

The Cusco Living Observatory:
a cosmological approach to tourism in the Peruvian Andes

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Abstract

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Architecture

This thesis focuses on the development of contemporary tourism infrastructure as well as cultural and archaeological sites in the Peruvian Andes. I seek to understand how tourists and those living in the Cusco region understand Peruvian culture through engagement with the land and physical remains of the Inca civilization. This thesis proposes a “living observatory” that expands upon the work currently being advanced by Planetarium Cusco by introducing research facilities and a medical clinic that would bridge indigenous traditions and frameworks with modern science. The Cusco Living Observatory aims to provide community health resources to the peri-urban and rural inhabitants of the Cusco region while also educating transient visitors about the links between the Incas’ understanding of the cosmos and their territorial expansion, including building practices, agriculture, medicine, and politics.

The rapid growth of Cusco’s tourism industry over the course of the 20th century has shaped and re-shaped the image of Peru, both domestically and abroad. As a fundamentally interdisciplinary project, this thesis advocates for meaningful engagement with Indigenous Andean culture and draws from the fields of tourism studies, archaeology, history, cultural astronomy, and environmental sustainability.



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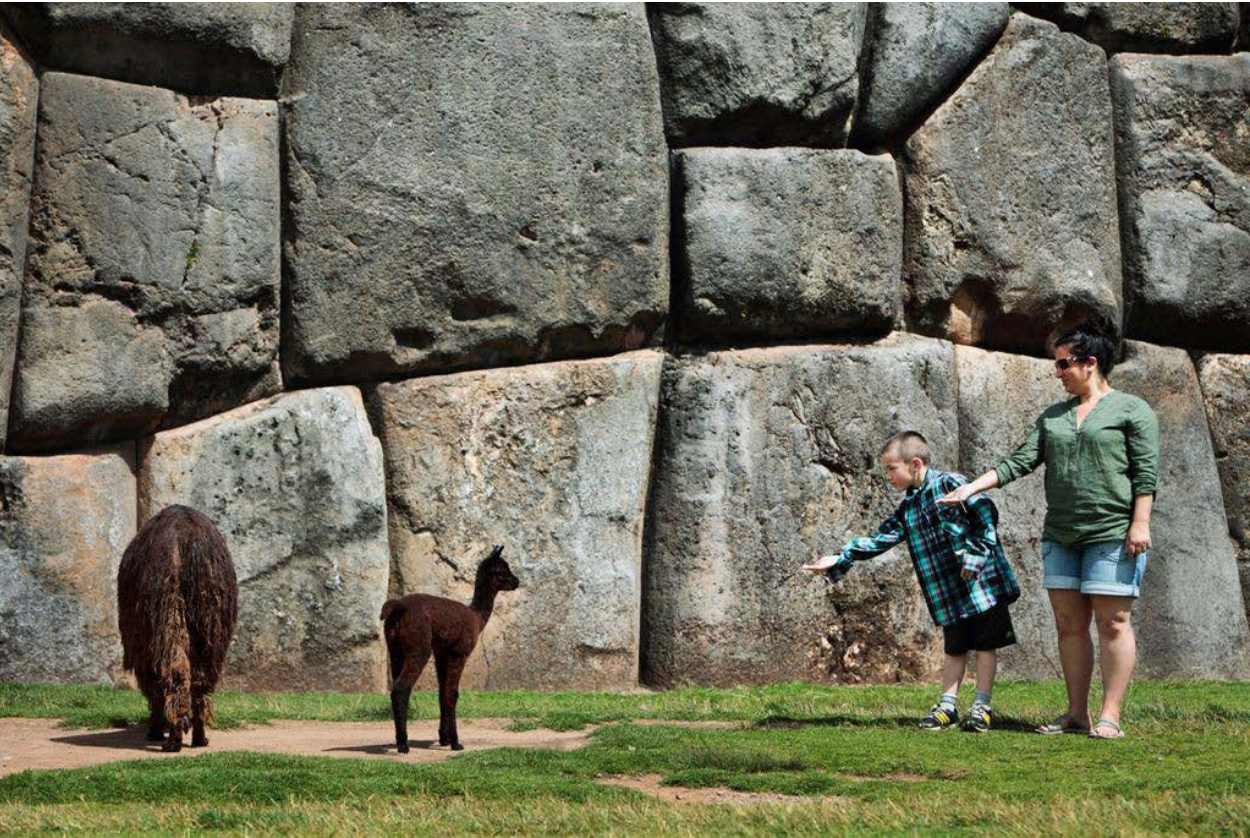


fig. 1, A Woman and Her Son Try to Feed a Llama Foal at the Inca Site of Saqsaywaman, 2011, Dieter Telemans

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fig.2, San Blas steps, Cusco, August 2024, photo by author

I INTRODUCTION

Situated at over 11,000 feet above sea level, Cusco is the historic capital of the Inca Empire, a vast territory that spanned from modern-day Colombia to Chile. When the Spanish Empire's armies arrived in the capital in 1533, they found a highly organized and militaristic society that had developed advanced systems of building technologies, agriculture, hydrologic engineering, politics, and religion. Spanish conquistadors quickly got to work redesigning the city in their image by disassembling Inca structures and using the precisely-cut stones to form the foundations of their new buildings. This literal layering of materials was intended to communicate dominance over the Indigenous population by sublimating the cultural heritage of the Incas into their new identities as subjects of the Spanish crown.

Despite persistent efforts to erase Indigenous traditions during the era of Spanish colonial rule, Peru's approximately 55 Indigenous groups have maintained cultural practices and 47 spoken languages, oftentimes through adaptation and hybridization with Catholicism and non-Indigenous Peruvian culture. According to the International Work Group for Indigenous Affairs, 83.4% of Indigenous Peruvians are Quechua, the group that is native to the central and northern Andes mountain range and who are the direct descendants of the Incas.

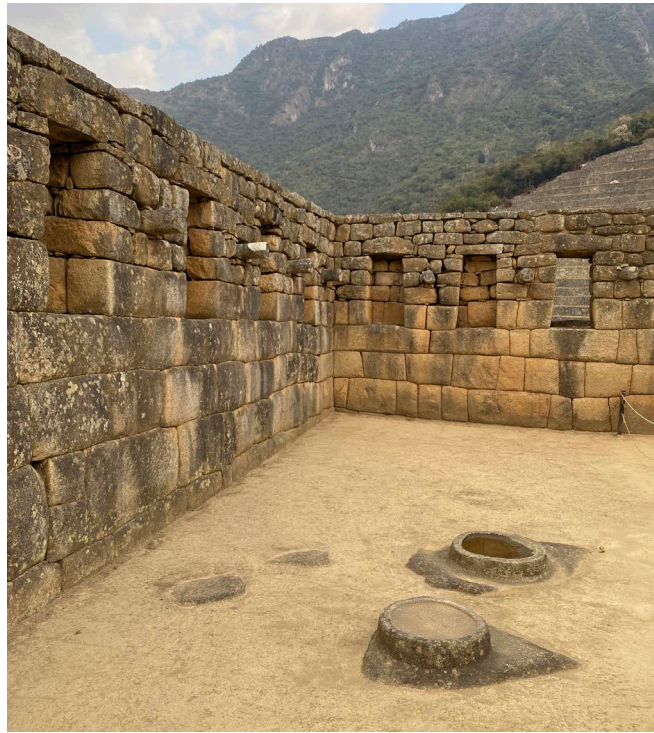


fig.3, Water mirrors, Machu Picchu, August 2024, photo by author

fig. 4, Crowds at Machu Picchu, August 2024, photo by the author

Many beliefs and practices attributed to the Incas live on in present-day Quechua culture. One of these foundational beliefs is that of the three realms – the sky, the earth, and the underworld – and their intrinsic interconnectedness that impacts all aspects of life, including agriculture, politics, and religion. This belief falls under the broad umbrella of the Andean cosmovision, the organizing worldview in which Quechua people believed and that illustrated the profound interconnections between human beings and all other living and non-living things.

The scholarly study of Inca astronomy has brought to light the powerful influence of celestial observation on Inca society. The Incas viewed themselves as a people who were descended from an all-powerful creator God (*Viracocha*), who was himself the creator of all other entities in the astronomical pantheon, such as the Sun god (*Inti*) and the Moon goddess (*Killa*). The Incas oriented their structures towards astronomical events and observed important alignments including equinoxes, solstices, and eclipses through ceremonial rituals and by carving stones (their primarily building material) into gnomons that cast shadows or into bowls that could hold water to act as astronomical mirrors. They were a civilization whose intimate relationship to the sky guided their actions on earth, from how they built, to how they grew food, to how elites ruled over their empire.

In the contemporary era of rapid globalization and the increased accessibility of international tourism, Cusco has experienced a massive influx of people visiting the historic Inca capital. As a Peruvian person who has lived most of my life abroad, I can confidently say that the Incas are Peru's most recognizable cultural export the world over. Though the nature of tourism varies widely, most visitors to Peru share the common aim to learn about the Inca Empire and Andean culture more broadly through visiting historic sites. In my research and trip to the Cusco region, it was evident that tourists were encouraged to visit sites with guides, and that those who traveled independently

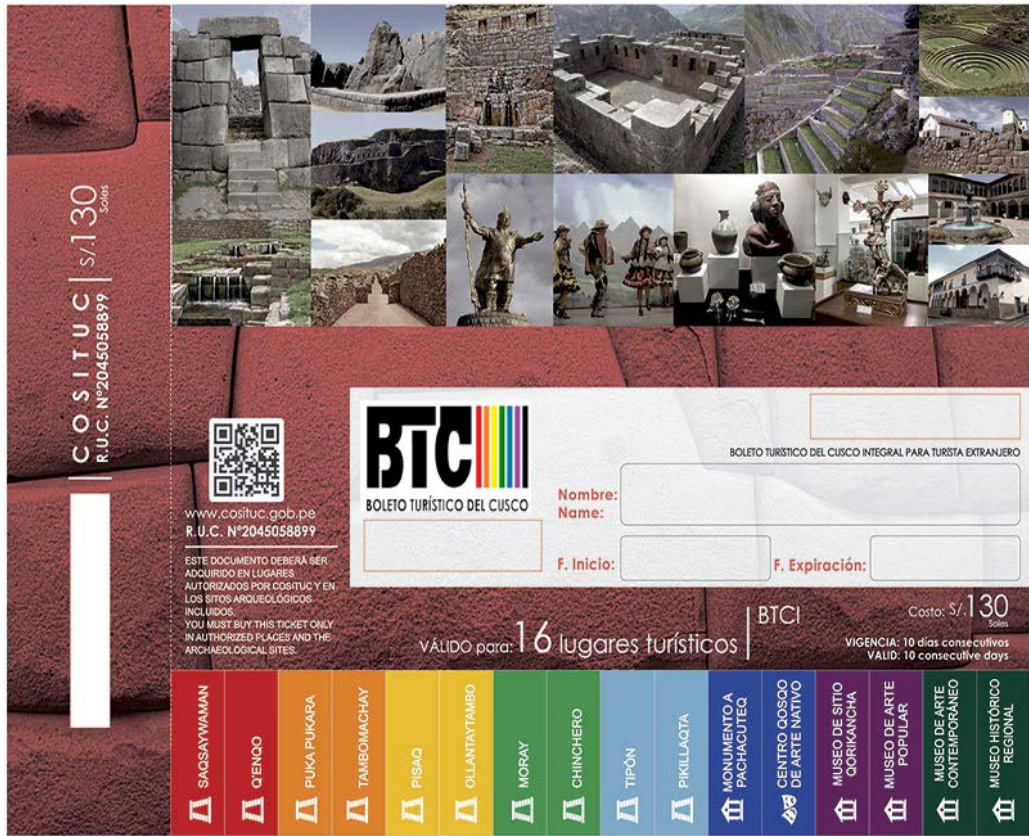


fig. 5, Tour group with guide at Qorikancha, August 2024, photo by the author

fig. 6, Cusco's "Tourist Ticket" (Boleto Turístico), permitting access to 16 sites of interest to tourists

were met with limited signage or site-specific interpretation. My own experience and extensive accounts from other visitors indicate that visiting historic sites independently often results in confusion and a sense of disconnection from history and environment.

This thesis proposes an approach to learning about the layered history of the Cusco region through a hybrid interpretive center, research facility, and community health clinic. This project is named the Cusco Living Observatory and builds upon the scientific communication work in the field of cultural astronomy that is currently being promoted by Planetarium Cusco, a family-run facility located on the north-west edge of the city adjacent to the Sacsayhuaman archaeological site. The Cusco Living Observatory expands the existing facilities of a museum, a domed planetarium, and an outdoor observation field through the addition of a research station for artists and scientists in-residence as well as a health clinic that provides culturally relevant medical care to the local population rooted in the use of Andean medicinal plants grown and processed on-site. With a multifaceted engagement with Inca culture in a uniquely contemporary setting, the Cusco Living Observatory offers a space for both tourists and locals to learn about Peru's pre-Columbian history in a way that can be meaningfully understood beyond the superficial overviews that are typical at most archaeological sites in the Andes. The Cusco Living Observatory draws attention to the interconnectedness between the material and immaterial realms that is the foundation of the Andean worldview, thus bringing to life the famed Indigenous history of the Andes while providing essential services to the local community.

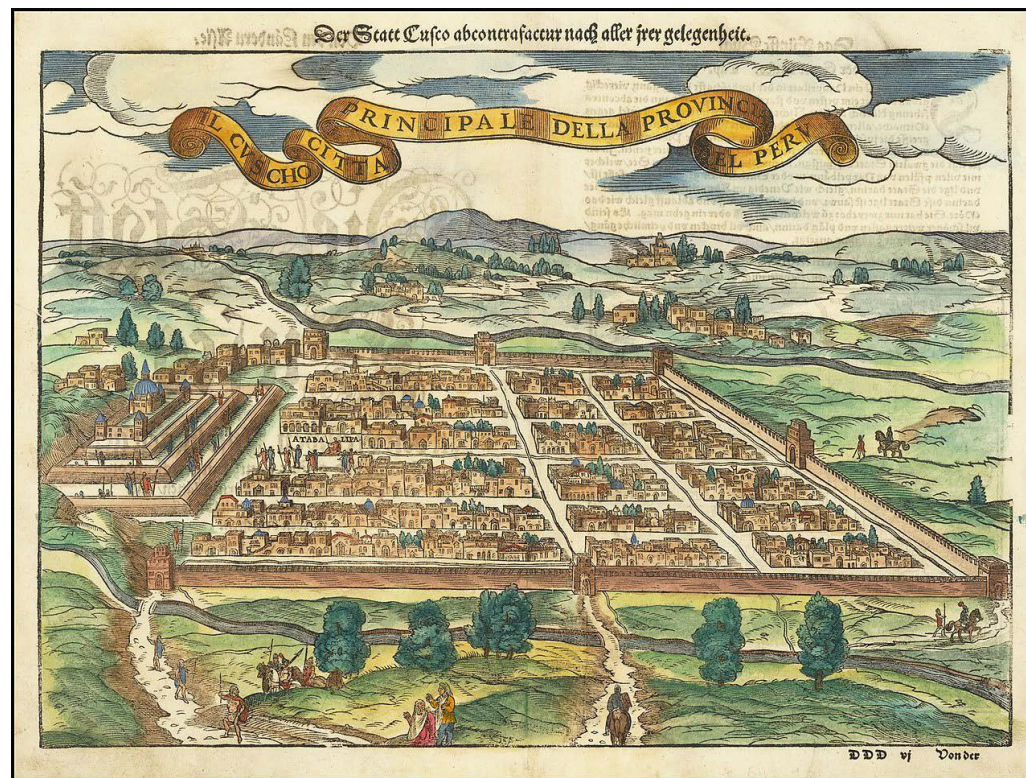


fig. 7, Map of Cusco, 1574, Sebastian Munster

fig. 8, Close-up of stone at Sacsayhuaman, August 2024, photo by author

II

THE INCA EMPIRE: LAND OF FOUR PARTS

Context of Cusco and the Inca Empire

The Incas were the last in a series of Indigenous nations that controlled western South America prior to the Spanish conquest of Cusco in 1534.¹ Having built upon the technology and systems developed by previous civilizations, the Incas were by far the largest and most advanced dynasty in the Americas prior to colonization. A series of emperors known in Quechua as the *Sapa Inca* ruled over a population that is widely estimated to have peaked at roughly 10 million subjects through an organized military that traversed the Andes and coastal regions via the *Qhapaq Ñan*, a paved royal road that was constructed to transport goods, food, animals, people, and messages across the empire.²

The Incas developed numerous building forms and construction techniques using the variety of stones that were available throughout the Andes. Precisely cut polygonal masonry is the hallmark of the Inca Empire, where it was typical to assemble walls out of large stones without the use of mortar to hold each unit together. Since earthquakes are common throughout the Andes, the Incas accounted for seismic risk through stable forms such as walls that battered inwards and trapezoidal openings. Incas constructed dwellings, temples, observatories, fortresses, altars, and storage buildings, always taking advantage of natural features such as mountains, running water, and monolithic stones.

