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Reimagining Fire Tower Typology: Enhancing Safety and Creating a Sense of Place

Chloe Bango

REIMAGINING FIRE TOWER TYPOLOGY:

ENHANCING SAFETY AND CREATING A SENSE OF PLACE

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Enhancing Safety and Creating a Sense of Place

Approval of Thesis Research
Project Book is Presented to:

Jade Yang

and to the
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College of Architecture and Construction Management

By

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SECTION

INTRODUCTION

1.1_BACKGROUND

Great Fire of 1910 left 3 million acres of land burned and 85 deaths. Early fire detection became a priority within the Forest Service.

1910

The Great Depression began and progress slowed on fire tower construction.

1929

Civilian Conservation Corps (CCC) formed by FDR. Huge amount of fire towers built.

1933

Used to spot enemy aircraft during World War II.

1941

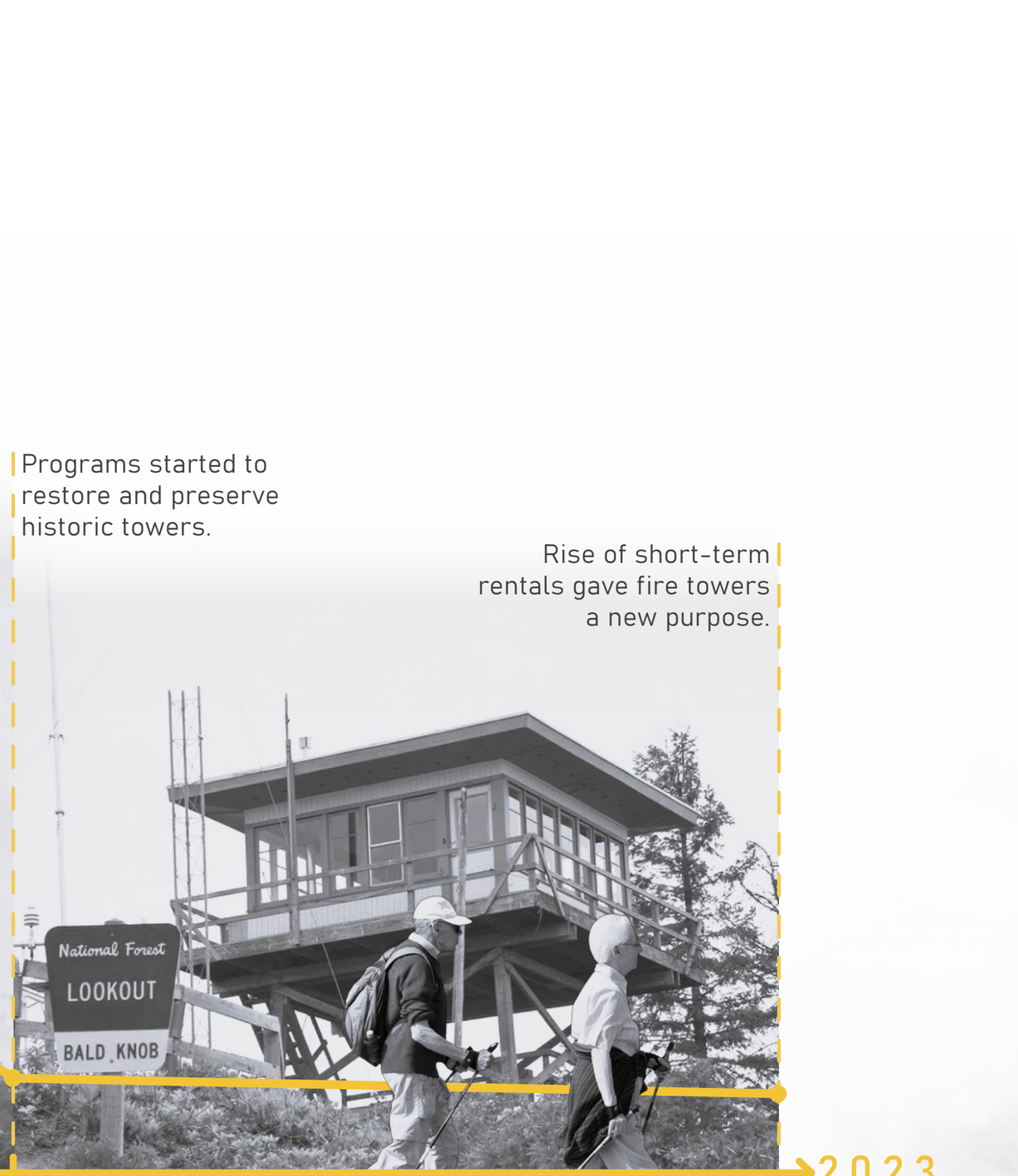
End of fire tower heyday.

1950

Development of new technology put fire towers in the backseat. Fire towers started to be decommissioned and fall into disrepair.

Programs started to restore and preserve historic towers.

Rise of short-term rentals gave fire towers a new purpose.



1964

1990

2023

1.2_ABSTRACT

This architectural exploration studies the transformative evolution of fire watch towers, shifting from their traditional role as fire safety devices to become inviting destinations for hikers and visitors. This paradigm shift not only embraces the functional aspect of fire prevention but also capitalizes on the inherent potential for these structures to serve as unique, inhabitable spaces within the natural landscape.

The design philosophy integrates state-of-the-art wildfire detection systems seamlessly into the architectural fabric, establishing a symbiotic relationship between safety and recreation. The incorporation of cutting-edge technologies, such as advanced sensors, satellite imagery, and real-time data analytics, enhances the tower's primary purpose of early fire detection and prevention. Simultaneously, the architectural transformation focuses on creating an immersive and sustainable experience for visitors. The towers are reimagined as multi-level, habitable spaces that offer panoramic views of the surrounding wilderness. Informed by principles of eco-friendly design, these structures harmonize with the natural environment.

The interiors of the towers are conceived as adaptable spaces, providing amenities for hikers, nature enthusiasts, and tourists. Communal areas and observation decks are strategically distributed throughout the structure, fostering a sense of community and environmental awareness.

The exterior design prioritizes aesthetics, blending seamlessly with the landscape while still making a bold architectural statement. The towers serve as beacons of safety and exploration, symbolizing the harmonious coexistence of human intervention and natural resilience.

This innovative approach not only transforms fire watch towers into destinations for leisure but also contributes to the preservation of natural ecosystems. By redefining the purpose of these structures, I aim to create a network of sustainable, technology-integrated landmarks that celebrate the beauty of our environment while proactively safeguarding it from the threat of wildfires.

1.3_METHODOLOGY

INVESTIGATION

Looking at the history and current conditions of fire towers in the United States, I have identified an architectural typology that needs an update.

GOALS

Take the existing program of fire towers and modify it to fit the current uses.

GATHER DATA

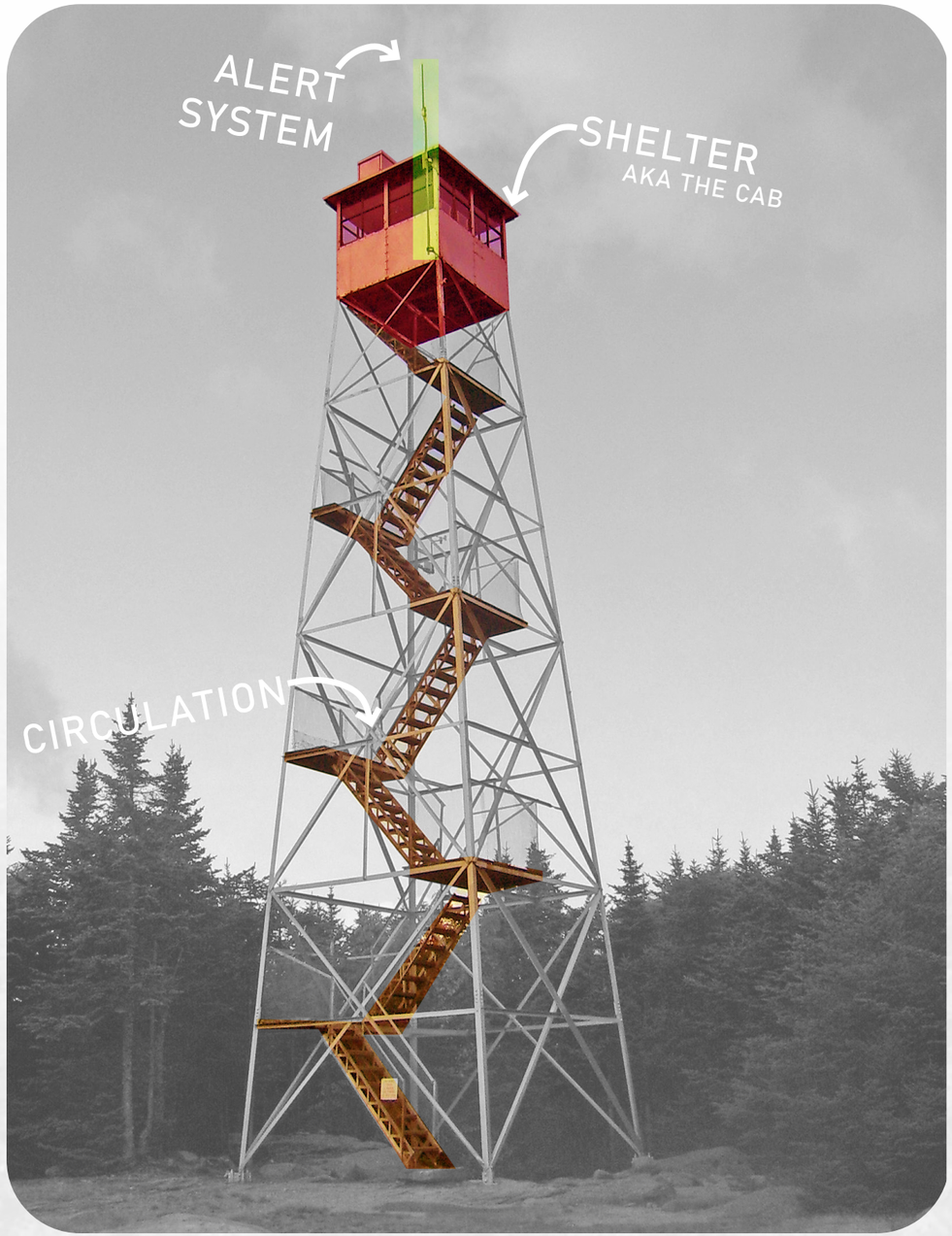
Study existing fire towers and towers that have been updated or have modern programs.

ANALYSIS

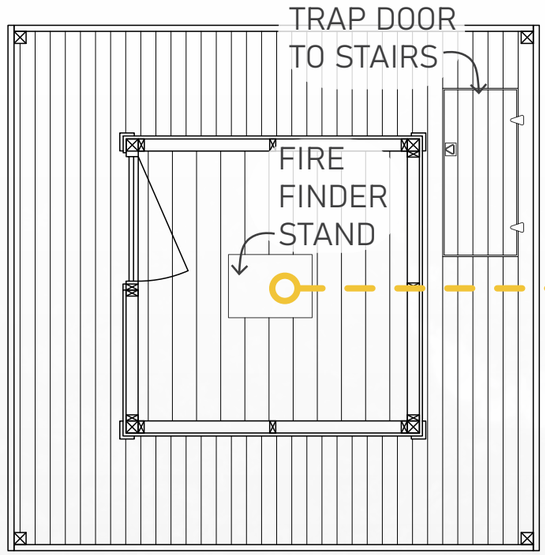
Analyze elements of my case studies and the sites I choose to help me design a fire tower with a modern program.

1.4_TYPICAL TOWER ANALYSIS

3 ELEMENTS OF FIRE TOWERS



CAB



Typical cab plan showing interior and exterior space.

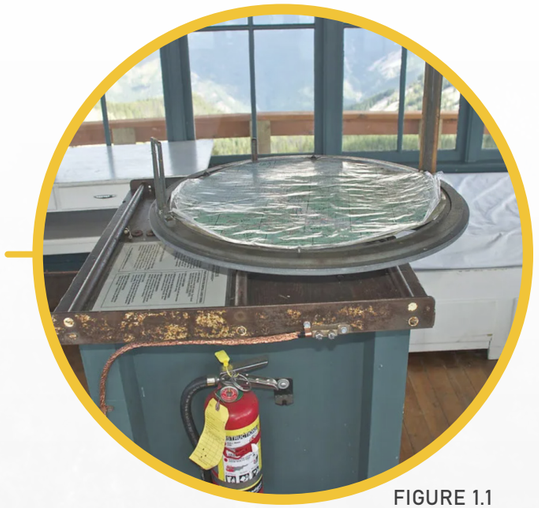
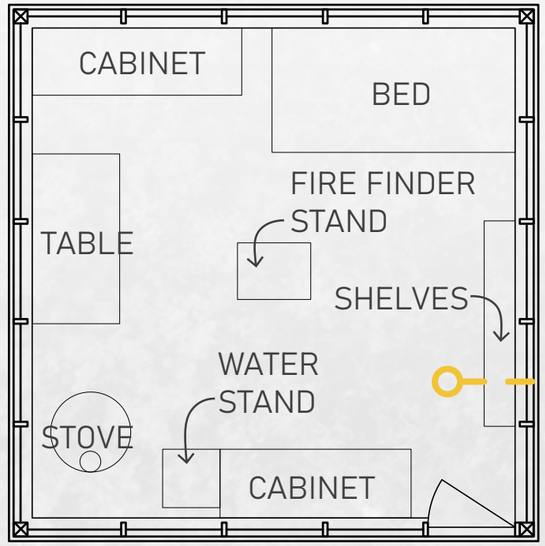


FIGURE 1.1



Typical cab plan showing interior space and FFE.

