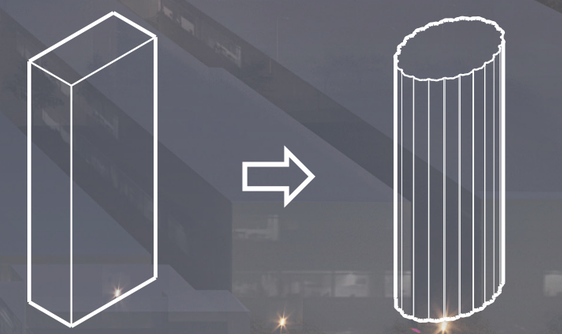
CIRCADIAN CURTAIN WALL

The Circadian Curtain Wall allows indirect natural light without heat gain and glare on the entire length of the perimeter. This is achieved, at all times of day, through its circular bay window geometry, and self-deploying shades that operate following the sun.

The curved lites incorporate an updated Trombe Wall cavity tied to building systems. The projecting bays allow wide-angle views connecting inside to outside.

On the exterior, it reads as a curtain that opens at the atria-- above the two entrances-- connecting the surrounding environment to the interior.

Structural curved glass eliminates 400 tons of aluminum compared to a conventional curtain wall enclosure.



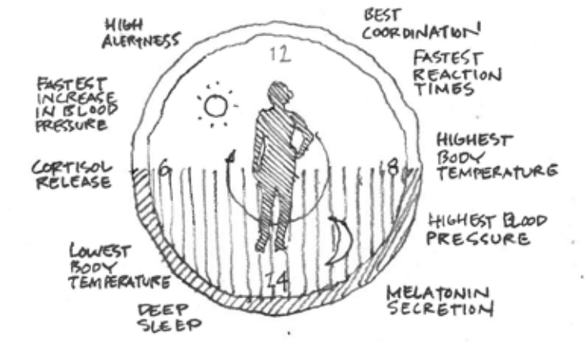
FLAT FAÇADE

CIRCADIAN FAÇADE

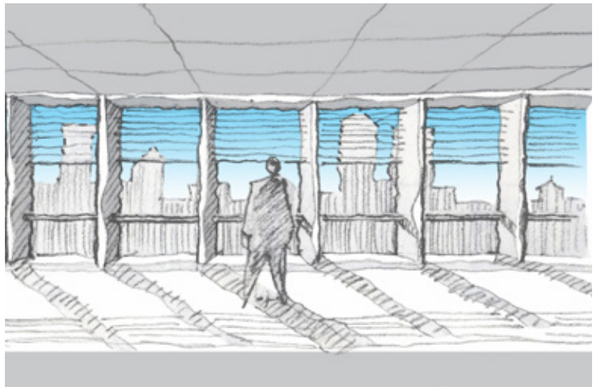
CIRCADIAN CURTAIN WALL

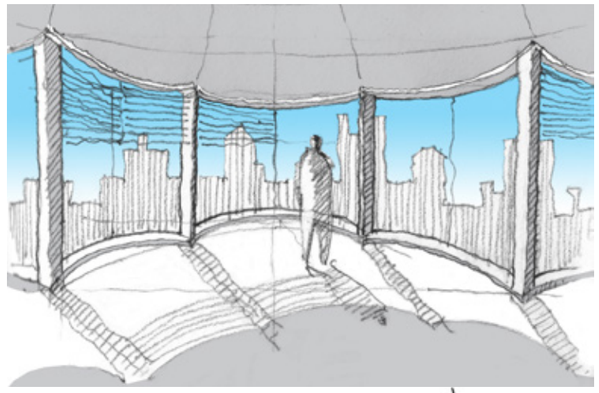
OLD/ FLAT **VS.** **NEW/ ROUND**

Circadian, latin *circa* + dies *day*



source: www.nobelprize.org



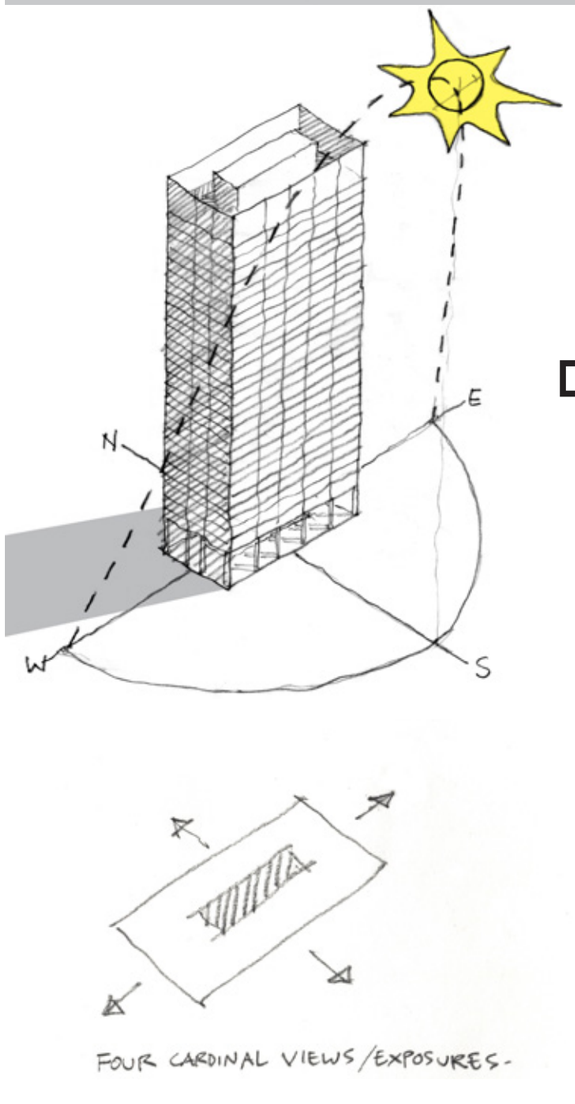


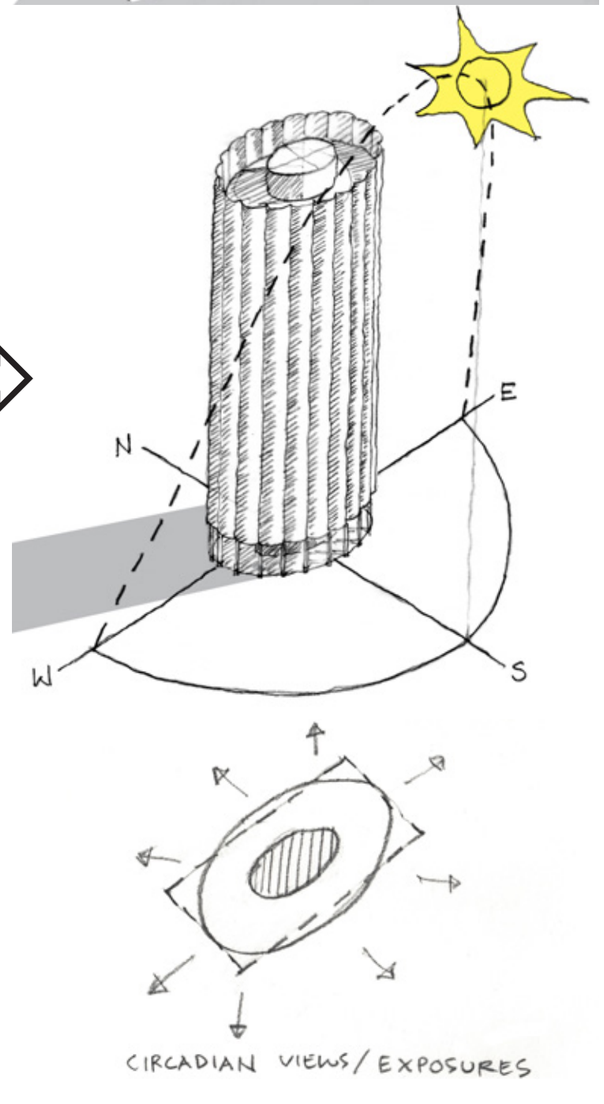
"Life on Earth is adapted to the rotation of our planet. For many years we have known that living organisms, including humans, have an internal biological clock that helps them anticipate and adapt to the regular rhythm of the day"

source: www.nobelprize.org

PROBLEM:

- Flat 'picture plane' view creates a separation between inside and outside, and limited field of view.
- Base case building is 120' x 180'. The program calls for 30 floors. Surface area is 270k sf.
- At any moment, the box is 50% self-shaded, but faces receiving direct sun require complete shading to control solar gain and glare.





SOLUTION:

- Projecting bay windows create feeling of connection between inside and outside.
- Circadian Tower floor plate is ovoid with 153' x 212' limiting dimensions. Surface area is almost 290k sf.
- Curved bay windows are self-shading, creating shadow and relief on the building surface. At any moment, the tower is approximately 75% self-shaded. In each bay some glass may be unshaded to allow view and natural light without heat gain and glare.

CIRCADIAN CURTAIN WALL

Light and View Looking North

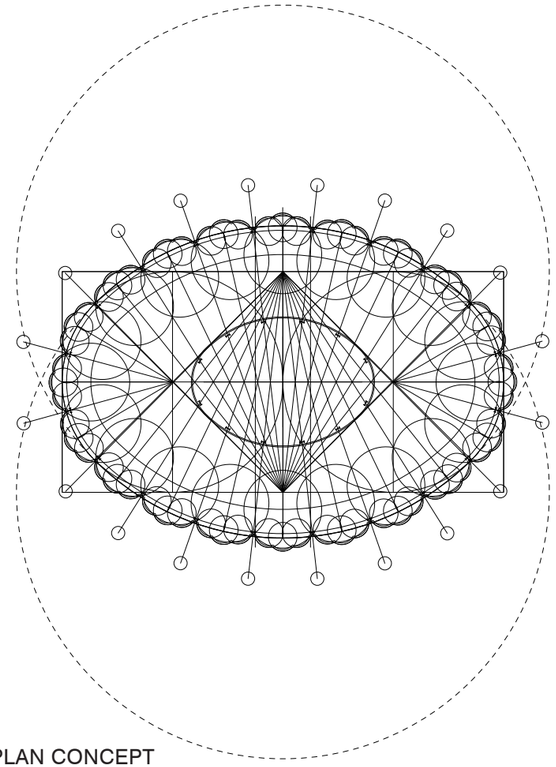
"Research shows that to a large extent employee well being is a result of connecting the occupants of spaces within a building with the world outside."