Cusco was the capital of the Inca Empire and as such was considered “the umbilical cord of the universe.”³ The Incas believed that the city, which occupies a basin surrounded by mountains in the Eastern Cordillera of the Andes, was the energetic point of origin for all living beings. The metaphor of Cusco as the birthplace of the empire is realized literally when studying plans of the region that show the *Qorikancha* temple in Cusco as the center from which 42 known *siq’is* (spiritual pathways) radiated into the expansive empire.⁴ Along these paths, the Incas built small shrines called *wak’as* to recognize the spirits occupying the land.⁵ Some *siq’is* were aligned with the movement of astronomical bodies. In Quechua, the Inca Empire was known as *Tawantinsuyu*, meaning “land of four parts.” The four regions of the empire met in Cusco and each *suyu* was characterized by unique ecology and inhabitants. Interpreting the cosmos created a unifying ideological foundation from which the Incas derived power and knowledge.⁶

Inca cosmology

The practice of astronomy was undeniably woven into the fabric of Inca society and maintains significance in present-day Indigenous Andean communities. Studying Inca interpretations of the cosmos gives insight into their organizing worldview, which is tangibly reflected in their approach to land management, building, and governance.

As the heart of the Inca religion, astronomy thoroughly informed governmental rule.⁷ The Inca emperor (*Sapa Inca*) was believed to be a direct descendant of *Inti*, the sun god. The vast pantheon of deities in the Andean religion included gods of natural features and phenomena, such as mountains, stars, rainbows, fire, and wind, in addition to sacred animals and the spirits of animate and inanimate beings. Reverence for the gods through prayer and ritual sacrifice was an essential feature of life in the Inca Empire, which was able to grow largely because of the Incas’ ability to create food surpluses through a mastery of terrace farming. Terrace farming was a way to level portions of mountains into

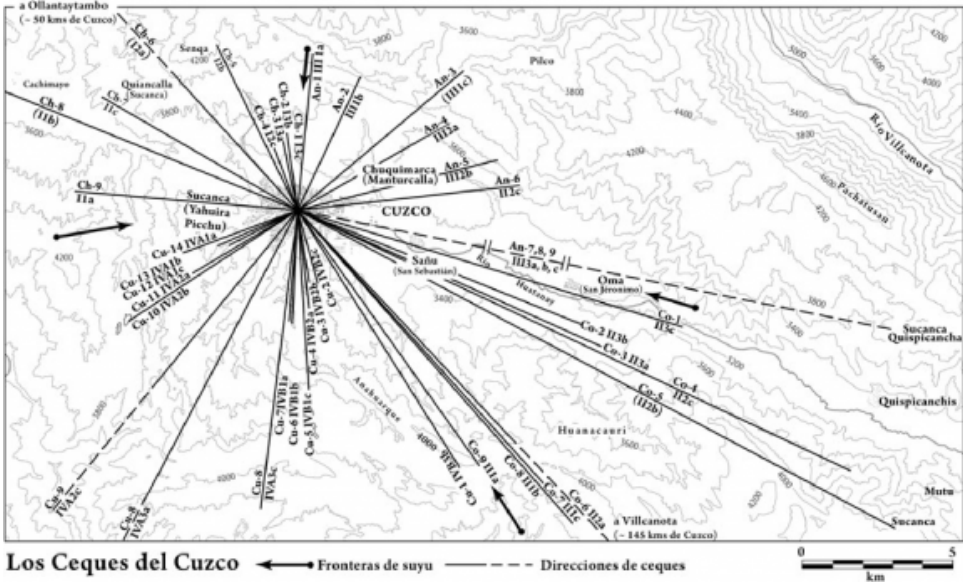


fig. 9, The distribution of the 41 lines or ceques in Cusco, 2010, R. T. Zuidema

fig. 10, Street of San Blas neighborhood in Cusco showing hybrid Inca and colonial construction and street-level water canals, August 2024, photo by author



fig. 11, Illustration of Inca farmer, drawn by author

stepped terraces through retaining walls, enabling farmers to plant and harvest crops on regular intervals. Inca engineers built an extensive canal system to transport water from nearby glaciers and rivers to irrigate crops, storing additional water in cisterns. Many of these landscape adaptations are still used in the present day by Andean farmers.

As an empire that was heavily dependent on agriculture for survival and growth, the Incas carefully observed climatological patterns through tracking weather and the night sky. Traditionally, Andean farmers have observed the relative brightness of the Pleiades star cluster in the night sky to predict El Niño events, which has a direct impact on crop yield.⁸ Archaeoastronomical research in Peru has proposed compelling arguments that the physical layout of Cusco and structures throughout the empire were oriented towards sunrises on the summer and winter solstices.⁹ Stone gnomons, sun gates, and *Intihuatanas* (ritual stones that cast shadows associated with the Inca calendar) were features found throughout the Inca landscape that used the sun to measure time, mark important dates, and transfigure solar orientation into spiritual meaning.

When an Inca subject faced a clear night sky, they focused not only on the visible stars and planets, but also on the voids between them. These “dark constellations” in the visible band of galaxy prominent in the Southern Hemisphere were interpreted by the Incas as great cosmological characters intended to guide them in their daily lives.¹⁰ In the Andean worldview, the universe could be thought of as being comprised of three realms, each of which had its own representative animal that featured heavily in Andean mythology: *Hanan Pacha* (the world above, where the gods reside) represented by the condor, *Kay Pacha* (the earthly world of the living) represented by the puma, and *Ukhu Pacha* (the world of the dead) represented by the serpent. Human beings were believed to travel through the three realms, being formed underground at birth, travelling through the earthly world of the living, and ascending to the world of the gods upon death.

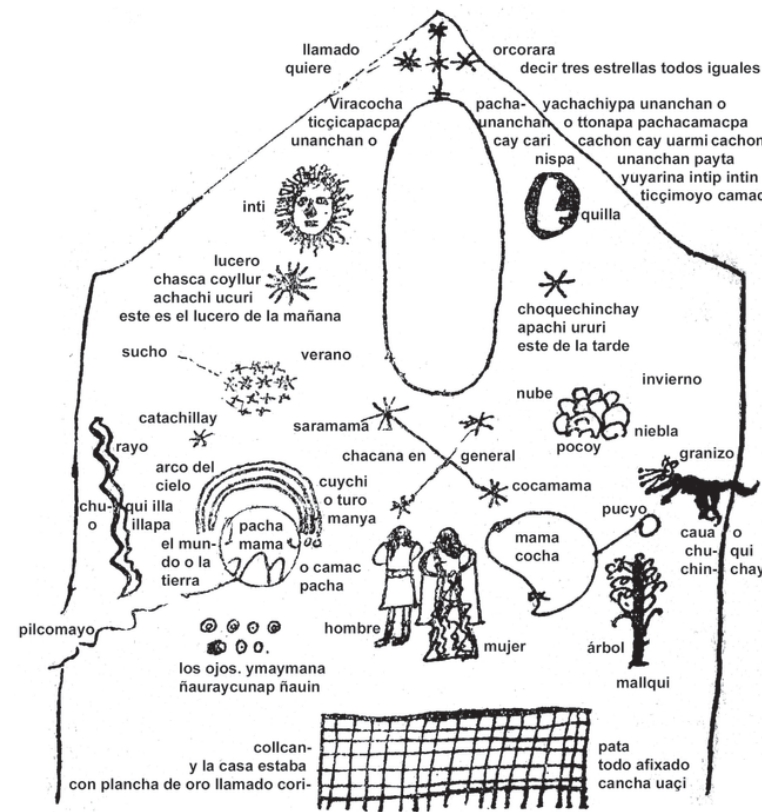


fig 12 + 13, Gold plate displayed at Qorikancha depicting Andean cosmovision as described by Joan de Santa Cruz Pachacuti Yamqui Salcamaygua in the chronicle "Relation of the Antiquities of This Kingdom of Piru," 1613, photo by author

The Andean cosmovision – a term widely used to describe how historic interpretations of the cosmos shaped the Andean worldview – presents a radical philosophy that, in stark contrast to the highly extractive form of capitalism that currently threatens the environmental stability of the region, argues for the rights of the natural world. In 2008, the Andean cosmovision of the Kallawaya, an itinerant group of healers living in the Bolivian Andes, joined the UNESCO list of Intangible Cultural Heritage.¹¹ Kallawaya healers use over 900 species of Andean plants to treat a range of medical conditions by employing practices passed down through a system of apprenticeship. Ritual ceremonies involve groups playing pan flute and drums, as music is believed to be a link to the world of spirits. The healing traditions of the Kallawaya and other Andean groups that practice traditional medicine rooted in the cosmovision form the living legacy of the Inca civilization and serve an important role in the wellbeing of many communities. At the same time, increased awareness of these traditions brought about by tourism has resulted in widespread misappropriation and commodification of Andean medicine. Environmental degradation and insufficient protections for Indigenous communities on the part of the Peruvian and Bolivian governments also threatens these practices.



Material Building Culture

The Inca civilization is renowned the world over for the mastery of stone masonry architecture. As the Incas were the last in a series of pre-Hispanic empires who lived on the western edge of South America, they built upon methods of working with stone from the Andean peoples they conquered. Nowadays, dry-fit stone masonry construction is an iconic symbol of Peru that attracts millions of tourists to the Andes annually. The enormous size of many Inca archaeological remains, the nearly unbelievable level of precision with which stones were cut, dressed, and fitted together, and the structures' harmonious integration into the landscape makes Inca stone masonry a truly remarkable accomplishment that occupies a place of pride in the Peruvian national identity.

fig. 14, Terrace farming in Ollantaytambo, September 2024, photo by the author



For the Incas and present-day inhabitants of the Andes, stones possess practical value as a sturdy, abundant material as well as rich symbolic significance. Stones used in the construction of numerous homes, citadels, palaces, and temples before the arrival of Spanish armies in the third decade of the 16th century were seized and reassembled as the foundations of imperial buildings and roads throughout Cusco, with hybrid colonial structures sitting atop the rocks. The Andean worldview stresses the importance of balance between the interrelated realms (*pachas*) within and beyond human view. As a result, stones, which were quarried directly out of the earth and formed using handheld tools, were understood to be a direct link to *Pachamama*, the life-giving earth itself. By building architecture out of that most essential element, stone was the spiritual bridge between the controlled world of the Inca Empire and the wild, uncontrolled world into which they expanded.

fig. 15, Intihuatana at Machu Picchu

Stone as material

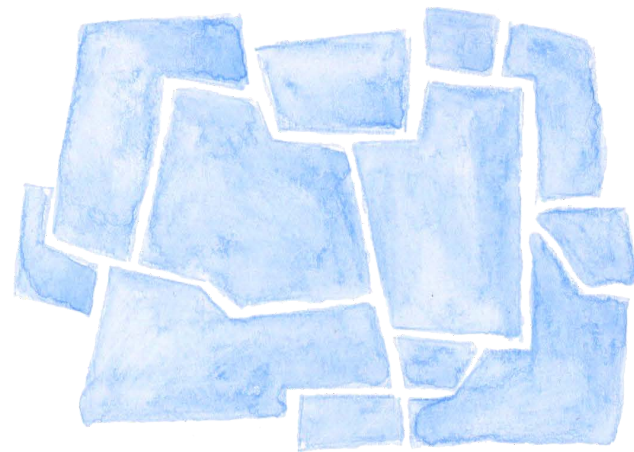
Most stones used during the construction of Inca buildings in the Cusco region were basaltic andesite extracted from Rumiqlolqa, a royal Inca quarry less than 30 miles southeast of Cusco.¹² Without the use of wheels or beasts of burden larger than a llama, tens of thousands of Inca laborers participated in large-scale infrastructure projects through a system of labor tax known as *mit'a*. The Inca political apparatus worked to maintain the careful balance of extracting labor and wealth across the massive empire while keeping disparate communities relatively self-sufficient with minimal disruption to agricultural activity.¹³ A percentage of men from across the empire spent a pre-defined number of months of the year working on monumental projects for Inca nobility, temples, or infrastructure such as the construction of canals. The labor tax served as a way to systematize individuals' investment in the growth of the empire and keep otherwise idle hands too busy to plan a revolt against the government.

Architects and stonemasons were exempt from the labor tax and served a vital role in the coordination of large-scale projects. Beginning at the quarry, stones would be rough-cut using large stone hammers and hauled by hand over long distances, possibly using log rollers, gravel, or sand to ease the journey. Many stones that have been studied in the modern era have small protrusions sticking out of what would otherwise be a smooth surface, indicating that they were likely formed that way purposefully to facilitate the use of push sticks or rope to transport them. These features are commonly referred to as hoist grips. Once stones reached the construction site, crews would use a range of tools including hammerstones of varying sizes, bronze pry bars, plumb bobs, grinders, files, and measuring devices to cut stones into shape.

Broadly, there are two types of stone masonry construction: fitted, wherein stones are shaped to sit in contact directly with one another without the use of mortar, and unfitted, wherein stones are generally shaped to a lower degree of precision and mortar is used between them as a binder. Inca architecture is most widely recognized for its refined fitted masonry. To this day, tourists marvel at the tight fit between many stones, some of which have such small gaps between blocks that it is impossible to wedge even a needle between them. Peruvian architect Santiago Agurto Calvo conducted what is to date considered to be the most detailed study of Inca masonry and identified four fitted stone masonry types.¹⁴

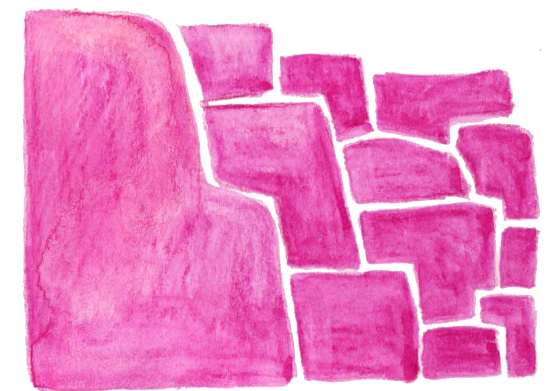
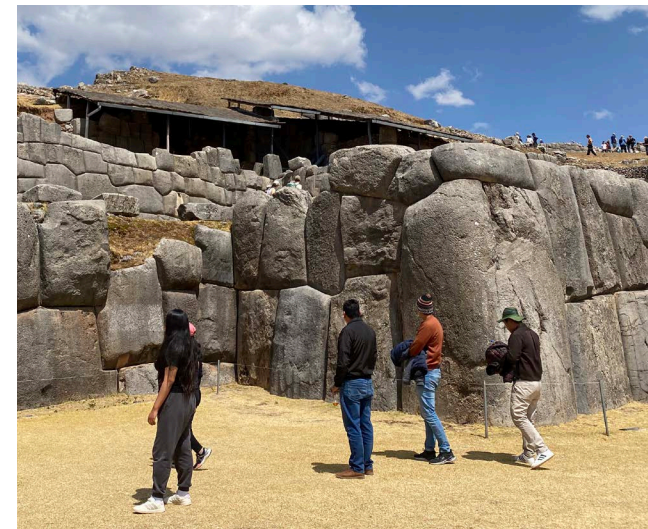


fig. 16 (upper left), Stone masonry detail (sedimentary coursing) at Qorikancha Temple, Cusco, August 2024, photo by author
fig. 17 (upper right), Solar observatory carved into stone outcrop, Qenqo, August 2024, photo by author
fig. 18 (lower left), Exterior wall of inhabited kancha (cellular coursing), Ollantaytambo, September 2024, photo by author
fig. 19 (lower center), Pedestrian street framed by kancha walls, Ollantaytambo, September 2024, photo by author
fig. 20 (lower right), Stucco-clad building with stone masonry base, Cusco, September 2024, photo by author



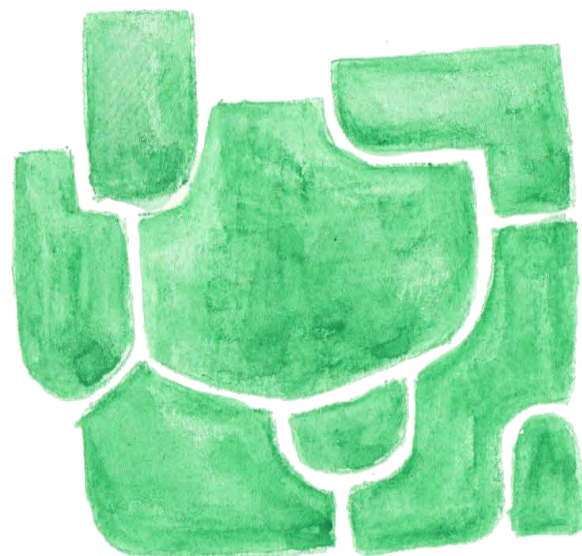
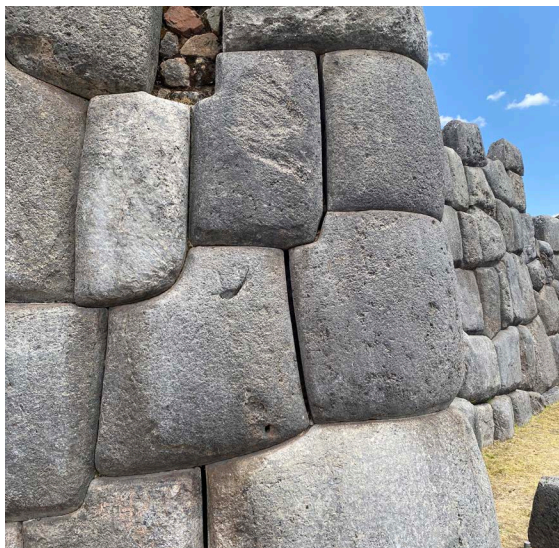
Cellular

Uncoursed masonry in which polygonal stones have rectilinear edges.