FIGURE 1.2

ALERT SYSTEM

FIGURE 1.3

When a fire watchman in a fire tower detects smoke in their designated zone, they play a critical role in initiating the wildfire response process. The fire watchman verifies the presence of smoke using **binoculars** or other observation equipment. They assess the size, location (using their **fire finder stand**), and behavior of the smoke to determine if it indicates a potential wildfire. The fire watchman immediately reports the smoke sighting to the appropriate authorities via **radio contact**. They provide precise information about the location of the smoke, including coordinates if available, and describe any relevant observations. Once the report of smoke is received by response agencies, they initiate the wildfire response process. This typically involves dispatching firefighting resources, such as ground crews, aircraft, and equipment, to the reported location of the smoke. The fire watchman may be asked to provide ongoing updates and assistance to support response efforts.

CIRCULATION

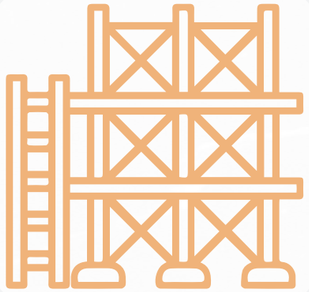
FIGURE 1.4

Fire towers are often constructed on elevated locations with limited available space. As such, the design of the stairs needs to **maximize vertical travel within a compact footprint.** By making the stairs steep and narrow, architects and engineers can minimize the amount of ground area required for the staircase. This design approach is particularly important for fire towers located in remote or rugged terrain where construction resources may be limited. While the steepness and narrowness of fire tower stairs may pose challenges for some visitors, especially those with mobility issues, these design features are often necessary to ensure the structural integrity of the staircase within the constraints of the tower's footprint. The stairs may include **periodic landings or platforms** where visitors can pause to rest or take in the views, but these are typically minimal in size to maintain the vertical continuity of the staircase.

SECTION 2
PRECEDENTS

2.1_FIRE TOWER TYPES

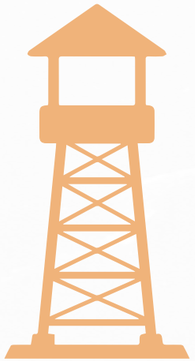
When analyzing fire towers, they can be catorigized best by their heights. This gives us 3 main categories: **SHORT, MID-SIZE, & TALL.** Here are three ways to approach the architectural analysis of fire watch towers. By examining fire watch towers through these architectural lenses, one can gain a comprehensive understanding of their design, functionality, and impact on the natural environment.



FORM AND STRUCTURE:

Materials and Construction: Examine the materials used in the construction of the fire watch tower. Assess whether the materials are selected for durability, resistance to weather conditions, and environmental sustainability.

Aesthetic Design: Evaluate the aesthetic elements of the fire watch tower, including its shape, proportions, and overall design. Consider whether the form of the tower is driven by functional requirements, aesthetic considerations, or a combination of both.



FUNCTIONALITY AND PRACTICALITY:

Spatial Configuration: Analyze the internal layout of the fire watch tower, considering the arrangement of spaces such as the observation cabin, equipment storage, and any additional facilities. Evaluate how the spatial design facilitates the functions of fire detection, observation, and communication.

Accessibility: Assess how the fire watch tower addresses practical concerns such as accessibility for maintenance and emergency situations.

INTEGRATION WITH THE LANDSCAPE:

Site Selection: Explore the rationale behind the choice of the tower's location. Assess whether it provides an optimal vantage point for fire observation and detection.

Visual Impact: Analyze how the fire watch tower visually integrates with the surrounding landscape. Consider whether the design complements or contrasts with the natural elements.

PRECEDENT LOCATIONS:

2.2_ PRECEDENT STUDIES

SHORT

These are still considered towers, eventhough they are missing the “tower” component. The cab ranges from 10 ft x 10 ft to 14 ft x 14 ft and can be 1-3 stories tall.

Defining Characteristics:

- Range from 1-3 stories off the ground

Materials:

- Stone or concrete foundation
- Wood
- Steel

Typical Landscapes:

- High peaks/mountains
- Rocky ground

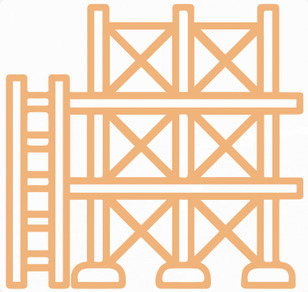
FIGURE 2.1

FIGURE 2.2

FIGURE 2.3

FIGURE 2.4

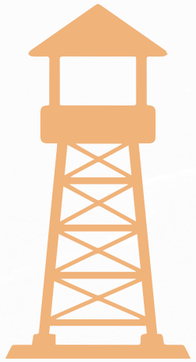
The Corsican Deer Observatories are a series of towers located within the Regional Natural Park of Corsica, designed specifically to provide visitors with high and hidden vantage points for observing the deer population in the park. These observatories offer a unique opportunity to view wildlife in their natural habitat while minimizing disturbance to the animals. Designed by Orma Architettura, the Corsican Deer Observatories are not only functional but also blend harmoniously with the surrounding landscape. Their architectural design integrates seamlessly with the natural environment, ensuring minimal visual impact and preserving the scenic beauty of the park.



FORM AND STRUCTURE:

Materials and Construction: These observation towers are made completely of wood.

Aesthetic Design: The vertical position of the wooden louvres is purposely done, in an effort to mimic the trees around it. The goal is to blend in with its surrounding as much as possible to not disturb the wildlife in the area. This is in hopes of getting to observe the wildlife without disturbing it.



FUNCTIONALITY AND PRACTICALITY:

Spatial Configuration: The interior spaces are blank slates and not set up for long-term use. The main purpose is to observe things outside the tower so there are many openings and windows to be able to view out of the tower from any angle.

Accessibility: These towers are very remote and accessibility is limited even once you do get to the tower. The landscape was purposely not disturbed as much as possible.

INTEGRATION WITH THE LANDSCAPE:

Site Selection: There are three towers in this national park in order to observe the wildlife from mutliple points throughout. They are spaced so that there is minimal overlaping areas of observation.

Visual Impact: These towers blend very nicely with the surrounding landscape and in the construction of these towers there is special care in the relationship with the ground to further seemlessly blend the two.

2.3_ PRECEDENT STUDIES

MID-SIZE

These towers are typically 30-60 feet tall. A typical cab for a mid-size tower ranges from 10 ft x 10 ft to 14 ft x 14 ft. When constructed out of wood, they are the least popular because they are not fire resistant in any way.

Defining Characteristics:

- Range from 30-60 feet off the ground

Materials:

- Steel/metal
- Wood
- Concrete

Typical Landscapes:

- Smaller mountains
- Areas with trees

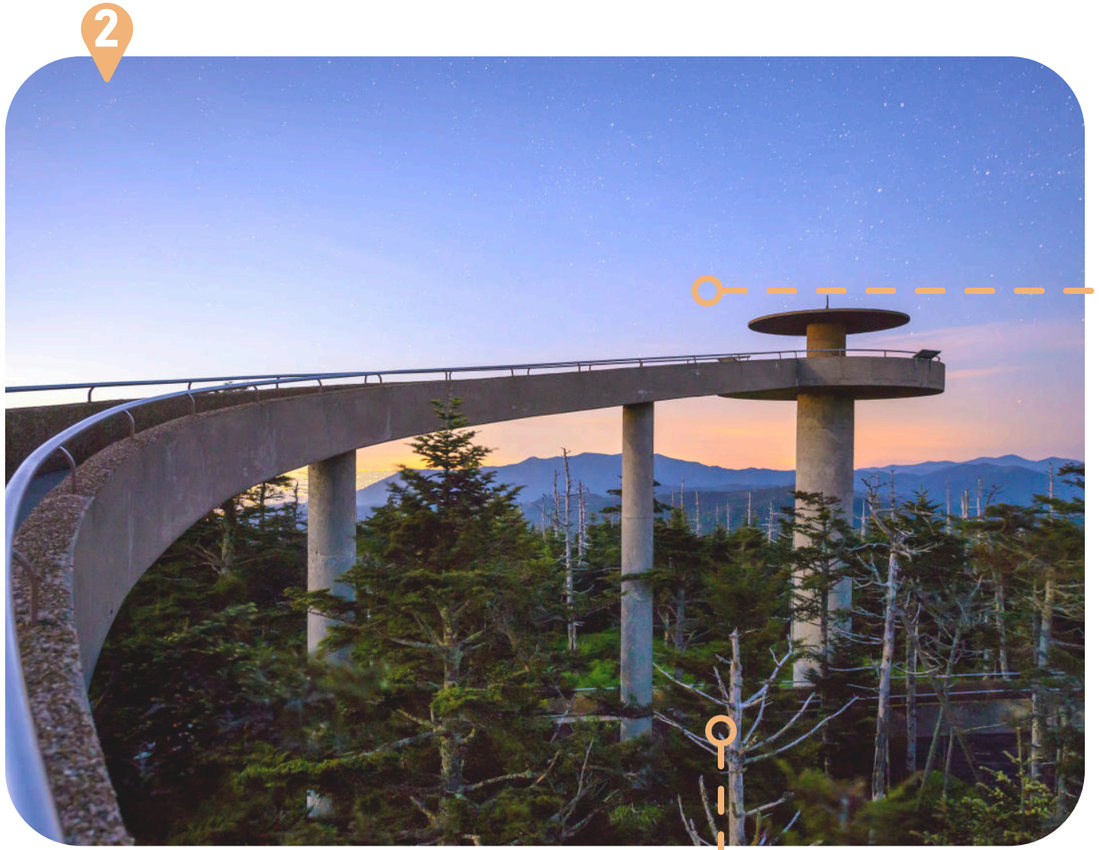


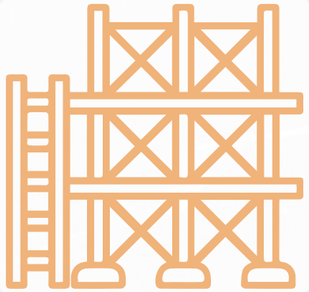
FIGURE 2.5

FIGURE 2.6

FIGURE 2.7

Clingmans Dome features a 45-foot (14 m) tall concrete observation tower, constructed in 1959 and listed on the National Register of Historic Places. This tower provides visitors with a spectacular panoramic view of the surrounding mountains and valleys, making it a popular spot for tourists and photographers alike.

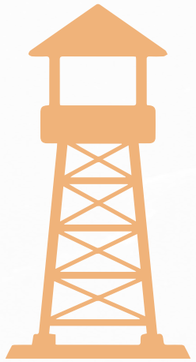
Additionally, Clingmans Dome is home to an air quality monitoring station operated by the Environmental Protection Agency (EPA). Situated at an elevation of over 6,600 feet (2,000 meters), this station is the second highest of its kind in eastern North America. The monitoring station plays a crucial role in tracking air quality and environmental conditions in the region, contributing valuable data to scientific research and conservation efforts.



FORM AND STRUCTURE:

Materials and Construction: The tower was built using pour-in-place concrete with rebar enforcement. This material choice was made to withstand the harsh winds and environment at that elevation.

Aesthetic Design: The design of the Clingmans Dome observation tower is simple yet effective, with a cylindrical shape and a spiral ramp leading to the top where visitors can enjoy panoramic views of the surrounding landscape.



FUNCTIONALITY AND PRACTICALITY:

Spatial Configuration: The observation area of Clingsman Dome is just an open deck at the top of the pathway. It is covered but not enclosed. It works very well as a place to see the views.

Accessibility: From the parking area, visitors can reach the tower using a steep, half-mile (0.8 km) paved trail leading to the summit. This trail is accessible to hikers of varying abilities but may pose challenges for individuals with mobility issues due to its steep incline.

INTEGRATION WITH THE LANDSCAPE:

Site Selection: Clingmans Dome's high elevation makes it an ideal location for scientific research and environmental monitoring. It is also in the center of the national park, making it an ideal location for tourists.

Visual Impact: The tower stands out against the lush, tree covered mountains around it. It has become an iconic landmark for visitors to the Smoky Mountains.

2.4_ PRECEDENT STUDIES

TALL

These towers vary greatly in size and height. A typcial cab still ranges from 10 ft x 10 ft to 14 ft x 14 ft. They are very sturdy.

Defining Characteristics:
- 60+ feet off the ground
- Sway in high winds

Materials:
- Steel
- Concrete or stone

Typical Landscapes:
- Flatter land
- Areas with lower visibility
- Areas with tall trees

FIGURE 2.8

Galayeto Lookout Tower resides in northern Hungary along a national trail that spans 683 miles through the country. Revitalized by the firm Nartarchitects, this project shows the potential decommissioned fire towers have to become temporary homes for hikers.

FIGURE 2.9

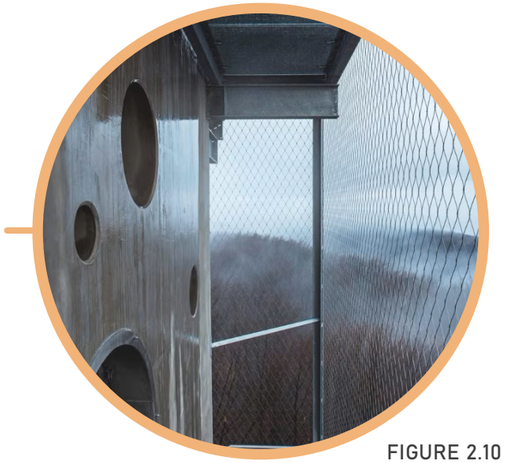
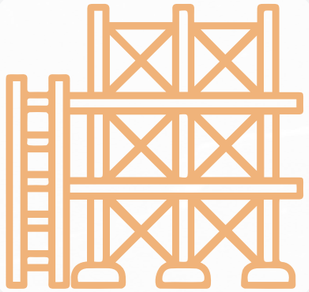


FIGURE 2.10

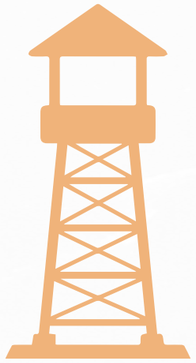
FIGURE 2.11



FORM AND STRUCTURE:

Materials and Construction: The lower stone part of the tower is original and the concrete addition was added for visitors to stay in. The stairway was moved to the exterior to allow more usable space inside the tower.

