

Marking A Center: Concept, Geometry, and Assembly
An Osteopathic Medical Center for the Community of Verón, Dominican Republic

n. fredrik hedvall
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may 4, 2007

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An Osteopathic Medical Center for the Community of Verón, Dominican Republic

N. Fredrik Hedvall

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of master of architecture.

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Blacksburg, Virginia
May 4th, 2007

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The subject of this thesis centers around the study of process; the process of taking a germinal concept or idea and translating it into the language of built form.

In this particular case, the process can be described as binary, containing two distinct stages. The first stage consists of the process of translating a gestural idea or sketch into a language which is geometrically descriptive and consequently reproducible.

The second stage of the process involves the translation of geometrical ideas into the language of construction. How can the dimensionless character of a geometrical model be expressed and accommodated architecturally?

Dedicated to my parents,
Åke and Britt-Marie Hedvall, in gratitude for their
continuous concern and support throughout an
unusually long student career.

Acknowledgements

A very special thank you to the members of my thesis committee for their advice, insight, encouragement, and understanding.

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Background

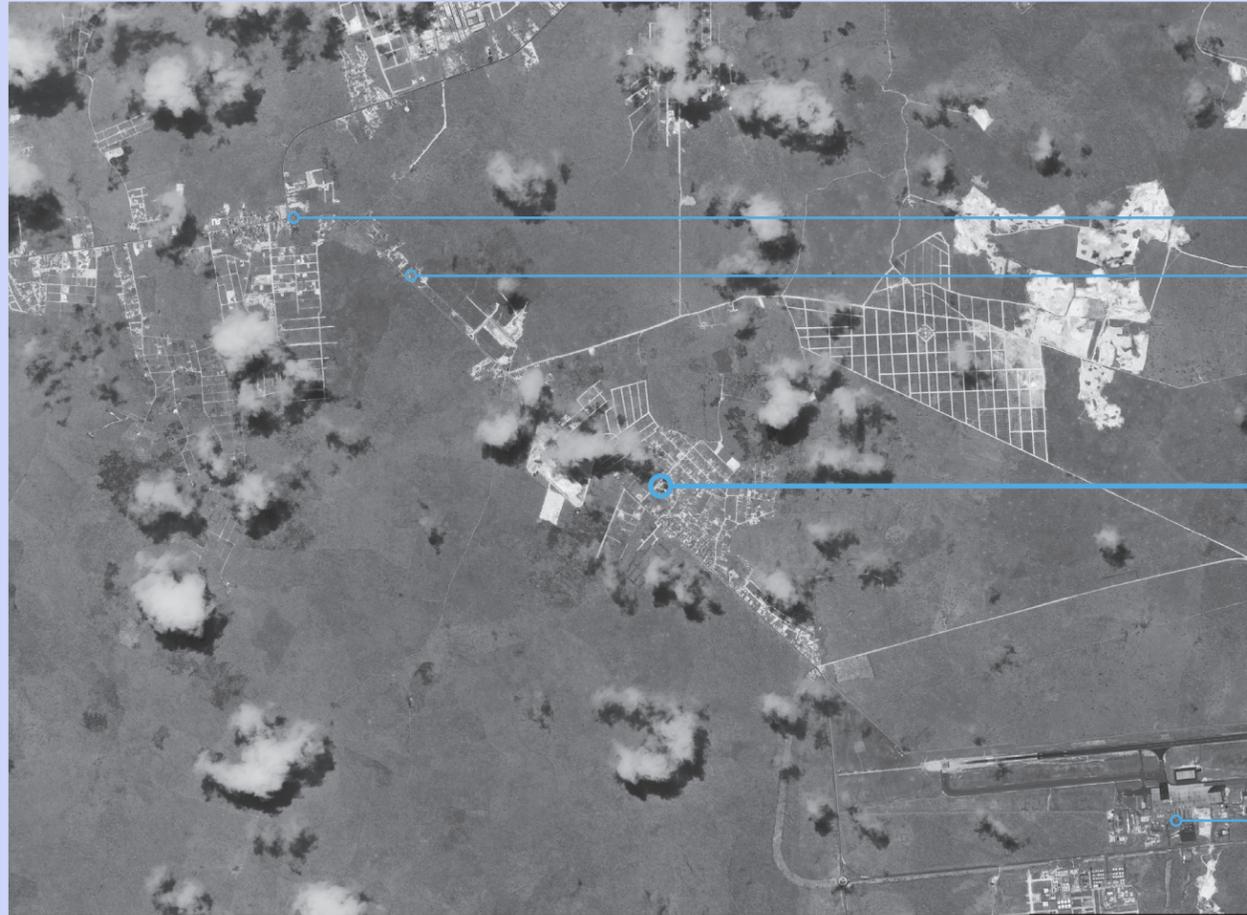


In 2006, under an agreement with government authorities, Grupo Punta Cana, and other non-profit agencies, The Virginia College of Osteopathic Medicine opened the doors of a newly renovated health center in Verón, Dominican Republic. Though the improvements in staffing and condition of the government facility were significant, many problems with the building remain. The existing facility is felt to be unfortunately sited, being somewhat remote from the most densely populated areas of Verón and therefore inconvenient to most of the community's non-driving population. VCOM will continue to utilize the existing clinic building, but long-range plans include the possibility of creating a new health center within the "High" Verón area, with expanded offerings to the community, including health education.

This thesis project has adopted the programmatic needs of such a facility and attempts to address some of the desires expressed by those closest to the project. Some examples are: a clinic which serves as a community center, a flag ship which reflects the values of VCOM and the practice of osteopathic medicine, a "healthy" building which minimizes the impact of its existence on the environment. For these reasons, the project described within addresses such issues as natural ventilation, shading, active solar strategies, and the implementation of local building materials.



The current clinic, though greatly improved since VCOM's renovation, still has many shortcomings. Primary among these is its size. The present clinic has only about 6 treatment rooms which double as staff offices. The waiting room only seats approximately 5 people requiring the conversion of a car port into an outdoor waiting area. With two entrances the flow and control of patients is far from ideal. The entrances to the clinic are barred and locked and only opened when the next patient is called in. The clinic windows are small providing inadequate ventilation and lighting to the facility's interior.



• Lower Verón (Verón Bajo)

• Location of Existing Clinic

• Upper Verón (Verón Alto)
Proposed Site

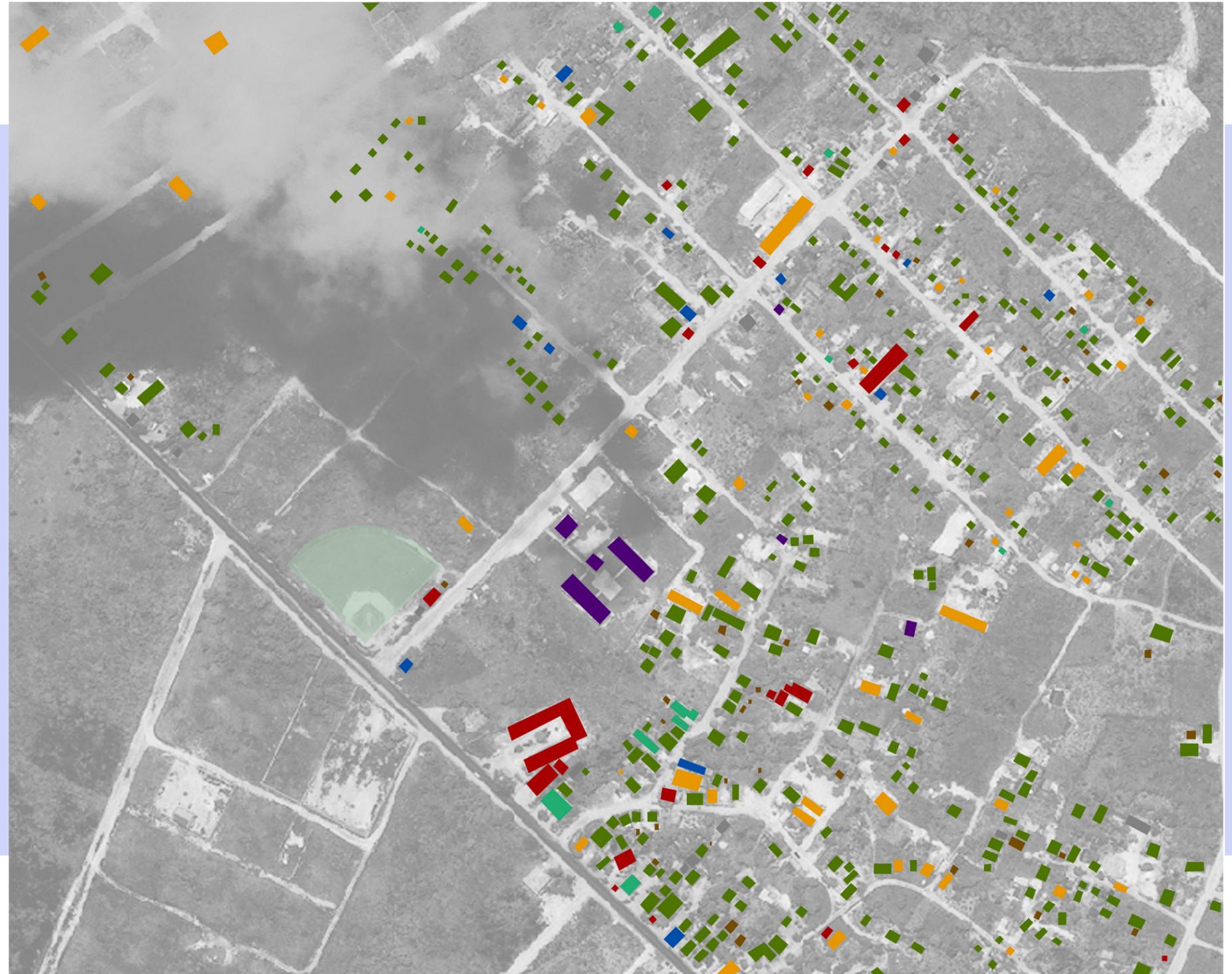
• Punta Cana Airport

The community of Verón is located near the easternmost tip of the Dominican Republic, approximately a 15 minute drive inland from the coast. In 1969 only three or four families lived in the area, and in 1993 there were less than 80 houses. Beginning around 2000, the area experienced a significant increase in its population. The stimulus for this growth was the development of a tourist industry in the area and the construction of numerous beach resorts along the eastern coast of the country. Attracted by the promise of work in the construction or service industry, workers from both Haiti and the Dominican Republic migrated to the area. With no housing readily available, the town of Verón grew into a sprawling squatter's settlement with an estimated population of 9,000.

Verón is divided into two distinct areas: Lower Verón (Verón Bajo) to the north west and Upper Verón (Verón Alto) to the south east. Although separated by some miles, the inhabitants think and speak of the two areas as one. The existing clinic lies along the road between these two areas. The proposed site for this project lies in Upper Verón.

-  Institutional
-  Residential
-  Mixed: Residential + Colmado
-  Colmado / Restaurant
-  Commercial
Mixed: Residential + Colmado
-  Under Construction
-  Outhouse / Latrine
-  Other

An unfortunate aspect of the rapid and uncontrolled growth of the area is the evident lack of a center or core to the town. As can be seen from aerial photographs of the town, the community is strung out along the highway and reveals no focal points or nodes. The site chosen for this project lies in an Upper Verón neighborhood nicknamed "villa plywood" which branches off a poorly paved street "la Avenida" and connects to the busy two-lane highway that runs between the resorts and the inland of the island. This particular site boasts two of the few civic facilities in the town. One is the Ted and Nancy Kheel Polytechnic High School; the other is the baseball field which is a popular place for members of the community to meet.





Examples of commercial buildings near proposed site.



Example of residence near proposed site.



Example of commercial building near site.



Ted and Nancy Kheel high school.



The proposed site as seen from the northeast. The outer wall of the community baseball field can be seen mid picture.



The proposed site as seen from the southwest. Portions of the high school are visible on the far right of the picture.

The climate of the area is classified as warm-wet to hot-wet, with average temperatures rarely dropping below 70 degrees Fahrenheit, and often exceeding 90 degrees Fahrenheit. Relative humidity is consistently over 90 percent in the morning, and rarely drops below 70 percent over the course of the day. Average monthly rainfall ranges from roughly 2.5 inches during the dry season, to 6 inches in the wet season. Verón sees roughly 44 inches of rain per year.

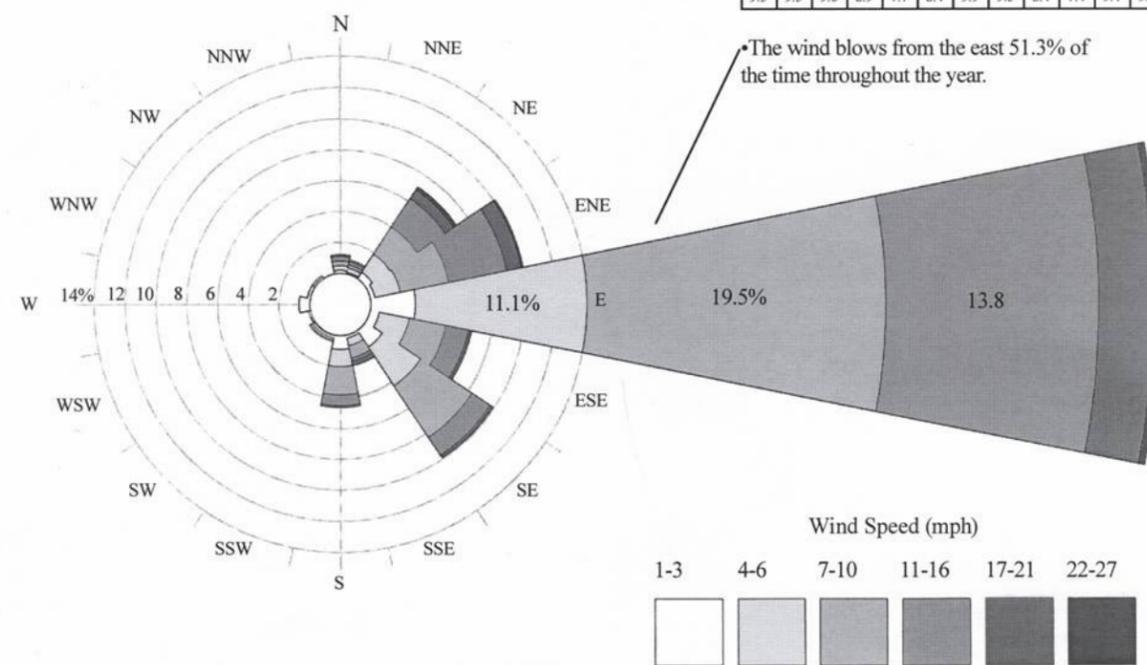
The climatic conditions of the Dominican Republic had a significant influence on the design of this project. Of primary importance was the desire to provide relief from the intense Caribbean sun by designing ample shading for both interior spaces and outdoor areas. The clinic was designed so that visitors would be shielded from the sun and rain from the moment of arrival.



Photo: David Weissberger

Annual Wind Speed and Direction

Frequency Graph (1973-1993)
Cabo Engaño, Dominican Republic
18° 37' N 69° 19' W



Source: International Station Meteorological Climate Summary CD-ROM, 1996
drawn 10-24-2005 by David Weissberger