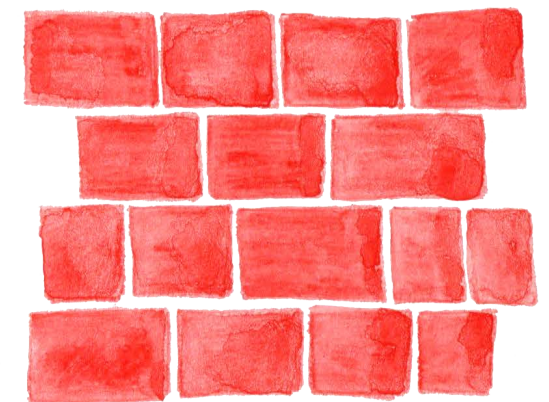
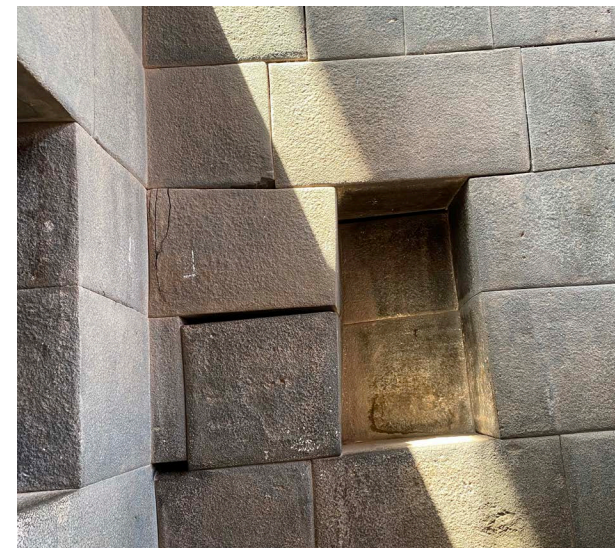
Cyclopean

Uncoursed masonry employing megaliths.



Fitted

Uncoursed masonry in which polygonal stones have curved edges.



Sedimentary

Coursed masonry made up of rectangular blocks arranged in straight courses. This type of masonry construction was reserved for the most important temples and palaces.

fig. 21 (top), 12-angled stone, Cusco, August 2024

fig. 22 (bottom), Sacsayhuaman, Cusco, August 2024, photo by author

fig. 23 (top), Sacsayhuaman, Cusco, August 2024, photo by author

fig. 24 (bottom), Qorikancha, Cusco, August 2024, photo by author

Because of the high degree of precision and finishing required in forming these stones, it is widely accepted that fitted stone walls were left uncovered on both sides. Forming quarried stones into building blocks was a highly labor-intensive process of subtraction. Builders used stone hammers to cut away small pieces of stone, which were repeatedly tested with other building blocks that had already been assembled into walls. The Quechua word *canincakuchini* translates to “nibbling away” and is used to describe the methodical process in which a stone is painstakingly shaped to fit in perfect alignment with its neighbors.

Inca builders assembled stones into highly regular structures that formed the empire’s signature style. Inca architecture was highly orthogonal in plan, with buildings and city blocks generally being laid out at 90-degree angles from one another. Most buildings consisted of a single room that was accessed via one trapezoidal door opening. Windows and niches also widened towards the bottom, lending a consistent form to all openings. Walls of Inca structures battered inwards on all four sides, most likely to increase structural stability given that the Inca Empire extended along highly seismically active areas. The two most common structures in the empire were the *kancha* and the *kallanka*.¹⁵ *Kanchas* were groups of single-room houses oriented orthogonally to one another that shared a common patio. The cluster of houses would often be enclosed by a single-story high wall with one entrance. *Kallankas* are the largest type of building documented in the Inca Empire and were used for large public ceremonies, feasting, celebrations, and temporary lodging. Like *kanchas*, *kallankas* were rectangular in plan and featured a gabled *ichu* and timber roof. However, the two types of buildings differed significantly in terms of scale, as *kallankas* could be hundreds of feet long compared to *kanchas* that were typically comprised of small structures intended to house close family units. The walls of these buildings would often be a hybrid of stone masonry and adobe,



fig. 25, (top left) Occupied kancha housing complex, Ollantaytambo, September 2024, photo by the author

fig. 26, (center left) Kancha illustration, The Incas: New Perspectives p. 176, by Gordon F. McEwan.

fig. 27, (bottom left) Hoist grips in stone masonry blocks, Ollantaytambo, September 2024, photo by the author

fig. 28, (top right) Illustration of how stones may have been shaped using handheld hammer stones, “Inca Stonemasonry,” by Jean-Pierre Protzen.

fig. 29, (bottom right) Preserved example of adobe and thatched structure, Pisac, August 2024, photo by the author

and steep roofs framed with timber and thatched with local feathergrass called *ichu* would be tied to the structure via stone peg-like fasteners carved into the top of walls.

In addition to constructing enclosed buildings, the Incas also made extensive use of stone masonry to shape the terrain around them. From terrace farming to aqueducts, Inca architects and engineers believed that the truest built expression of the Inca Empire came from collaboration with the earth (*Pachamama*), whom they venerated. Architects and stone masons would often design sun gates, which were portals that framed the sun at specific angles or oriented viewers towards points of interest in the surrounding landscape.



fig.30, Wall niches and roof pegs at the royal estate of Pisac (sedimentary coursing), August 2024, photo by the author



fig. 31 (top), Agricultural terraces at Machu Picchu, August 2024, photo by the author
fig. 32 (bottom), Sun gate, Ollantaytambo, September 2024, photo by the author



Stone as symbol

Architecture was used as a tool of territorial expansion across the Inca Empire in ways both physical and ideological. Inca remains in the provinces outside of Cusco reveal a practice of building on top of and alongside natural stone outcroppings, or what historian Carolyn Dean refers to as “living rocks”.¹⁶ These large pieces of embedded bedrock or superficial deposits could be found in abundance throughout the Andes and there is evidence that Inca builders used their locations to select sites for a range of structures, from simple *kanchas* to imperial fortresses. Rocky outcrops were sometimes manually shaped to form the foundation of buildings that sat atop them, which some historians posit offered structural stability in the event of earthquakes.¹⁷ There are numerous examples of carved outcrops that were formed to cast shadows during specific dates on

the Inca calendar, collect rainwater or the blood of sacrifices for observation or rituals, or to serve as altars for religious ceremonies.

During the reign of the Incas, architecture, like agriculture, animal husbandry, and weaving, was a means of imposing order on the untamed lands and people of the Andes.¹⁸ As the empire expanded, building on stone outcrops ensured that Inca architecture became an inextricable part of newly acquired territories. One could interpret carved outcrops as the bridge between wild and controlled, a manifestation of the important and aspirational Andean concept of *tinkuy*, meaning a convergence between two different forces that ultimately work together to create harmony.¹⁹ Mastering stone demonstrated the Incas position of control within the divinely-formed landscape. Incas built structures, roads, canals, and terraces with an understanding that artificially shaping the land using materials harvested from it would greatly impact the universal order between the three realms. They understood themselves to be appointed by *Viracocha*, the creator god, to actuate the empire’s order over the environment through carefully crafted interventions that were always finely calibrated to the 360-degree conditions surrounding each site.²⁰ Present-day residents of the Andes practice a tradition tracing back to pre-Inca times that involves offering a small amount of *chicha* (a fermented beverage made of corn popular in the region) to the earth while laying the first foundational stone for a new house. This tradition, named *tinka*, emphasizes the degree to which the earth itself is viewed as an essential collaborator in building projects.²¹

fig.33 (left), Royal Mausoleum, Machu Picchu, photo by Carolyn Dean

fig. 34 (right), Sacsayhuaman detail, Cusco, August 2024, photo by author

Elements of Power

The profound connections between stone and the Andean cosmological belief system can be observed through the Incas' advanced hydraulic engineering. Incas venerated many bodies of water and numerous water sources in the Cusco region were recognized as sacred sites (*wak'as*) that were incorporated into the system of spiritual paths (*siq'is*) that radiated out from the historic capital.²² Lake Titicaca is the most sacred body of water in the Andes and, according to Inca oral tradition, is said to be the birthplace of humanity. Archaeologist Tamara Bray theorizes that Inca leaders used their knowledge of hydraulic engineering to control the most vital natural substance in the empire, thus exerting power in the realms of spirituality, politics, and day-to-day use.²³ This was accomplished by channeling water from rivers and streams into a centralized system of aqueducts and canals that were directed to targeted sites oriented around the cult of water worship and ritual cleansing, such as Tambomachay and Tipon. Access to water across the hierarchy of Inca society was tightly regulated and the state controlled individual Inca subjects' water use. Rather than fetching water from a natural spring, civilians across the empire would have instead been restricted to collecting it from channels and spouts constructed by their imperial masters.²⁴ Through studying the extent to which the Incas sought to manage water movement and access, one can understand the key role that building with stone had in the relationship leaders cultivated between their subjects, the natural world, the cosmos, and their own authority.

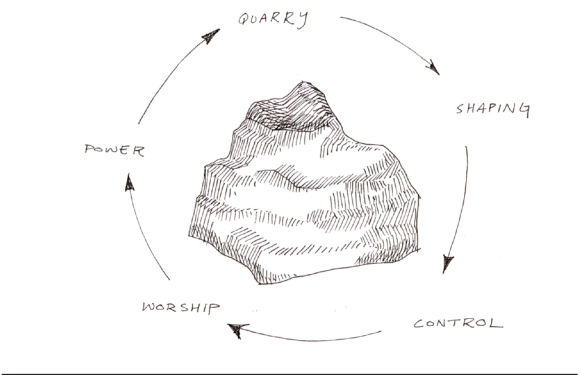


fig. 35, Cycle of the stone, drawn by author



fig.36 (upper left), Inca stone water channels and well, Pisac, August 2024, photo by the author

fig. 37 (bottom left), Inca water spout, Tambomachay, August 2024, photo by author

fig. 38 (upper right), Inca aqueduct, Ollantaytambo, September 2024, photo by the author

fig. 39 (bottom right), Inca aqueduct with highly refined integrated carved stone outcropping, Ollantaytambo, September 2024, photo by the author



fig. 40 (top), Sacred Rock of Machu Picchu, photo by Carolyn Dean

fig. 41 (bottom), Integrated Inca outcrop (with sedimentary coursing),
Pisac, phot by Carolyn Dean

Moving Forward in Stone

The Incas' use of stone as a building material is a fascinating study of architecture as a manifestation of the nature's grandeur. Architects, masons and laborers from all over the empire developed a highly labor-intensive practice of craftsmanship with a material which was found in abundance in the Andes. The village of Ollantaytambo, located in the Sacred Valley, is the most famous of a small handful of communities in which residents currently inhabit traditional Inca *kanchas* and use the stone roads, water channels, and farming terraces constructed over five hundred years ago. Small-scale attempts to build with stone using Inca techniques, specifically in pursuit of the iconic mortarless fit, have proven to be challenging and an impractical way to use the material in modern construction. However, stone is still widely used as a foundation for adobe buildings and in the landscape for fencing and terraces. These stones are assembled using mortar to reduce the time and expense of forming each into a unique shape. Whether employed in a traditional Inca structure or in the modern day, stone as a building material is suitable for the climate and conditions of the Cusco region due to its durability, sensory qualities, and cultural significance.

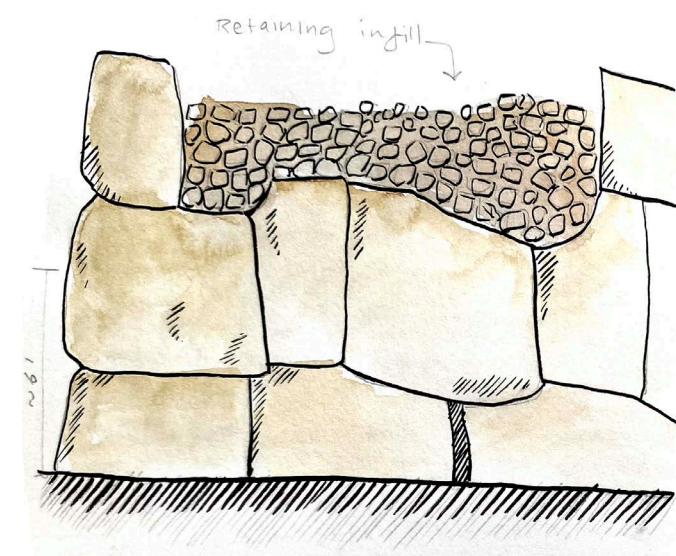


fig. 42, Sketch of Sacsayhuaman wall, August 2024, drawn by author

III

CUSCO IN THE PRESENT DAY

Cusco was once a small settlement in the greater Huatanay Valley. The settlement grew into a city during the period of Inca rule, which began in the mid-1400s, and was a highly contested seat of power during the Spanish conquest of Peru which began in 1532. After the Spanish formally sieged Cusco in 1534, the already weakening Inca Empire quickly collapsed. Alongside Lima, Cusco became an important political center whose inhabitants were largely stratified along economic and ethnic lines.

Peru declared independence from Spain in 1821, after which Cusco steadily grew until an economic crisis in the 1840s caused a sharp fall in the population and economic stagnation that lasted until the early 1900s. In 1911, an explorer from Yale University named Hiram Bingham publicized his “rediscovery” of the Inca citadel of Machu Picchu, which led to a surge of international interest in the region’s abundant cultural and material resources. Cusco quickly became an important nexus for the sale of Andean wool and Amazonian rubber. In 1933, the national government of Peru in Lima gave the city a sudden infusion of money for the purpose of carrying out “great works” in celebration of the 400th anniversary of Cusco’s founding as a Spanish city, which accelerated industrial and urban development.²⁵



“The Incanization of Cusco is always premised on the grandeur of the Inca empire and its elite manifestations rather than its tributary citizens and their descendants.”

Helaine Silverman, “Touring Ancient Times: The Present and Presented Past in Contemporary Peru”

fig. 43, Hiram Bingham and Pablito at the Intihuatana of Machu Picchu, 1911, photographer unknown



fig. 44 (top), Yarn dyeing and weaving demonstration, Chinchero, September 2024, photo by author

fig. 45 (bottom), Porters on trek to Machu Picchu, photo from AB Expeditions

A major earthquake in 1950 devastated Cusco, resulting in significant architectural losses. However, the catastrophe posed an opportunity to rebuild the city and implement modern services, such as a hydroelectric plant on the Urubamba river. The rebuilding effort spurred the construction of a slew of neo-Inca and neo-colonial style buildings in metropolitan Cusco. UNESCO was deeply involved in recovery efforts and sent technical advisors to the city to secure Cusco's architectural patrimony. The organization declared the historic center to be a world heritage site in 1983.²⁶ Thus began the "touristification" of Cusco, which Branca and Haller described as the development of resources and infrastructure that primarily serves a tourist population, as opposed to the process of gentrification, which describes general "social upgrades" for a larger cross section of the population.²⁷

An international destination

Through periods of internal conflict and military dictatorship, Cusco steadily grew in popularity as a tourist destination. The city was initially popular with backpackers but with the construction of hotels and passenger rail service connecting Cusco to Machu Picchu, greater numbers of tourists sought to create their own adventures in the Andes.