Aesthetic Design: The tower reflects a contemporary architectural style that incorporates elements of stone and concrete construction. This style emphasizes clean lines, geometric shapes, and a minimalist aesthetic while still harmonizing with the natural surroundings.



FUNCTIONALITY AND PRACTICALITY:

Spatial Configuration: With the additional interior levels added to the original tower, visitors can inhabit the tower overnight. There is still an observation deck on the top of the tower for those visitors who do not spend the night.

Accessibility: There is a sidewalk leading up to the tower but the only way to access the upper levels in the tower is to climb the narrow and abundant stairs.

INTEGRATION WITH THE LANDSCAPE:

Site Selection: The site was originally selected because it was a good location to spot wildfires and was renovated due to its popularity amongst visitors and proximity to the national trail in Hungary.

Visual Impact: The tower incorporates earth-toned colors and textures to complement the surrounding environment, minimizing visual disruption and enhancing the overall visitor experience.

SECTION 3
SITE

3.1_SITES

APPALACHIAN TRAIL:

The Appalachian Trail is a 2,197.4 mile trail spanning from Georgia to Maine. It takes thru hikers typcially 6 months to complete.

FIGURE 3.1

MM 99.7 ALBERT MOUNTAIN FIRE TOWER

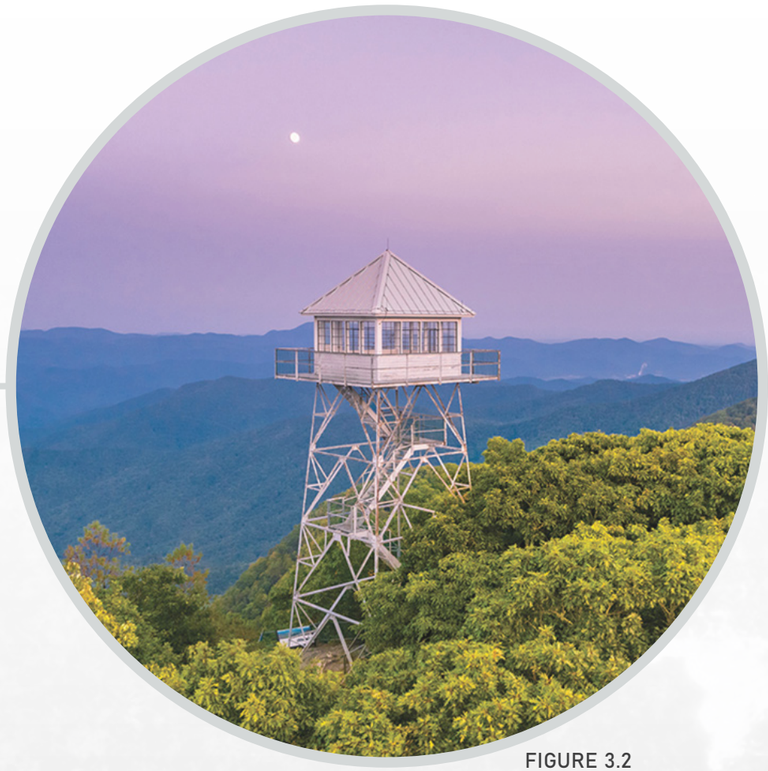


FIGURE 3.2

Albert Mountain stands at 5,217 feet in elevation at mile marker 99.7. Initially, a log lookout cabin existed on the mountain built around 1942, but it was replaced in 1951 by a 55-foot steel tower. The tower served to replace abandoned lookout towers on nearby mountains and provided fire detection for the Coweeta Hydrologic Laboratory.

FIGURE 3.3

MM 119.7
WAYAH BALD FIRE TOWER

Wayah Bald stands at 5,342 feet in elevation at mile marker 119.7. Built in 1937 by the Civilian Conservation Corps, the tower featured 3 stories, including an observation deck on the second level offering views of the Nantahala National Forest and living quarters for watchmen on the third level equipped with beds and a wood stove. Cracks in the tower led to water damage, prompting the discontinuation of fire detection services in 1945. Eventually, the upper levels were removed for safety reasons in 1947, leaving only the stone base and a modified observation deck. The wood roof had to be rebuilt in 2018 due to a wildfire destroying the previous roof.

FIGURE 3.4

MM 131.2
WESSER BALD FIRE TOWER

Wesser Bald stands at 4,631 feet in elevation at mile marker 131.2. The original tower was built 1936 by the Civilian Conversation Corps as a live-in lookout. The live-in cab was destroyed by arson in 1979 and replaced in the early 1990s by the USFS with the current observation deck for hikers. The deck is 30 feet off the ground, supported by the original metal base.

3.2_SITE CONDITIONS FOR MM 99.7

ALBERT MOUNTAIN FIRE TOWER

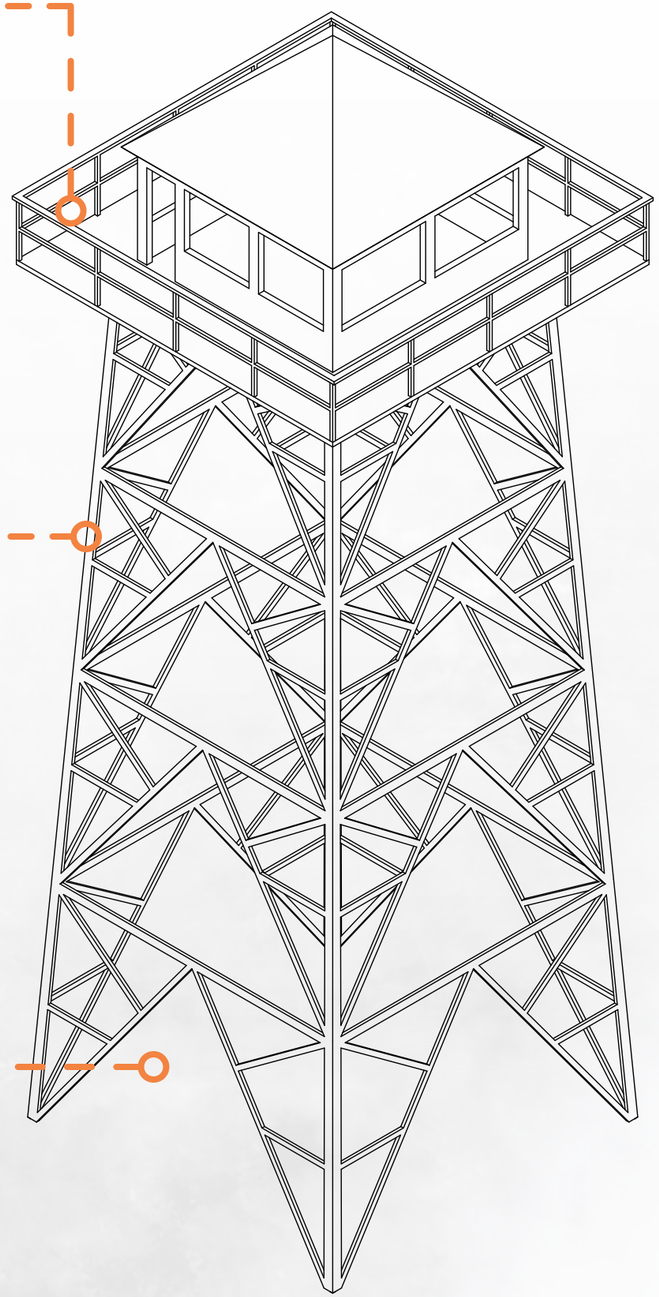
The fire tower is accessible via the Appalachian Trail (AT), which runs along the ridgeline of Albert Mountain. Hikers can reach the summit of Albert Mountain by following the AT, which passes directly by the fire tower. The trail leading to Albert Mountain Fire Tower features a moderate to strenuous incline, with rocky sections and uneven terrain. Hikers should be prepared for a challenging ascent, particularly on the final stretch leading to the summit. Like many high-elevation locations in the Appalachian Mountains, Albert Mountain is subject to rapidly changing weather conditions. Visitors should be prepared for potentially cool temperatures, strong winds, and the possibility of rain or fog, even during the warmer months. The fire tower itself is a historic structure that was originally built for fire observation and detection. While visitors can climb the stairs to the top of the tower, the structure may have limited accessibility or be closed to the public at certain times due to safety concerns or maintenance needs. From the top of Albert Mountain Fire Tower, visitors are rewarded with breathtaking views of the surrounding mountains and valleys. On clear days, it's possible to see for miles in every direction, making it a popular destination for hikers and photographers.

FIGURE 3.5

FIGURE 3.6

FIGURE 3.7

FIGURE 3.8



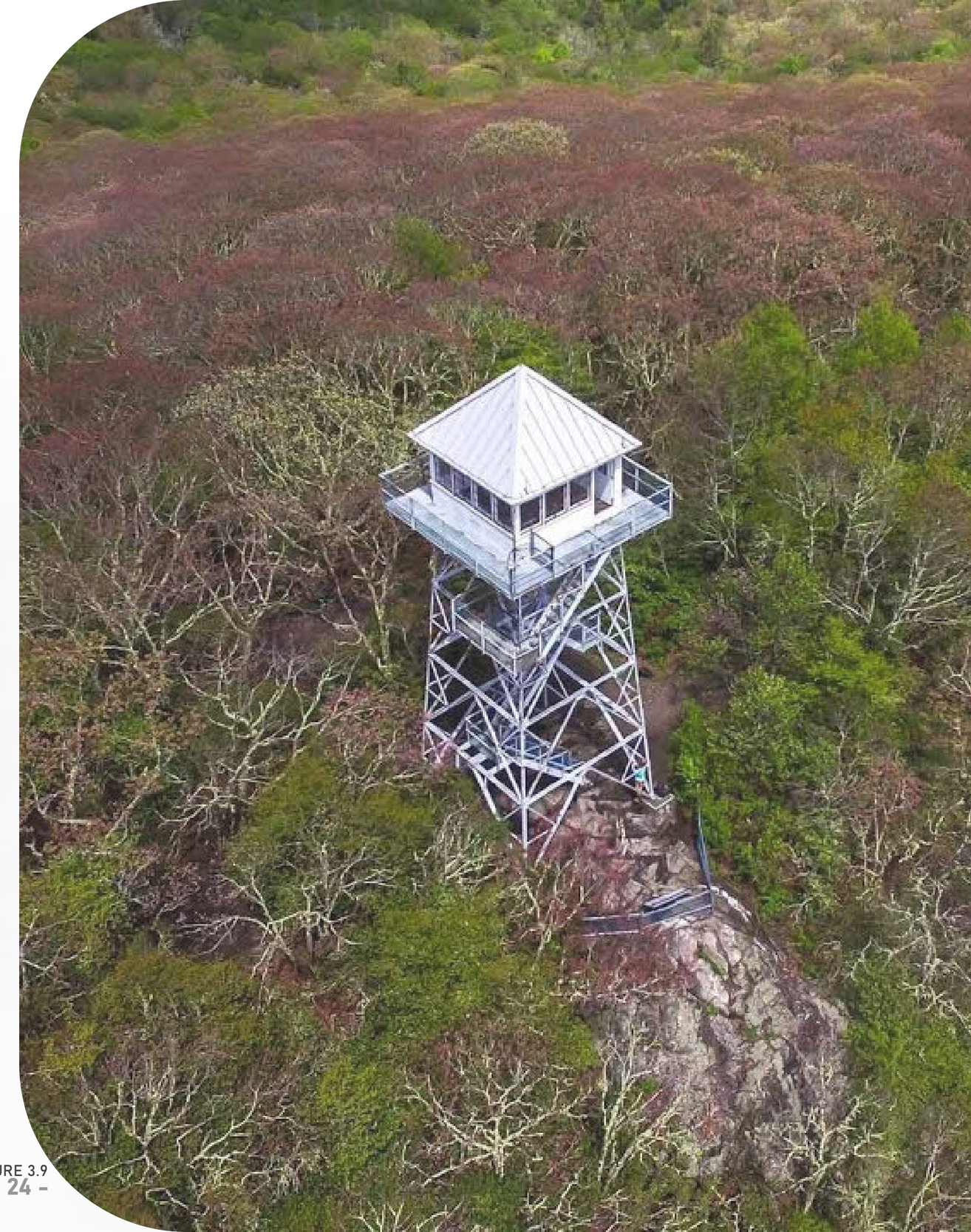


FIGURE 3.9

3.2_SITE CONDITIONS FOR MM 119.7

WAYAH BALD FIRE TOWER

Wayah Bald Lookout Tower is accessible via the Wayah Bald Trail, which is a moderately graded trail that winds through the forest to the summit. The trail is approximately 1.5 miles (2.4 kilometers) long and is suitable for hikers of varying skill levels. Additionally, the site is accessible by car via Wayah Road, which leads to a parking area near the trailhead. The trail leading to Wayah Bald Lookout Tower features a well-maintained paved path with some rocky sections and gradual inclines. While the trail is not particularly challenging, visitors should be prepared for a moderate hike, especially if hiking during inclement weather or in winter conditions. In winter, the trail may be covered in snow and ice, requiring appropriate footwear and caution. Also in the winter, the access road is shut off to visitors due to potentially dangerous conditions. At the summit of Wayah Bald, visitors will find the historic Wayah Bald Lookout Tower. The tower offers panoramic views of the surrounding mountains and valleys, making it a popular destination for hikers and sightseers. Overall, Wayah Bald Lookout Tower provides visitors with an opportunity to experience the natural beauty of the Appalachian Mountains from a unique vantage point. Whether accessed by hiking or driving, the site offers breathtaking views and a chance to connect with the rugged wilderness of western North Carolina.