source: www.metalsinconstruction.org/design-brief/

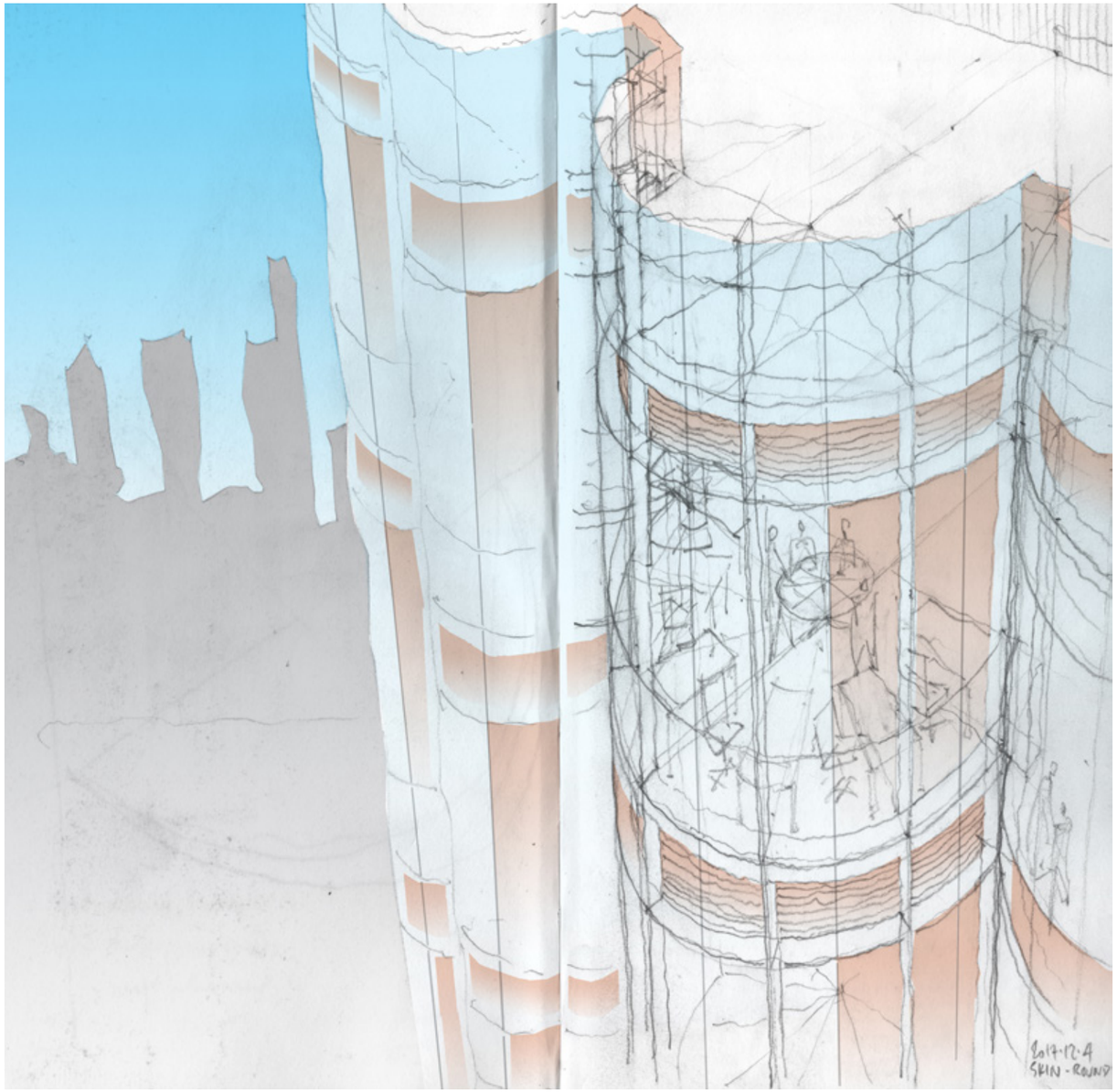
CIRCADIAN CURTAIN WALL

CIRCADIAN RHYTHM & ORGANIC FORM-- BIOPHILIA

- The Circadian Curtain Wall creates projecting bays of space that have 180 degrees of light exposure and potential view. It recaptures the advantages of exposure, and possibly ventilation, of the early skyscraper bay windows.
- The geometry of the Circadian Tower, from its flower-like floor plan to the vertical bays that read as bundled stalks, or a draped curtain, is based on response to the arc of the sun moving across the sky every day.
- The curved surfaces evoke an organic, biomorphic order that suggests the forces of nature, and of life.
- Current psychology research supports E.O. Wilson's Biophilia theory that we are naturally attracted to Nature and natural forms. Buildings with naturalistic qualities, and integrated living plants and water and views to Nature, contribute to less absenteeism and increased productivity.



PLAN CONCEPT



THE BAY WINDOW REINVENTED

- LIGHT: Constant indirect light afforded by automatic shades and the curved window geometry promote comfort and connection to the outside.
- VENTILATION: Perimeter induction ventilation is an expensive and inefficient means of providing the conditioned air necessary in a large commercial building in NYC, but the Closed Cavity system can act as a heat exchanger and heat pump in concert with the building mechanical systems. The system also incorporates filtered trickle vents for occupant control of fresh air

- Reliance Building, the Chicago Bay Window. 1895.

- Wainwright Building, Expression of organic order in ornament. 1891.

"Because the living environment is really what sustains us."
E.O. Wilson

CIRCADIAN CURTAIN WALL

REDUCED EMBODIED ENERGY

Ultimately, Wellness depends on the health and ecology of our environment, and the experiential features of the Circadian facade must be governed by concern for material economy and minimizing embodied energy.

- The conventional curtain wall is made up of 5’ wide x floor-height aluminum frames with glass infill. Mullions take wind load to the floors, requiring appr. 5 psf of aluminum.

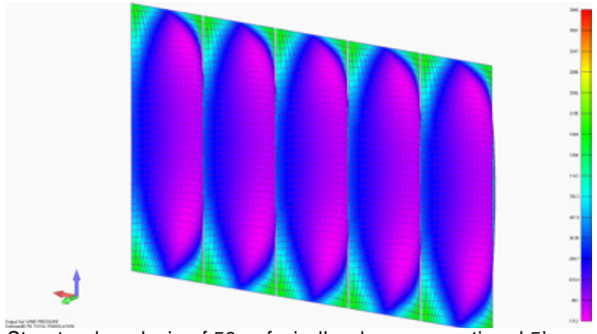
- The Circadian Curtain Wall curved glass acts as a beam spanning floor-to-floor, leaving the unit frame as a chassis for weather seals, connections to the mechanical systems and firesafing. This tower has a surface area of approximately 300K sf. If aluminum is cut in half by use of the curved glass it saves almost 400 tons of aluminum. This is a significant amount of embodied CO2 equivalent.

- Structural savings is offset by the curved glass and shading controls and mechanical couplings for the filtered air. But these, combined with the self-shading form of the building generated by the bay-window, effectively eliminate solar gain through the facade, and allow indirect light which reduces heat load and energy use for artificial lighting throughout the day.

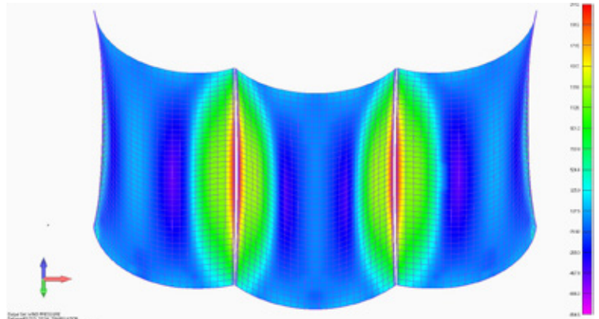
- Reduced carbon footprint and connection between the building occupant and the circadian rhythms of shades and lights synced to the time of day all contribute to occupant well-being.

