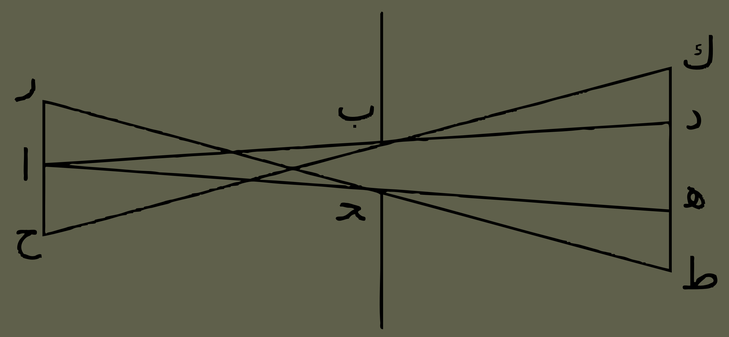
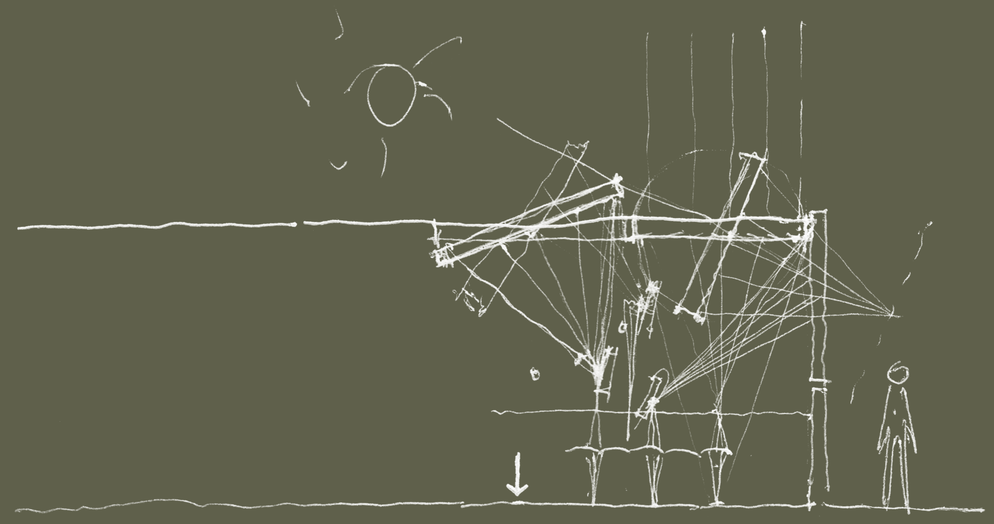


THE TIME IS NOW

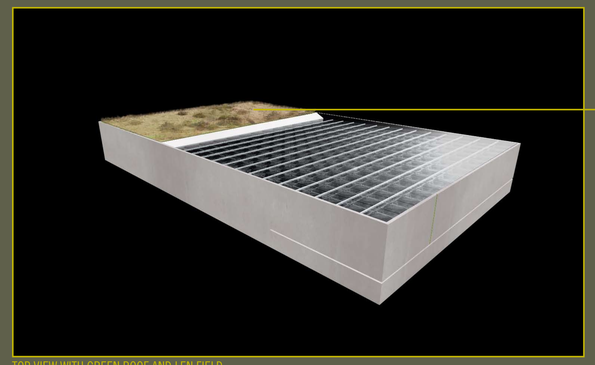
THE IBN AL HAYTHAM PAVILION FOR MUSHRIF PARK
A PROTOTYPE DESIGN BY THE LAND ART GENERATOR INITIATIVE

THE DESIGN OF THE IBN AL HAYTHAM PAVILION pays tribute to the Arab scientist Ibn al Haytham who, over one thousand years ago through his experiments with optics, built the first camera obscura and successfully projected an entire image from outdoors onto a screen indoors. He was the first to recognize that light travels always in a straight line and yet can be refracted with materials such as glass and water. Thus we are designing a pavilion that captures the energy of the sun and transforms it into 196 vertical columns of light through a series of lenses. These columns of light can be seen in the adjacent camera obscura room as they shift their position throughout the day, following the movement of the sun. Markers in the room will also allow these columns of light to function as a sundial so that viewers can track the time of day. Concentrated photovoltaic (CPV) collectors receive the condensed power of each beam at the floor level, generating a peak capacity of approximately 160KW. The pavilion will therefore serve as a source of beauty and inspiration for park-goers as well as a source of clean energy for the park. The power from the pavilion would reduce the external electrical demand load of the park by about 10%-20%.