FIGURE 3.10

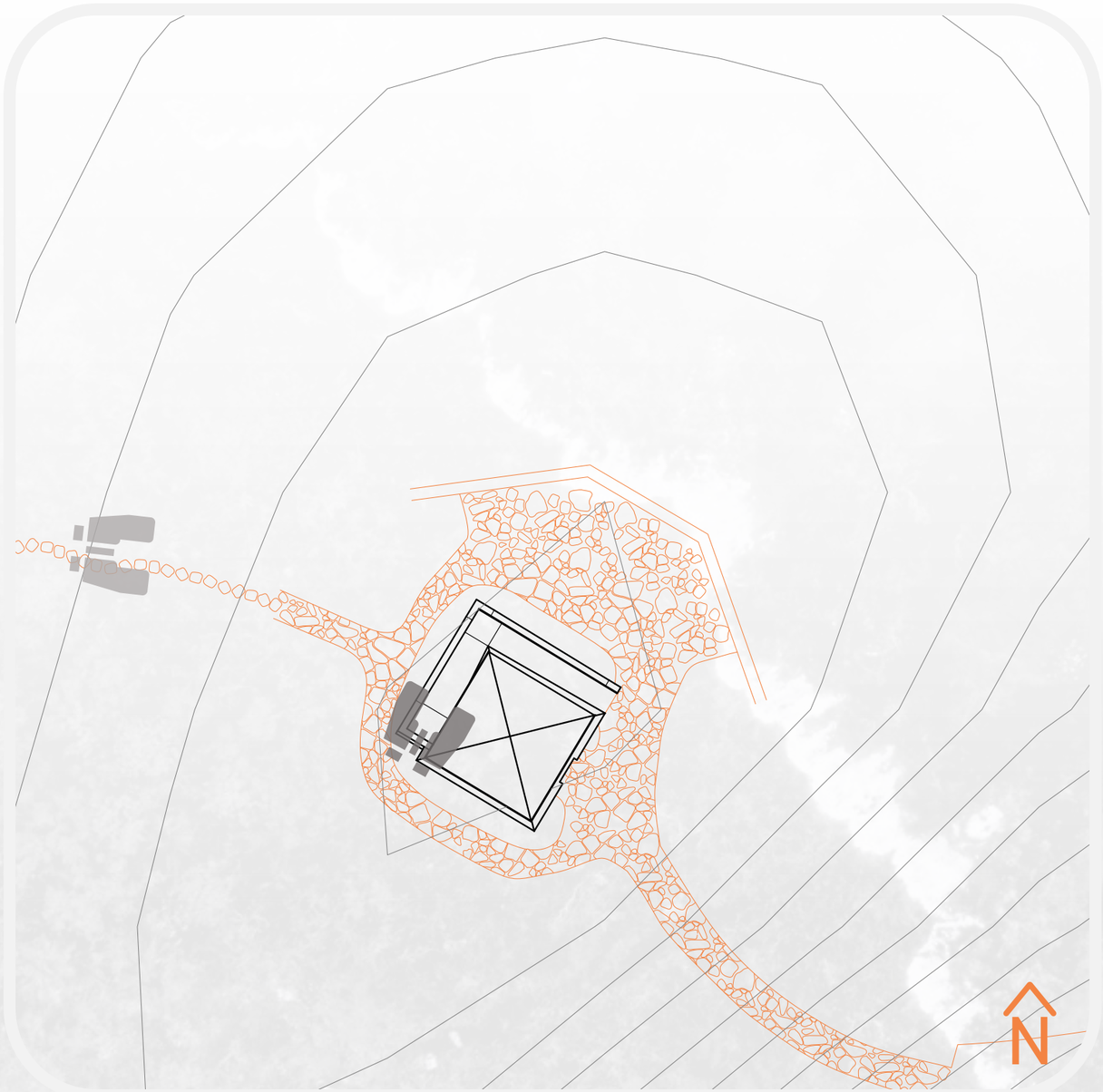


FIGURE 3.11

FIGURE 3.12

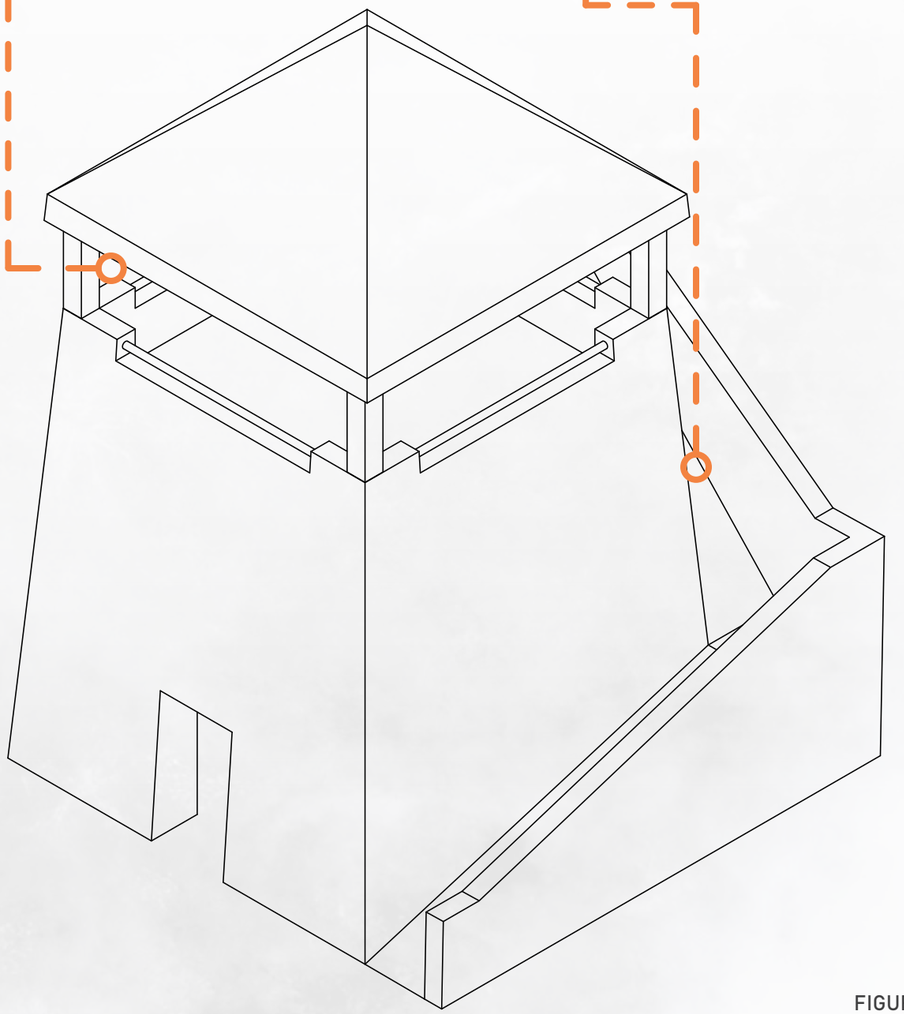


FIGURE 3.13

3.2_SITE CONDITIONS FOR MM 131.2

WESSER BALD FIRE TOWER

Wesser Bald Lookout Tower is accessible via the Appalachian Trail (AT), which passes directly by the summit. Hikers can reach the tower by following the AT, which offers a moderately graded trail through the forest. The trail to Wesser Bald is approximately 4 miles (6.4 kilometers) one way from the nearest trailhead, making it a moderate hike for most visitors. The trail leading to Wesser Bald Lookout Tower features a well-maintained dirt path with some rocky sections and gradual inclines. While the trail is not particularly challenging, hikers should be prepared for a moderate hike, especially during inclement weather or in winter conditions. The forest around Wesser Bald is predominantly a mix of deciduous and coniferous trees, including species like oaks, maples, spruces, and pines. This dense forest cover provides habitat for diverse wildlife but also plays a role in the area's susceptibility to wildfires, hence the historical presence of the fire lookout tower. The area supports a variety of wildlife, including deer, black bears, and numerous bird species, which can be both a draw for nature enthusiasts and a consideration for visitor safety. At the summit of Wesser Bald, visitors will find the historic Wesser Bald Lookout Tower. The tower offers panoramic views of the surrounding mountains and valleys, making it a popular destination for hikers and sightseers. Visitors can climb the stairs to the top of the tower to enjoy the expansive views, weather permitting.