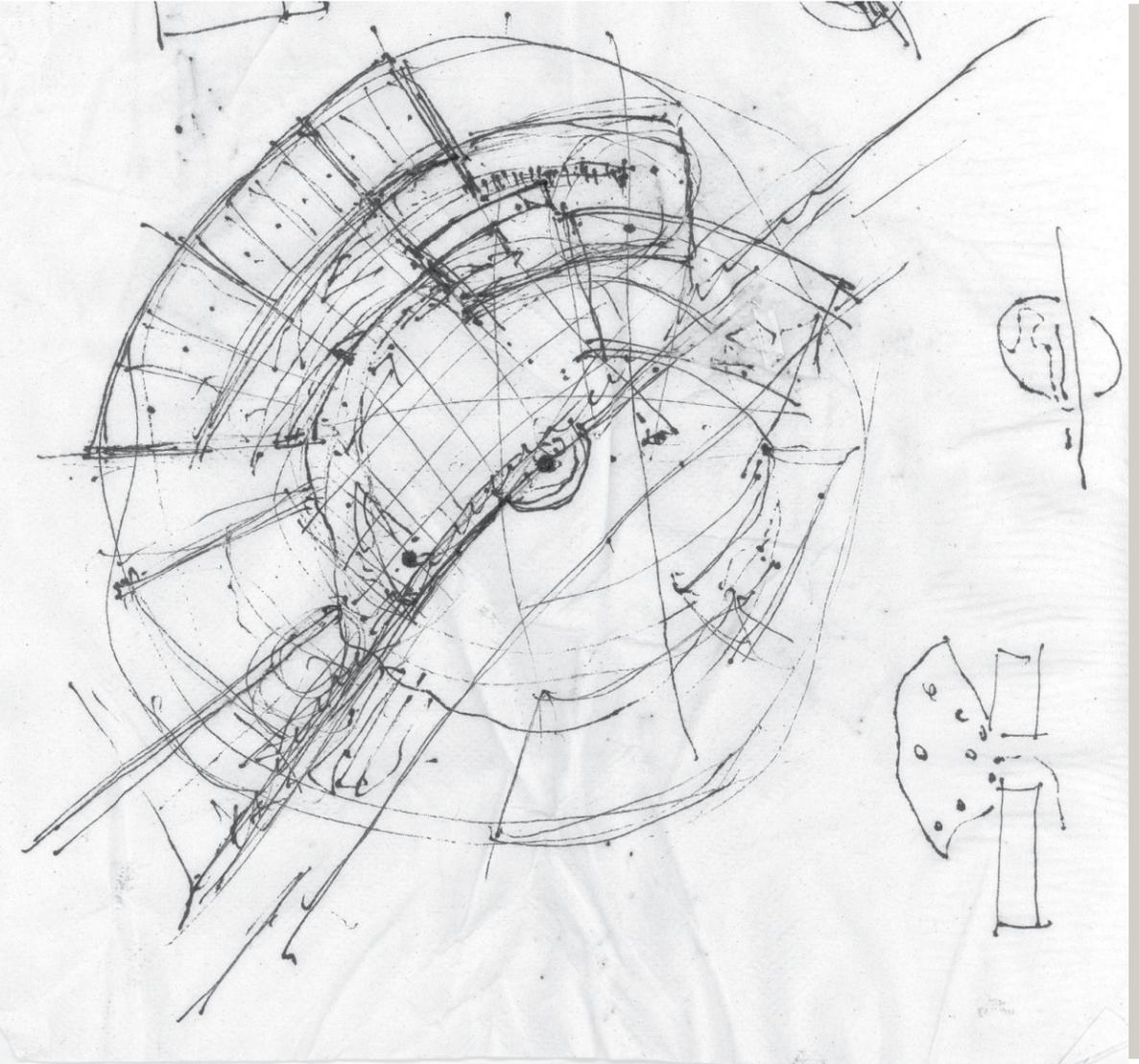


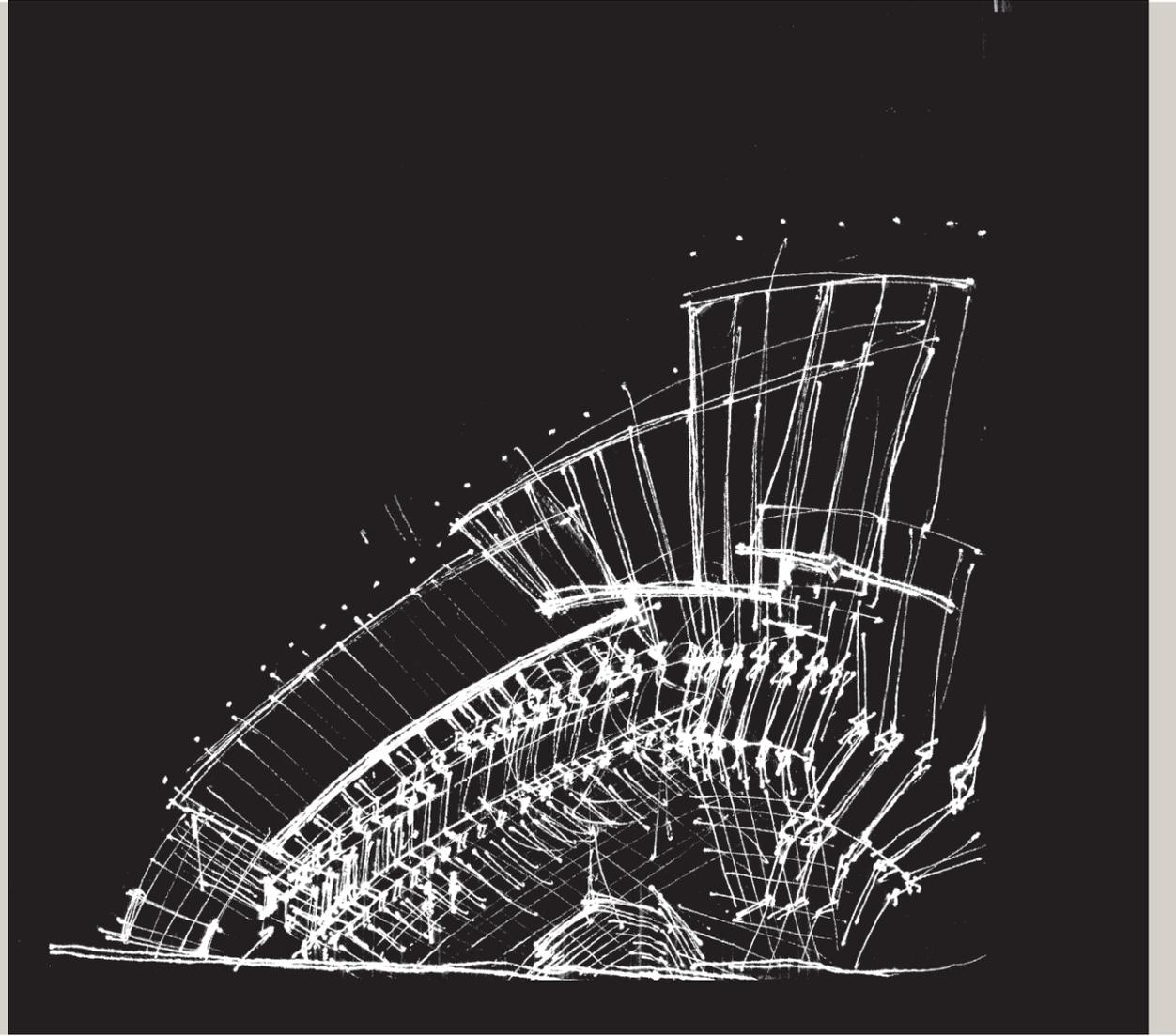
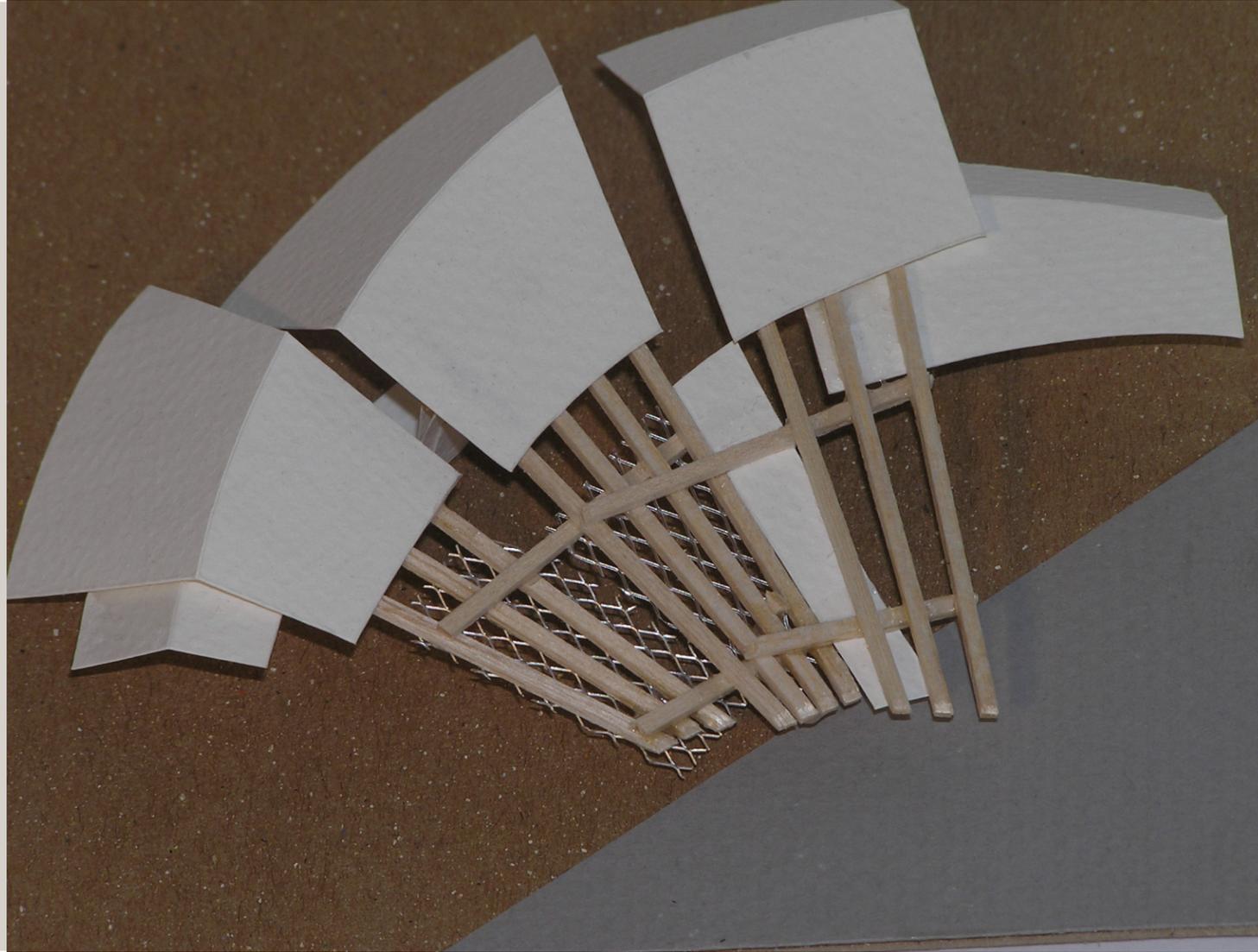
At a latitude of 18.5 degrees, The Dominican Republic is exposed to a steady 11 to 13 mph wind. These trade winds were responsible for bringing Christopher Columbus to the island in 1492. The reliability of these winds makes Verón an ideal location for the implementation of natural ventilation strategies.

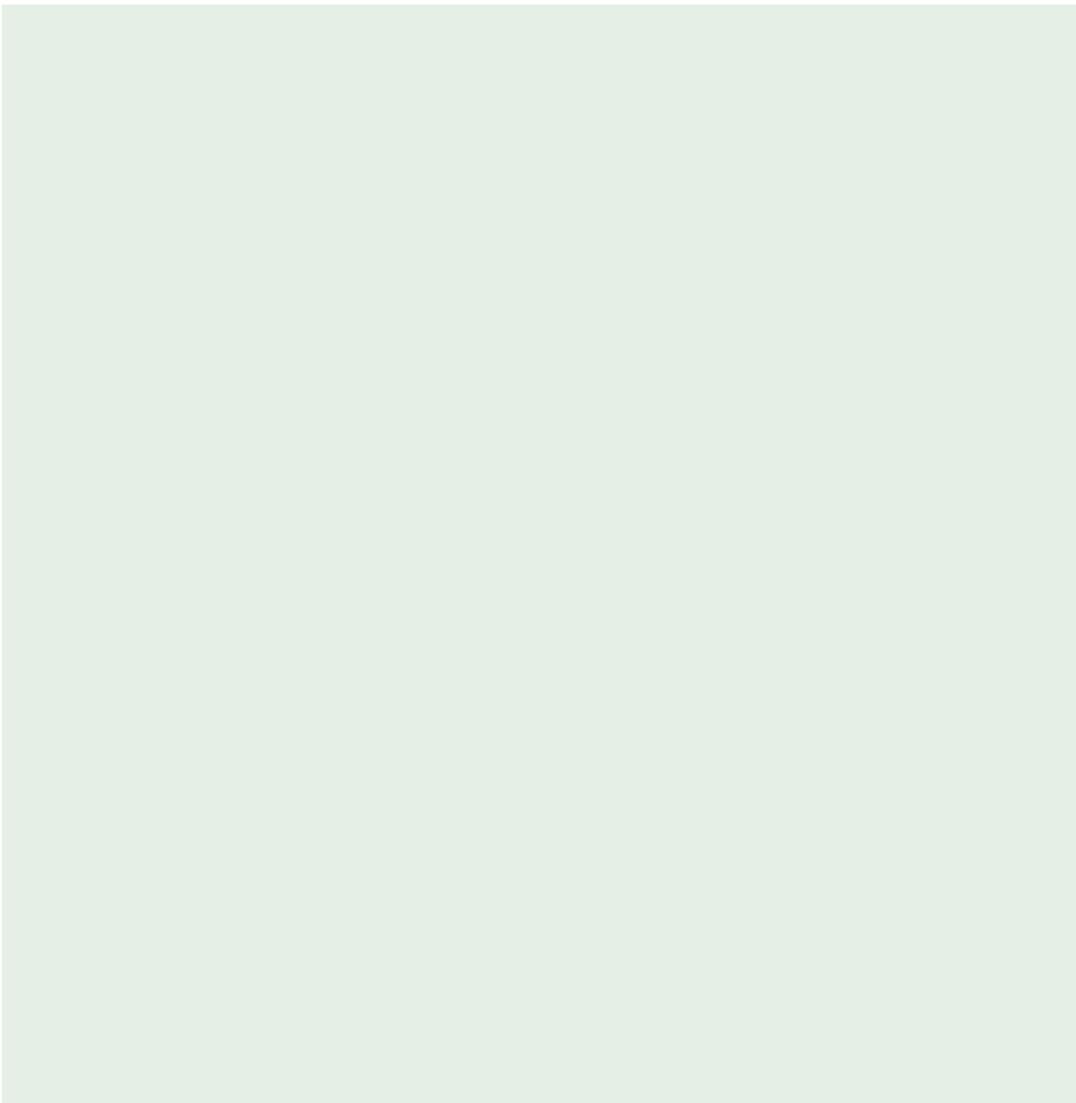
Process: Giving Shape to Concept

The concept for the Verón Health Center had its origin in the desire to mark a center, a point around which the sprawling, linear settlement could gravitate. Some of the earliest sketches of the design are simply of a circle intersected off center by a strong diagonal. The Health Center was conceived as a circular grouping of buildings that define an interior space which could serve as an outdoor waiting area, a public plaza, and an urban landmark. The facility straddles the road sharing the interior plaza and its center with the community.

The roof of the building was also an early and important consideration. From very early in the process it was to be a strong visual element in the design, consisting of a series of overlapping roof planes revolving around a single point.

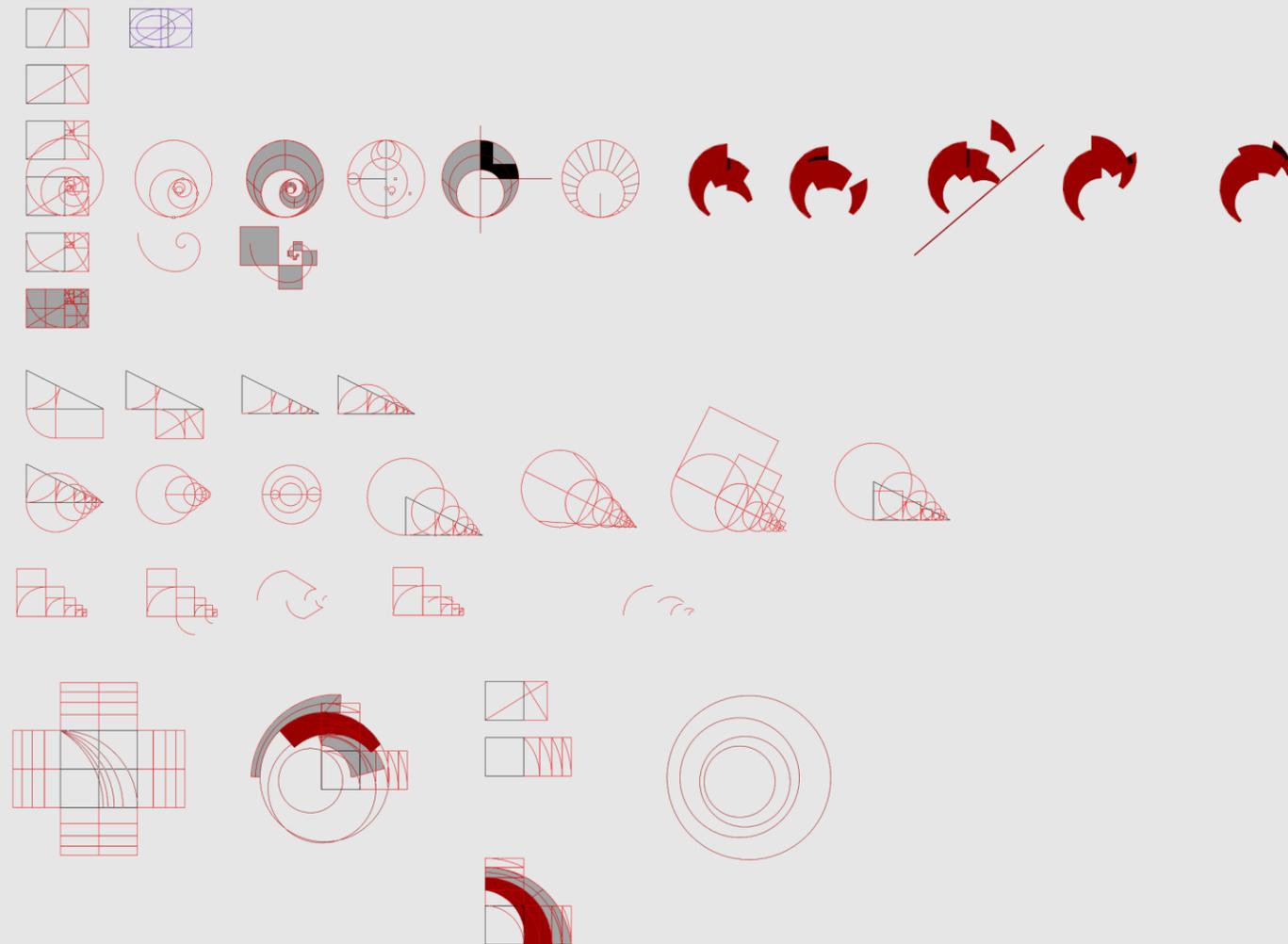




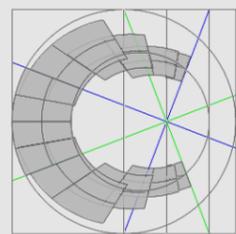
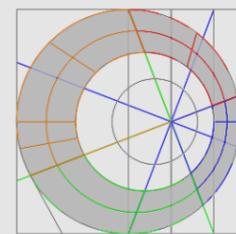
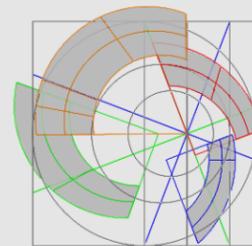
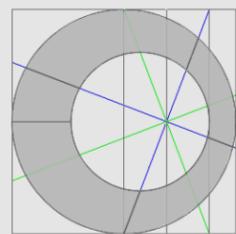
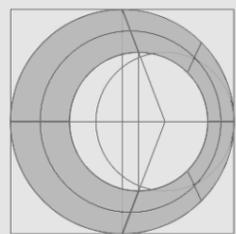
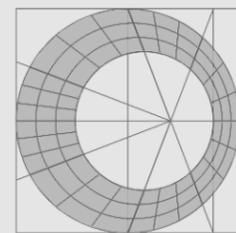
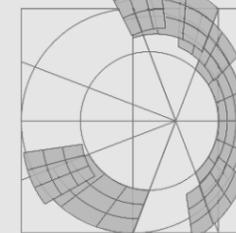
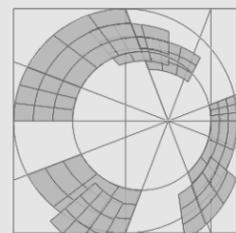
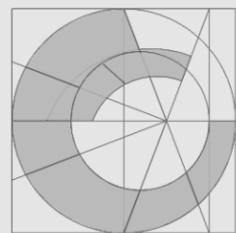
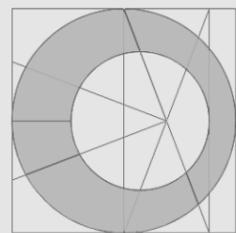
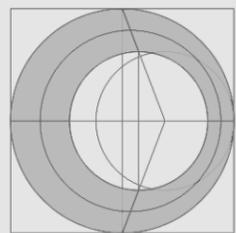
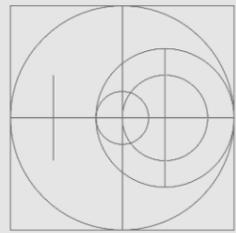
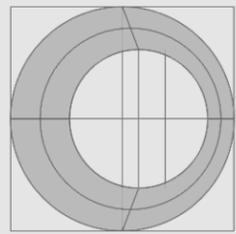
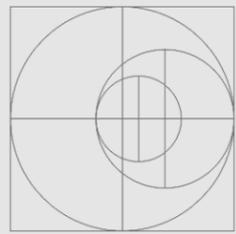
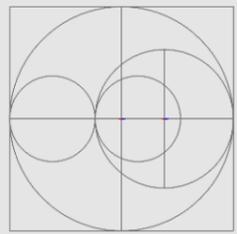