As of 2025, the population of Cusco is expected to reach 500,000 inhabitants. Cusco is the fifth largest city in Peru by population and by far one of the most frequently visited by tourists in South America.²⁸ Since the mid-20th century, the city has seen a massive influx of primarily Quechua speaking internal migrants from the greater Department of Cusco or other regions of Peru. These migrants are drawn to Cusco for economic and job opportunities, which have been largely brought about by the rapid growth of the tourism industry. The municipal government of Cusco has made a concerted effort to emphasize the city's Inca past in an attempt to rebuild it as a modern ancient city that is intended

to serve as the tourist capital of Peru and the Americas at large.²⁹ The museification of Cusco has created a form of tourism oriented around the superficial engagement with archaeological and otherwise historic sites, which have expanded to include the fabric of the city itself.³⁰

Cusco’s tourism-driven growth has resulted in unevenly distributed economic gains and the expansion of peri-urban areas of lower-quality development outside of the city center. The growth of the tourism industry and associated influx of capital have sharply increased real estate prices. Maps and aerial views of Cusco show significant urban density in the city center, which lies in a naturally occurring alluvial fan surrounded by mountains. The edges of the city are occupied by ad-hoc informal settlements in addition to an increasing number of ranch-style homes that are designed to be short-term rentals or vacation homes for upwardly mobile Peruvians and foreigners in search of the “Andean idyll” of comfortable, picturesque rurality with close access to the amenities of a city.³¹ Urban development not only impacts city-dwellers, but also rural laborers who face the paradox of a seemingly ever-expanding market in which to find employment and a dwindling of the very agricultural land that they rely on and that Cusco’s tourism industry promotes to visitors. The city finds itself in a catch-22 wherein the phenomenon of museification that presents Inca history for touristic consumption encroaches on the rural environment that is the reason so many visitors are drawn to the Andes in the first place. Through this process, the rural outskirts of Cusco become a postmodern leisure landscape, an “Andean amusement park” replete with the infrastructure to offer dune buggy tours, bungee jumping, paintball, guided treks, and rock climbing.³²

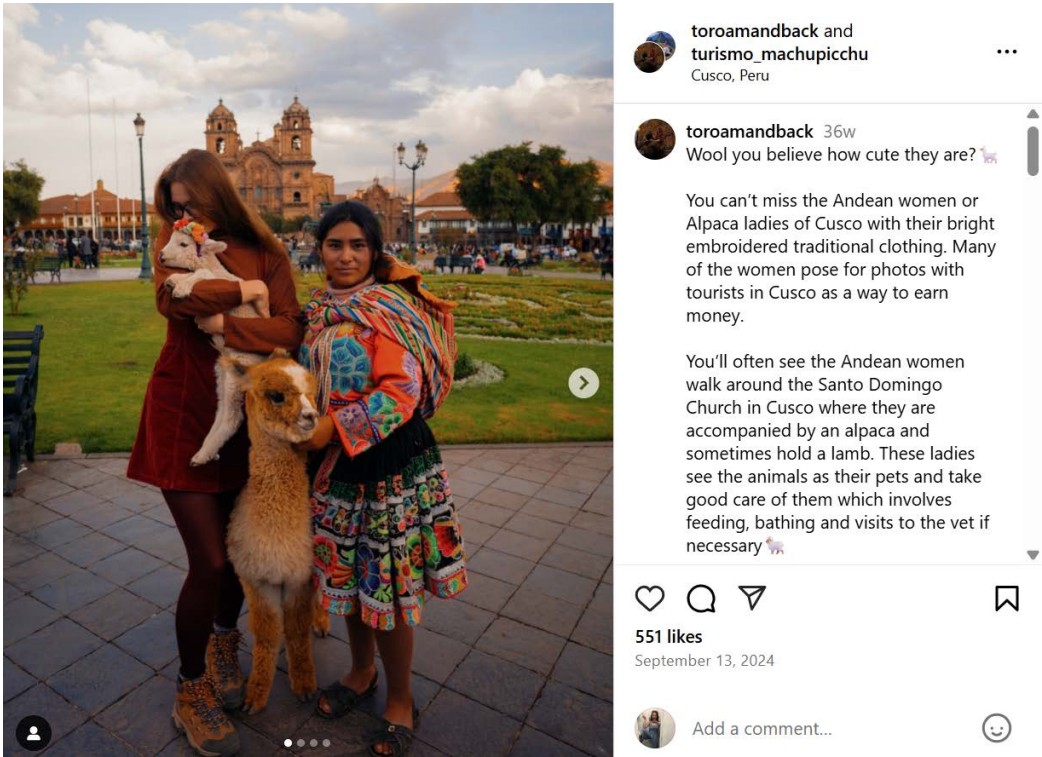


fig. 46 (top), Locals and tourists at Inti Raymi Festival, Sacsayhuaman, date unknown photo by Robert L. Vickery

fig. 47 (bottom), Instagram screenshot of @toroamandback showing “sacamefotos” woman who receives tips in exchange for photos with her and her animals

It is undeniable that Cusco's significance transcends its position as an economic driver in the Peruvian economy. Cusco is imbued with symbology from its Inca and colonial past. The city's meaning shifts depending on the stakeholder. Indigenous locals who are direct descendants of Inca subjects can lay claim to a venerated history while experiencing disenfranchisement due to systematic under-investment in regional services and opportunities. The national government based in Lima has a vested interest in promoting the image of Cusco as a living Inca city that appeals to international travelers. Tourists are drawn to Cusco because it is both remote and comfortable, possessing guides who can lead hikers across glaciers and restaurants that can cater to dietary restrictions. Tourism intensifies Cusco's mythologization as investors and government stakeholders extract financial value out of the city's Inca history.³³

Socio-Economic Factors

According to the Regional Development Plan published by the Cusco regional government in 2022, Cusco's population is becoming increasingly rural due to the growth of peri-urban and rural settlements around the historic center of the city. In 2022, approximately 61% of residents in Cusco lived in urban areas while 39% lived in rural areas.³⁴ Nearly 90% of residences in Cusco are single family homes, though they vary significantly in type of construction and quality depending on where they are located. In a study of homes with finished (hardwood, concrete, composite materials) versus earthen floors, authors of the Regional Development Plan found that 71% of homes in urban areas have finished floors versus only 13% in rural areas.³⁵ Earthen floors are strongly linked to precarity, poverty, and negative health outcomes. Additionally, residents of these homes experience discomfort from the cold that results from having unfinished/uninsulated floors, leading them to use more fossil fuels to heat their homes.

The Regional Development Plan analyzed Cusco's Human Development Index (HDI) in comparison to other regions in Peru and the country at large. HDI is a statistical composite index of literacy rates, life expectancy, and quality of life as measured by Gross National Income (GNI) per capita. In 2022, the Human Development Index in Cusco was 0.700 in comparison to the national HDI of 0.762.³⁶ Upwards-trending HDIs are largely seen on the coast of Peru, particularly in Lima. The COVID-19 pandemic stalled positive developments in the Cusco region in 2020, and the region's HDI has yet to recover to pre-pandemic levels.³⁷ A 2021 investigation by NPR found that Peru had the highest COVID mortality rate in the world due to a combination of factors that included poor testing and treatment facilities, the isolation of rural communities, an under-funded public healthcare system, overcrowded living conditions, and a massive informal economy making it impossible to adhere to a nationwide lockdown.³⁸

The modern medical system in Peru fails to meet patient needs in rural parts of the country, particularly where traditional medicine is still practiced under persecution or stigma.³⁹ The demand for medical care from rural and peri-urban communities is also too high to be met by donations, and when NGOs like the Red Cross build health stations, they are often left under- or un-staffed.⁴⁰ It is difficult to introduce and sustain ongoing medical services to impoverished and under-resourced communities.

Doctors trained in Peru receive limited education on traditional medicine despite the fact that all registered physicians are required to complete one year of practice in a rural or marginal-urban area upon graduating from medical school.⁴¹ Traditional plant-based medicine is often the primary form of medical care to which individuals who have been historically abandoned by the modern medical system have access. Traditional medicine

carries tangible connections to local culture and traditions. For healthcare practitioners to be effective in rural and peri-urban Cusco, it is vital for them to integrate traditional medicine and knowledge into their services. Not only would this build trust with the communities they serve, but in places where it is already logistically challenging and cost-prohibitive to access many forms of modern medicine, traditional medicine may be the most effective and accessible option through which to administer health care.

Nearly 25% of Peruvians live below the poverty line and providing services to vulnerable communities is made more difficult in the face of ongoing political instability.⁴² The economic marginalization of low-income peri-urban and rural communities makes them more likely to become sick and suffer from contracting treatable diseases and a widespread lack of hygiene resources. Community-run organizations that promote regionally-specific medical treatment exist in Cusco and include Yachaq Medicina Andina, Nutricion, y Ecologia and Instituto de Ecologia y Planatas Medicinales. These organizations work with community leaders, healers, and physicians to facilitate workshops to empower people with information relating to nutrition, hygiene, and preventative health. A bottom-up approach to community health has the potential to be more responsive and targeted than centralized efforts based in Lima or abroad. For the Cusco Living Observatory to meet the needs of the local peri-urban and rural population, it must contend with the region's pressing health crisis.

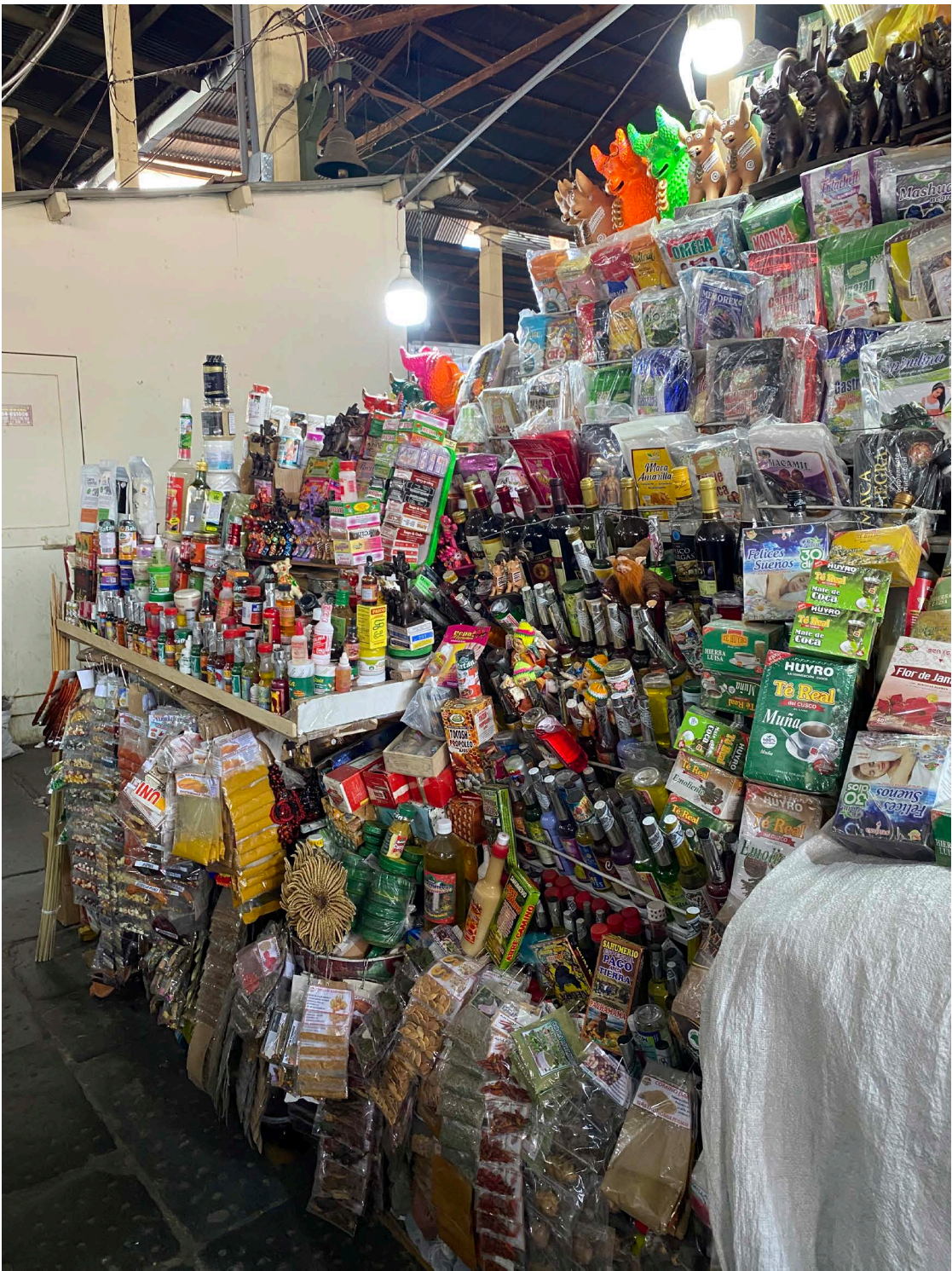


fig. 48, Traditional medicine vendor at San Pedro Market, Cusco, August 2024, photo by the author

Environmental factors

Cusco occupies a glacial basin in the Andean highlands and experiences a subtropical climate with a distinct wet and dry season. The dry season runs from May until September and is characterized by low humidity, clear skies, and cool temperatures, which are ideal for the outdoor activities that are popular in the region. Average daily temperatures during the dry season range from the low-30s to the mid-60s Fahrenheit. The rainy season runs from October until April and is generally warmer and more humid than the dry season, producing lush vegetation but more risk of potential travel disruptions due to flooding or landslides on roads. Average daily temperatures during the rainy season range from the high-40s to the high-70s Fahrenheit.⁴³

Taking advantage of the abundant solar access while mitigating glare is a priority in designing energy-efficient structures in Cusco. Buildings should incorporate low-tech strategies to regulate indoor comfort in a generally cool yet sunny environment, including using an exterior material like stone on the façade of the building to capture thermal heat, thus passively heating structures that are in use during cold days and in the evenings. Using photovoltaic panels, solar hot water heaters, automated blinds, and low-reflectivity indoor finishes would also help minimize the reliance on supplemental energy to take advantage of passive daylighting and solar energy generation.

Annual rainfall in Cusco ranges from an average of 5 inches in the month of January to less than a quarter of an inch in the month of June.⁴⁴ Throughout the Andean highlands, it is common to see stone gutters running at street-level directing rainwater through often steep terrain into a sewage system. Controlling the flow of water in inhabited mountainous regions by channeling it back into rivers, collecting it for human consumption, or using it in gravity-fed irrigation systems pre-dates the arrival of the Spanish in Cusco. Rainfall in Cusco has become increasingly variable with climate range,

and both drought and flooding are major concerns in the region. Minimizing water consumption on-site through replacing water-intensive vegetation with drought-tolerant plants, recycling graywater, and using composting toilets where possible reduces the environmental impact of new construction.

The Cusco-Vilcanota Fault System bisects the city and has long posed a major seismic hazard to local inhabitants. Cusco's many unreinforced masonry and adobe buildings are at risk of damage or collapse as a result of the roughly 100 small earthquakes that hit the region every year. The inconsistency of seasonal rainfall has resulted in a highly variable depth of the region's water table, which can trigger landslides separately from **and in** concert with earthquakes.⁴⁵

Climate change is in the process of destabilizing the natural environment of the Cusco region, exacerbating complex issues that impact a quickly growing population such as water management, air quality, and biodiversity.



fig.49, Wildfires near Machu Picchu, 2022, Reuters

IV

SITE ANALYSIS, PROGRAM, AND METHODOLOGY



fig. 50, Aerial view of Cusco, Google Earth

The city of Cusco is located in an alluvial fan surrounded by mountains, though the larger metropolitan area extends outwards in all directions. The most densely populated area of the city is in the basin and can be seen through maps and aerial photographs. Cusco's boundaries take their form primarily because of the presence of steep mountains and agricultural land. However, Cusco's peri-urban neighborhoods are becoming increasingly populated by internal migrants who moved to the city from other parts of Peru in search of job opportunities. They are predominantly of Indigenous Quechua descent. Property value in the historic center of Cusco is so high that most of the population of the rapidly growing city has few options but to live in the expanding informal settlements on the edge of Cusco which encroach on rural land that has historically been used for agriculture.