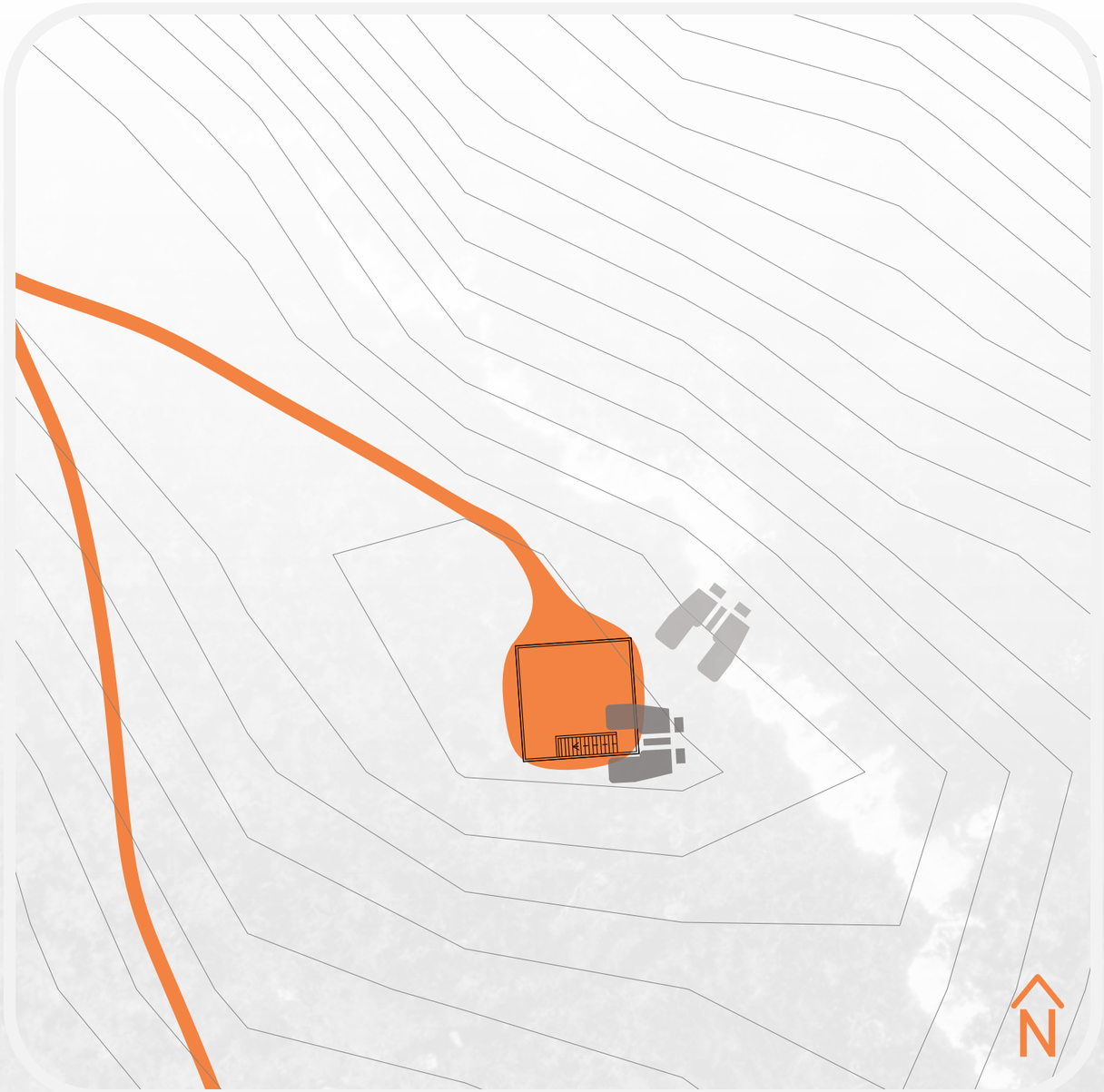


FIGURE 3.14

FIGURE 3.15

FIGURE 3.16

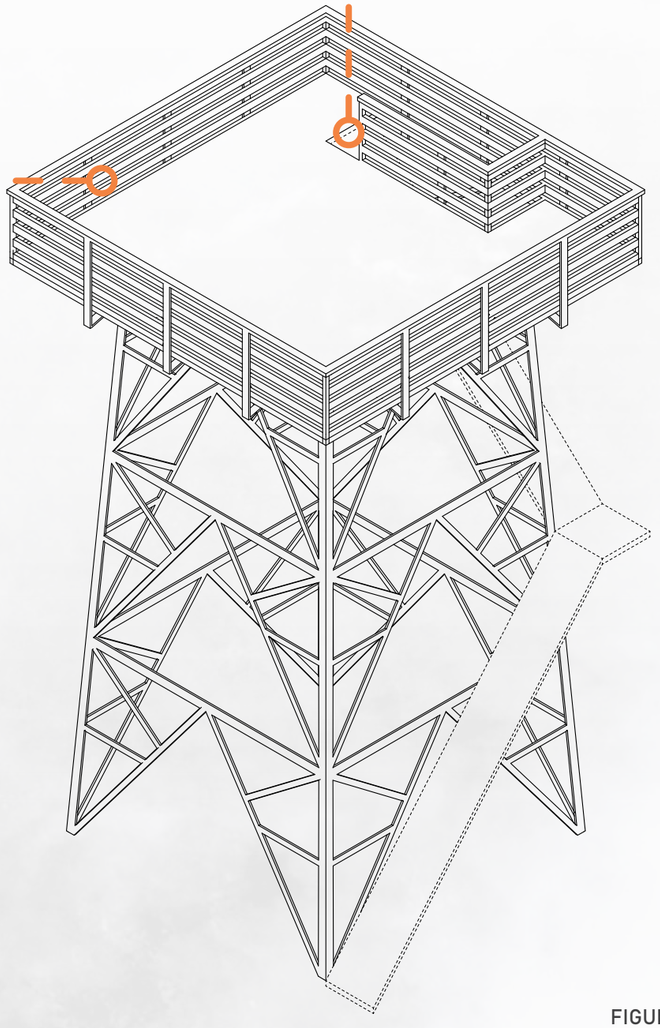


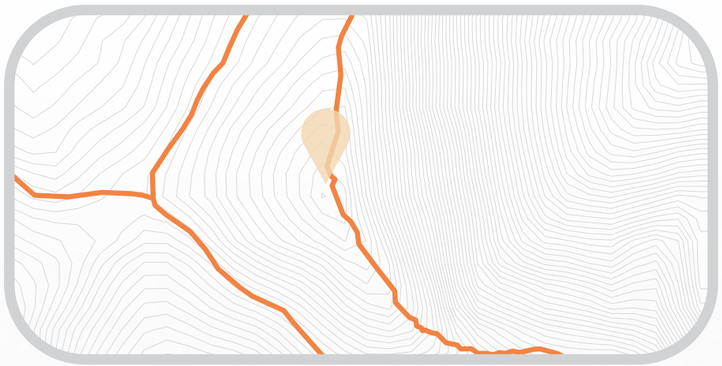
FIGURE 3.17

SECTION 4
PROCESS

4.1_SITE INFLUENCES ON DESIGN

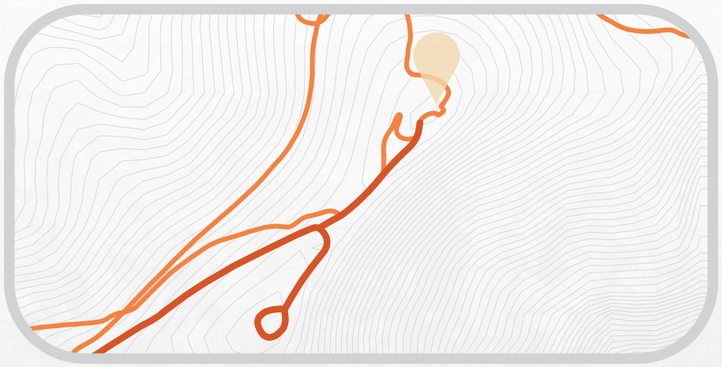
ACCESSIBILITY

MM 99.7



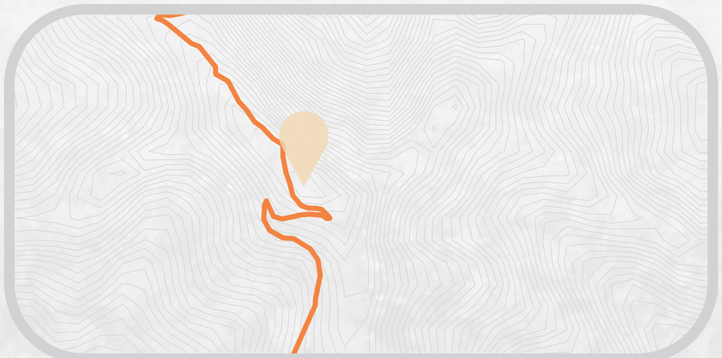
Albert Mountain fire tower is approximately a half mile from the nearest service road, but the half mile hike to the tower is uphill and rocky. Construction materials would have to be light enough to make the hike.

MM 119.7



Wayah Bald fire tower has an access road that leads almost directly to the tower. There is a parking lot and other facilities nearby with a short 100 meter walk to the tower itself.

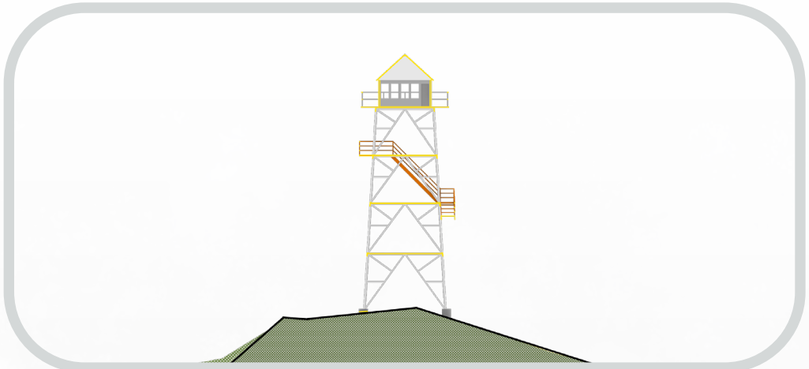
MM 131.2



Wesser Bald fire tower is approximately a mile and a half from the nearest road, therefore any construction material would need to be hiked in. The hike is rocky, but not very technical.

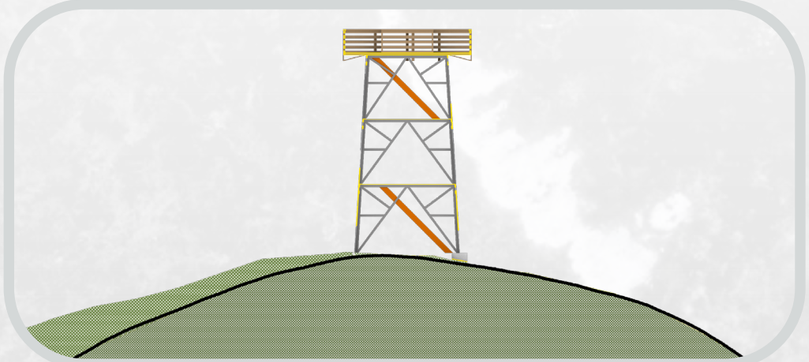
CAMPING CAPABILITY

MM 99.7



MM 119.7

MM 131.2



EXISTING MATERIALITY

Albert Mountain fire tower is located on an area with a steep slope on all sides. There is a small area that could be used to camp, but it is only enough for one or two small tents. The tower is able to provide needed additional sleeping space.

MM 99.7

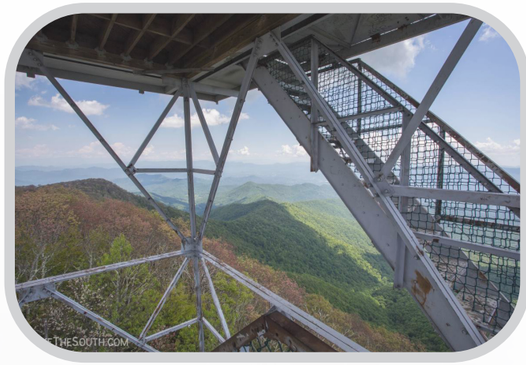


FIGURE 4.1

Albert Mountain fire tower's primary material is steel. The structure, stairs, and cab are all steel with a concrete foundation.

FIGURE 4.4

Wayah Bald fire tower is located on a relatively flat peak with a lot of open space around the tower. There are many opportunities for camping near the tower, so extra sleeping space in the tower is not required.

MM 119.7

FIGURE 4.2

Wayah Bald fire tower is a stone tower with a wooden roof structure over the second level observation deck.

FIGURE 4.5

Wesser Bald fire tower is located on a peak with steep slopes dropping off around it, making camping near the fire tower difficult. The tower would benefit from additional sleeping areas in the tower.

MM 131.2

FIGURE 4.3

Wesser Bald fire tower has a steel structure and stairs with concrete foundations and a wooden observation deck.

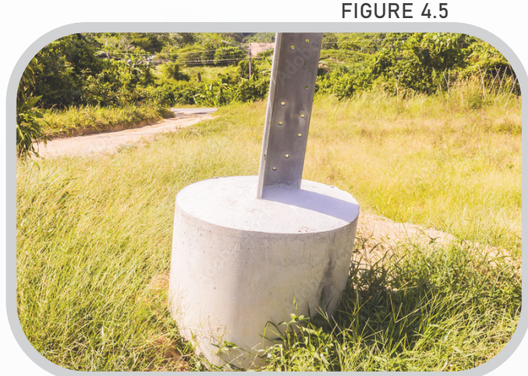
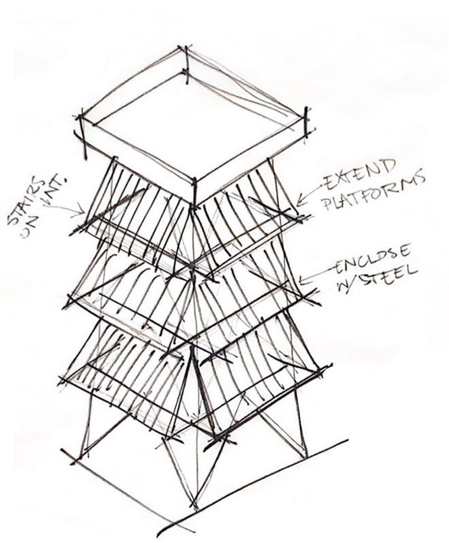
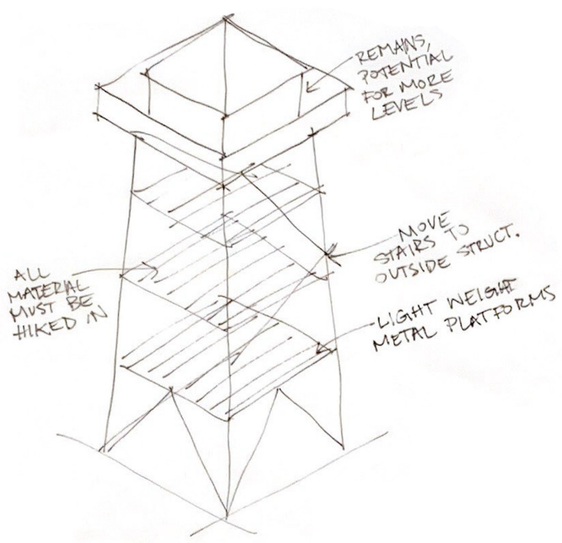


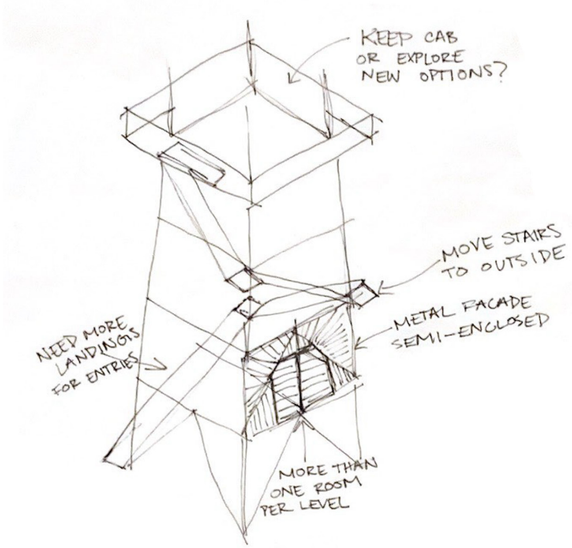
FIGURE 4.6

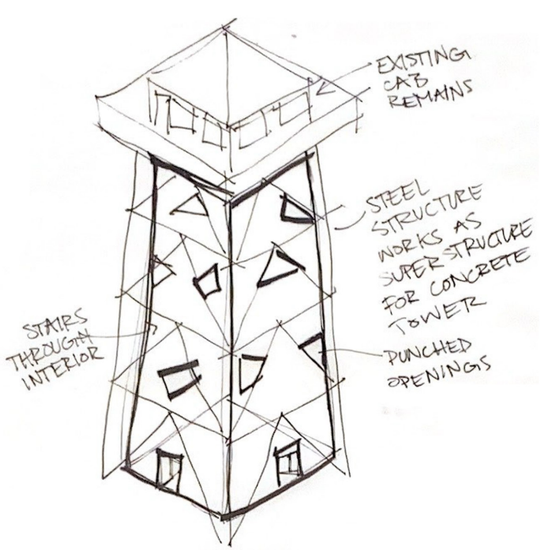
4.2_ITERATIONS FOR MM 99.7

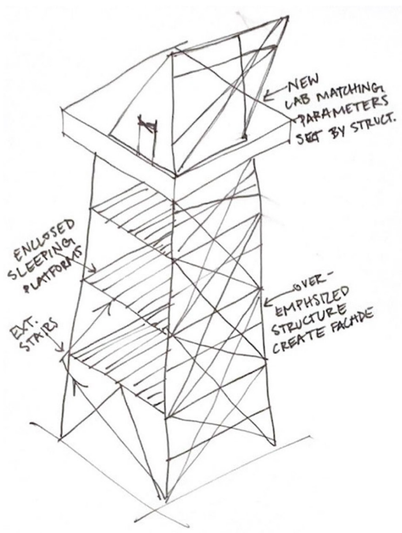
After taking into account the site variables and taking inspiration from the ecology of the surrounding areas, sketches were done to experiment with design solutions. Using the same criteria from the precedent studies in the beginning of my research, a design was chosen that was deemed the best solution.

