVIBES (2018). SKYKOMISH, WA WEATHER.
RETRIEVED FROM: HTTPS://WWW.AREAVIBES.COM/SKYKOMISH-WA/WEATHER/

BAINBRIDGE, D. & HAGGARD, K. (2011). *PASSIVE SOLAR ARCHITECTURE: HEATING, COOLING, VENTILATION, DAYLIGHTING, AND MORE USING NATURAL FLOWS*. WHITE RIVER JUNCTION, VT: CHELSEA GREEN PUBLISHING COMPANY, C 2011.

BAY, J. & ONG, B. (2006). TROPICAL SUSTAINABLE ARCHITECTURE: SOCIAL AND ENVIRONMENTAL DIMENSIONS. BANGALORE, INDIA: ELSEVIER LTD., C 2006.

CHING, F. (2015). *ARCHITECTURE: FORM, SPACE, AND ORDER*. HOBOKEN, N.J.: WILEY, C 2015.

CLARK, R. H. & PAUSE, M. (2012). *PRECEDENTS IN ARCHITECTURE: ANALYTIC DIAGRAMS, FORMATIVE IDEAS, AND PARTIS*. HOBOKEN, N.J.: JOHN WILEY & SONS, C 2012.

DOERR, T. [DOERR ARCHITECTURE]. (APRIL 17, 2010). PASSIVE SOLAR SIMPLIFIED (PARTS 1-6).
RETRIEVED FROM: HTTPS://WWW.YOUTUBE.COM/CHANNEL/UC9ARBXDY6PA2RXQ4EAD6WSA

E-BUILD.IN. (2018). PAREKH HOUSE: CHARLES CORREA ASSOCIATES.
RETRIEVED FROM: HTTPS://EBUILD.IN/PAREKH-HOUSE-CHARLES-CORREA-ASSOCIATES

ENCYCLOPEDIA BRITANNICA (2018). CHARLES CORREA.
RETRIEVED FROM: HTTPS://WWW.BRITANNICA.COM/BIOGRAPHY/CHARLES-CORREA

GIOVANNINI, J. (2010). NATURAL WONDER: MOUNTAIN PEAKS AND HIGH DESERT VISTAS ORIENT A RESIDENCE OUTSIDE TAOS, NEW MEXICO.
RETRIEVED FROM: HTTPS://WWW.ARCHITECTURALDIGEST.COM/STORY/NATURAL-WONDER-ARTICLE

GIFFORD, R. (2014). *ENVIRONMENTAL PSYCHOLOGY: PRINCIPLES AND PRACTICE*. (5TH ED.). COLVILLE, WA: OPTIMAL BOOKS.

MODIFI, S.M. (2007). PASSIVE ARCHITECTURAL COOLING PRINCIPLES FOR ARID CLIMATES: 2ND PALENC CONFERENCE AND 28TH AIVC CONFERENCE ON BUILDING LOW-ENERGY COOLING AND ADVANCED VENTILATION TECHNOLOGIES IN THE 21ST CENTURY. UNIVERSITY OF SCIENCE AND TECHNOLOGY, IRAN.

OLSON KUNDIG (2018). KIRSTEN R. MURRAY: EVERY DAY
RETRIEVED FROM: HTTPS://WWW.OLSONKUNDIG.COM/PROJECTS/KIRSTEN-R-MURRAY-EVERY-DAY/

OLSON KUNDIG (2018). TOM KUNDIG.
RETRIEVED FROM: HTTPS://WWW.OLSONKUNDIG.COM/PEOPLE/TOM-KUNDIG/

P.S., SREEKANTH (2011). THE ARCHI BLOG: CHARLES CORREA – PAREKH HOUSE.
RETRIEVED FROM: HTTPS://THEARCHIBLOG.WORDPRESS.COM/2011/01/09 CHARLES-CORREA-PAREKH-HOUSE/

PREDOCK, A. (2018). DESERT BEGINNINGS: PORTABLE REGIONALISM.
RETRIEVED FROM: HTTP://WWW.PREDOCK.COM/DESERTBEGINNINGS/DESERTBEGINNINGS.HTML

SISSON, P. (2015). ARCHITECT TOM KUNDIG TALKS INSPIRATION AND THE IDEAL CABIN.
RETRIEVED FROM: HTTPS://WWW.CURBED.COM/2015/11/6/9903182/TOM-KUNDIG-INTERVIEW-WORKS

WORKS CITED

WEATHERSPARK (2018). AVERAGE WEATHER IN AHMEDABAD, INDIA. RETRIEVED FROM: HTTPS://WEATHERSPARK.COM/Y/107349/AVERAGE-WEATHER-IN-AHMEDABAD-INDIA-YEAR-ROUND

WEATHERSPARK (2018). AVERAGE WEATHER IN TAOS, NEW MEXICO, UNITED STATES. RETRIEVED FROM: HTTPS://WEATHERSPARK.COM/Y/3513/AVERAGE-WEATHER-IN-TAOS-NEW-MEXICOUNITED-STATES-YEAR-ROUND

WATERPROOFPAPER (2018). PRINTABLE MAPS: WORLD. RETRIEVED FROM: HTTPS://WWW.WATERPROOFPAPER.COM/PRINTABLE-MAPS/WORLD/MAP-OF-THE-WORLD.PDF