Curved glass acts as a beam, allowing fewer, thinner mullions & savings of 400 tons of aluminum in the tower skin.

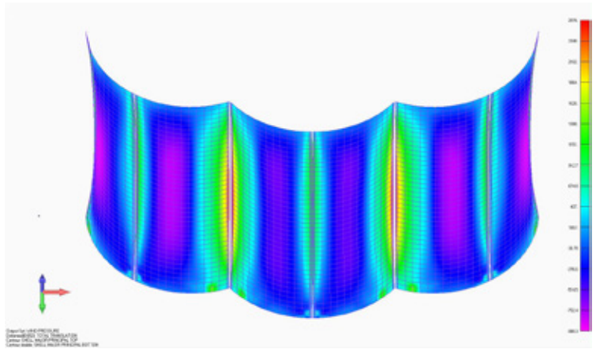
The curved bay windows are self-shading, allowing some shades to be up at all times on most bays and reducing reliance on artificial light.



- Structural analysis of 50 psf windload on conventional 5’ x 15’ units shows mullions are required to take wind load in order to limit deflection to acceptable maximum.

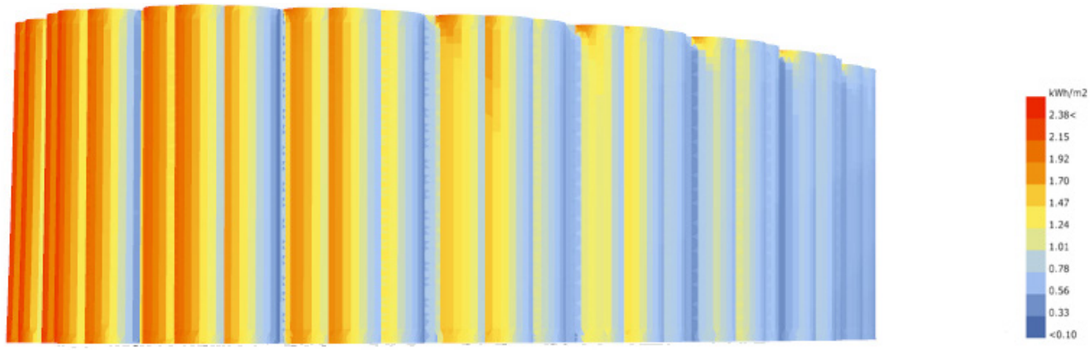


- Structural analysis of 50 psf windload on 10’ x 15’ curved lites in Circadian Curtain Wall units shows no mullions are necessary for structural purposes if glass is connected by structural silicone. Aluminum frames are included to provide housing for automated shades, and chassis for anchors and gaskets.

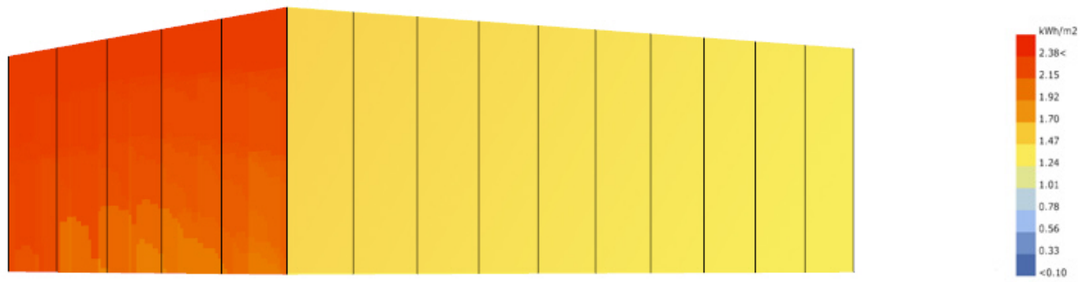


- Structural analysis of 50 psf windload on 5’ x 15’ curved lites in Circadian Curtain Wall units shows no mullions are necessary for structural purposes if glass is connected by structural silicone. The smaller glass is more economical, but there are more joints and seals.

DECREASED EFFECTIVE SHGC



- CIRCADIAN CURTAIN WALL Radiation Analysis New_York_City_Central_NY_USA_1967
  21 AUG 11:00 - 21 AUG 12:00
  Total Radiation:4.7 kWh/m2



- BASE CASE Radiation Analysis New_York_City_Central_NY_USA_1967
  21 AUG 11:00 - 21 AUG 12:00
  Total Radiation:7.8 kWh/m2

- The Circadian Tower surface is approximately equal in area to the baseline conventional rectangle for a floorplate that is also roughly equivalent, but the incident solar heat energy measured on the baseline enclosure surface is almost twice that of the Circadian Tower at a given point in time. This translates into a significant decrease in heat load and glare affecting occupants for the Circadian Curtain Wall.