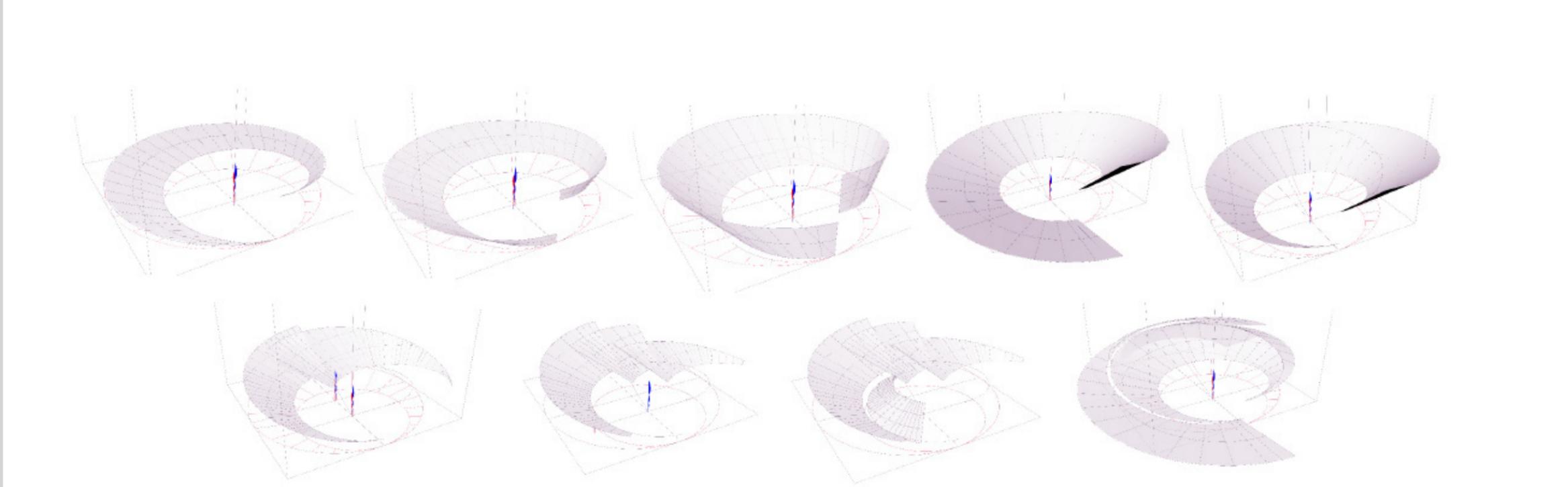
The site plan illustrates the relationship between the health center, the high school across the street (purple) and the community baseball field. The choice of this site was informed by the wish to add more "mass" or civic importance to this area which already has two important community facilities.





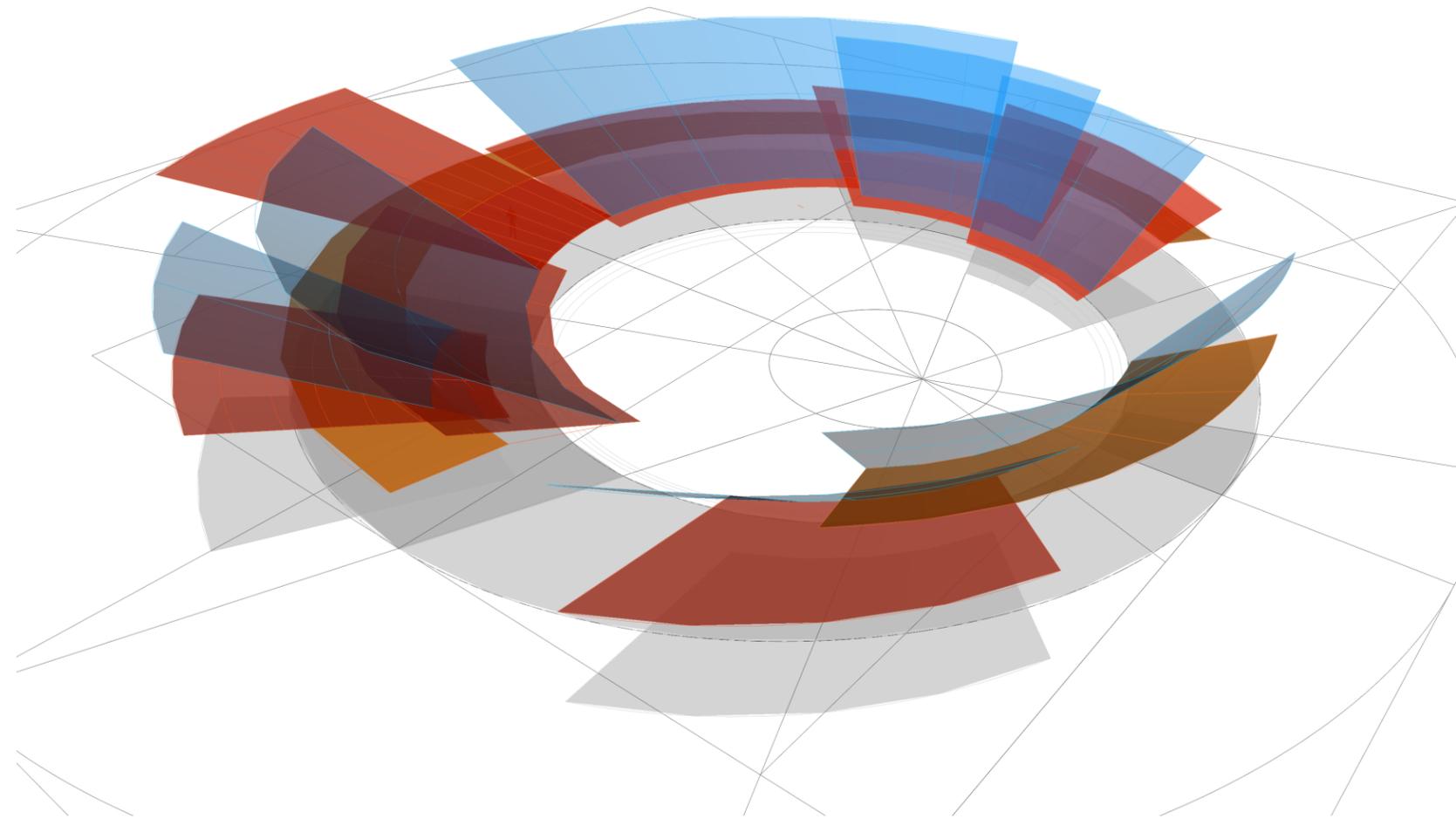
The process of translating the early concept sketches and models to a more precise and describable language was an important aspect of this project. A concise method of describing the complex shapes of the roof was sought in order to simplify construction and assembly.

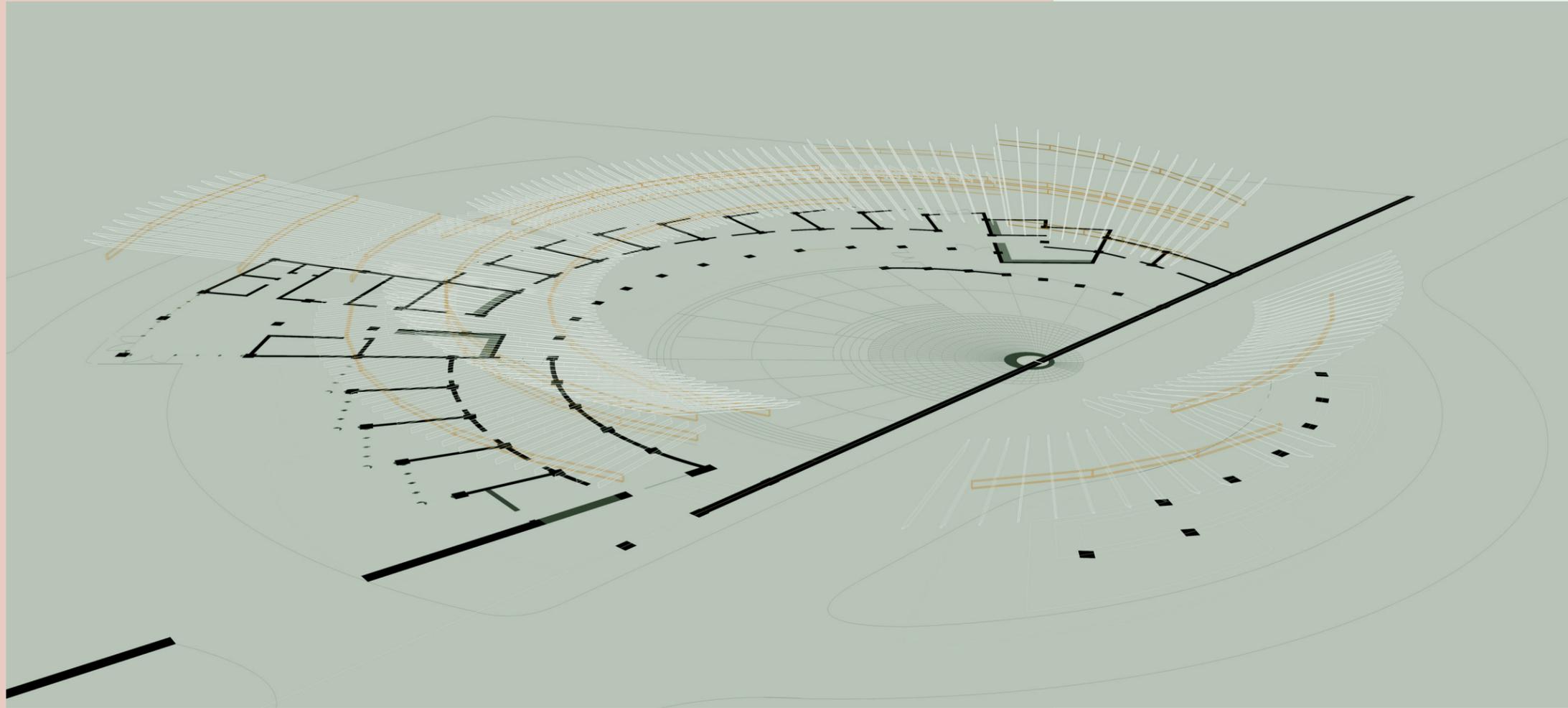




A series of geometrical studies of the health center roof based upon the manipulation of a helix.

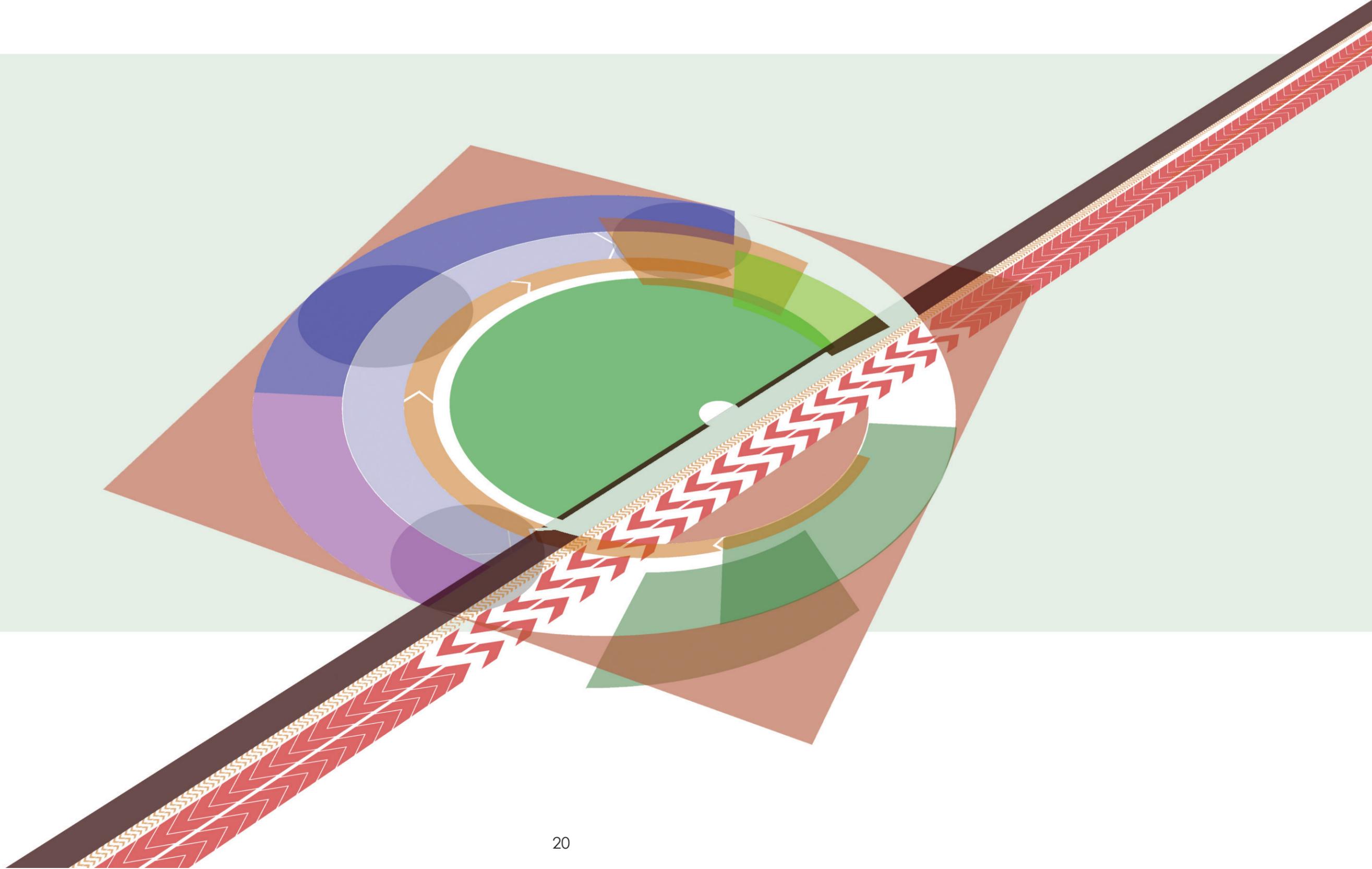
Geometric study of health center roof. The differently pitched roofs are simply described by the relationship of two harmonically derived circles rotated around, and oriented toward, a common though non-central point.

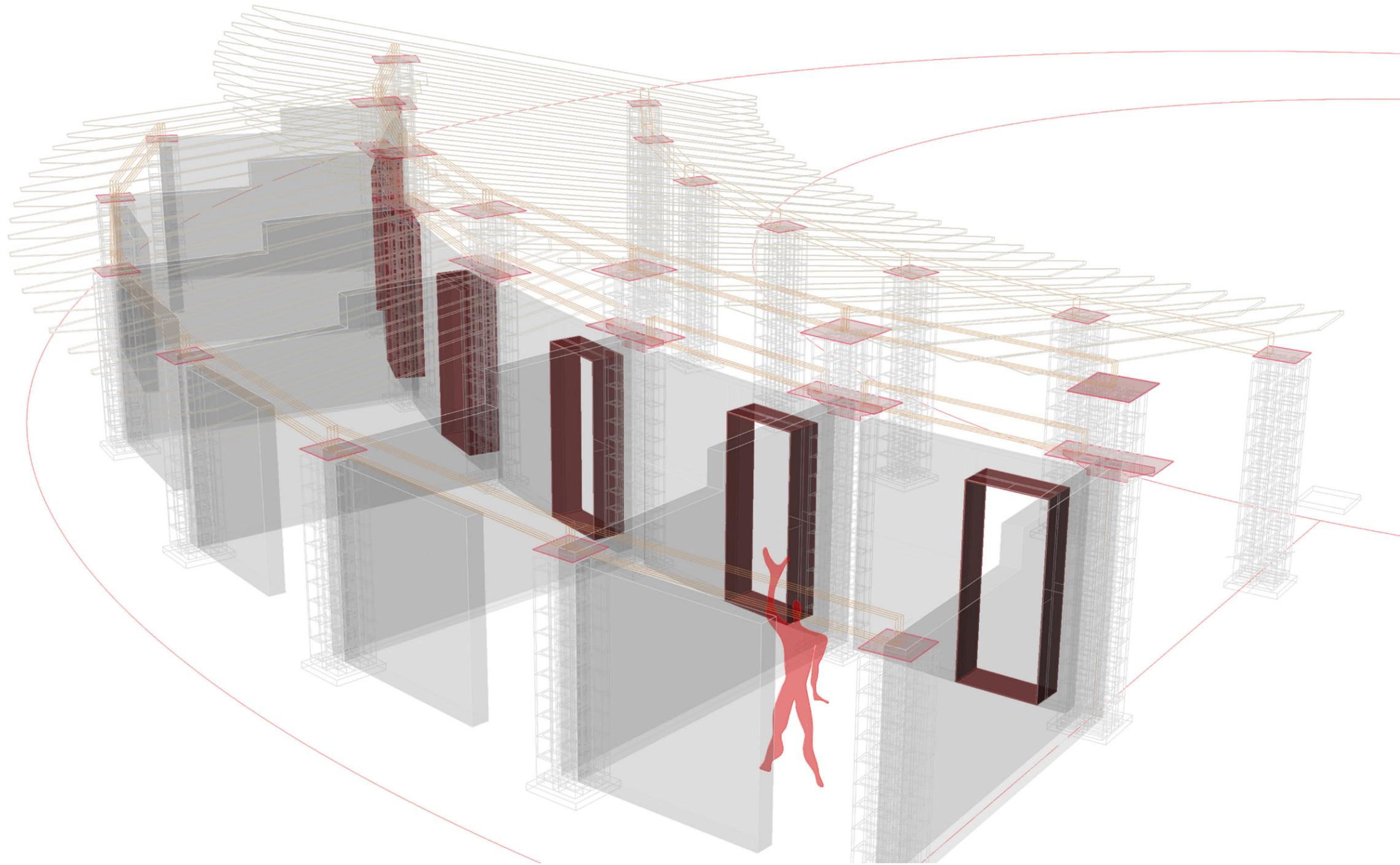




Perspective plan showing relationship between floor plan and roof structure.