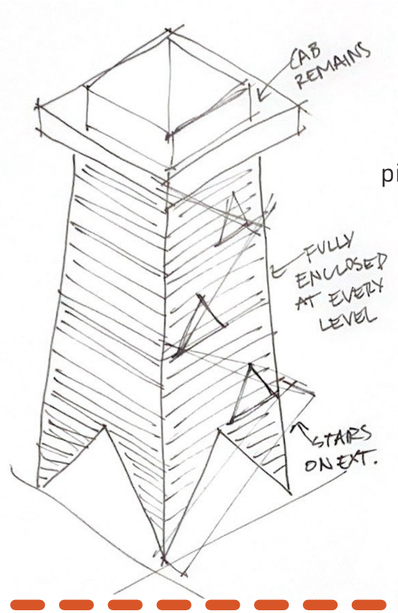




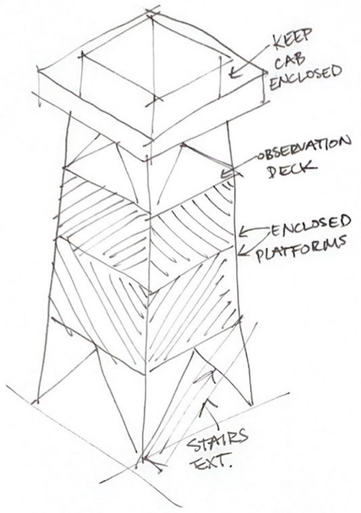


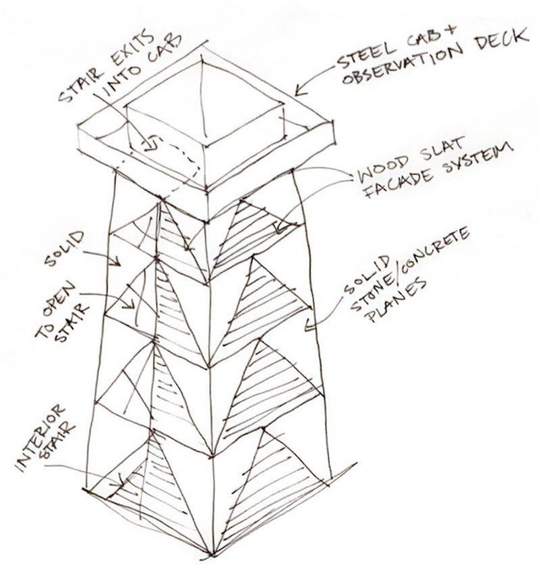




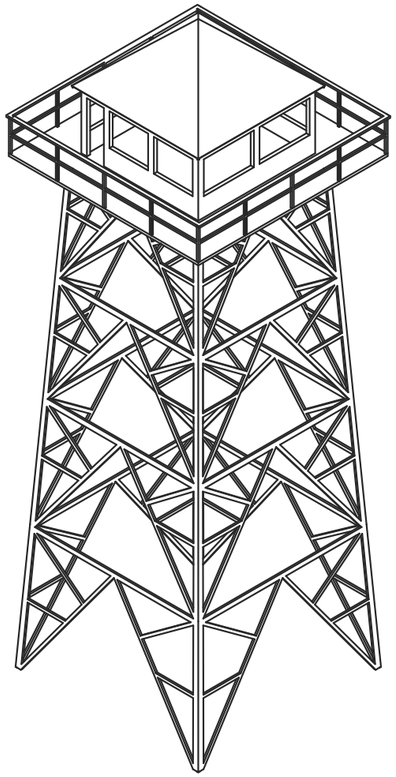


This design resembles the needles from pine trees found in the area.



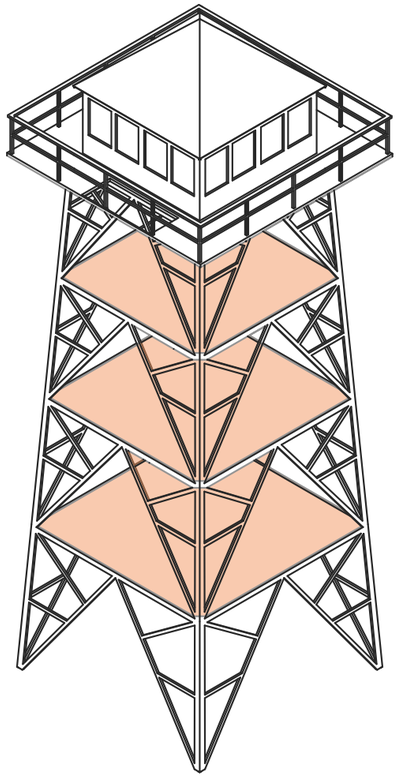


4.3_DESIGN SYNTHESIS



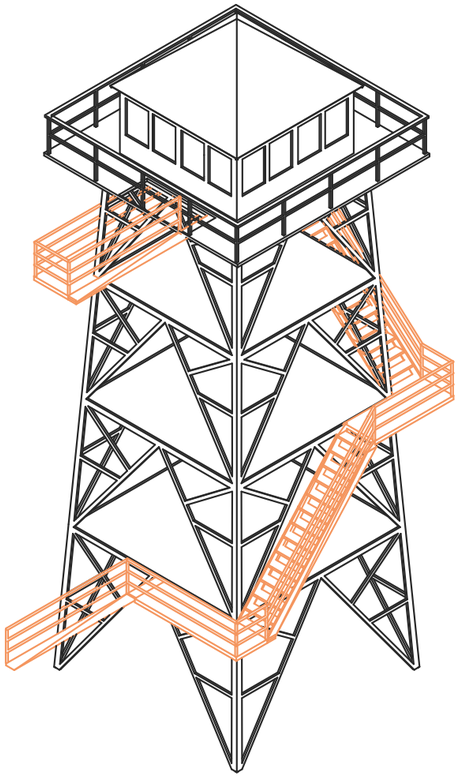
PHASE ONE:

Original stairs removed to make space for platforms.



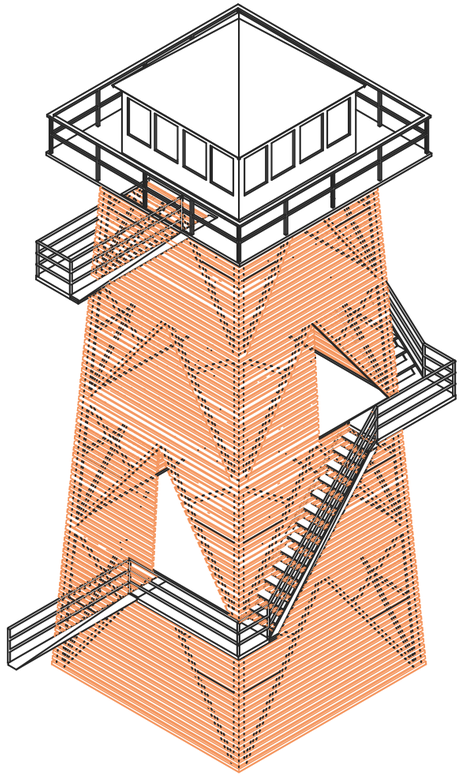
PHASE TWO:

Platforms added at every possible level to increase area of sleeping space.



PHASE THREE:

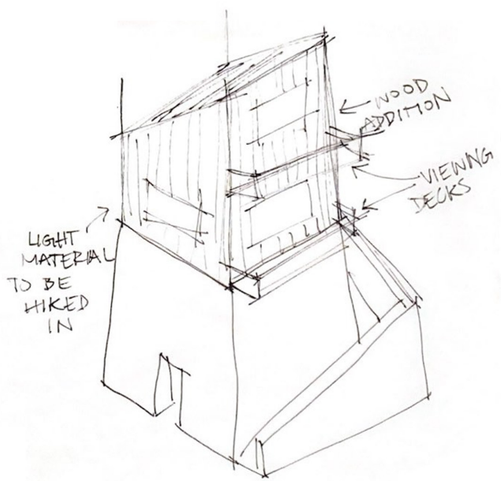
Stairs with more and larger landings to align with new platforms.

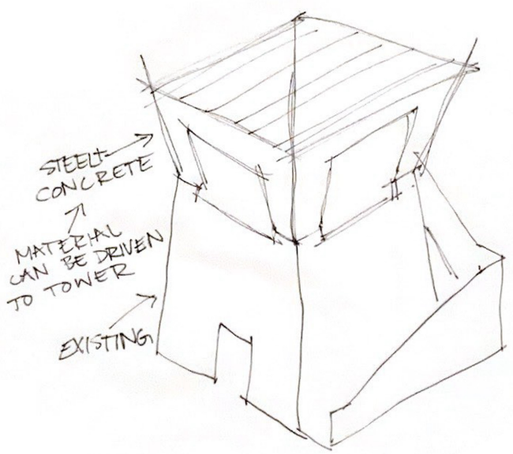


PHASE FOUR:

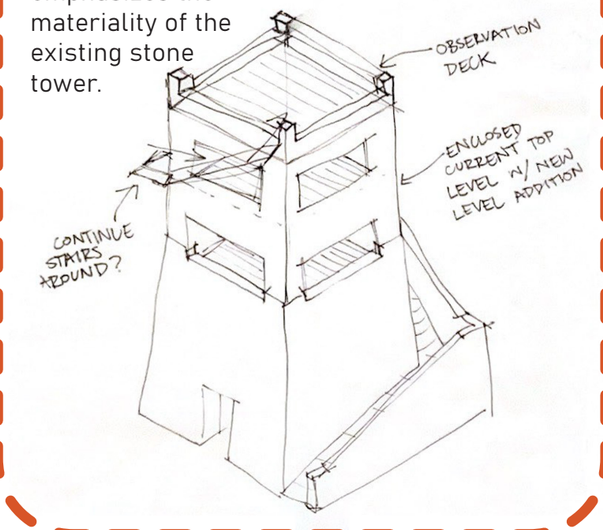
Horizontal metal louvres added to enclose sleeping platforms.

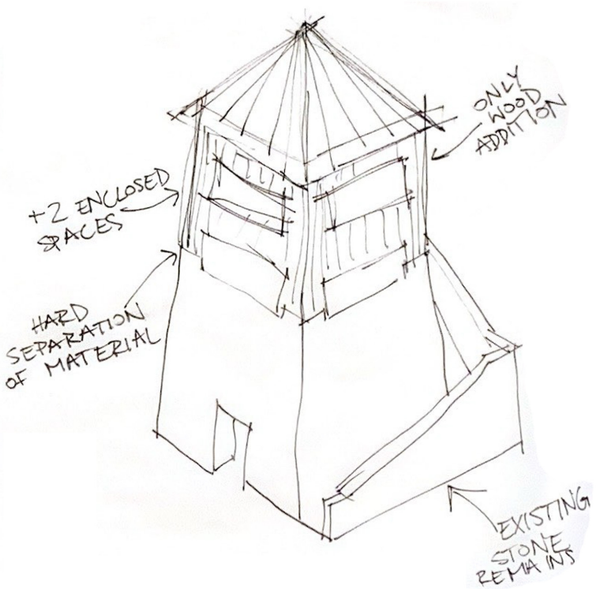
4.4_ITERATIONS FOR MM 119.7

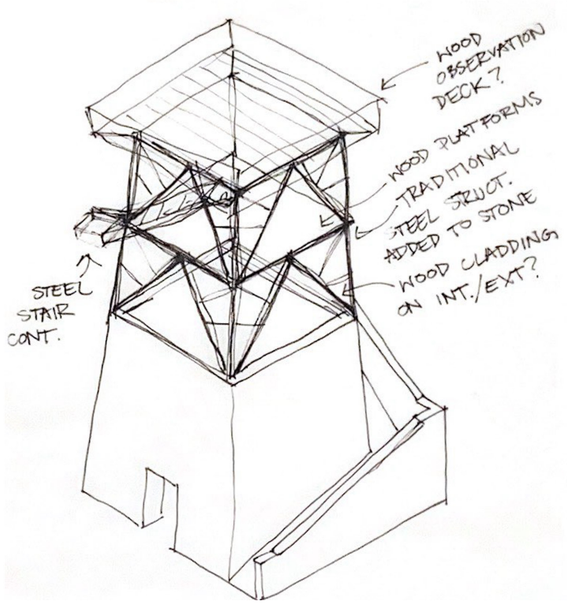


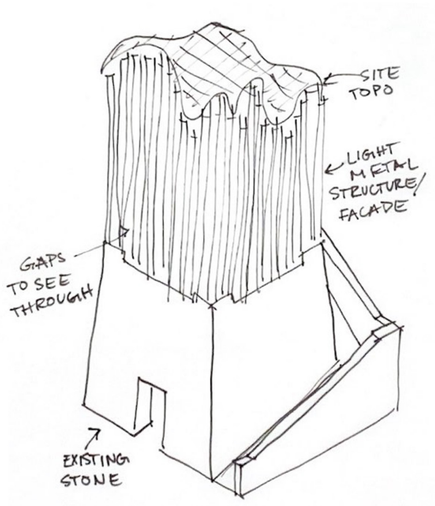


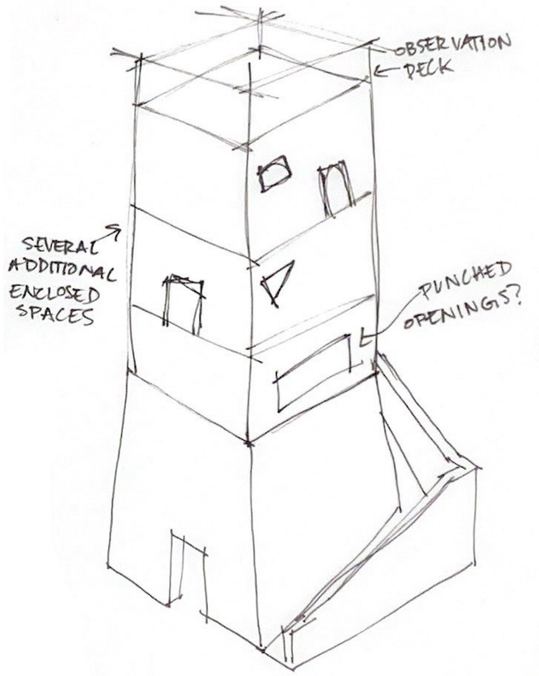
This design emphasizes the materiality of the existing stone tower.