The site selected for this thesis is the 1.7 acres of land Planetarium Cusco owns and occupies. Planetarium Cusco is an independent family-run planetarium and educational center on the north-west edge of Cusco. It is located on one of the hillsides surrounding Cusco with a direct view of the city. Planetarium Cusco is part of the Sacsayhuaman archeological park and is within the Llaullipata Forest. Sacsayhuaman, the citadel for the historic Inca capital, is one of the most-visited archaeological sites in Peru, thanks in part to its proximity to Cusco. Planetarium Cusco runs educational programs to teach tourists and local students about the traditional Andean worldview through astronomy.

Staff members operate nightly programs in English and Spanish wherein vans of tourists are driven fifteen minutes north from the center of the city. Once on site, visitors are rotated through a slideshow presentation about the Incas' understanding of astronomy, a projected display within the domed planetarium, and outdoor astronomical observation using telescopes. These guided experiences last approximately two and a half hours in total. Additionally, the planetarium runs educational programs for local students in the Cusco region to help them gain exposure to the field of astronomy.

Planetarium Cusco currently occupies a building which has been constructed out of adobe, stone masonry, and timber. The roof is a combination of *ichu* and clay tiles. On their website, the planetarium describes their facility as “resembling any typical Andean house,” indicating that whether the facility was purpose-built or converted for its present use, it is important to the organization of the planetarium to occupy a building that appears familiar to locals and blends into its surroundings.

The planetarium occupies the southernmost point of the site, which also includes an auxiliary storage building and a small photovoltaic array. Since the site is on a hill, it has expansive views of Cusco to the southwest. With a 76-foot change in grade from the northeast to the southwest, the site is partially terraced using stone retaining walls in a manner that is typical for navigating varied topography in the region. The north, west, and east edges of the site are densely forested with non-native eucalyptus trees, as is typical in the Llaullipata Forest. The ground coverage is primarily grass and the area around the planetarium building is flat to facilitate outdoor observation.

Planetarium Cusco is unique because unlike most museums and archeological sites in the region that promote pre-Hispanic history, the organization's mission is to educate locals and tourists about how Indigenous approaches to science, technology, and society can be applied to modern life. In a nightly lecture, guides at the planetarium clearly communicate

the impacts climate change, overdevelopment, and resource extraction have on the Andean biome. In the Andes, rural populations that rely on agricultural production are some of the most impacted by climate change, which causes unpredictable weather patterns, flooding and wildfires. Planetarium Cusco advocates for a more balanced approach to resource management inspired by techniques developed by pre-Hispanic civilizations, including the Incas. Through dynamic group-based participation in their programming, tourists tap into a sense of wonder that distinguishes their experience at the Planetarium from most other museums or archaeological sites, where information is communicated via limited signage. The educational message of Planetarium Cusco is vital, particularly as the growth of the tourism industry attracts increasing numbers of people to a region that relies on the use of non-renewable resources to keep up with demand for transportation networks, accommodations, and experiences.



fig.51, Exterior view of Planetarium Cusco, August 2024, photo by author

Cultural Astronomy

The programmatic approach to this project is informed by the fields of cultural astronomy and archaeoastronomy. These fields are the study of how people in the past understood observable phenomena in the sky and the role the sky played in their cultures. These interrelated fields bridge evidence-based scientific investigation and anthropological research, creating a rich nexus through which to understand a foundational organizing element of many human societies. Interpretive centers, museums, and planetariums dedicated to teaching the public have an additional opportunity to highlight the astronomical traditions of Indigenous cultures that developed prior to colonization and exist in the present day.

The 'Imiloa Astronomy Center in Hilo, Hawaii is a leader in the field of culturally-specific scientific communication. Founded in 2006, it features exhibits on the overlap between Hawaiian culture and astronomy, with particular emphasis on the use of the sky in Polynesian naval wayfinding and the legacy of trade between the Pacific Islands.⁴⁶ The 'Imiloa Astronomy Center is part of the University of Hawaii at Hilo and is located one hour from the Mauna Kea Observatories. It draws upon the resources and expertise of researchers in the fields of climate science, history, Hawaiian language, and museology. As a family-oriented destination, the 'Imiloa Astronomy Center has a specific focus on educating young people about Hawaiian culture through engaging tactile displays, a vast garden, and shows inside of the 120-seat planetarium. It is a model for how to blend science with history to uplift a culture that experienced degradation as a result of colonization.



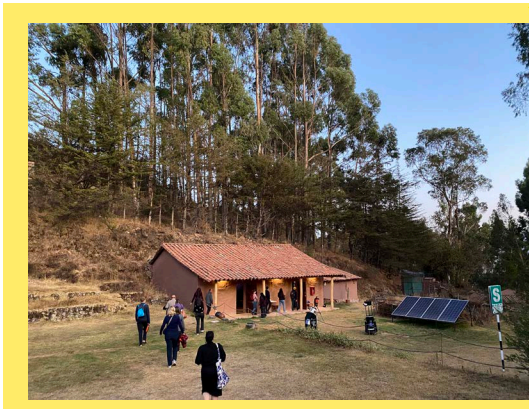
fig. 52 (bottom), Telescope set up outside of Planetarium Cusco, August 2024, photo by author

The ‘Imiloa Astronomy Center is a founding member of the One Sky Project, an international collaboration of scientific communicators “focused on increasing understanding of cultural and indigenous astronomy, its historical and modern applications, and how One Sky connects us all.”⁴⁷ The One Sky Project has produced eight films that are formatted to be screened inside domed planetariums, each focused on a different culture’s sky-lore. As the One Sky Project’s multi-media and place-based educational work expands, the Indigenous Andes would surely provide essential contributions to sharing the living legacy of the cosmovision.

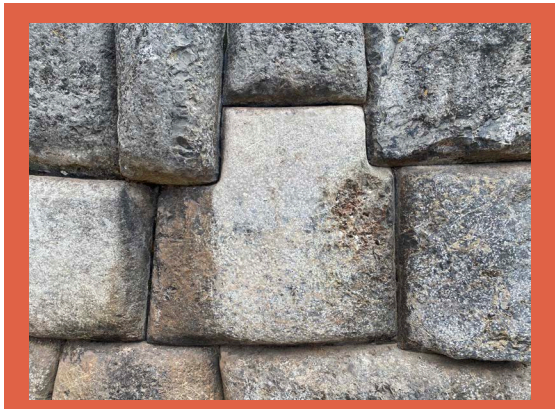
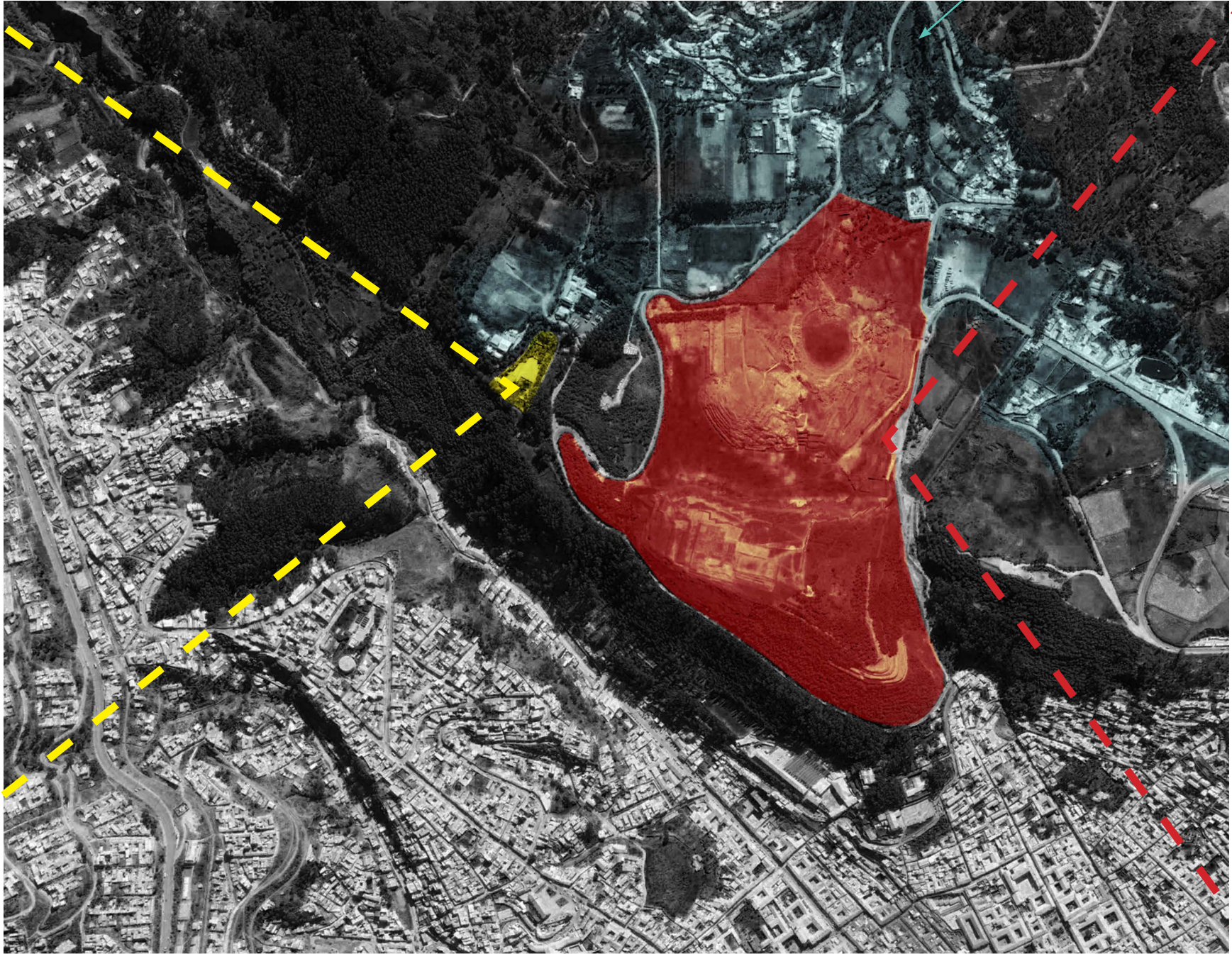
In this thesis’ area of investigation, the family-run Planetarium Cusco uses lectures, visual displays, and direct astronomical observation to teach a wide variety of visitors about the historic ways in which Andean people have used the sky to orient themselves, both physically and metaphorically. I seek to bolster research conducted on-site and expand the impact of the planetarium’s work through its integration into the Cusco Living Observatory. Encouraging public engagement with cultural astronomy may help deepen understanding of Indigenous Andean culture and prevent the loss of vital heritage.



fig. 53 (top), Tourists observing projected constellations in the domed planetarium at Planetarium Cusco, photo from Planetarium Cusco website
fig. 54 (bottom), Screenshot of One Sky Project’s Finding Patterns: Celestial Canoe short film about the sky lore of the First People of what is now northern Canada, One Sky Project website



Cusco Planetarium 2024.



Sacsayhuaman archaeological site, 2024.



fig.55, Aerial diagram showing site and adjacencies, image by author

The Andean Worldview in Action

In addition to information gathered during the literature review and my own visit to Peru in 2024, the study of the Andean worldview significantly informed the methodology for developing a project for the site of Planetarium Cusco. The historic and current residents of the Andes share the interpretation of reality that the world is comprised of three realms occupied by different but interconnected beings, forces, and deities. The realms are commonly represented by three animals, which have symbolic meaning in Andean mythology. The inner-earth realm, known as *ukhu pacha*, is represented by serpents said to be from where humans originate. *Kay pacha* is the realm of the outer earth, our observable reality which living humans and terrestrial creatures occupy. It is represented by a puma. *Hanan pacha* is the celestial realm of the sky, including all cosmological bodies and weather forces, and is associated with condors. This belief system reveals a keen awareness of the reciprocal links between humans, animals, the natural environment, and the immaterial realm beyond our grasp. The related Andean concept of *yanantin*, meaning complementary dualism, expands on the importance of balance between opposing forces. Harmony between the cosmos and the inner earth may be mediated through actions on the physical world we as humans occupy, and it is our role to maintain equilibrium.

With the cosmological worldview in mind, I developed a multi-faceted program on the site that expanded the Planetarium’s mission through material engagement with the three realms. From the scale of the human body to the cosmos, the profound interconnectedness between humans, our environment is a complex topic that warrants exploration.

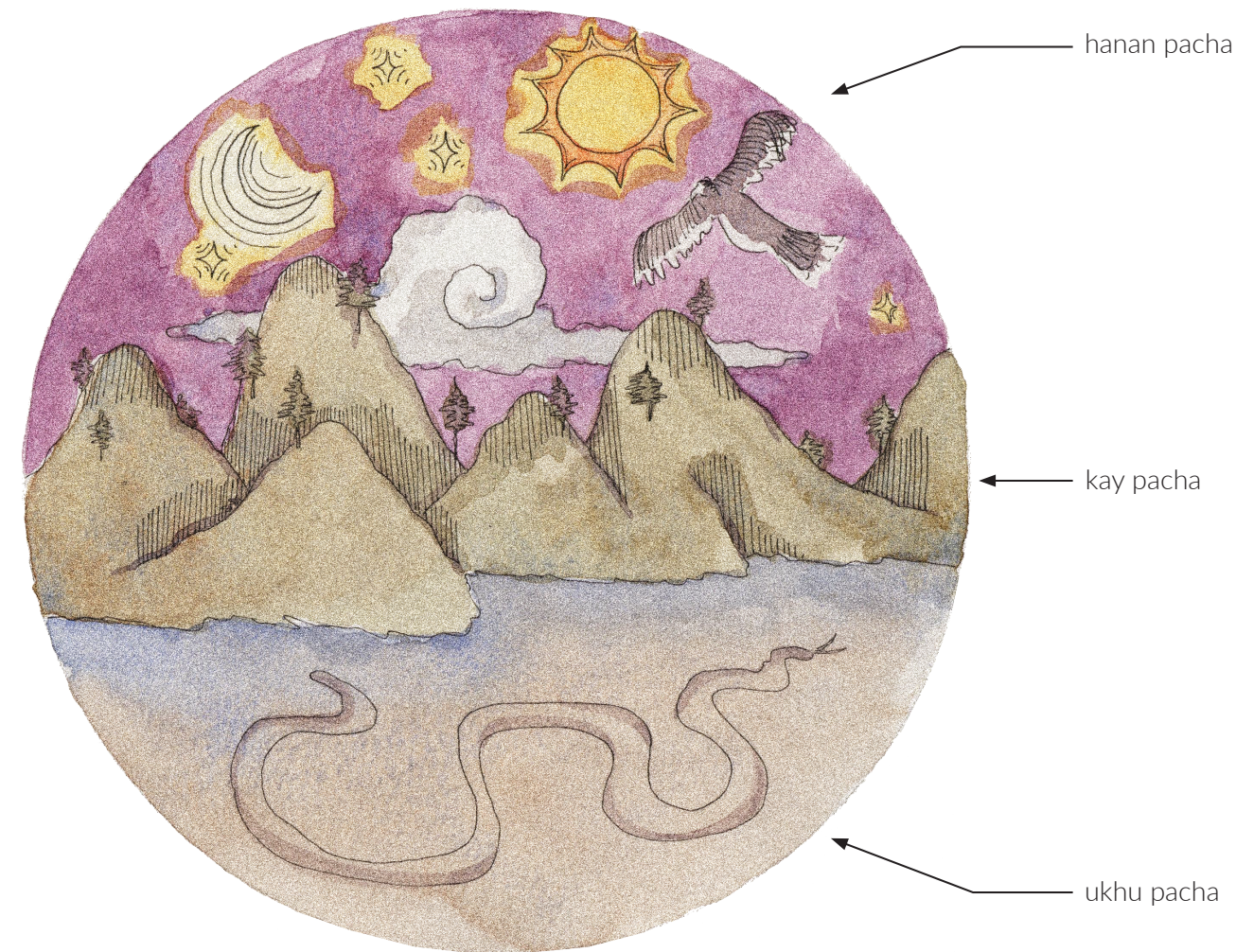


fig. 56, Illustration of the Three Realms of the Andean Worldview, drawn by author

V

DESIGN RESPONSE

This thesis proposes an expansion of Planetarium Cusco's programming to more holistically meet the needs of locals and tourists through a meaningful engagement with Indigenous traditions of astronomy, community knowledge, and spiritual and physical care. The Cusco Living Observatory and aims to promote traditional knowledge systems to educate tourists on the living legacy of pre-Hispanic civilizations while providing physical and informational resources to locals to connect with culturally empowering traditions that have historically been stigmatized.