Circulation diagram

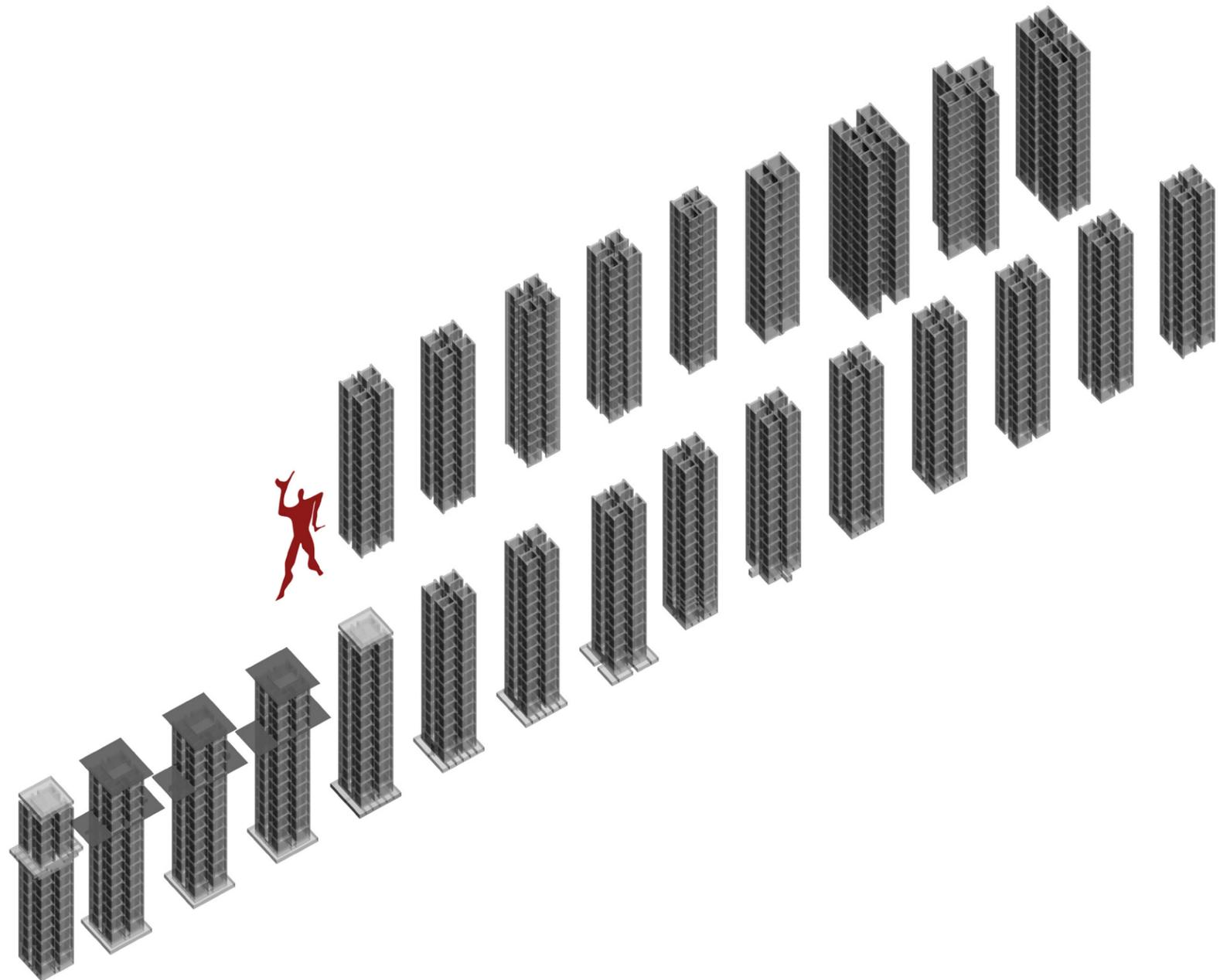


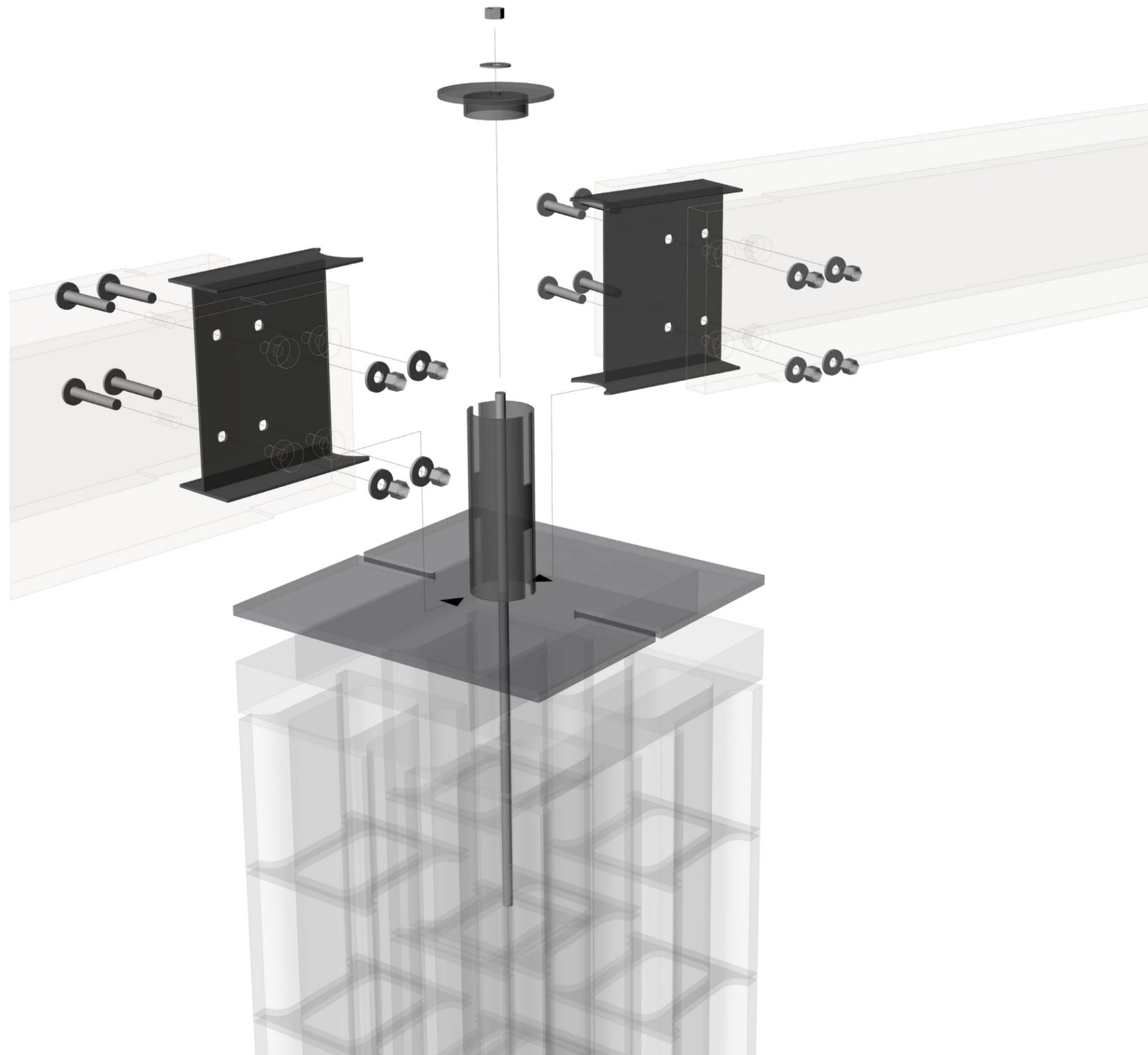


The process of translating the geometrical model of the health center to a constructible model is largely evident in the structure of the facility.

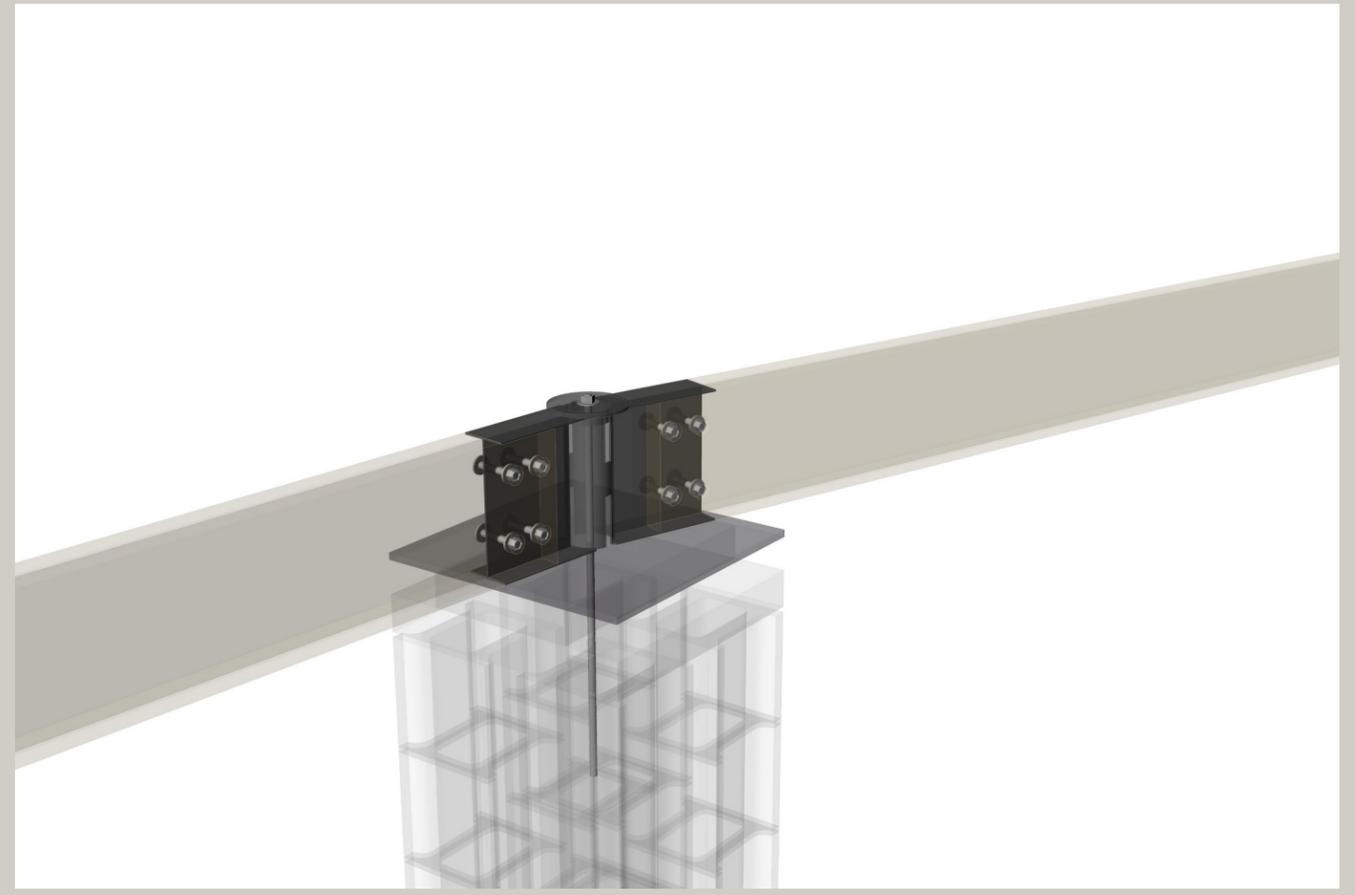
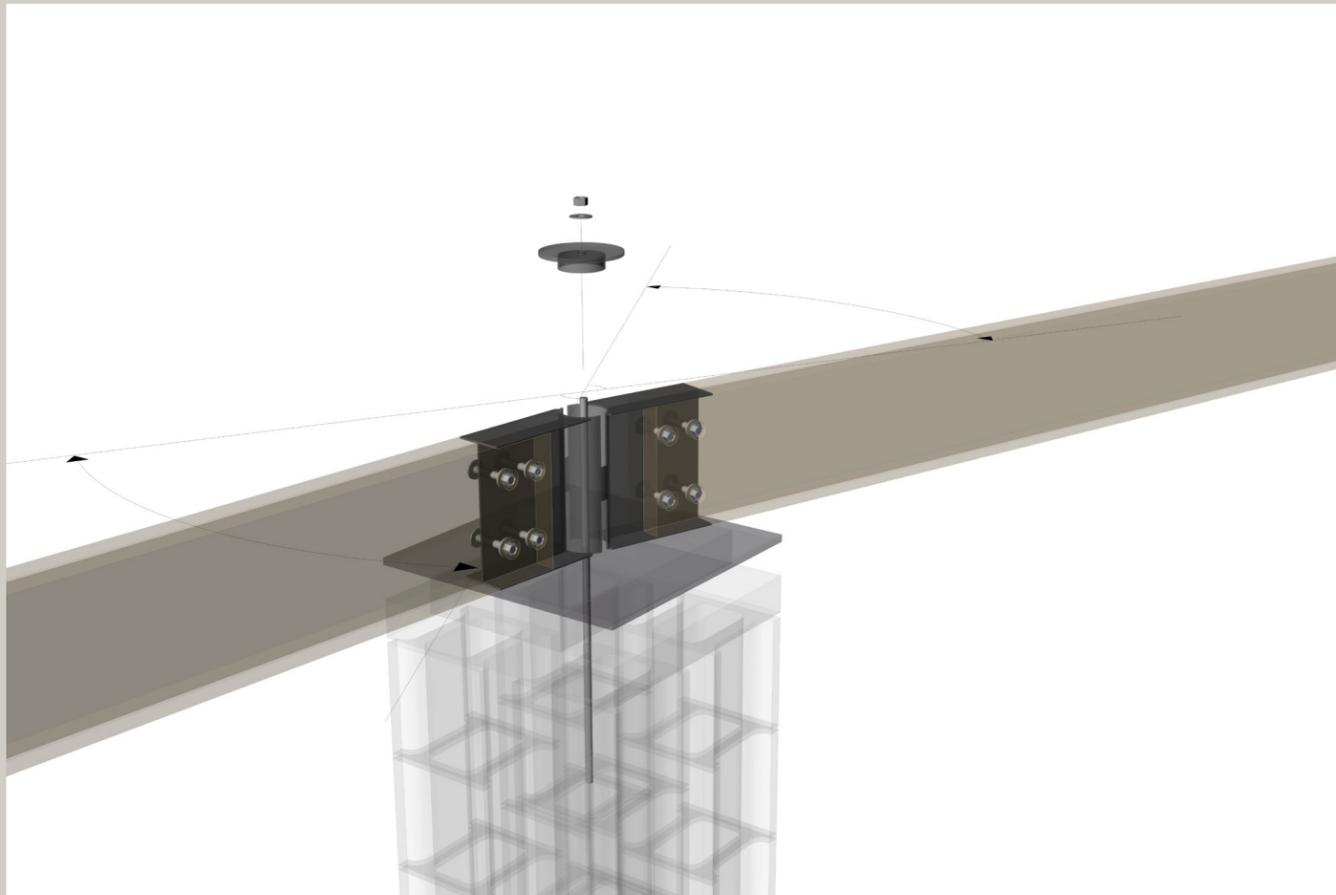
The structural order of the health center begins with the columns or piers which support the roof. These piers, with few exceptions, strictly follow the radial pattern described by the geometric model. The piers are spanned by compound wood beams which in turn support the rafters which give shape and structure to the roof. Interior partitions are non load-bearing and are free to oppose the radial composition of the facility.