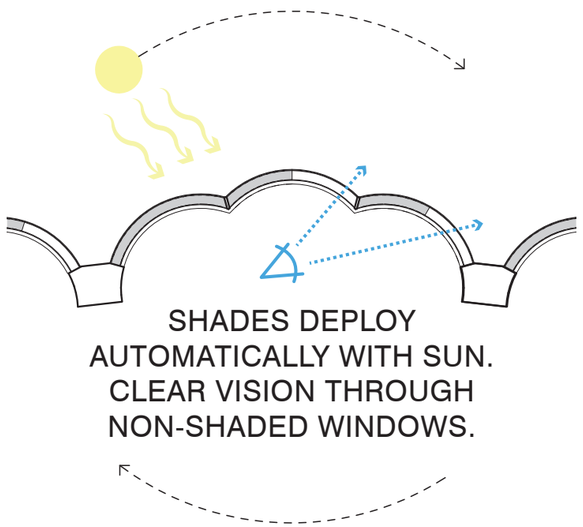
CIRCADIAN CURTAIN WALL

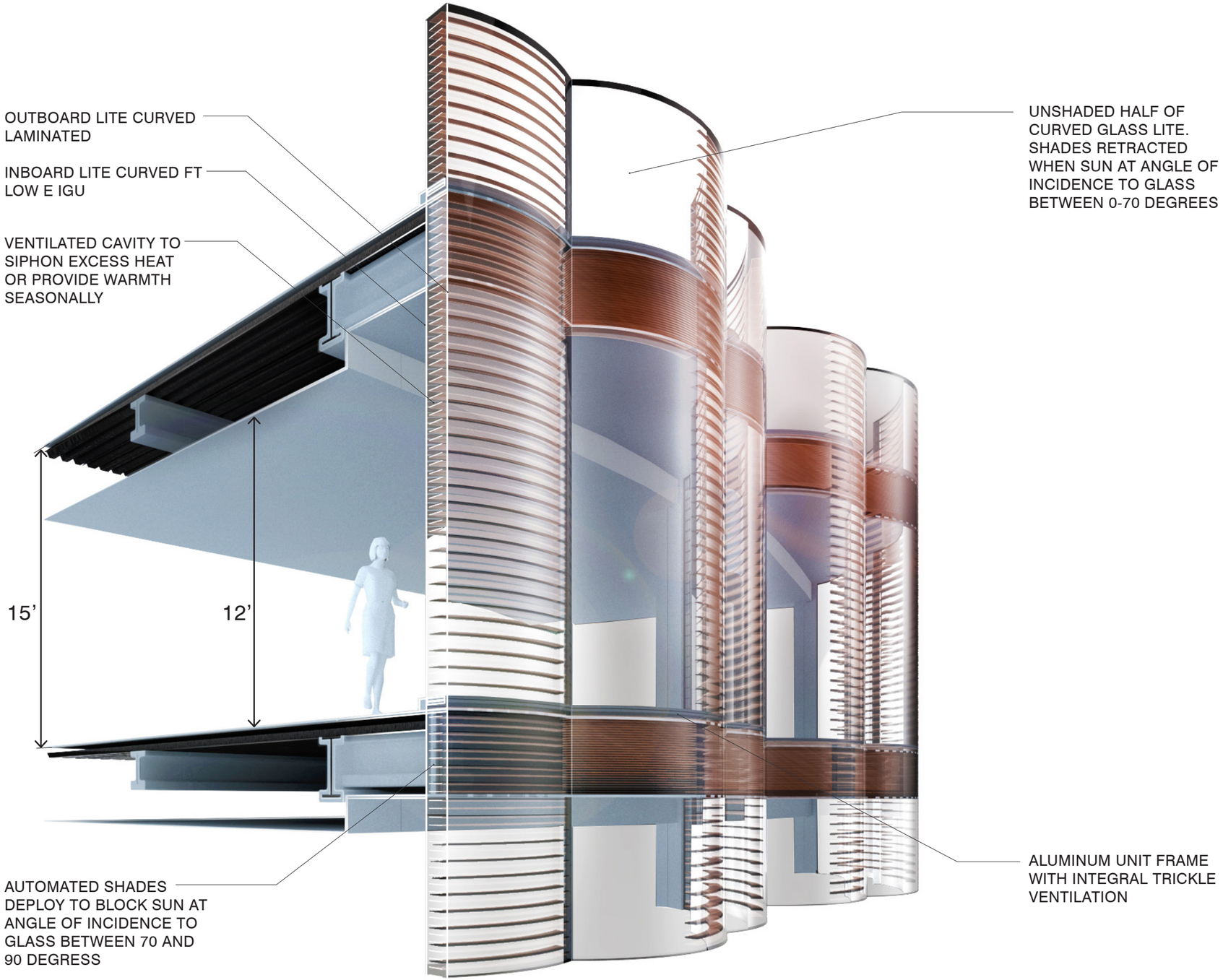
EXTERIOR

The typical bay is based on a 25-foot column span divided into three nominally 10’-wide bay windows. Each of these is a 90-d segment of a circle arrayed on a 90-d segment of a circle defined by the column points.

- Every unit is identical-- experiential variety is created by the automated shading and wide-angle views. This grants economy of production.
- The automated shades serve to keep one half each bay window protected from direct solar gain and glare at all times, changing to respond to the location of the sun throughout the day.
- The Enclosed Cavity housing the shades is kept pressurized by circulating filtered dry air which can deliver or siphon away heat to and from the perimeter to efficiently control occupant sensible comfort near the windows.

The principal innovation of the Circadian Curtain Wall is the curved facade bay with an updated Trombe Wall cavity housing automated shades and ventilation, creating views, constant indirect light, and occupant-controlled comfort.





CIRCADIAN CURTAIN WALL

WORKSPACE

The Oval form of the floorplate of the Circadian Tower provides a sense of center everywhere in the space. The column bays are naturally defined as neighborhood or cluster spaces where occupants form optimal-sized communities for collaboration.