The traditional Andean worldview, of which the cosmovision is a core component, lives on throughout the Cusco region, though it has morphed and faced persecution over time. However, the belief in the innate interconnectedness between human beings, the natural environment, and the invisible spiritual realm provides a framework that may help address the multifaceted issues facing the region in the present day, from climate change to economic disparities. The Cusco Living Observatory offers space for the study of Andean traditions with the broader mission of facilitating building coalitions for Indigenous self-determination in the face of ongoing social and political marginalization.



fig. 57, Concept collage, image by author

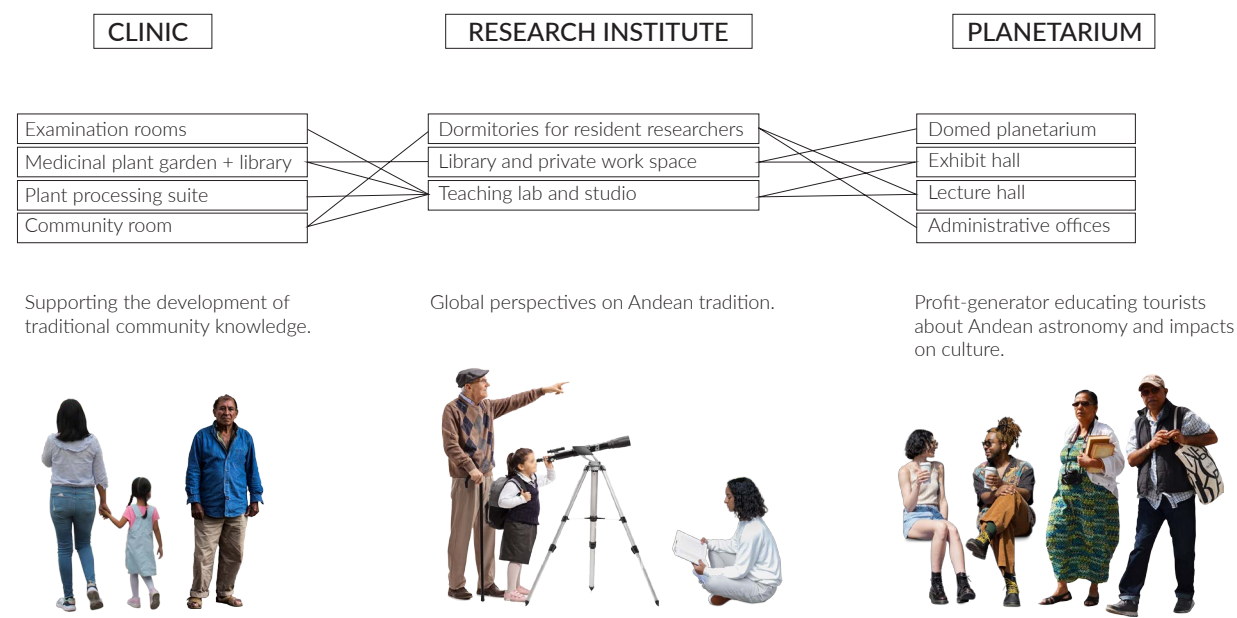


fig. 58 (top), Diagram highlighting site pathway, image by author

fig. 59 (bottom), Stakeholder diagram showing interconnected program elements, image by author

The Path

The Cusco Living Observatory presents a tripartite approach to the promotion of traditional knowledge. Three new buildings are embedded onto the site of Planetarium Cusco and are linked through a gently sloping promenade that navigates the steep terrain at a five-degree slope, with rest stops integrated at switchbacks to promote mindful travel and reflection. Visitors enter the site on foot at the eastern edge and walk northwesterly down a straight path leading to the clinic. To the right, stone retaining walls rise out of the earth and form the lowest terrace of the medicinal garden. Retaining walls blend into the façade of the buildings throughout the site, appearing to retreat into the environment.

Continuing beyond the clinic, visitors turn 300 degrees counterclockwise to continue their descent down the primary axis of the site, which runs in alignment with true north/south so that a stone gnomon positioned at the center of the path can accurately measure the passage of time.

The promenade terminates at a plaza, bordered to the west by the planetarium. The plaza, paved with the same local andesite as the rest of the path, is designed to be used for outdoor gatherings, lectures, and observation of the night sky.

Environmental Strategies

The Cusco Living Observatory is designed to celebrate and utilize the features of its natural environment, such the slope, strong year-round sun, heavy summer rains, and eucalyptus forest that covers and surrounds much of the site. A photovoltaic array captures energy from the sun to power lights, fans, and equipment throughout the observatory, while the stone-masonry exterior walls of buildings blend into the terrace walls that shape the landscape and employ a widely-used local material for thermal mass, keeping the buildings a comfortable temperature through the cool evenings and winters.

Though the northern half of the site is currently covered with non-native eucalyptus trees, I propose harvesting the majority of them and using the wood for structural timber, cladding, and flooring in the new buildings. Eucalyptus trees are known to negatively impact native plant biodiversity, consume large amounts of water – an often scarce and valuable resource in Cusco – and be highly flammable in the event of wildfires, which are an increasing risk. The northern third of the site will be converted from forest into a terraced native plant garden, in a style still used today by farmers in this steep, mountainous environment.

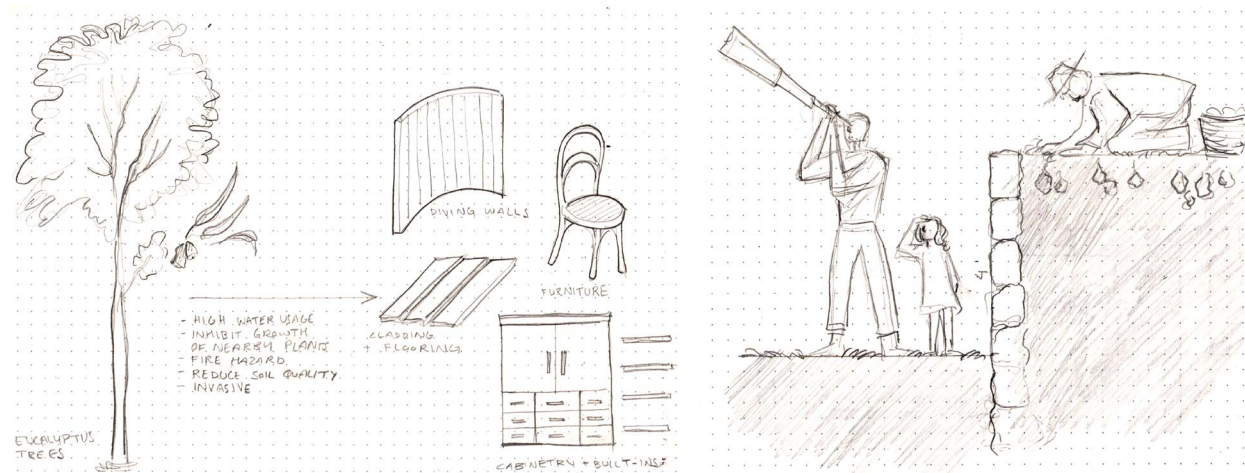


fig. 60 (top), Environmental diagram, image by author

fig. 61 (lower left), Sketch showing future uses for eucalyptus, drawn by author

fig. 62 (lower right), Concept sketch showing relationship between terraces and observation, drawn by author

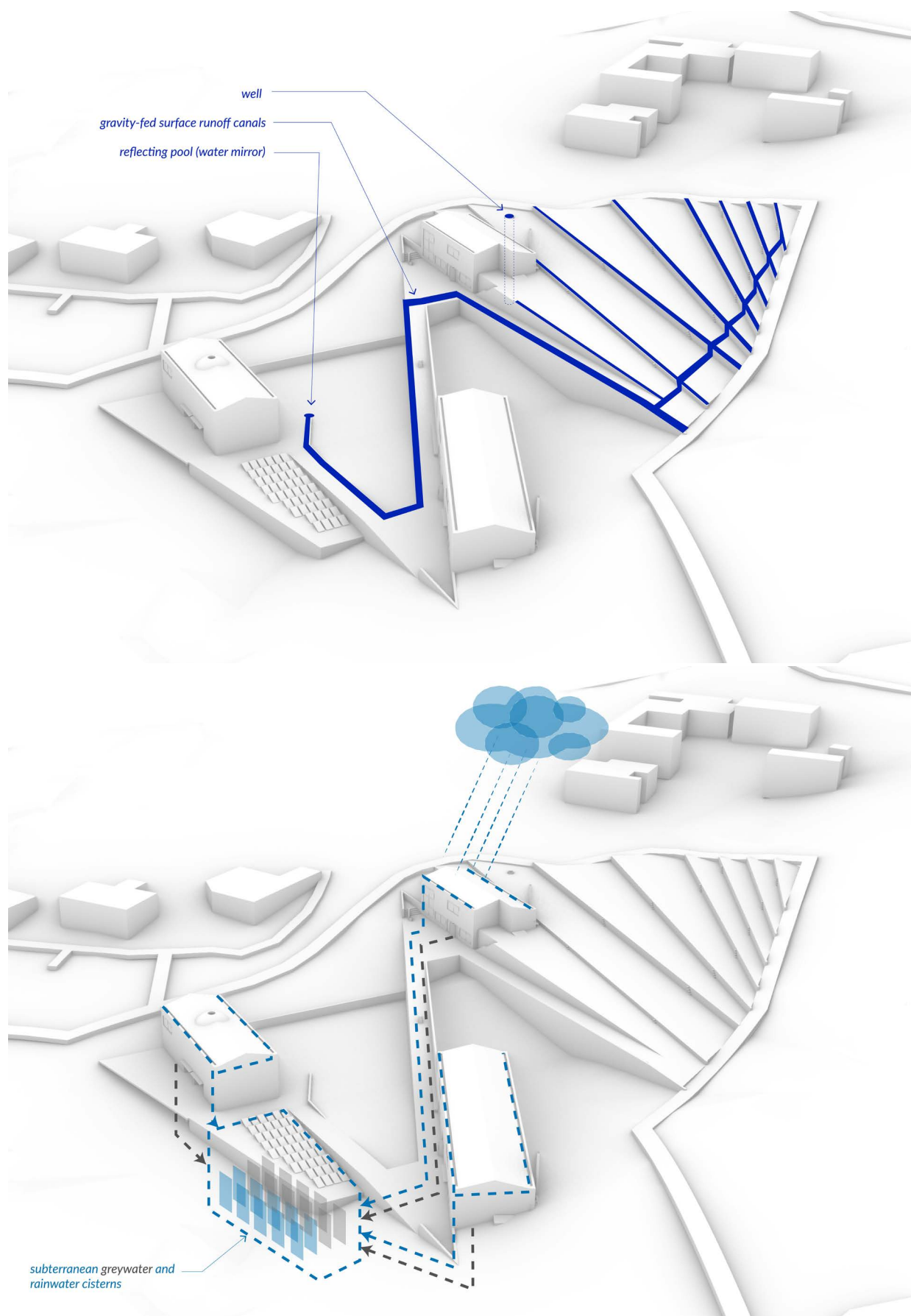
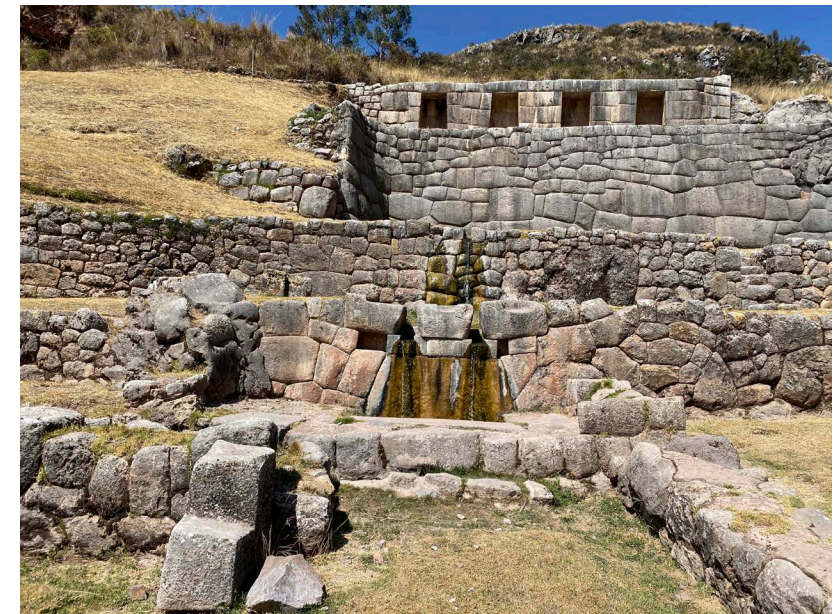


fig. 63 (top), Diagram showing rainwater channels and collection points, image by author

fig. 64 (bottom), Diagram showing rainwater collection on buildings and greywater system, image by author

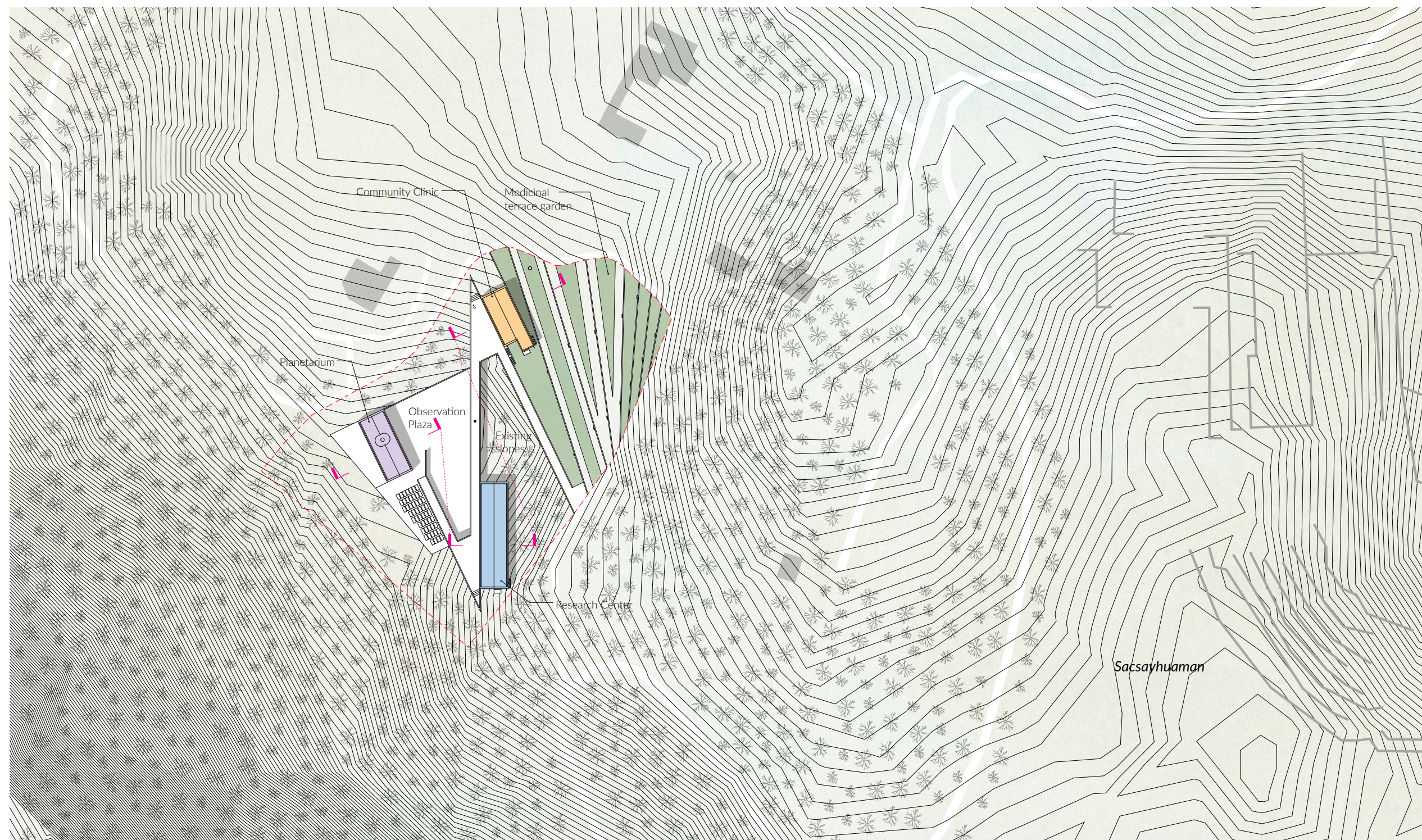


Water

The Cusco Living Observatory blurs the boundaries between landscape and architecture as a place where a diverse community of locals and visitors can study the historic adaptations of the Andean environment, which humans have inhabited and shaped for thousands of years.