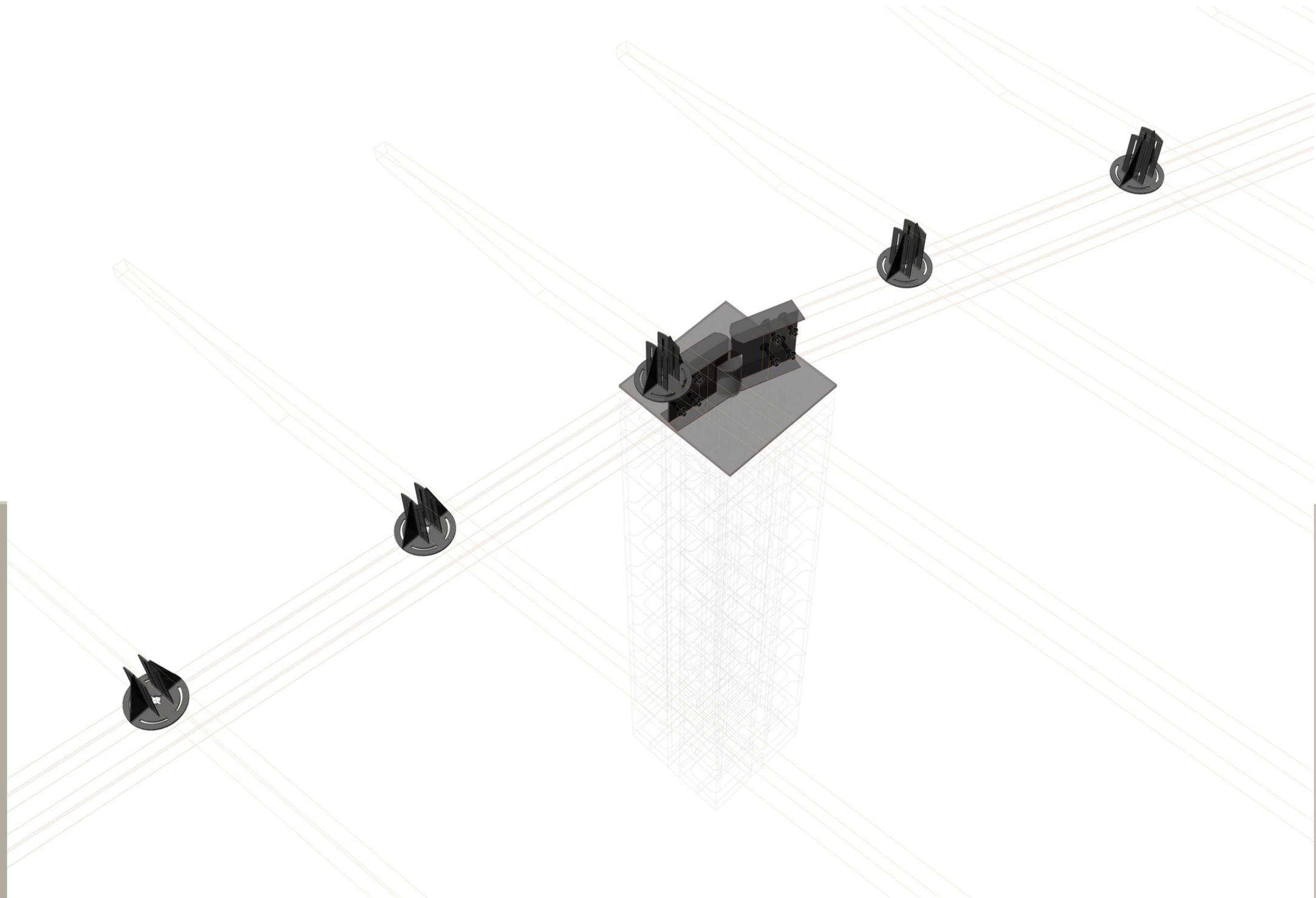
The structural piers are composed of four 8x8 concrete masonry units stacked so as to leave a two-inch gap running the length of each face. This gap was intended to reveal the presence of the regulating lines or planes which dictate its position. The gap was also felt to "lighten" the roof since it seems to contradict the structural expression of the gravitational forces present.

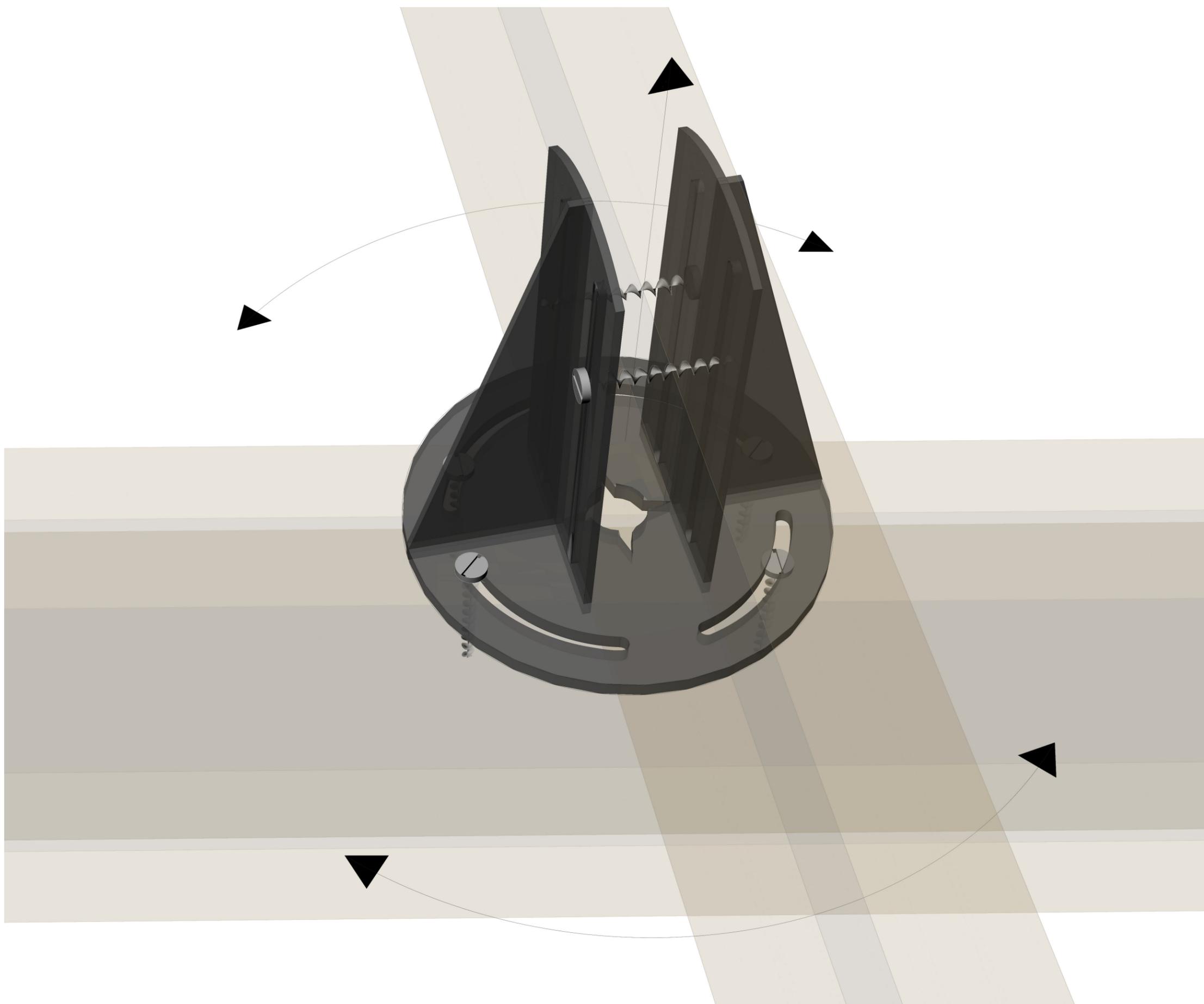
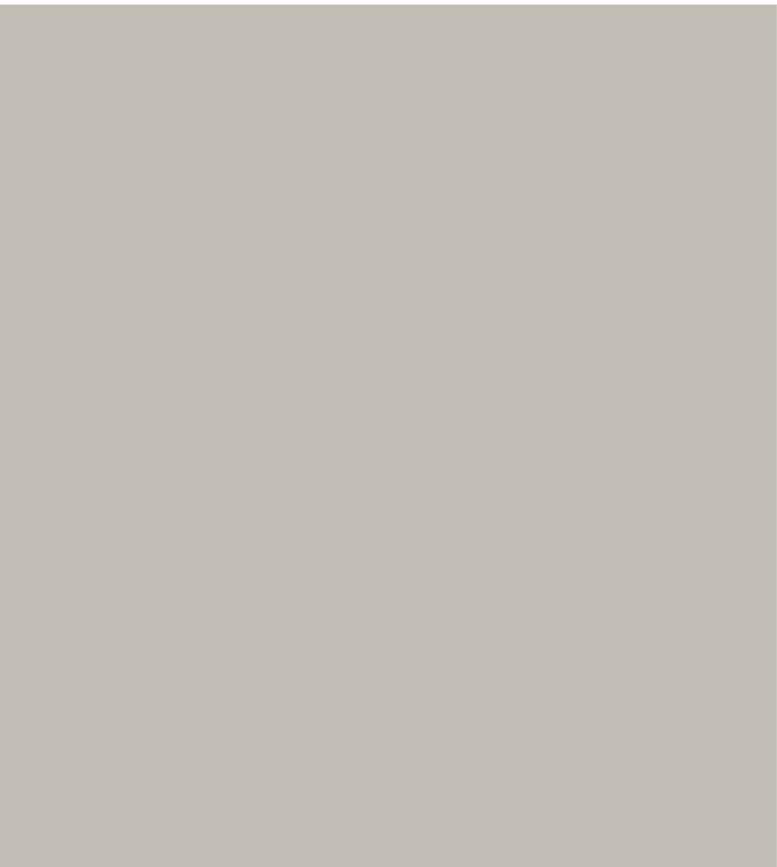


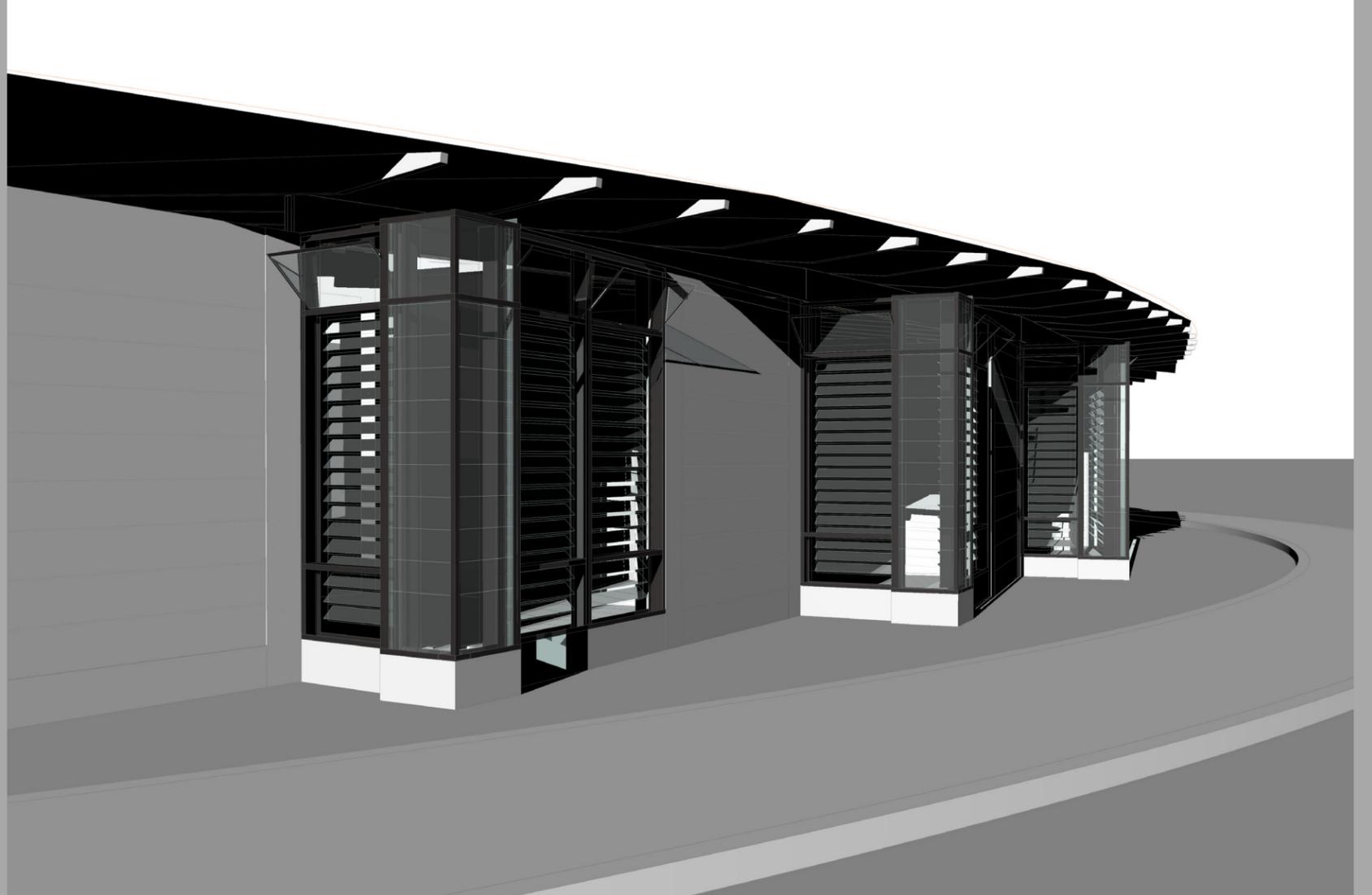


The steel capitals which cap each pier were designed to facilitate the construction of the Verón Health Center by accommodating the many oblique angled intersections that result from employing orthogonal building materials to construct a circular design. The capital consists of a steel plate and cylinder which are joined to the cmu pier via a threaded rod. The compound wood beams are capped at each end by a short section of steel wide flange. The distal ends of each flange are concave and engage the cylinder of the capital on which it rests. Once in its proper position the beam(s) can be fastened in place by the crowning cap and nut. The capital can therefore accommodate all the varying angles at which the beams meet the piers.