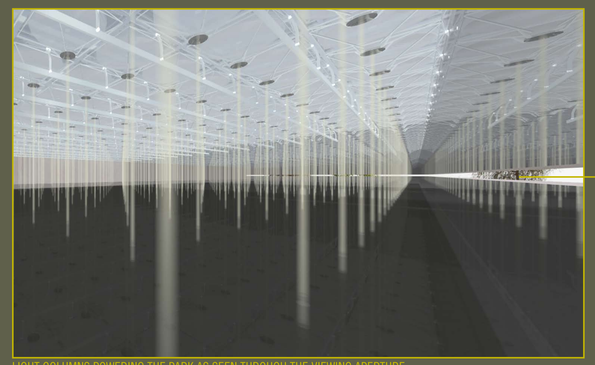
THE IBN AL HAYTHAM PAVILION WOULD GENERATE 10%-20% OF MUSHRIF PARK'S ENERGY NEEDS THROUGH CONCENTRATED PHOTOVOLTAIC TECHNOLOGY.

MUSHRIF PARK, DUBAI, UAE



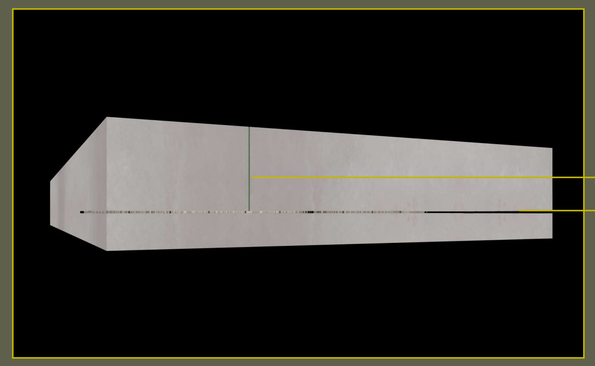
TOP VIEW WITH GREEN ROOF AND LEN FIELD

CAMERA OBSCURA ROOM

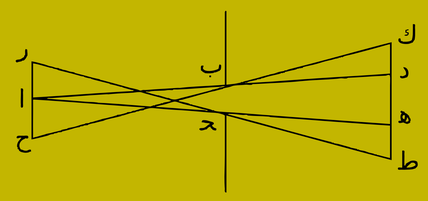


LIGHT COLUMNS POWERING THE PARK AS SEEN THROUGH THE VIEWING APERTURE

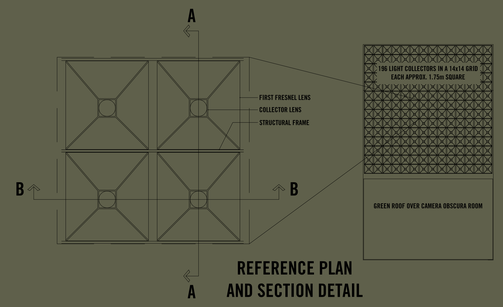
ENTRANCE TO CAMERA OBSCURA ROOM



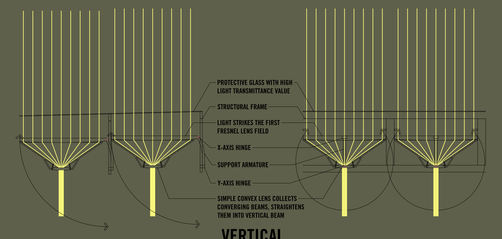
THE FIRST CAMERA OBSCURA WAS BUILT BY ARAB SCIENTIST ABU ALI AL-HASAN IBN AL-HAYTHAM, born in Basra (965–1039 AD), who carried out practical experiments on optics in his "Book of Optics". In his experiments, Ibn Al-Haytham used the term *Al-Bayt al-Muthlim*, translated in English as dark room. In the experiment he undertook in order to establish that light travels in time and with speed, he wrote: "If the hole was covered with a curtain and the curtain was taken off, the light traveling from the hole to the opposite wall will consume time." He reiterated the same experience when he established that light travels in straight lines. A revealing experiment introduced the camera obscura in studies of the half-moon shape of the sun's image during eclipses which he observed on the wall opposite a small hole made in the window shutters. In his famous essay "On the Form of the Eclipse" ("Maqalah-fi-Surat-al-Kosuf") he commented on his observation: "The image of the sun at the time of the eclipse, unless it is total, demonstrates that when its light passes through a narrow, round hole and is cast on a plane opposite to the hole it takes on the form of a moon-sickle."



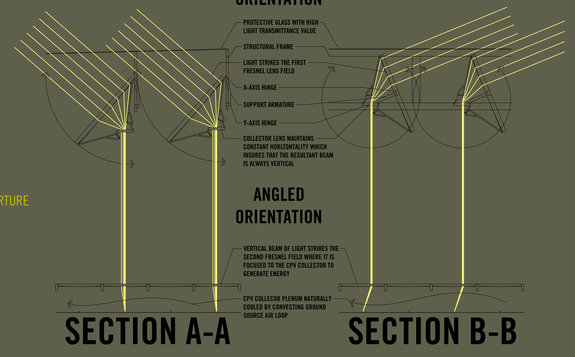
Al Haytham's observations of light's behavior through a pinhole.