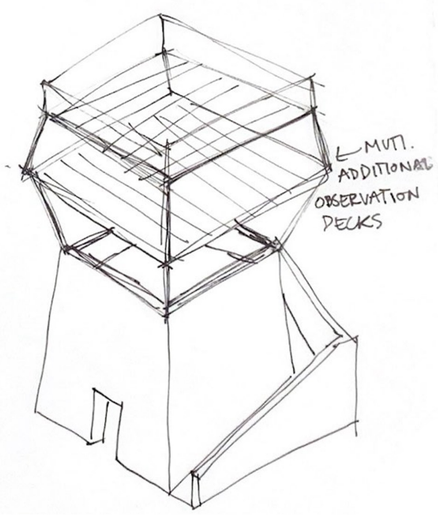




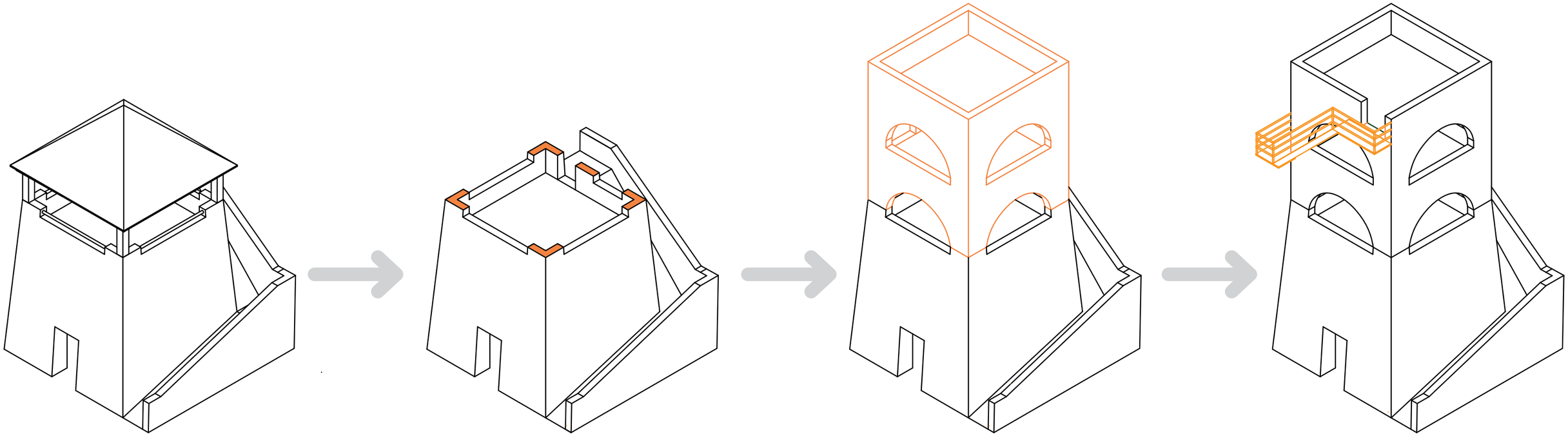








4.5_DESIGN SYNTHESIS



PHASE ONE:

Original tower.

PHASE TWO:

Wooden roof removed to make way for additional levels

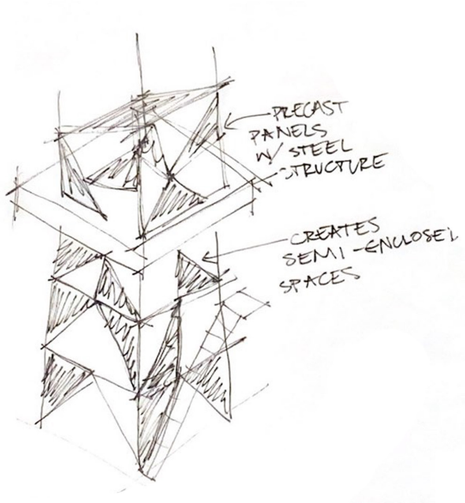
PHASE THREE:

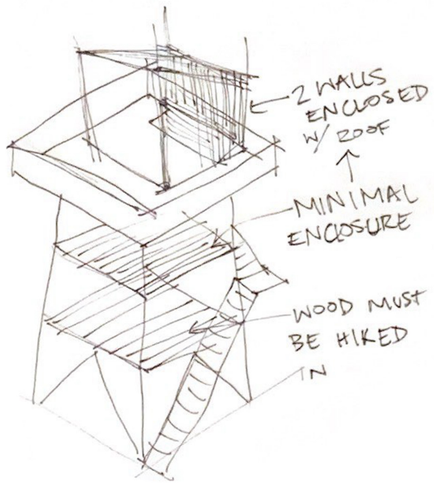
Two additional levels added with pour-in-place concrete walls with arched openings.

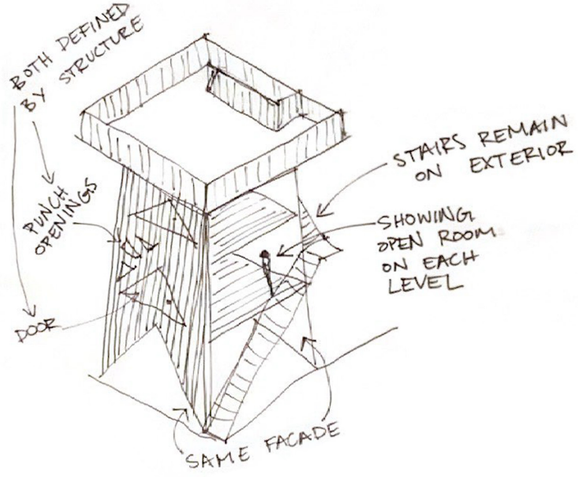
PHASE FOUR:

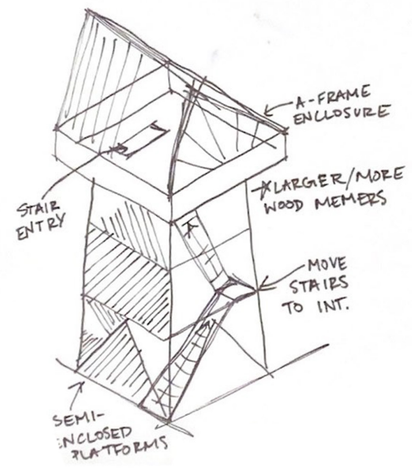
Additional stairway added to connect base of fire tower with the new levels.

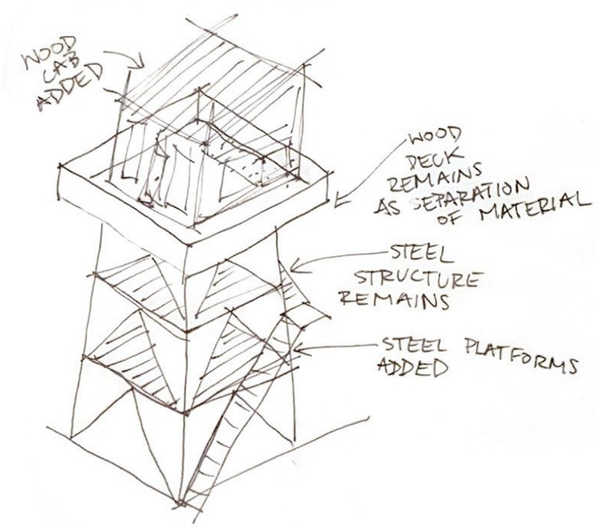
4.6_ITERATIONS FOR MM 131.2

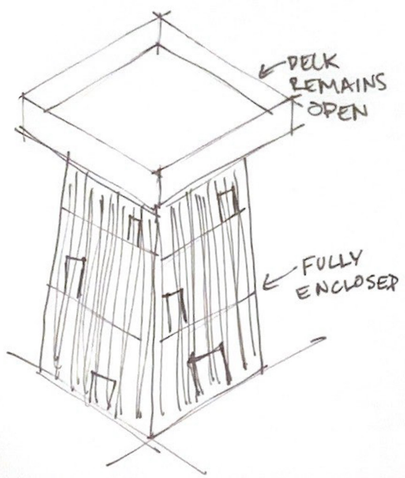


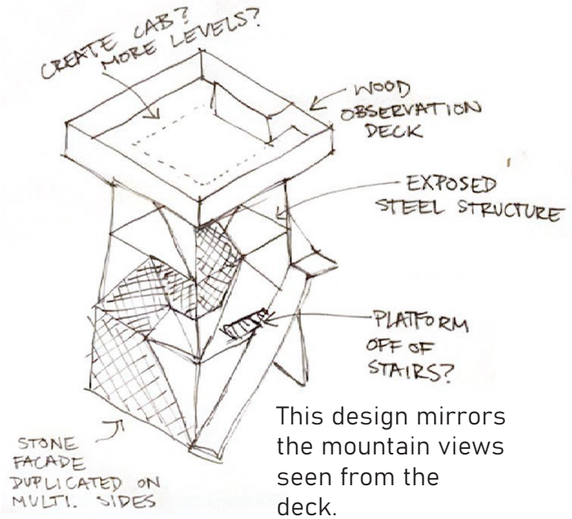




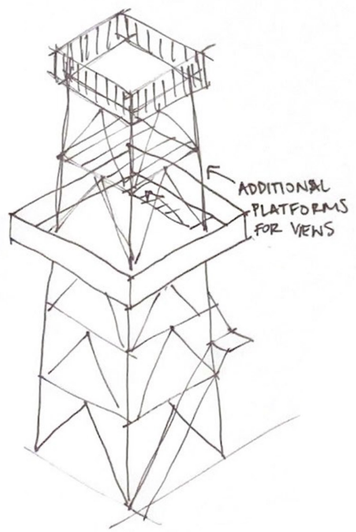




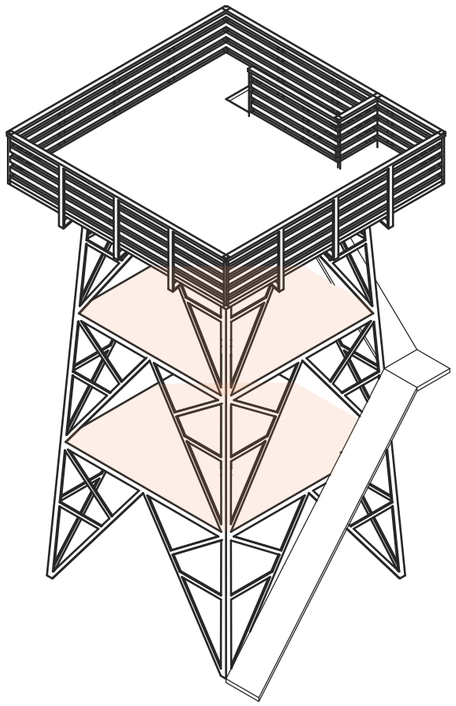




This design mirrors the mountain views seen from the deck.

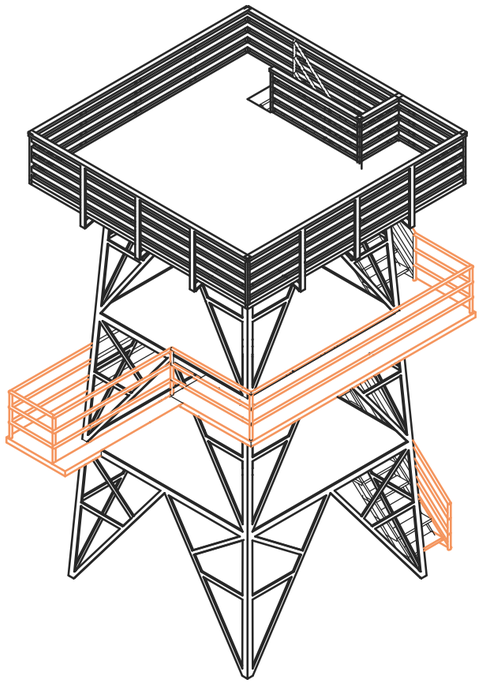


4.7_DESIGN SYNTHESIS



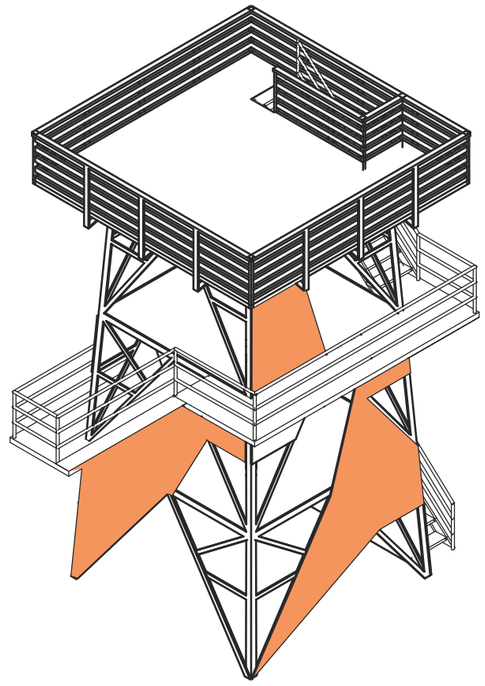
PHASE ONE:

Platforms added at every possible level to increase area of sleeping space.



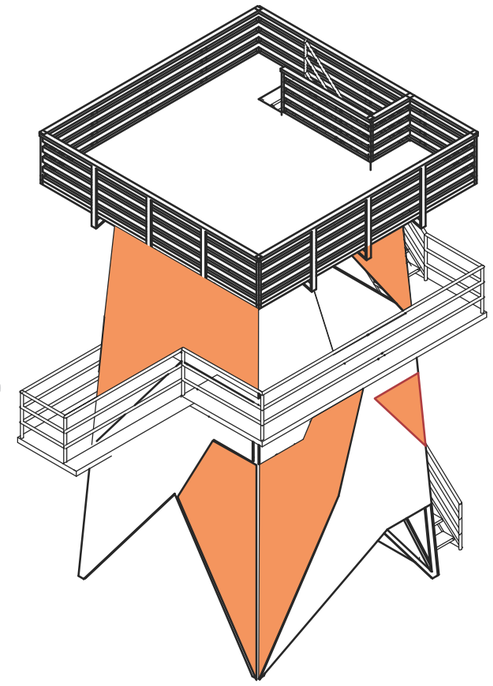
PHASE TWO:

Stairs with more and larger landings to align with new platforms.



PHASE THREE:

First level of facade added. This is corrugated metal sheets attached along the existing structure.