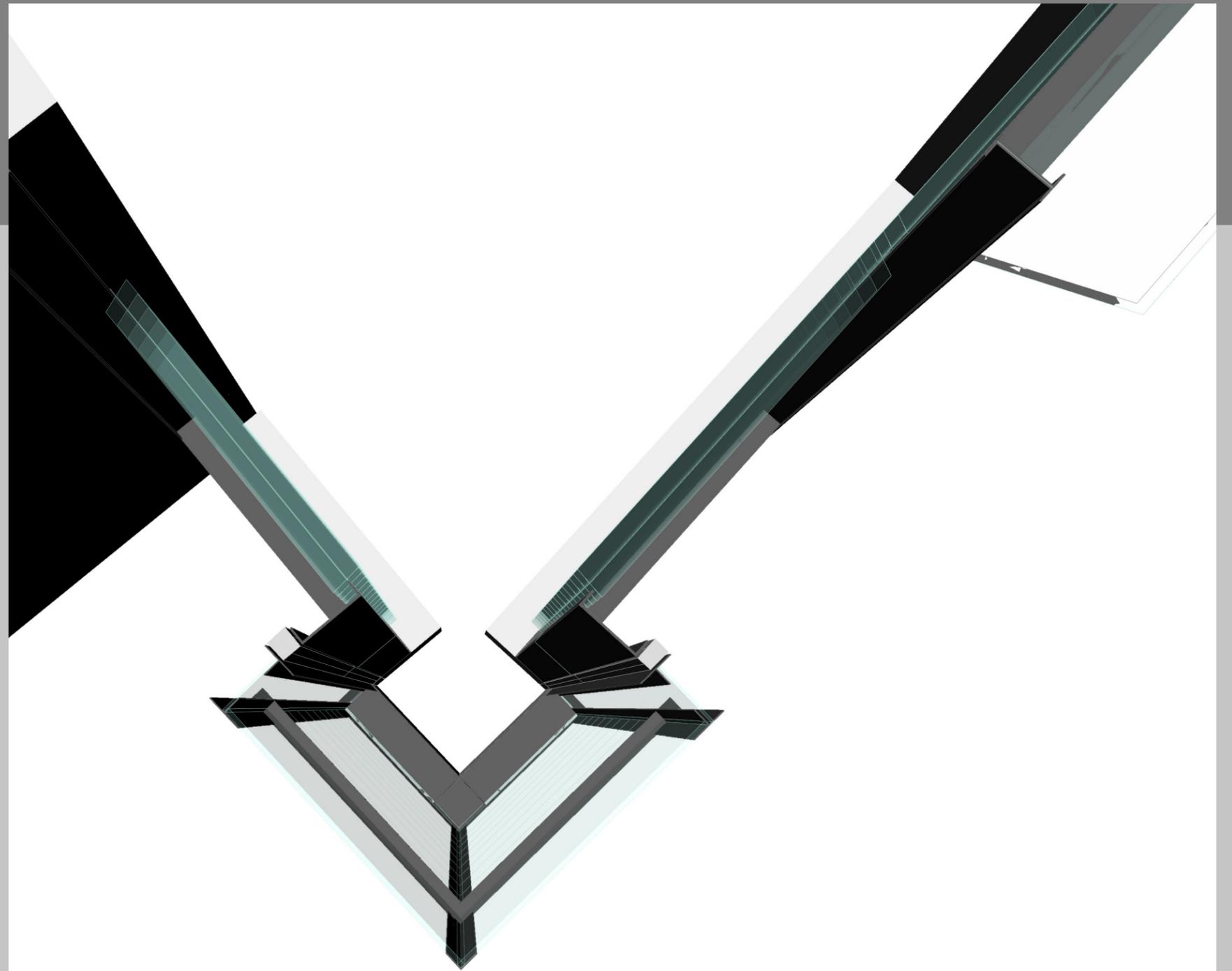




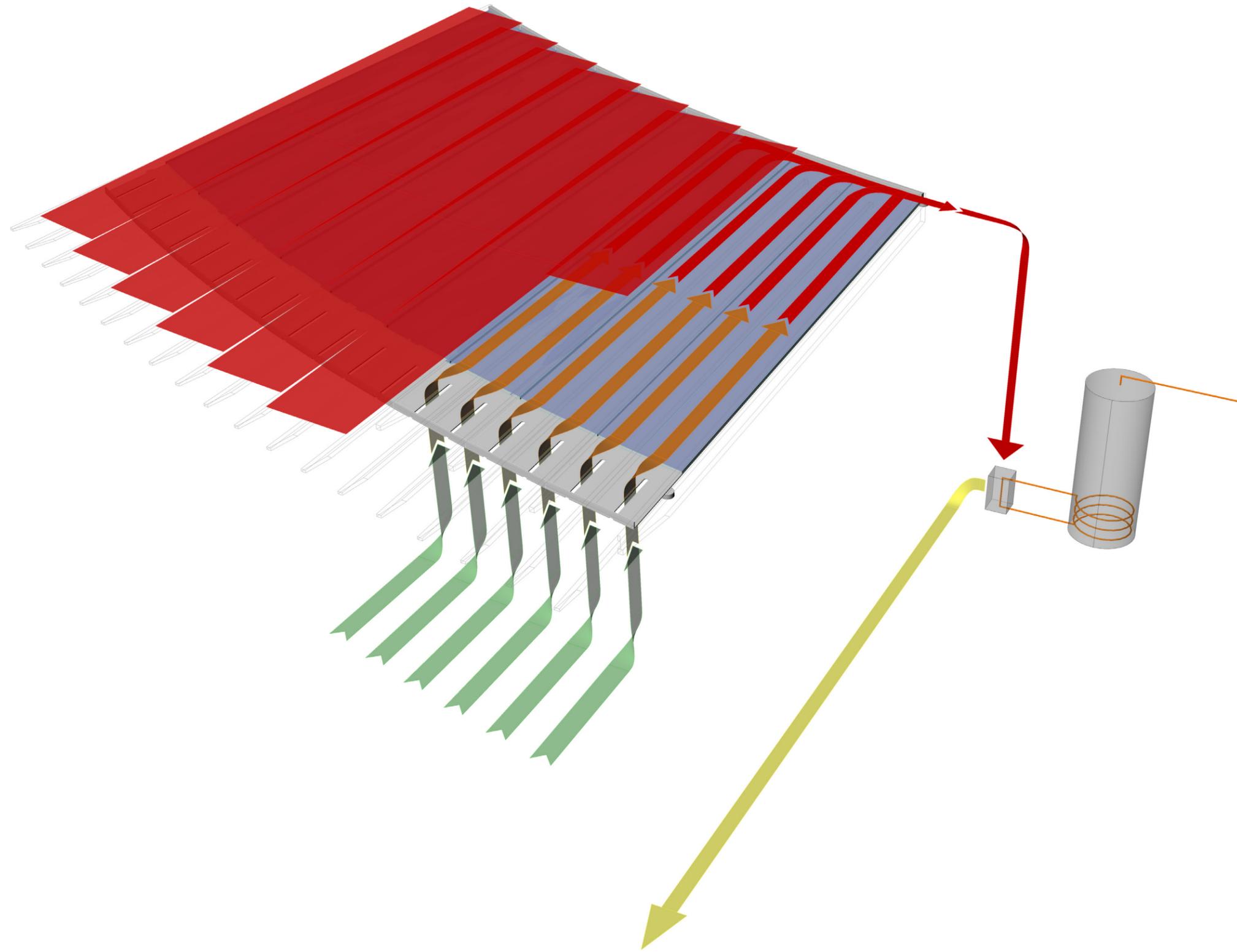




The corner windows of the clinic's treatment rooms were designed to adjust to the changing angles of intersection between neighboring walls. Rather than intersecting and joining non-orthogonal walls, a single orthogonal hollow glass column was devised to accept each wall. Any variations in angle between this column and the two walls can be absorbed longitudinally and concealed between the two members.

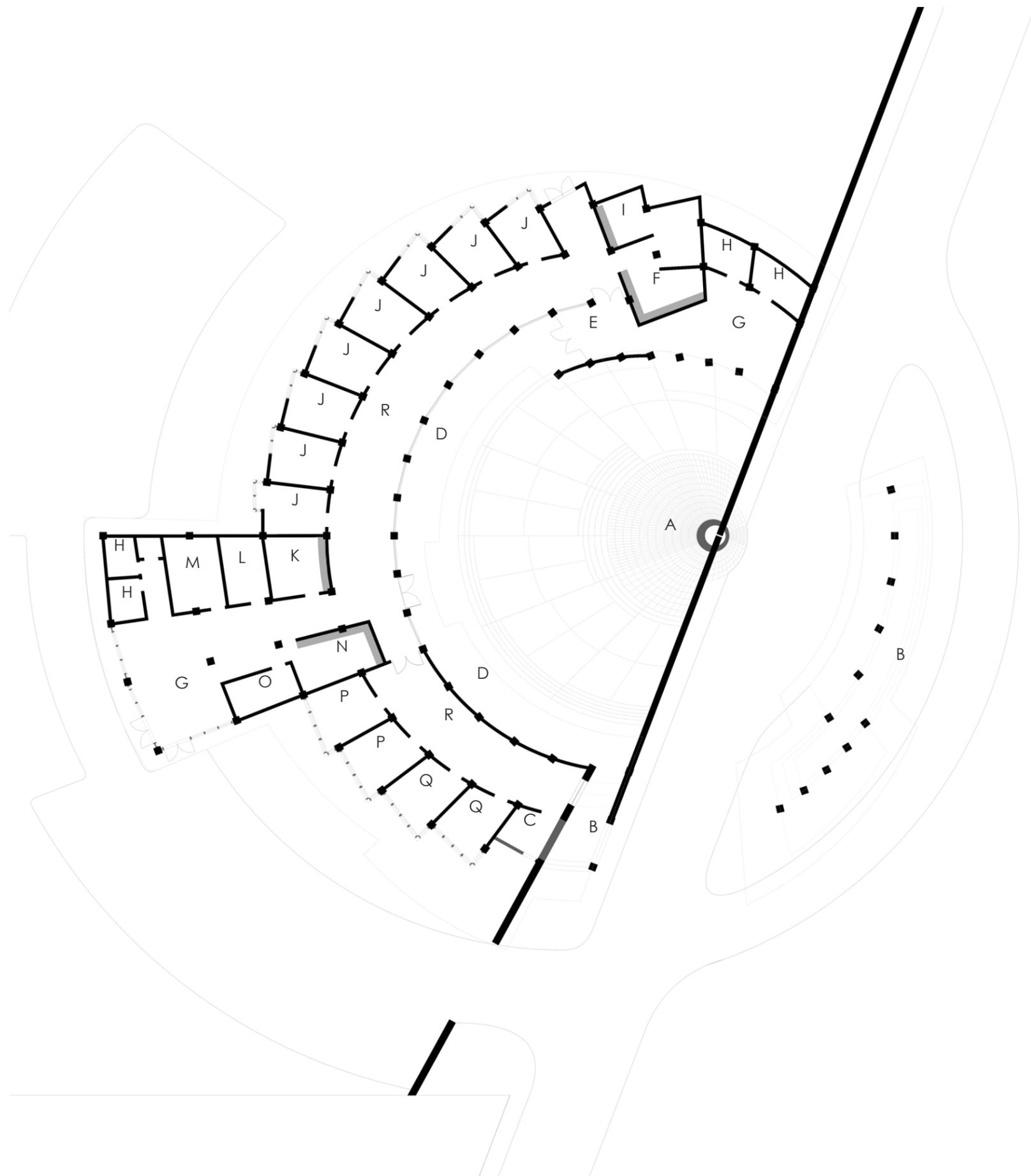


Perspective view of glass corner column from above.

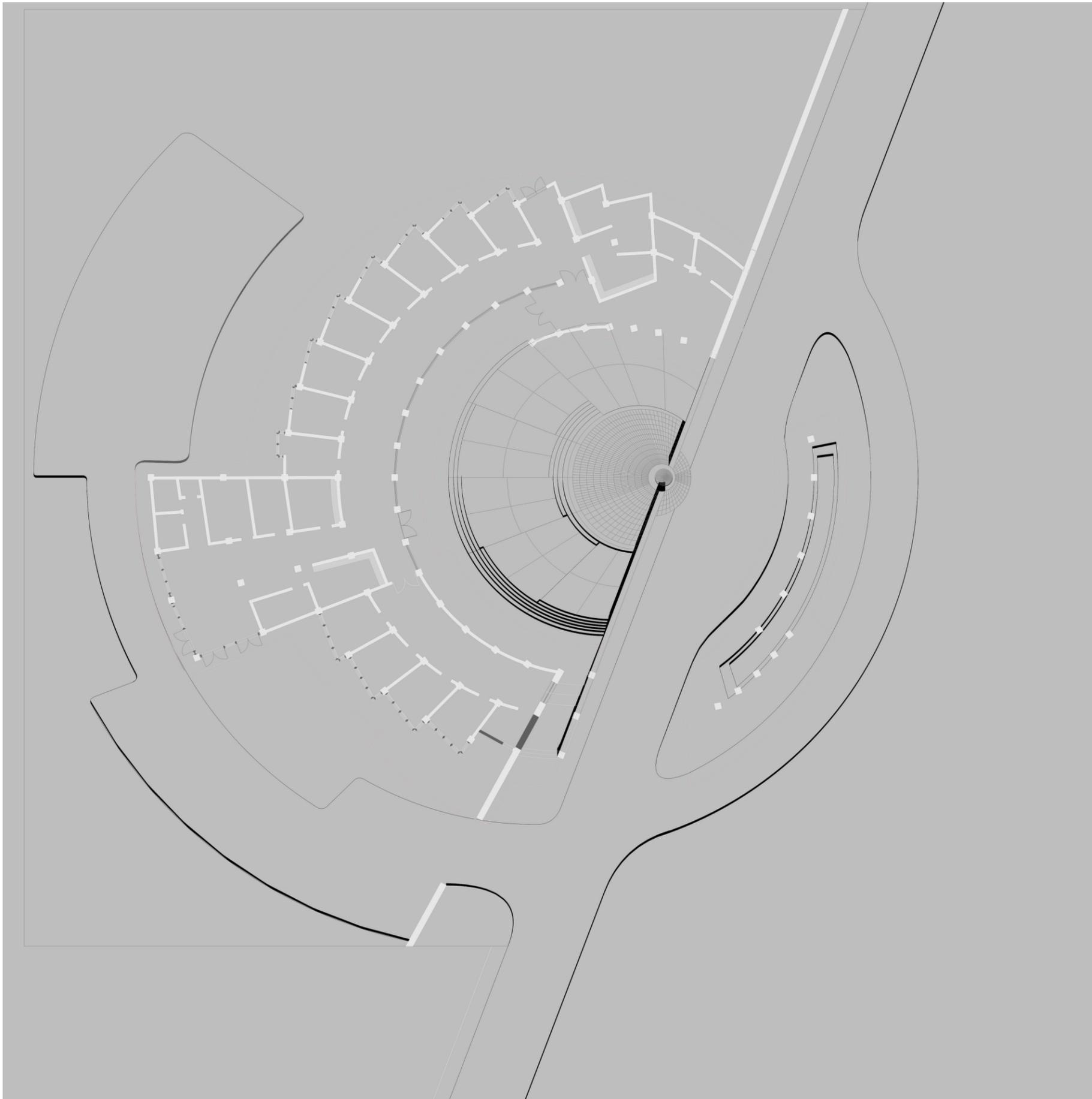


The roof of the Verón Health Center is designed as a double envelope structure. Supported by the structural rafters below, an insulated hollow core is created by a secondary layer of smaller rafters which also serve as a surface for the attachment of the metal sheet roofing. A double envelope roof would be beneficial in the Dominican Republic since the heat produced by solar radiation on the large roof could be vented before radiating into the inhabited spaces below. The heated air within the cavity could also be passed through a heat exchanger and used to pre-heat the facility's hot water supply.

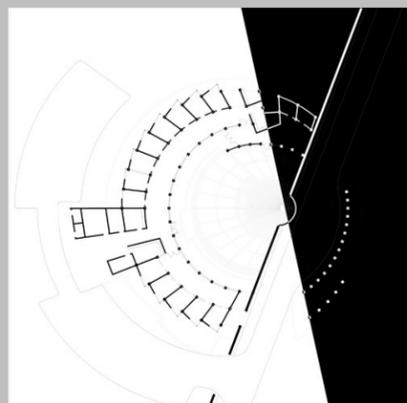
The metal roof sheets are attached to the secondary rafters in an overlapping scale-like fashion in order to minimize the need for custom cutting and folding each sheet.



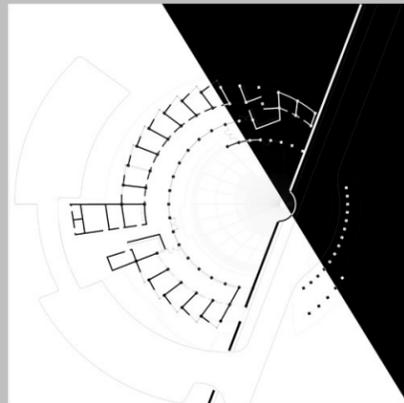
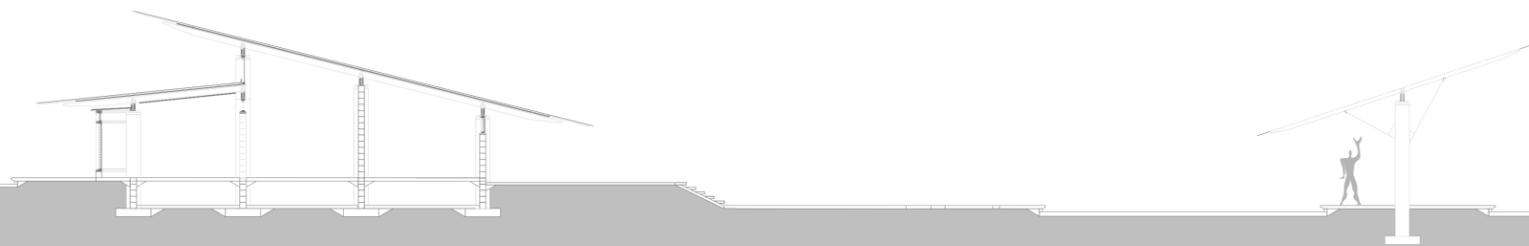
- A plaza
- B gate house portico
- C gate house
- D covered walk
- E foyer
- F reception
- G waiting
- H rest rooms
- I business / administration
- J outpatient treatment rooms
- K pharmacy
- L laboratory
- M x-ray
- N reception - acute care / inpatient
- O education room
- P surgery
- Q maternity
- R circulation corridor



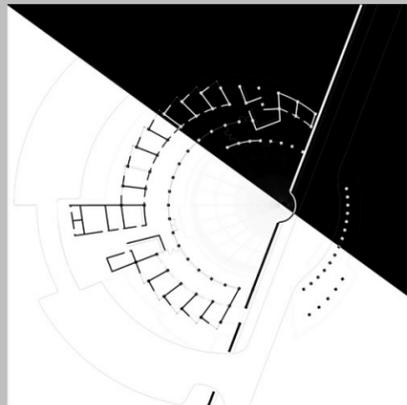
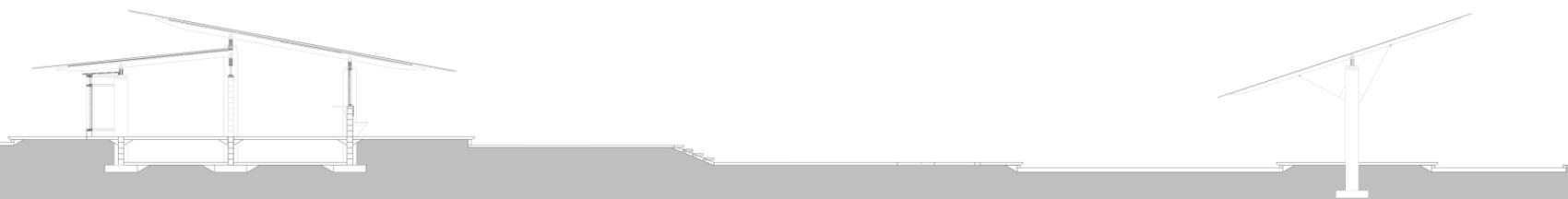
Floor plan showing changes in elevation of clinic plaza and grounds.



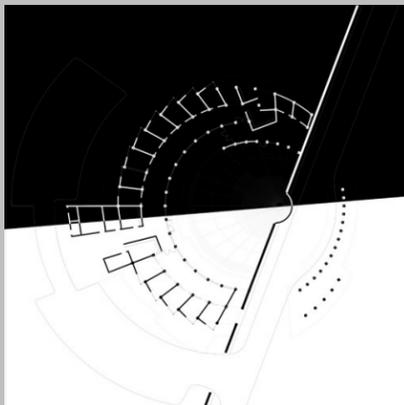
Section through waiting room
and reception/business office



Section through entrance, corridor, and outpatient treatment room.