Water consumption is managed through the use of solar-assisted composting toilets, drought tolerant indigenous plants, a greywater irrigation system, and channels that direct overflowing rainwater to a reflecting pool at the center of the plaza, inspired by pre-Hispanic water mirrors, which were used to observe solar eclipses. Due to the limited capacity of Cusco's municipal sewer system, water consumption will be managed entirely on-site. Drawing attention to the movement of surface water emphasizes Andean culture's view of water as a vital source of power and connection to nature.

fig. 65, Inca aqueduct, Tambomachay, photo by author



Community Clinic
 Research Center
 Planetarium

Site Plan



1" = 100'



fig. 66, Cusco Living Observatory site plan, image by author



Unfolded Site Section

1/16" = 1'-0"

0' 8' 16' 24' 40'

fig. 67, Cusco Living Observatory site section, image by author. Note grade change across site and repeated form of buildings.

Materials

The three buildings on this site appear to emerge out of the landscape, clad in an exterior wall made of andesite stone and a thick, breathable thatched roof made of ichu. By creating a double-wall system in which stone masonry is the exterior-facing surface, the buildings take advantage of the material's durability and capacity to store and gradually release thermal energy from the sun. Since stone retaining walls also form the terraced garden and support the zig-zagging sloping promenade, the buildings' matching material palette creates an effect as though they are emerging from the reconfigured matter of the earth itself. This material synergy is reinforced because neighboring Sacsayhuaman was built entirely out of andesite. In the context of the Cusco Living Observatory, the use of this stone represents a tangible continuity with the Inca history the site aims to elucidate.

The interior walls, separated from the stone walls by a small air gap, are a hybrid timber frame (harvested from eucalyptus trees on-site) and adobe system. Between the eucalyptus structure, the adobe bricks and plaster coating are earthen materials found in abundance and widely used in vernacular architecture of the Cusco region. The familiar tactile qualities of adobe and plaster and their ability to regulate indoor temperature while purifying the air lends an inviting, warm quality to the interior walls.

Stone and adobe are ubiquitous building materials found in communities throughout the Andes, though they are often associated with rurality and poverty. Steel and concrete are often viewed favorably as modern structural systems that may better resist weathering and seismic damage, though the carbon-intensive process of importing and building with them creates a large environmental footprint and contributes to the cultural degradation of traditional building materials and techniques. The Cusco Living Observatory aims to leverage the accessibility and sustainability of locally available materials to create buildings that express the unique haptic qualities of the Andes. Emerging out of terraces

and hillsides, the buildings reflect an alignment with the organization's mission by orienting visitors' attention towards the landscape.

Using traditional materials presents the opportunity to involve residents of Cusco in the construction process. Methods of laying stones, forming adobe bricks, and installing thatched roofs is widely understood by rural and peri-urban communities who are generally intimately involved in the building and maintenance of their own homes. The participatory nature of small-scale traditional construction can integrate traditional Quechua rituals associated with building, such tink'a, which involves making an offering to the earth before laying down the first foundational stone. This may lead to deeper regional acceptance and engagement with the Cusco Living Observatory once it is constructed.

This project intends to inspire reconsideration of regional materials and a widespread investment in using them in contemporary high-performance construction. The hybrid structure proposed for the buildings of the Cusco Living Observatory was greatly inspired by the system developed for the Druk White Lotus School in Ladakh, India.



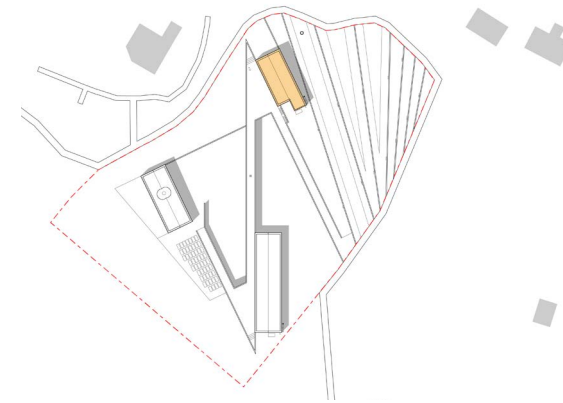
fig. 68 (top), Stone, adobe, and thatched roof building, Ollantaytambo, September 2024 image by author

fig. 69 (bottom), Stone retaining wall with integrated drainage system, Ollantaytambo, September 2024 image by author



Community Health Clinic Section

1/8" = 1'-0" 0' 4' 8' 12' 20'



Herbarium and Community Health Clinic

After walking alongside a terraced medicinal plant garden, the Community Health Clinic is the first building visitors encounter when entering the site from the east. The spiritual and physical work of caring for community members in the Andean worldview is rooted in the inner-earth realm. Plants are grown in the garden from seed and healing rituals involving music, chanting, and often, the presence of other people connects the local population who would use the clinic to the earth and members of their community.

The building's ground floor, which is embedded into the terraced earth behind it, is not conditioned by mechanical systems but remains cool because of the insulative qualities of the earth. The second story is at grade with the lowest of a series of cascading terraces that occupy the easternmost third of the site. At the entrance of the building, a hand-washing station helps promote health and connection to the element in an area where up to 25% of residents don't have access to running water.⁴⁹ The ground floor is divided into a double-height multipurpose room for community meetings, workshops, and celebrations to the north, while an herbarium which stores medicinal plants and seeds cultivated in the neighboring garden and processed on-site occupies the ground floor of the building. Community members would plant, harvest, dry, and store medicinal plants

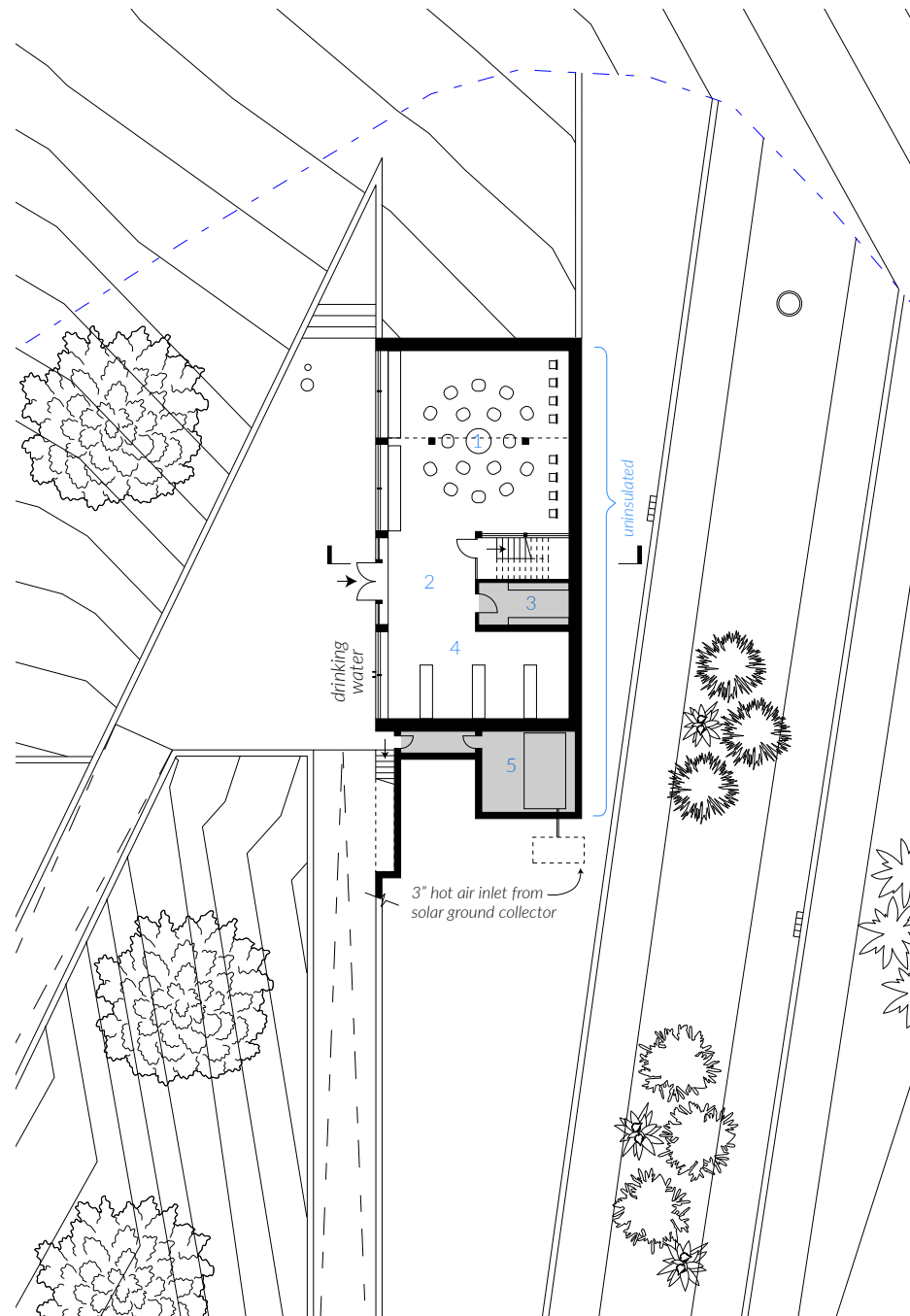


fig.71, Illustration of coca plant and uses, drawn by author

on site, creating a circular system of knowledge and practice for multiple generations of cusqueños who use it as a resource. Private examination rooms and a plant processing workshop occupy the second floor of the building, which is oriented towards the medicinal garden.

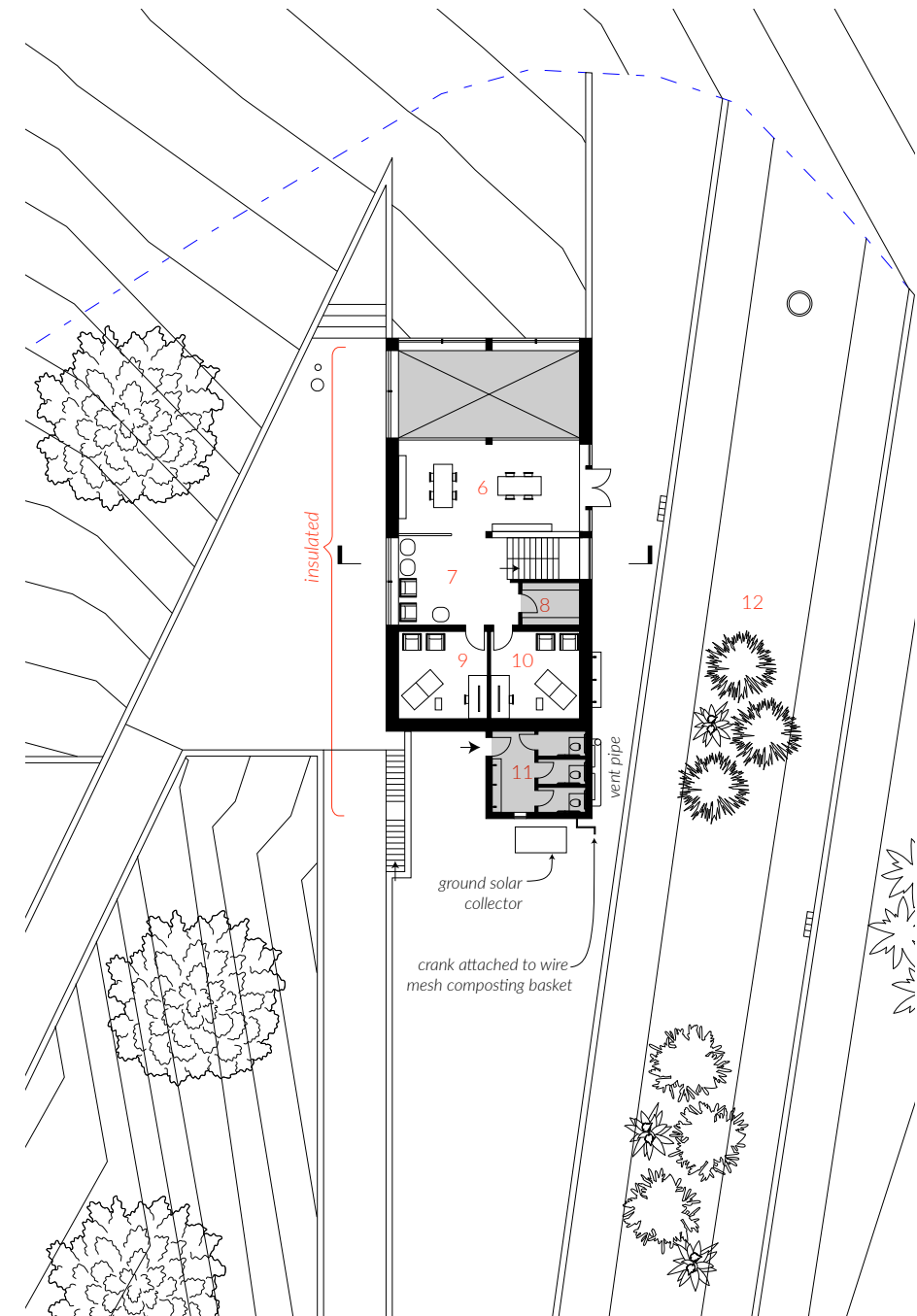
In the Andean worldview, physical and spiritual health are closely linked. Curative plants are typically processed and used in the form of infusions, tinctures, balms, syrups, and essential oils. Most tourists in Cusco engage with plant medicine without even realizing it by drinking mate de coca, a tea made by steeping the leaves of the coca plant in hot water. The resulting tea has a herbaceous, lightly-sweet flavor and is considered an effective treatment for altitude sickness. Other Andean plants used to treat health conditions ranging from eczema to arthritis include calendula, dandelion, fava beans, chamomile, flax, mint, and oregano.

The field of Indigenous pharmaceutical ecology is made up of healers who belong to the communities in which the knowledge of how to use plants as medicine originates and is transmitted. Researchers, usually from outside of these communities, apply empirical testing to the plants and study them from a sociological perspective. They seek to understand the measurable qualities of plant medicine and its role in communities. The clinic is imagined as a community-run resource that is engaged with the National Center for Intercultural Health in Lima and the Institute of Traditional Medicine in Iquitos.



Ground Floor

fig.72, Community Health Clinic Plans, drawn by author



Second Floor

1/16" = 1'-0"



- 1 Community meeting room (sala)
- 2 Entryway
- 3 Storage + mechanical
- 4 Herb library + storage
- 5 Second stage composting chamber
- 6 Jarring and processing room
- 7 Waiting room
- 8 Storage + mechanical
- 9 - 10 Clinic
- 11 Composting toilets
- 12 Medicinal terrace garden



fig.73, Exterior approach to Community Health clinic, image by author



fig.74, View south towards Cusco from terraced Medicine Garden, image by author



Research Center Section

1/8" = 1'-0" 0' 4' 8' 12' 20'

fig.75, Research Center section, image by author



Research Center

Following the flow of rainwater that collects on the edges of the sloping promenade, one reaches the second building on the site – the research center. This building features six dormitories, a kitchen, a library, a lab, and studio space.

The research center is the home base for a rotating crew of Peruvian and international scholars from a wide variety of disciplines who are united by an interest in the study of tradition as a means to advance their field. The ground floor features the lab and studios where researchers-in-residence carry out their projects and invite locals and tourists to participate in seminars. Bedrooms, a kitchen, and a library comprise the second floor of the building.

Grounded in the terrestrial realm of living beings, material culture, and the natural environment, the research center is a hub for interdisciplinary scholarship. Many popular archaeological attractions, including neighboring Sacsayhuaman, are also active excavation sites that host researchers from all over the world for digs. There are currently few opportunities for these scholars as well as those pursuing research in other fields to engage in public-facing work with tourists or locals in Cusco. The Research Center is envisioned as the bridge between the academy and the general population. The labs and studios on the ground floor would host workshops on the researchers' areas of expertise and serve as the experimental arm of both the community health clinic and the southernmost building on the site, the planetarium.