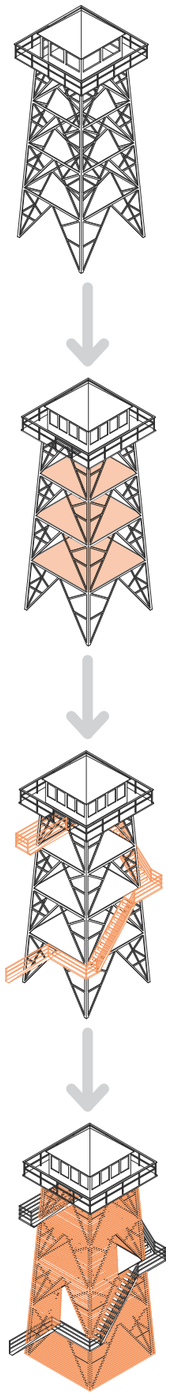


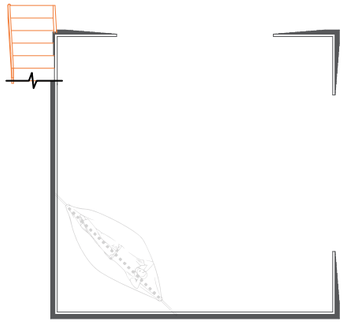
PHASE FOUR:

Second layer of facade added. This is perforated metal sheets completely enclosing the facade.

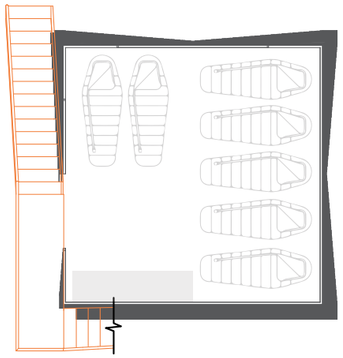
SECTION 5
DESIGN

5.1_FINAL DESIGN FOR MM 99.7

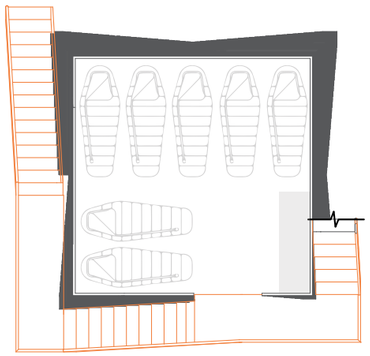




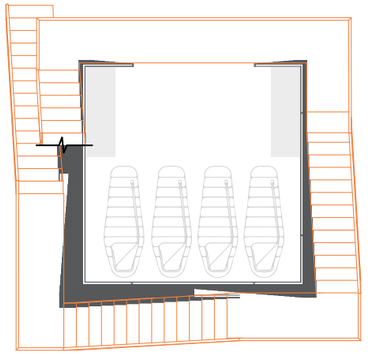
LEVEL 1 - HAMMOCK COVE
SCALE: 1/8” = 1’-0”



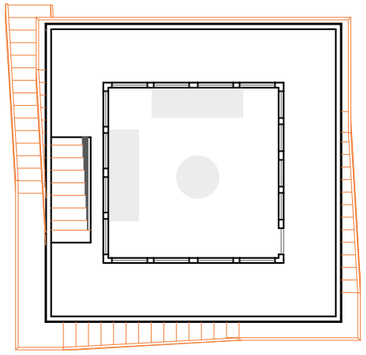
LEVEL 2 - CAB
SCALE: 1/8” = 1’-0”



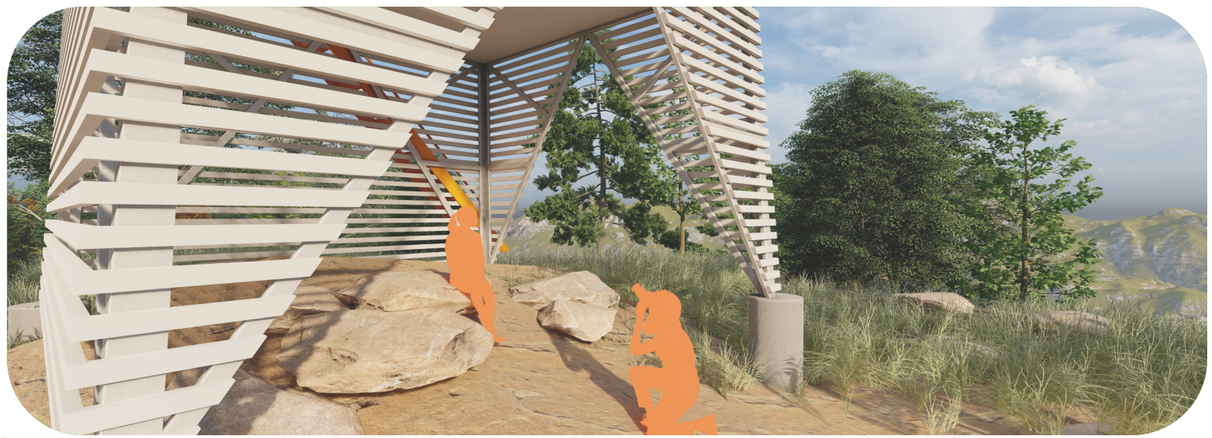
LEVEL 3 - CAB
SCALE: 1/8” = 1’-0”



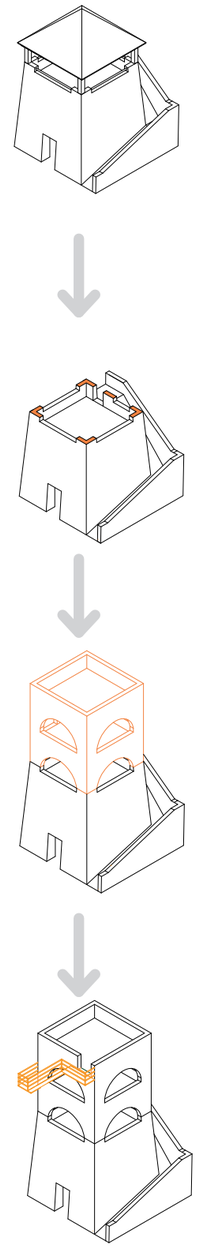
LEVEL 4 - CAB
SCALE: 1/8” = 1’-0”

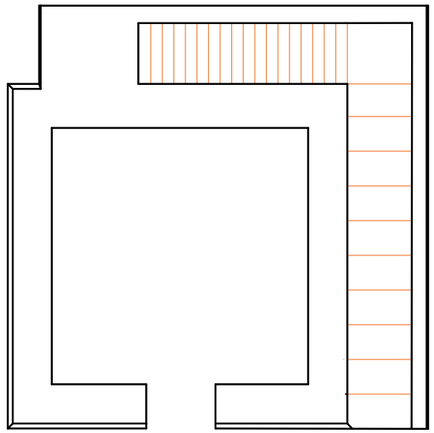


TOP LEVEL -
OBSERVATION DECK
SCALE: 1/8” = 1’-0”



5.2_FINAL DESIGN FOR MM 119.7





LEVEL 1 - HISTORIC GROUND LEVEL
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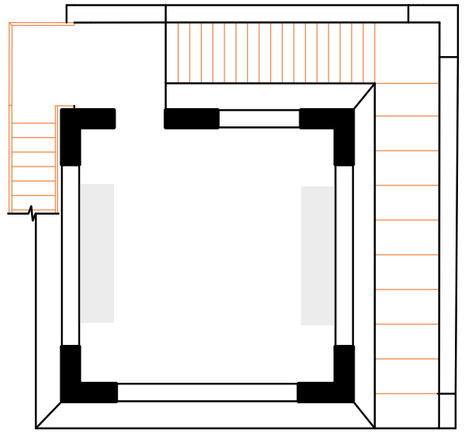
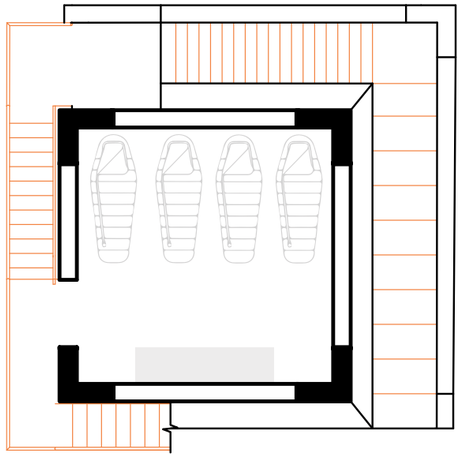
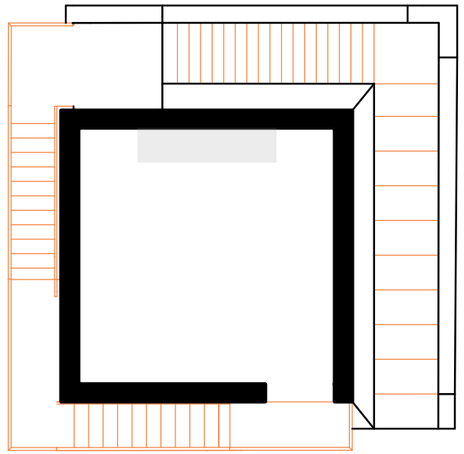


LEVEL 2 - OBSERVATION DECK
SCALE: 1/8” = 1’-0”

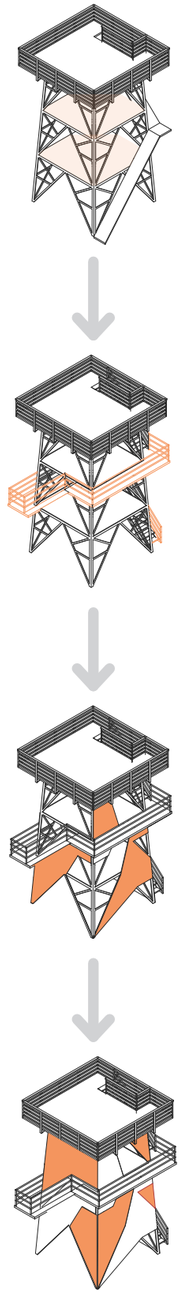


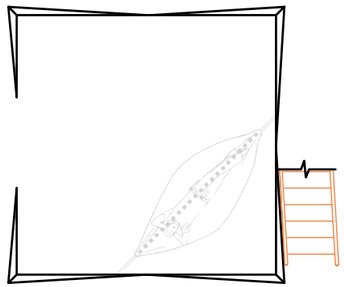
LEVEL 3 - CAB
SCALE: 1/8” = 1’-0”



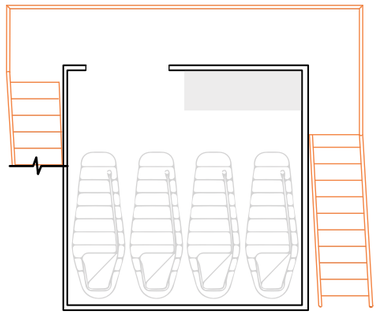
TOP LEVEL -
OBSERVATION DECK
SCALE: 1/8” = 1’-0”

5.3_FINAL DESIGN FOR MM 131.2

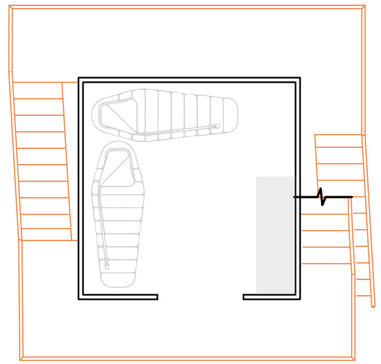




LEVEL 1 -
HAMMOCK COVE
SCALE: 1/8” = 1’-0”



LEVEL 2 - CAB
SCALE: 1/8” = 1’-0”



LEVEL 3 - CAB
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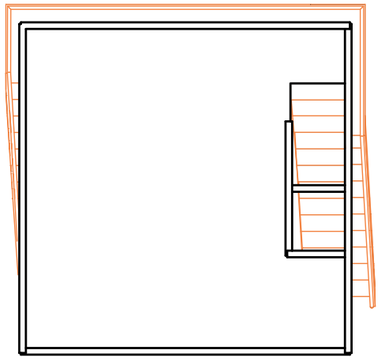
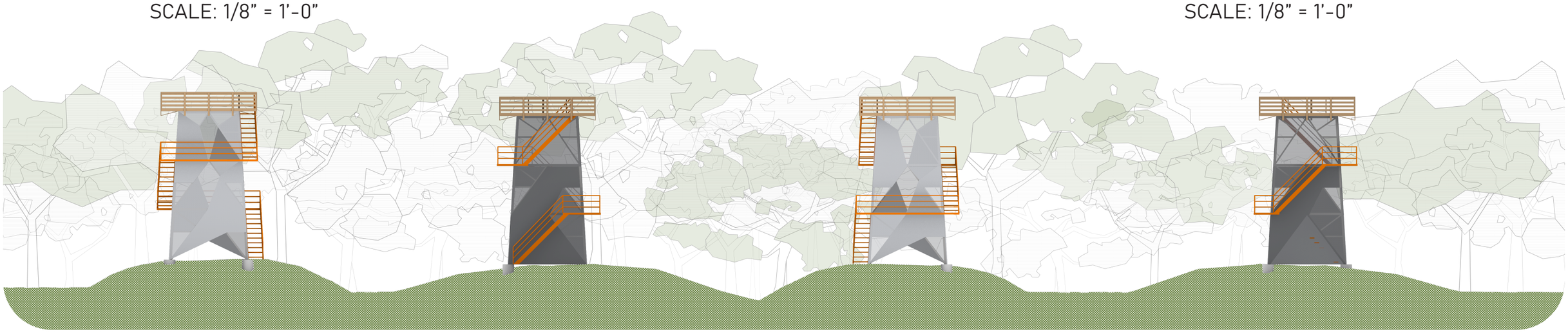


TOP LEVEL -
OBSERVATION DECK
SCALE: 1/8” = 1’-0”



5.4_BIBLIOGRAPHY

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