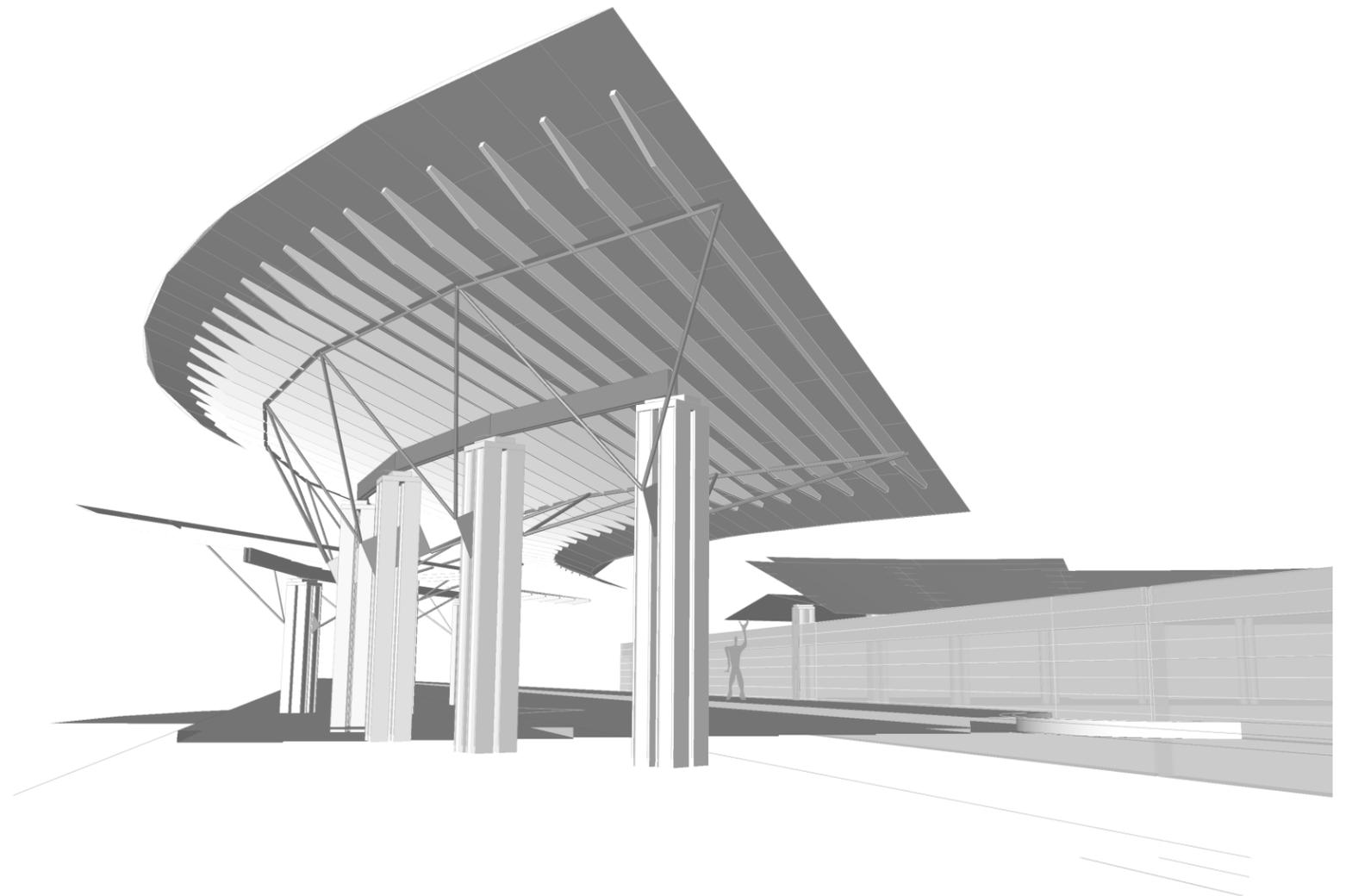


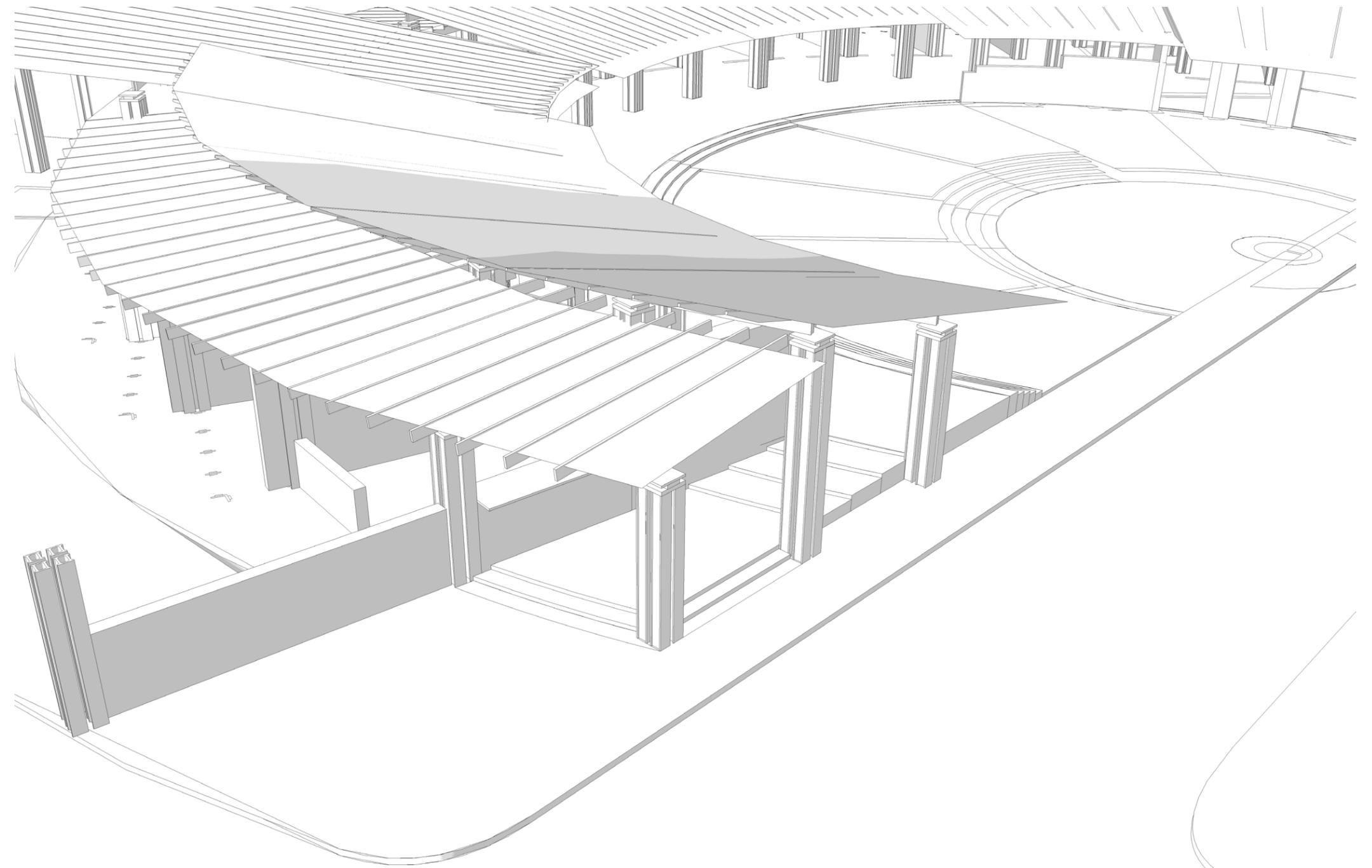
Section through corridor, and outpatient treatment room.



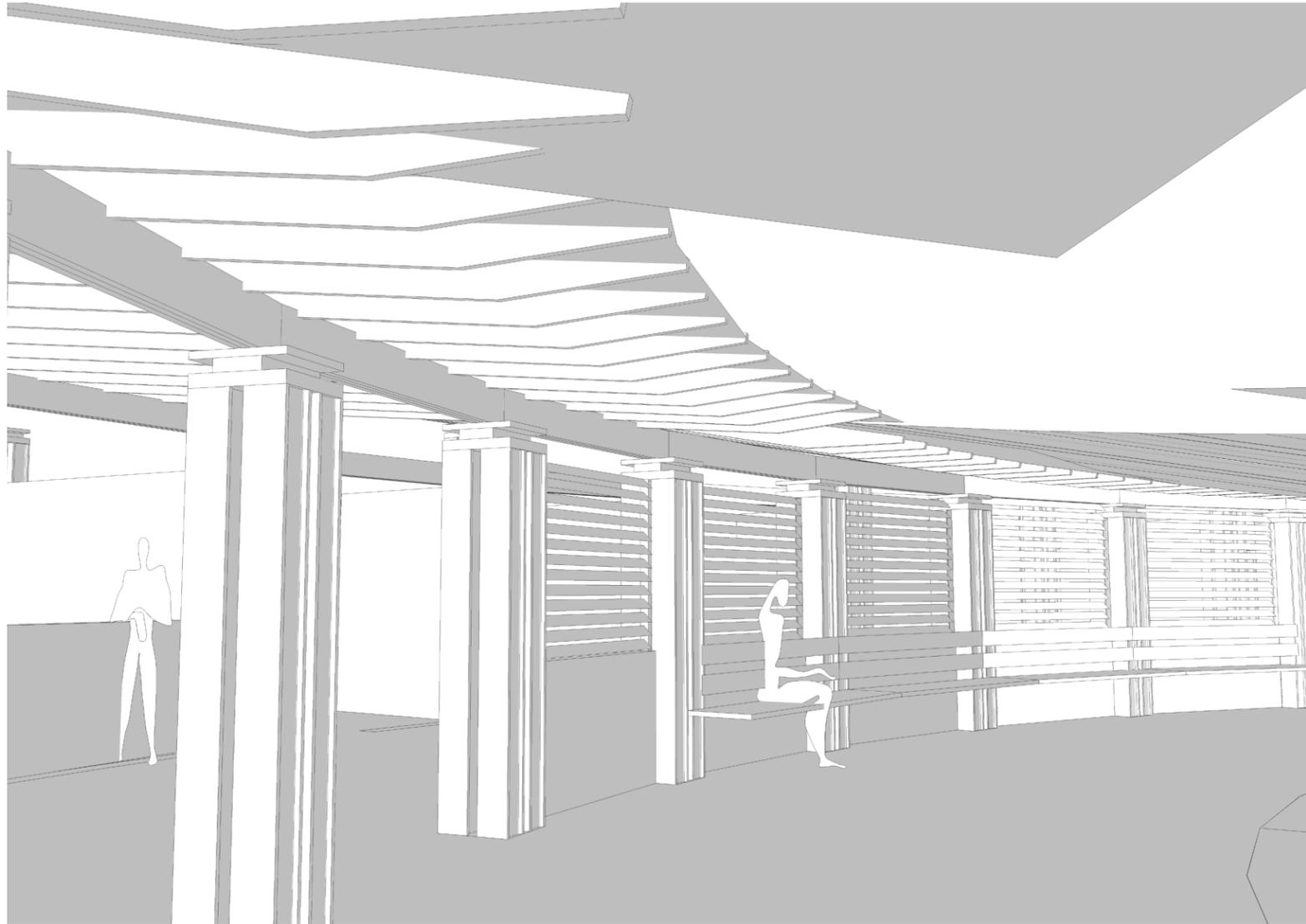
Section through x-ray, laboratory, pharmacy, and corridor.

The roof canopy standing across the street from the health center serves as a drop off area for patients and as a bus shelter for the community, further reinforcing the role of the central plaza as a center for the town. The canopy through its curving lines helps to guide visitors to the clinic toward the gate house and the covered walkway which leads to the main entrance.



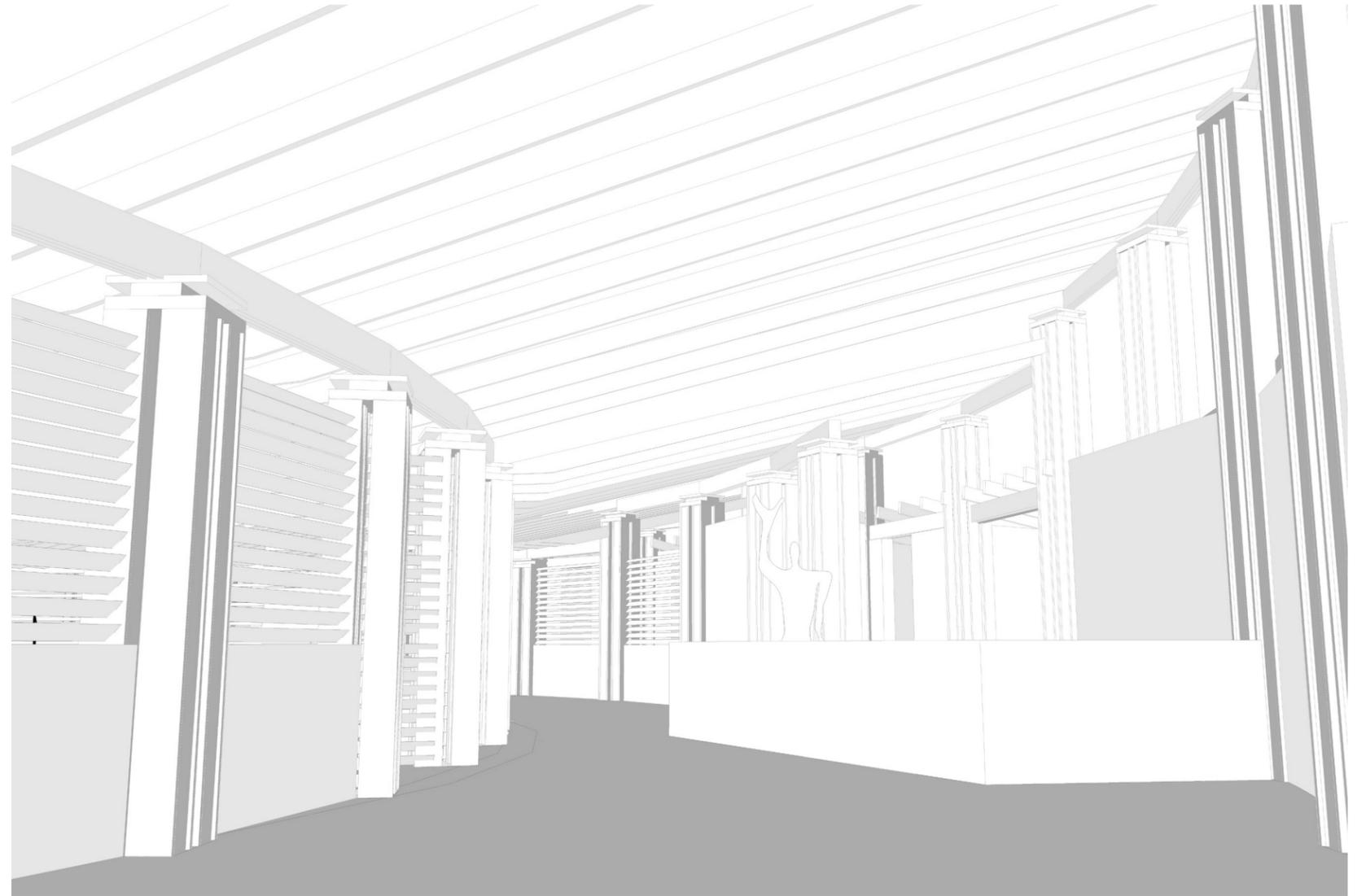


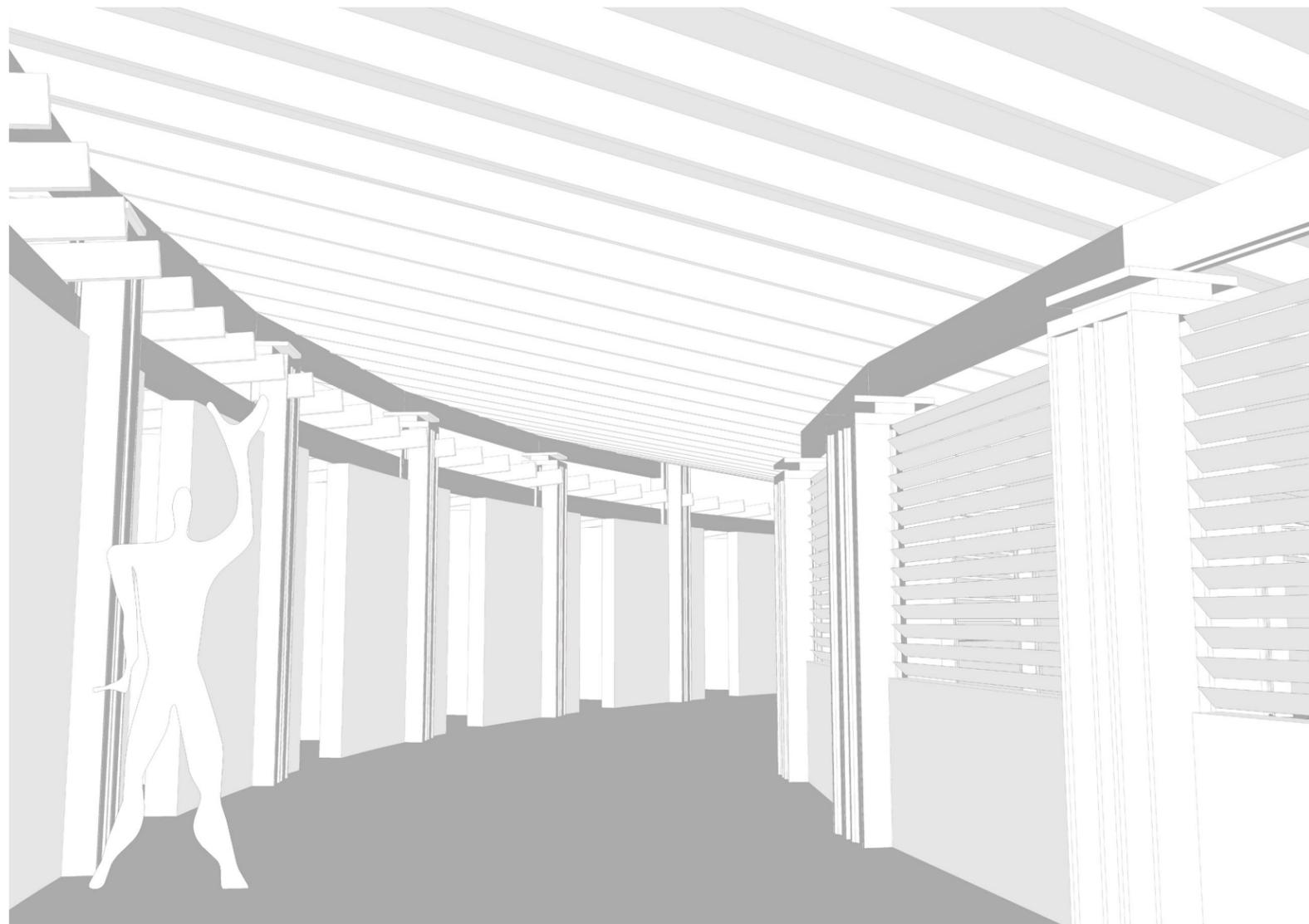
The gate house located at the southern end of the building serves as the first control point of access to the clinic. The open portico and steps mark the beginning of a covered walkway that wraps around the plaza and leads visitors to the main entrance.