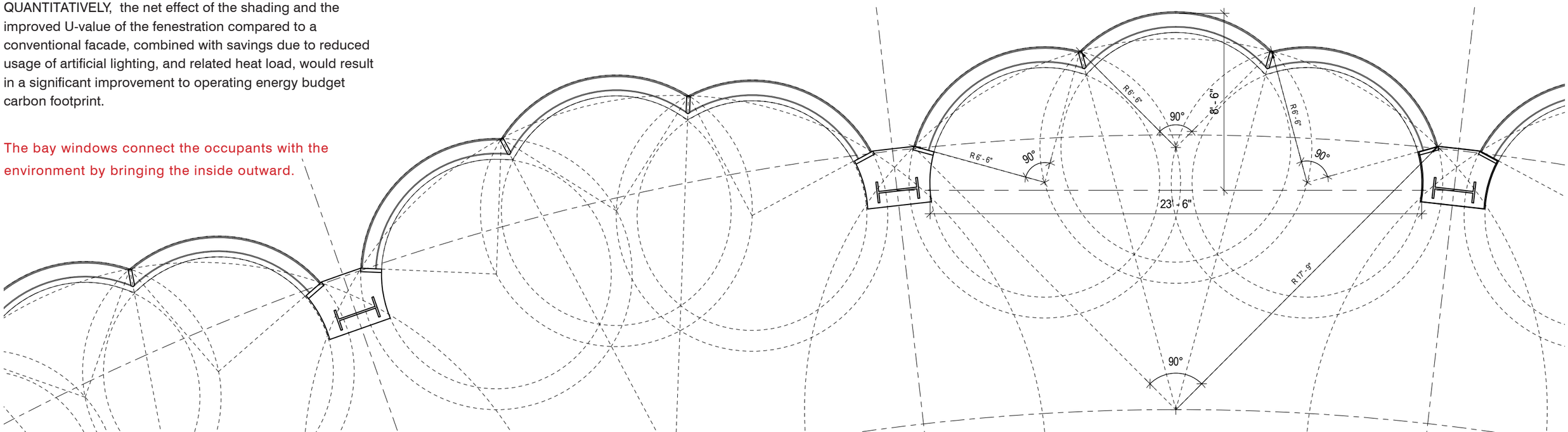
- While the bay window connects the occupants with the environment by bringing the inside out, the North and South Atria form collective spaces bringing the outside in to the building. These provide semi-conditioned buffer spaces which are natural attractors depending on seasonal and circadian rhythms.

- The automated shades serve to keep one half each bay window protected from direct solar gain and glare at all times, changing to respond to the location of the sun throughout the day.

QUALITATIVELY, the Circadian Curtain Wall creates awareness of the time of day and the surrounding environment from inside the building, as well as improved lighting and thermal comfort. From the exterior, it creates a facade with scale and relief, a sense of a whole made up of human-scaled parts which relate to the size of a traditional bay window.

QUANTITATIVELY, the net effect of the shading and the improved U-value of the fenestration compared to a conventional facade, combined with savings due to reduced usage of artificial lighting, and related heat load, would result in a significant improvement to operating energy budget carbon footprint.

The bay windows connect the occupants with the environment by bringing the inside outward.