REFERENCE PLAN AND SECTION DETAIL

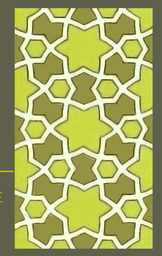


VERTICAL ORIENTATION

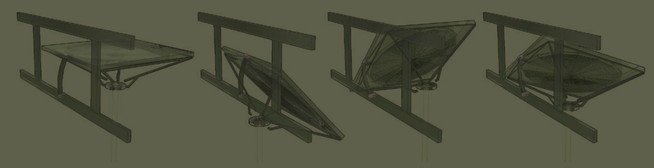


ANGLED ORIENTATION

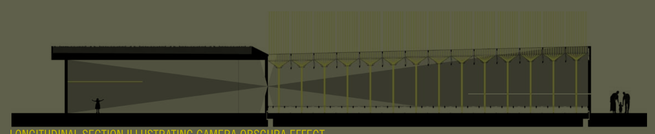
SECTION A-A SECTION B-B



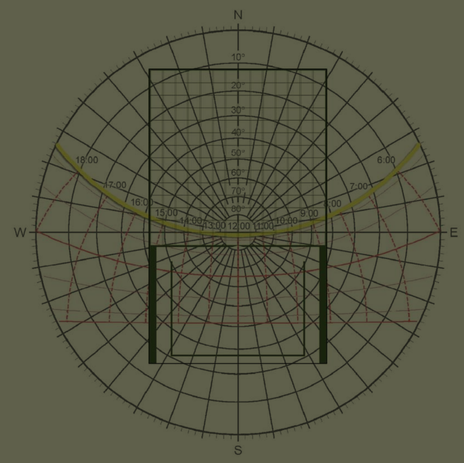
- Area of lens field: 576 square meters
- Assumed operating efficiency of system: 15%-30% (45% cell efficiency- loss from lenses, angle obstructions, and heliostatic tracking)
- Resulting peak energy capacity: 86 KW-172 KW
- Typical output per day: 1200 KWH
- Typical output per year: 400 MWH
- Cost per MWH: AED 300
- Cost savings generated per year: AED 120,000
- Construction cost: AED 4,000,000
- Payback: 30yrs



HELIOSTATIC DUAL AXIS ROTATION ILLUSTRATION



LONGITUDINAL SECTION ILLUSTRATING CAMERA OBSCURA EFFECT



BUILDING ORIENTATION AND SOLAR PATH DIAGRAM

CONCRETE: A SUSTAINABLE BUILDING MATERIAL

RESOURCE EFFICIENCY. The predominant raw material for the cement in concrete is limestone, the most abundant mineral on earth. Concrete can also be made with fly ash, slag cement, and silica fume, all waste by-products from power plants, steel mills, and other manufacturing facilities.

DURABILITY. Concrete builds durable, long-lasting structures that will not rust, rot, or burn. Life spans for concrete building products can be double or triple those of other common building materials.

THERMAL MASS. Structures built with concrete walls, foundations, and floors are highly energy efficient because they take advantage of concretes inherent thermal massing ability to absorb and retain heat. This means homeowners can significantly cut their heating and cooling bills and install smaller-capacity HVAC equipment.

REFLECTIVITY. Concrete minimizes the effects that produce urban heat islands. Light-colored concrete pavements and roofs absorb less heat and reflect more solar radiation than dark-colored materials, such as asphalt, reducing air conditioning demands in the summer.

MINIMAL WASTE. Concrete can be produced in the quantities needed for each project, reducing waste. After a concrete structure has served its original purpose, the concrete can be crushed and recycled into aggregate for use in new concrete pavements or as backfill or road base.

CONCENTRATED SOLAR PHOTOVOLTAIC CELLS

Concentrated photovoltaic (CPV) technology concentrates sunlight through a lens onto a high performance solar cell, thus increasing the electricity generated over conventional PV panels. Typical photovoltaic panels only convert about 10 to 15 percent of incoming light into energy. CPV cells can reach efficiencies of 45 percent. Typically the CPV solar cell lies directly beneath the fresnel lens or parabolic mirror concentrator. In the Ibn Al-Haytham Pavilion, the system is modified to create beams of vertical light with the power of 800 suns by concentrating sunlight through fresnel lenses at the roof. These beams are then re-concentrated at the raised floor level by a second fresnel lens field and onto the CPV cells which are arrayed in a naturally cooled plenum space at ground level.

BENEFITS OF GREEN ROOFS

- Grow fruits, vegetables, and flowers.
- Reduce heating (by adding mass and thermal resistance value) and cooling (by evaporative cooling) loads on a building—especially if it is glassed in so as to act as a terrarium and passive solar heat reservoir—a concentration of green roofs in an urban area can even reduce the city's average temperatures during the summer.
- Increases roof life span.
- Reduce stormwater run off.
- Filter pollutants and carbon dioxide out of the air .
- The soil and plants on green roofs help to insulate a building for sound; the soil helps to block lower frequencies and the plants block higher frequencies.
- Filter pollutants and heavy metals out of rainwater.
- Increase wildlife habitat in built-up areas.