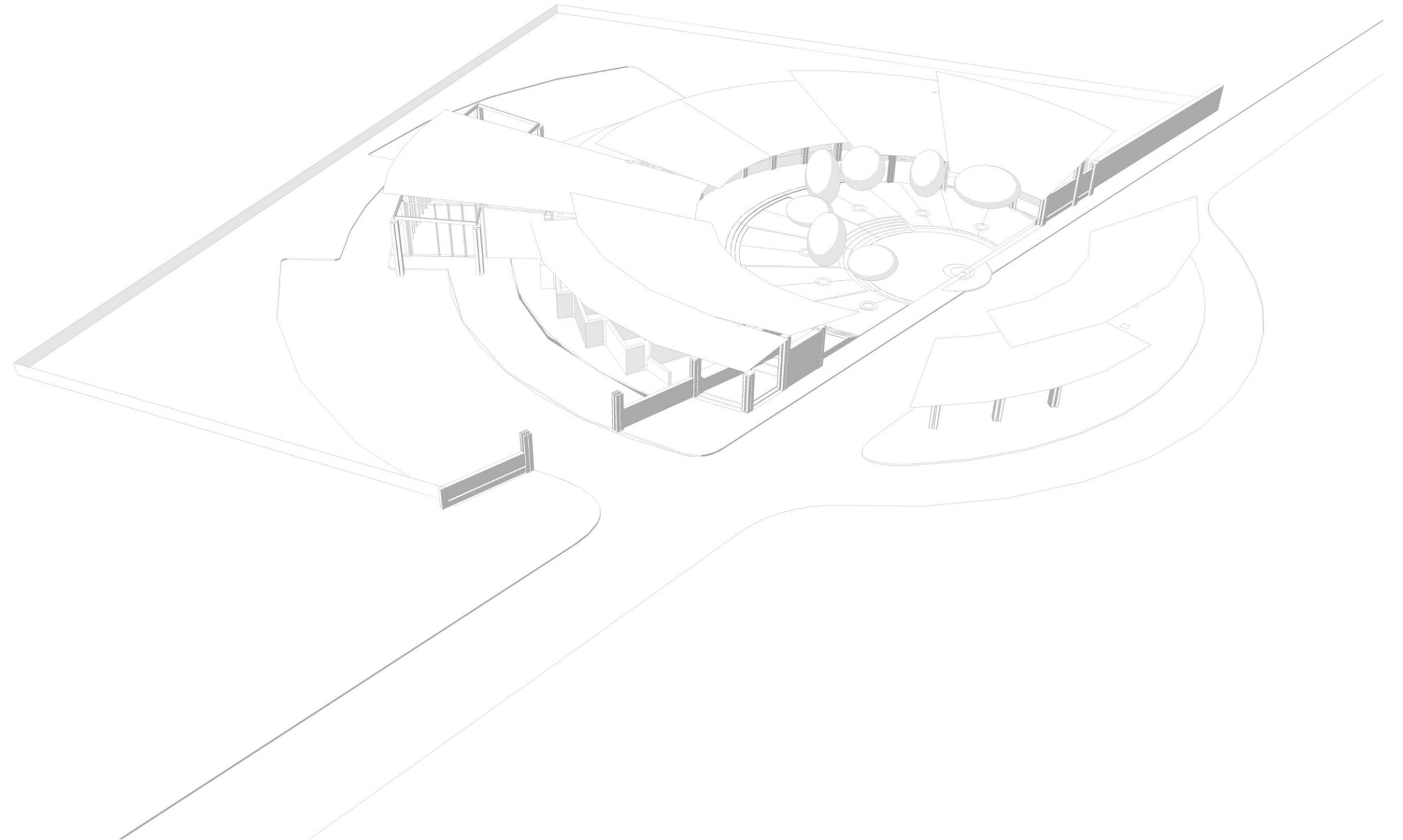
A canopy of rafters protects visitors to the clinic from the intense tropical sun and sudden downpours. This area, facing the tree-filled plaza also serves as an outdoor waiting area.

The waiting room and reception area are the loftiest spaces of the facility with louvered panels facing the plaza and louvered clerestory windows providing natural ventilation and daylight. The reception desk acts as the second control point in the clinic.





The over-sized main corridor serves as the spine connecting all five volumes of the facility. This area was conceived as a working office for medical staff with ample room for counters or storage. The space is well lit and ventilated by the plaza-side louvred windows and clerestory.



Aerial perspective of the facility showing the grounds surrounding the facility.

The intent of this thesis was to study the process of translating a gestural idea or concept into the language of construction and building. The first step of the process involved the search for a geometrically-based interpretation of a conceptual idea or sketch. The process could be described as a distillation, a repeated re-working of a model until a sufficiently concise, simple, and harmonious geometric translation was achieved. The final geometric model for the clinic could be easily described by the manipulation of two proportionally related circles which share a common, though non-central, rotational origin.

The points, lines, and planes described by the geometric model serve as regulating influences upon the construction of the clinic facility. The second part of the thesis dealt largely with the constructed expression of the geometric model produced. The decisions to reflect or contradict the underlying geometry were influenced by the need to reconcile the orthogonal nature of the building materials and a non-orthogonal model. This need for adjustability led to the design of various elements capable of “absorbing” the similar but non-uniform angles and pitches that occurred at major joints of the building. The outcome wished for was a building whose construction and assembly reflected the regulating geometry which governed the design while retaining the spirit of the original gestural idea.

David Weissberger: Pages 1 (left), 9, 10

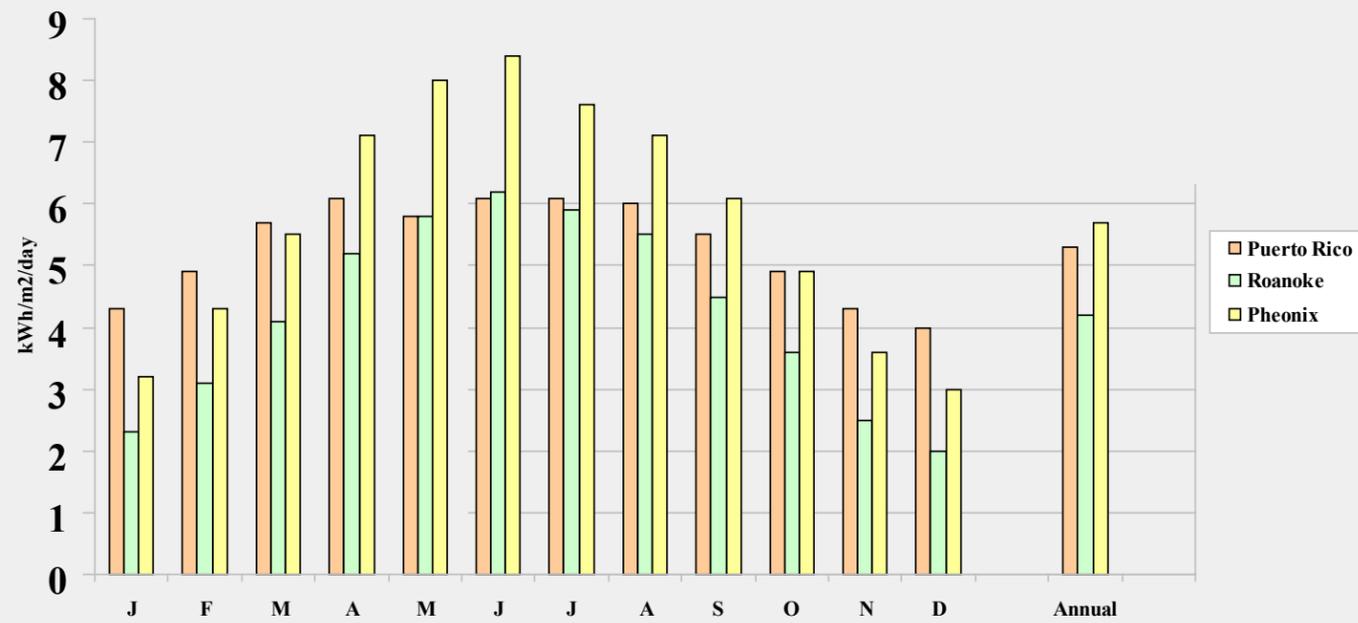
Digital Globe Services, Inc. : Pages 3, 4

All other photographs by the author.

Mean Monthly Solar Radiation (1961-1990)

Falling on a Horizontal Flat surface

Uncertainty of +/- 9%



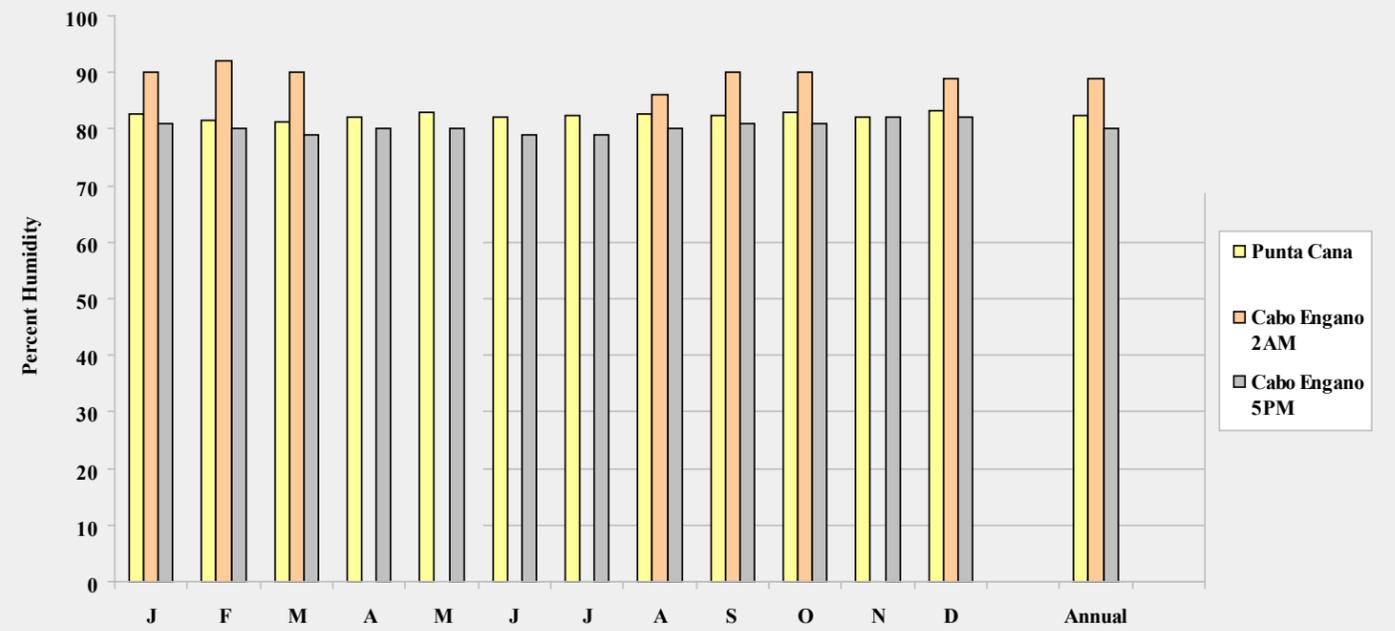
Source: Renewable Resource Data center website (http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/)

Data Source: National Solar Radiation Database

San Juan 18.43 N, 66.00 W / Roanoke 37.32 N 79.97 W / Pheonix 33.43 N 112.02 W

Mean Monthly Relative Humidity

* Morning Humidity data missing for April, May, June, July, and November



Source:

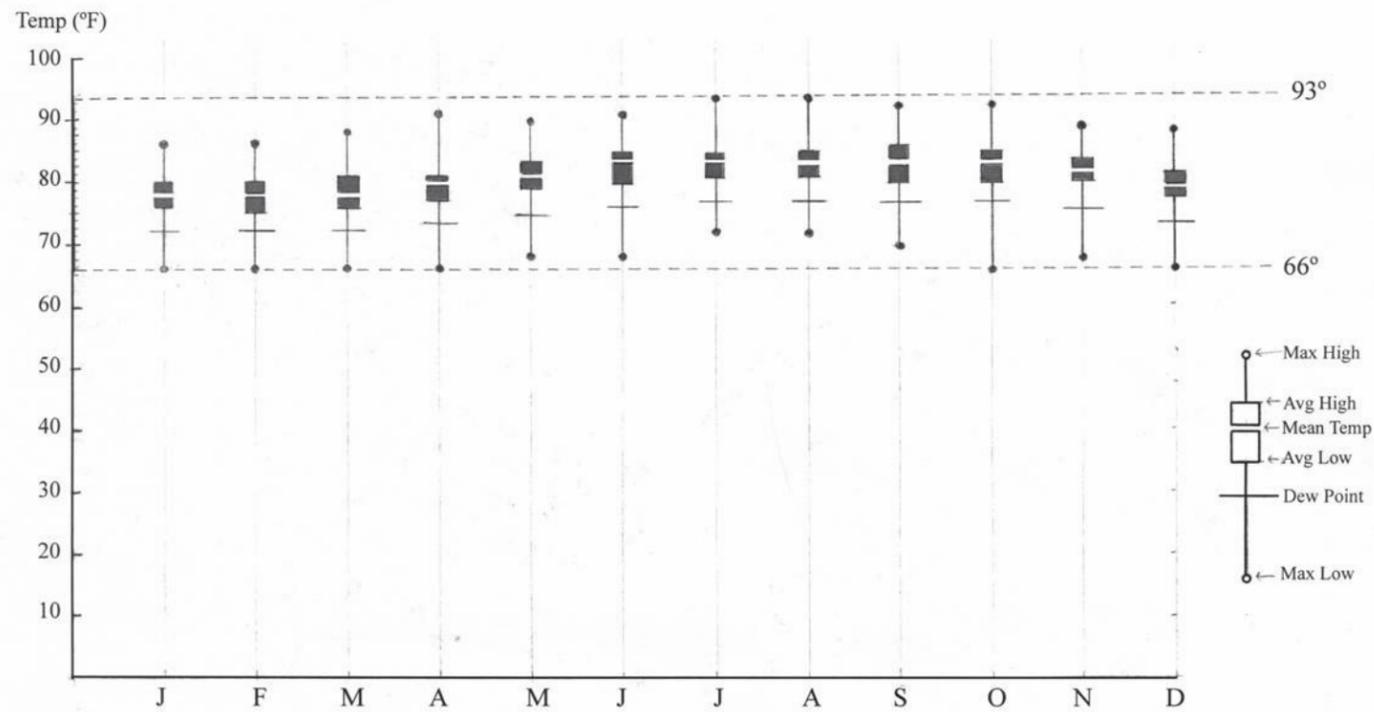
Punta Cana: www.onamet.gov.do/onamet/frameset.htm (Dominican Meteorological Department)

Cabo Engaño: International Station Meteorological Climate Summary CD-ROM, 1996

Punta Cana 18°34'N, 68°21'W / Cabo Engaño 18°37'N, 69°19'W

Average and Extreme Monthly Temperatures with Dew-Points

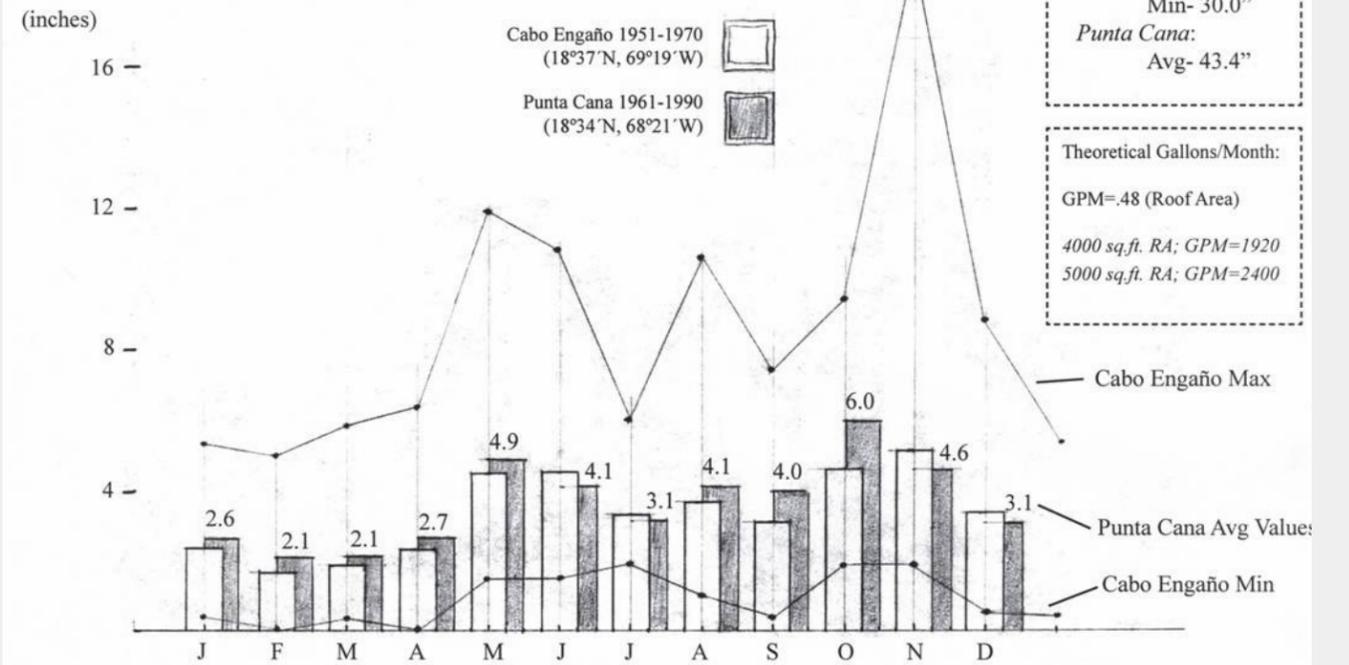
Cabo Engaño, Dominican Republic (18°37' N, 69°19' W)
(1973-1993)



Source: International Station Meteorological Climate Summary CD-ROM, 1996
Drawn by David Weissberger 10-20-2005

Average Monthly Rainfall

Two sites in the Dominican Republic



Totals:
Cabo Engaño:
Max- 62.7"
Avg- 41.4"
Min- 30.0"
Punta Cana:
Avg- 43.4"

Theoretical Gallons/Month:
GPM=.48 (Roof Area)
4000 sq.ft. RA; GPM=1920
5000 sq.ft. RA; GPM=2400

Sources:
Cabo Engaño data: International Station Meteorological Climate Summary CD-Rom, 1996
Punta Cana data: WMO data from www.worldweather.org
Drawn by David Weissberger 10-25-2005