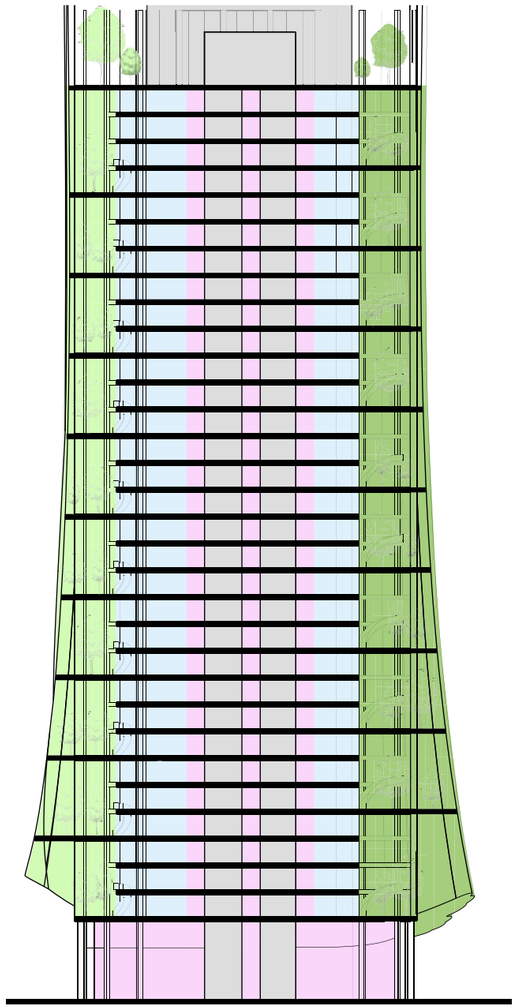


CIRCADIAN CURTAIN WALL

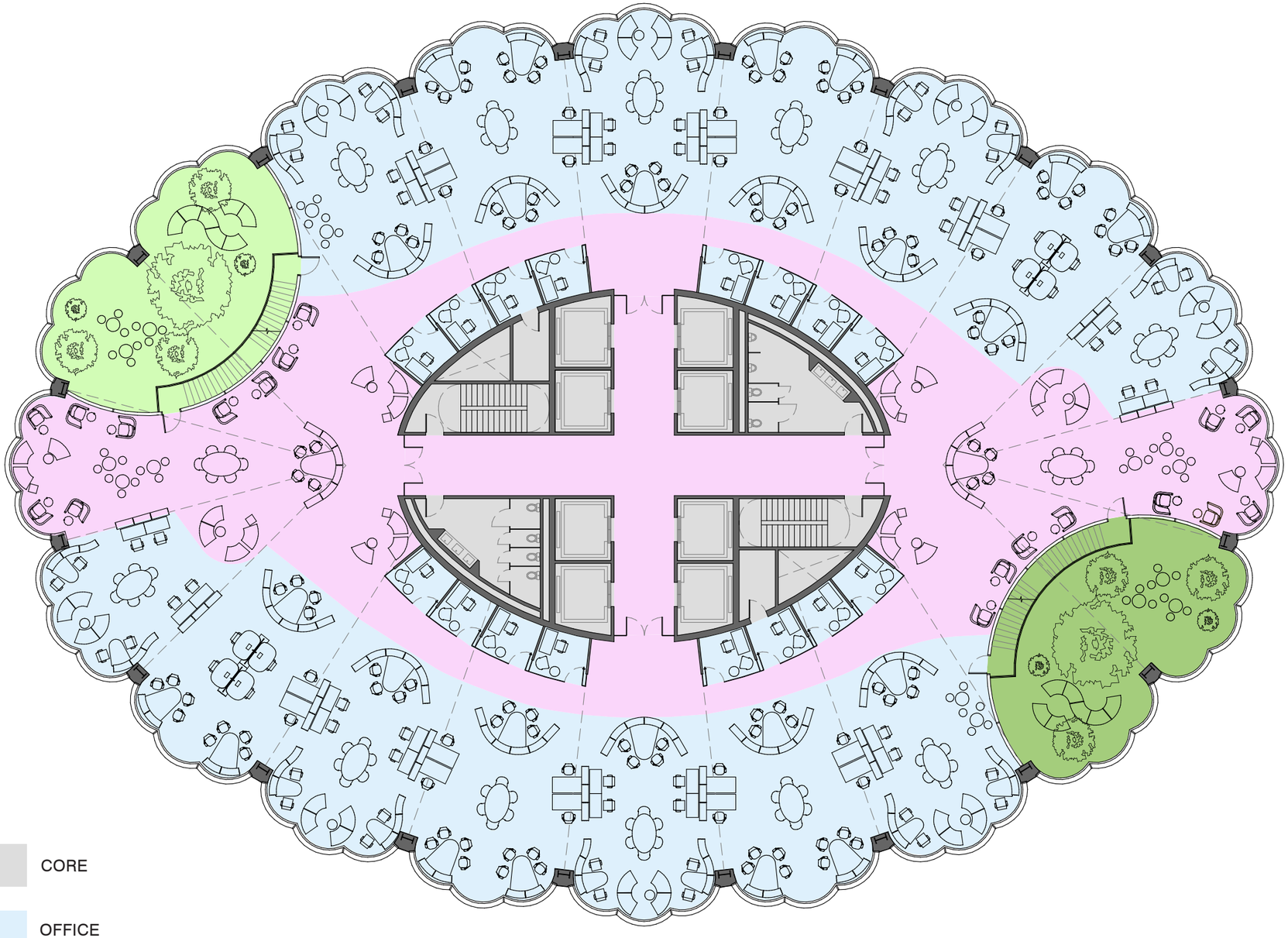
PLAN & SECTION

The 3-lobe cluster defines a space scaled to the most effective group size for creative collaboration. Almost every point on the floor can see the two atria, providing polar orientation.

The North and South Atria bring the outside inward. The Atria provide gardens connecting to the roof, with rejuvenating plants, fresh air and water features.