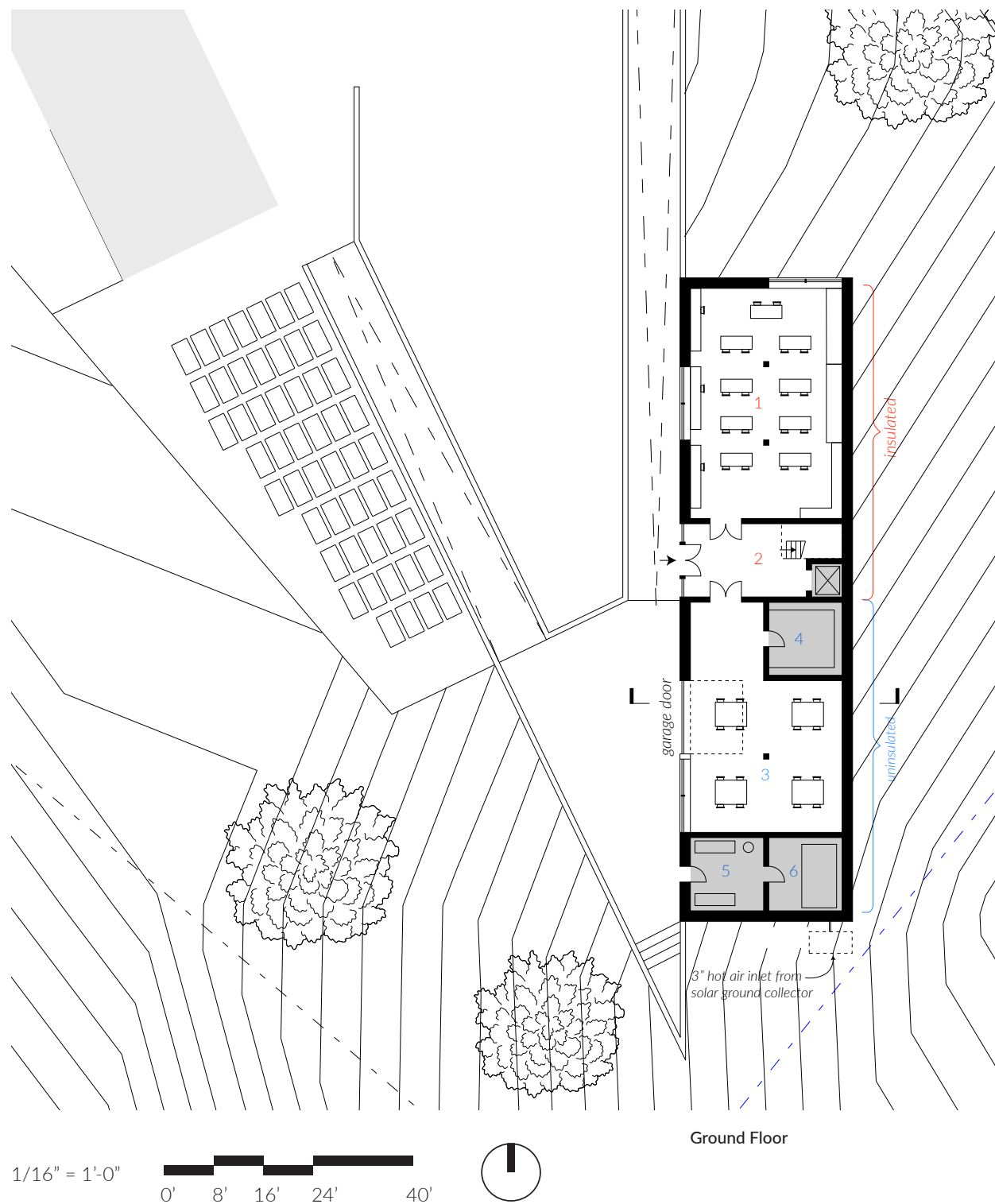
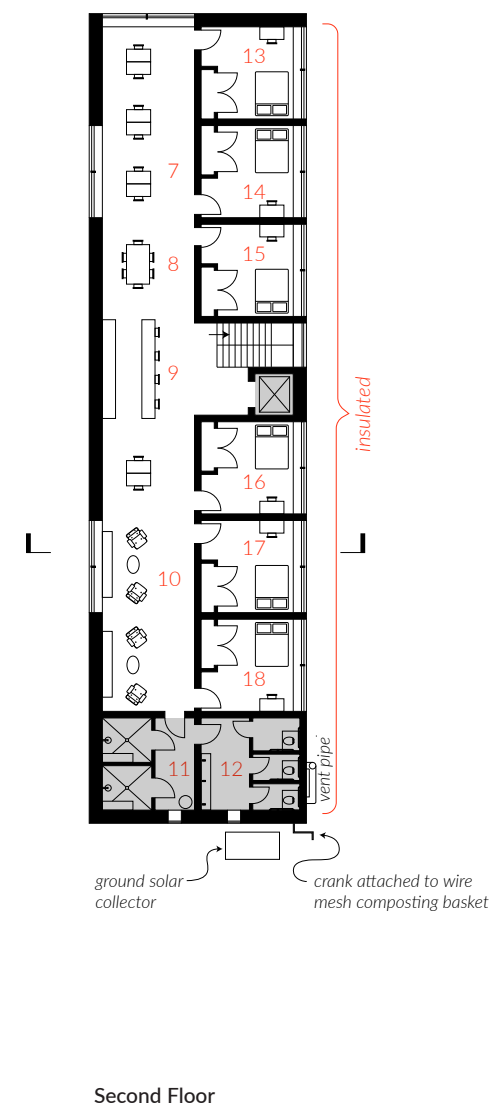


fig. 76, Research Center plans, image by author



- 1 Teaching Lab
- 2 Lobby
- 3 Studio
- 4 Storage
- 5 Mechanical
- 6 Second stage composting chamber
- 7 Work stations
- 8 Dining
- 9 Kitchen
- 10 Library
- 11 Shower + hot water tank
- 12 Composting toilets
- 13 - 18 Bedrooms



fig. 77, View towards plaza from Research Center, image by author



fig. 78, View towards Research Center from Plaza, image by author

Foreign researchers following Hiram Bingham's legacy have sought discovery and inspiration in Cusco's rich history and biodiversity. Being a hub of global scholarship has been a double-edged sword: as Cusco's profile rises as a result of publications and media coverage, the city's history and culture has often been misappropriated and misunderstood. Additionally, visiting researchers have a long history of stealing artefacts to be presented in international museums or private collections, contributing to the erasure of domestically-held Peruvian material heritage. The research center is focused on what people can learn from one another and the earth, whether it be scholars collaborating across disciplines or through classroom-based teaching. It is imagined as a hub for ideas to cross-pollinate, a place where local people, researchers, and tourists may interact as equals outside of a capitalist exchange.



Planetarium and Interpretive Center Section

1/8" = 1'-0" 0' 4' 8' 12' 20'

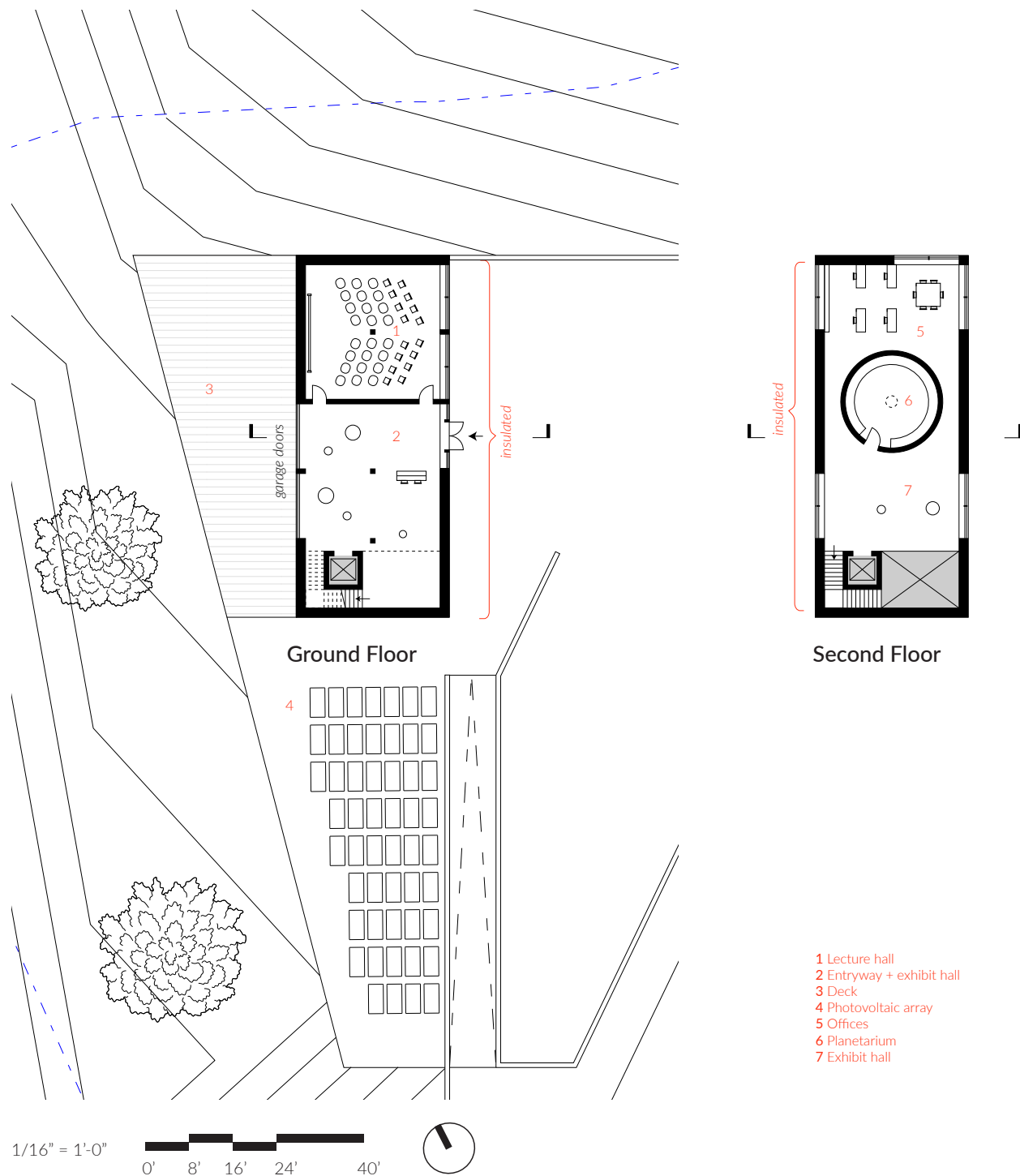
fig. 79, Planetarium and Interpretive Center section, image by author



Planetarium and Interpretive Center

Walking down the promenade to the lowest level of the site, one reaches a triangular plaza and the doors of the planetarium. This building houses the staff of the existing Cusco Planetarium, who strive to teach tourists and local students about the unifying cosmological view the Incas believed in through exhibitions, projections, and direct observation using telescopes and sky scanners.

On the first floor of the planetarium, guests walk through an exhibit about the legacy of cosmological observation in the Inca Empire and how interpretations of the night sky manifested in architecture, agriculture, and the structure of pre-Hispanic society. A dedicated lecture hall accommodates up to fifty audience members for themed presentations, an activity which is currently conducted in the small lobby of Planetarium Cusco. On the second floor of the building, a domed planetarium that doubles as an oculus holds up to twenty visitors who turn their gaze upwards to watch projected views of constellations, animated visualizations of Andean astronomy, and, during unprogrammed hours, the clouds passing overhead. Beyond the ground-floor exhibits,



visitors can access the south-facing deck, which has an elevated view above the city to observe the night sky with telescopes.

Information early Inca astronomers gathered from the skies, including planetary alignments, the perceived brightness of celestial bodies, and “dark constellations” informed agricultural planning, the layout of settlements, and their system of governance. In fostering a connection to celestial realm of the night sky, which cultures around the world have gazed at and interpreted for thousands of years, the planetarium attempts to clarify the links between the past and present in the Andes.

Visitors and residents of the Cusco Living Observatory are invited into a state of heightened awareness of their place in the world, both geographically and historically. Through shared experiences and a connection to nature, those who spend time on the site learn about strategies for environmental and community resilience inspired by Andean culture, which can then be taken home with them. Each of the three buildings facilitates connection to the surrounding environment in distinct ways that reflect one of the three interconnected pachas (realms). Visitors navigate the site from top to bottom, at all times enveloped by tall eucalyptus trees, native medicinal plants, expansive views towards Cusco and the ever-changing sky.

fig. 80, Planetarium and Interpretive Center plans, image by author



fig. 81, View towards of Observation Deck, image by author



fig. 82, Section perspective of planetarium dome, exhibit hall, and office, image by author

VI

CONCLUSION

When I began my visit to Peru in the summer of 2024, I knew that I was interested in the study of tourism because even though I was born in Lima, I often feel like a foreigner while visiting Cusco because of the extent to which tourism has shaped the city. I started by walking the path of the tourist, visiting as many museums, markets, and archaeological sites as I could to understand the strengths and weaknesses of the region's tourism infrastructure. I spoke with dozens of tourists, guides (both licensed and unlicensed), and docents about what they wanted out of the cultural exchange inherent in international tourism. On a whim, I booked a visit to Planetarium Cusco and became immediately fascinated by their mission and framing of the Andean cosmovision as not simply an artefact of the past, but as a source of potentially life-saving knowledge if studied and actualized with careful consideration.

I wanted to see what it would look like to bring tourists and locals together in an effort to solve one another's problems. This thesis contends that the tremendous capital and investment in tourism infrastructure can be leveraged to form not only more meaningful experiences for tourists, but opportunities for local people to connect with Andean culture and gain access to educational opportunities. The Cusco Living Observatory imagines a future in which tourists are not siloed into a pre-defined set of commodifiable experiences and locals do not have to participate in the tourism industry at the expense of their cultural integrity. Through the creation of shared space adjacent to a ticketed archaeological site, cusqueños gain access to a non-commercialized public realm. On a single site, a variety of individuals engage with Indigenous traditions through active practice, study, and communication. This project may provide a framework for

sustainable tourism that leads to deeper cross-cultural understanding and improved living conditions for local communities, particularly in formerly colonized lands.

My work on this thesis was impacted by a number of limitations, including the fact that I was not able to return to Cusco after my research trip to study the site further. While I am fluent in Spanish, I do not speak Quechua and thus was unable to communicate with many Indigenous locals in their first language. This thesis could be developed further through a deeper study into principles of Andean landscape architecture and medicinal plants, which have proven to be an incredibly rich topic of investigation that I only touched on lightly in this project. Additionally, I could more thoroughly develop the tectonic language of the building to select materials and structural systems that embody the concepts found within the Andean cosmovision. Finally, I had hoped to explore the Cusco region's transit systems at the outset of this project and develop low-carbon strategies to bring visitors to the Cusco Living Observatory from the city center (ideas included a dedicated hiking path, gondolas, and funiculars to navigate the steep grade).

Despite these limitations, this thesis has the potential to expand into a research-driven practice focused on cultural empowerment and environmental adaptation. I have found it deeply rewarding to immerse myself in the study of Andean culture as a way to understand aspects of my own heritage as a multiracial Peruvian person. As I pursue further research into the topics presented in this thesis, I will continue to study spaces devoted to intercultural communication and ways in which human beings and nature can operate in mutual symbiosis. I hope to contribute to the advancement of these ideas not only within the realm of tourism, but throughout the built environment at large.



fig. 83, Condor's view of the Cusco Living Observatory, image by author

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fig. 69 (bottom), Stone retaining wall with integrated drainage system, Ollantaytambo, September 2024 image by author

fig. 70, Community Health Clinic + Medicine Garden Section, image by author

fig. 71, Illustration of coca plant and uses, drawn by author

fig. 72, Community Health Clinic Plans, drawn by author

fig. 73 Exterior approach to Community Health clinic, image by author

fig. 74, View south towards Cusco from terraced Medicine Garden, image by author

fig. 75, Research Center section, image by author

fig.76, Research Center plans, image by author

fig. 77, View towards plaza from Research Center, image by author

fig. 78, View towards Research Center from Plaza, image by author

fig. 79, Planetarium and Interpretive Center section, image by author

fig. 80, Planetarium and Interpretive Center plans, image by author

fig. 81, View towards of Observation Deck, image by author

fig. 82, Section perspective of planetarium dome, exhibit hall, and office, image by author

fig. 83, Condor's view of the Cusco Living Observatory, image by author

IX. FOOTNOTES

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X. QUECHUA GLOSSARY

Canincakuchini – the process by which stone blocks are gradually “nibbled away” by hammers

Inti – sun, sun-god

Intihuatana – ritual Stone associated with the Inca astronomic calendar

Kancha – Inca courtyard-style houses

Killa – moon, moon-goddess

Pacha - realm

Hanan Pacha – celestial realm
Kay Pacha – earth realm
Uku Pacha – inner-earth realm

Pachamama – Mother Earth

Qhapaq Ñan – royal road, the paved highways Incas built to traverse the empire

Qolqa – deposit

Qorikancha – Temple of the Sun in Cusco, the most significant temple in the Inca empire

Rumi – stone

Sapa Inca – Inca emperor

Siq'i – spiritual path radiating out of Cusco

Tawantinsuyu – “Realm of the Four Parts”, the historic name of the Inca Empire

Tinkuy – the convergence of two things or forces that come together to form a flow

Wak'a – sacred site, altar