S-N SECTION



CORE

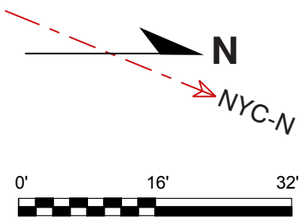
OFFICE

CIRCULATION/
BREAKOUT SPACE

SOUTH ATRIUM

NORTH ATRIUM

TYPICAL FLOOR PLAN



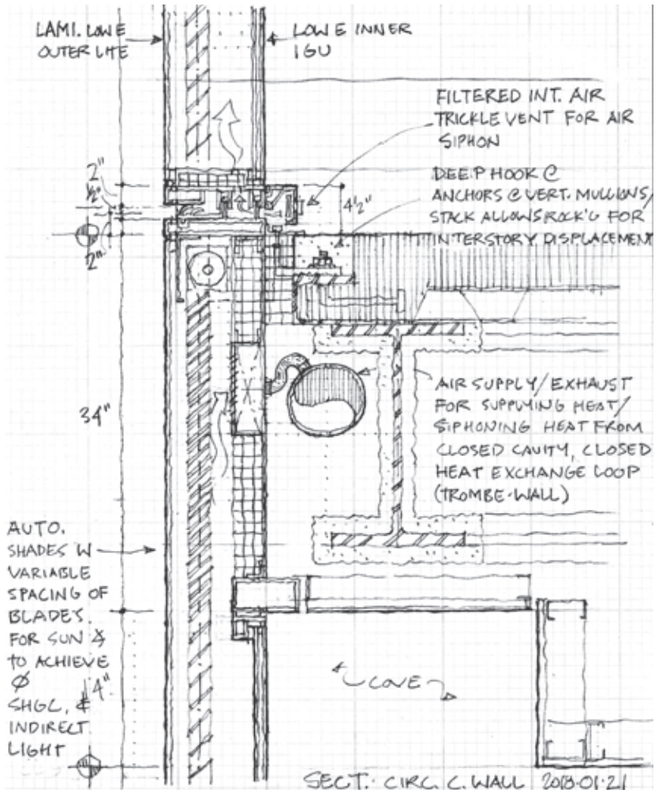
CIRCADIAN CURTAIN WALL

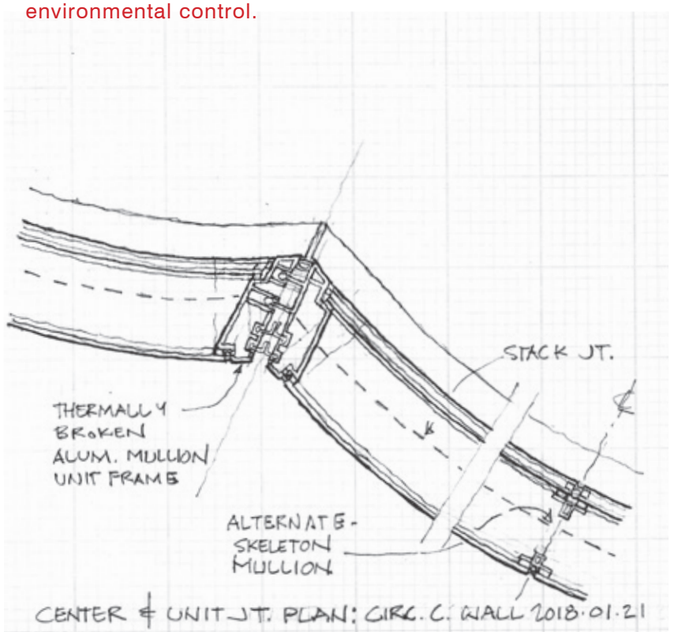
DETAILS

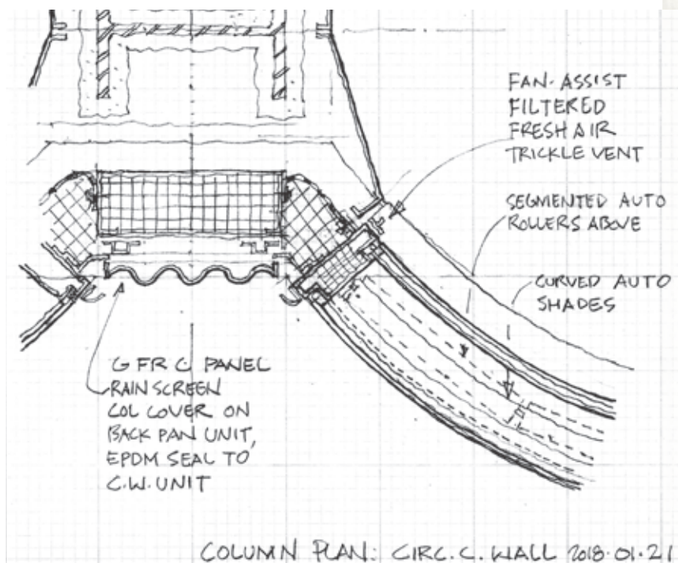
The facade system is based on a conventional aluminum unitized curtain wall, with a shallow cavity created by an outer lite of laminated glass housing automated shades.

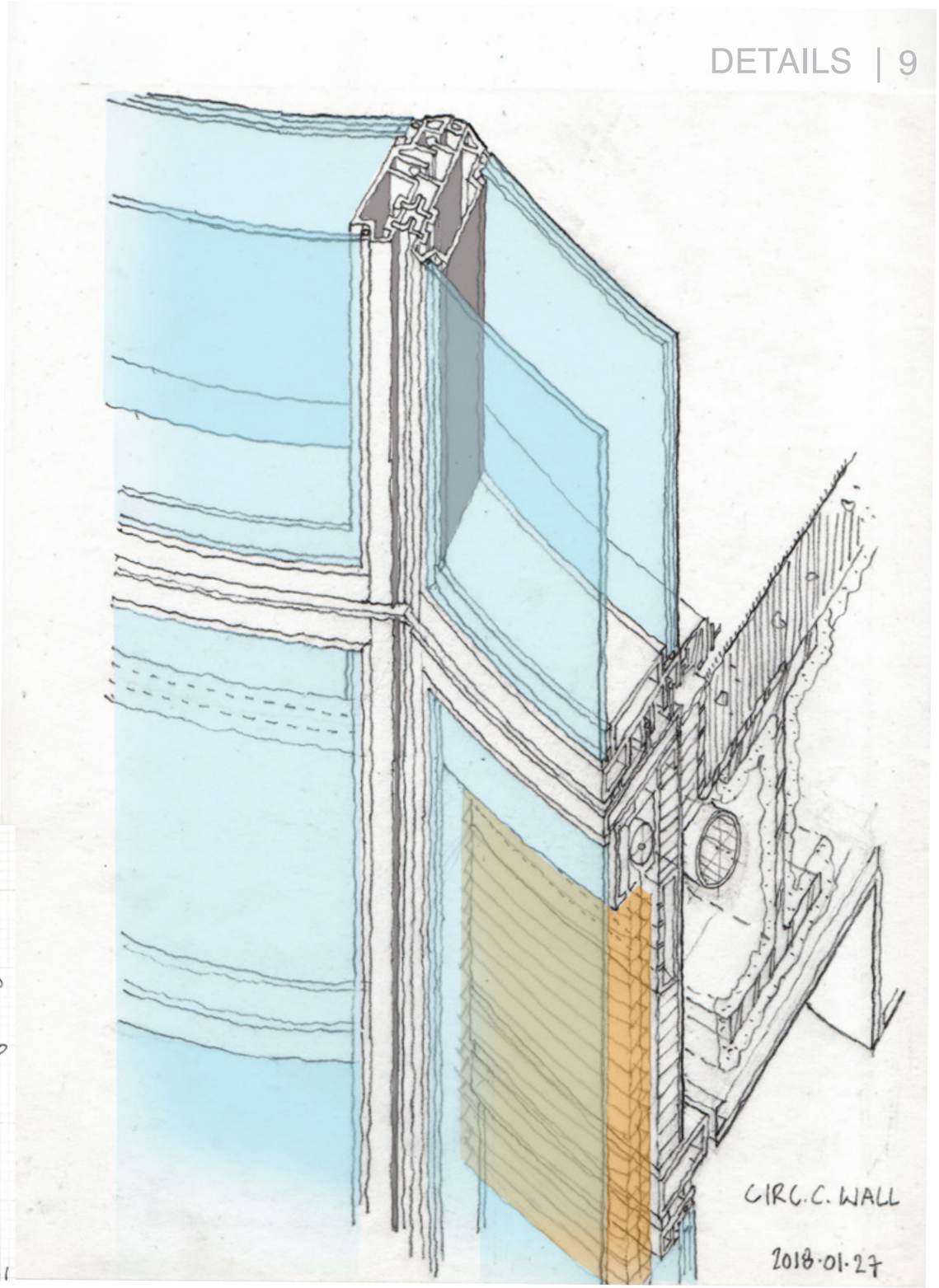
- Glass spans vertically taking windload to the frame and slab-edge anchors.
- The shades are protected from wind and kept clean in the pressurized cavity which functions as a Trombe Wall-- heated air can be utilized to warm the occupants adjacent to the glass or the air can be siphoned off to reduce cooling load on the sunny side of the building in summer.
- Trickle vents are incorporated to allow occupants control of localized fresh air supply without sacrificing economy and efficiency of centralized air handling.
- Net quantity of aluminum compared to a conventional wall with 5'-wide units is reduced by approximately half, offsetting the energy cost of additional layer of glass.

The system adapts tested technology to innovative geometry to create enhanced occupant experience and environmental control.









CIRCADIAN CURTAIN WALL

Wellness depends on body and mind-- and spirit. The Circadian Curtain Wall is conceived for performance with regard to energy use, comfort, and embodied energy, and for aesthetic effect.

In the same way that the theory of Biophilia assumes the health benefits of natural environments are the underlying basis of our emotional attraction to Nature, applying an organic logic to the design of the office building enclosure can result in a form that is aesthetically compelling.

From the lobed, flower-like plan geometry to the fluted exterior evoking cellular clusters and soap bubbles-- or the draped folds of a curtain-- the Circadian tower expresses an organic approach to function, form, and wellness of its occupants.