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Contemporary Building with Historic Precedent: Botanical Research Institute of Texas

ARC 5423: Ecological Issues

Fall 2012 Semester

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I enjoyed the Botanical Research Institute of Texas so much when I visited it that I thought it would be nice to return to it for this assignment. There are many sustainable techniques employed in this building which have historic precedents. The ones I will focus on today are:

1. Cistern
2. Entrance Mat
3. Geothermal Well

But first, let's take a more detailed look at this building's site and plan layout….

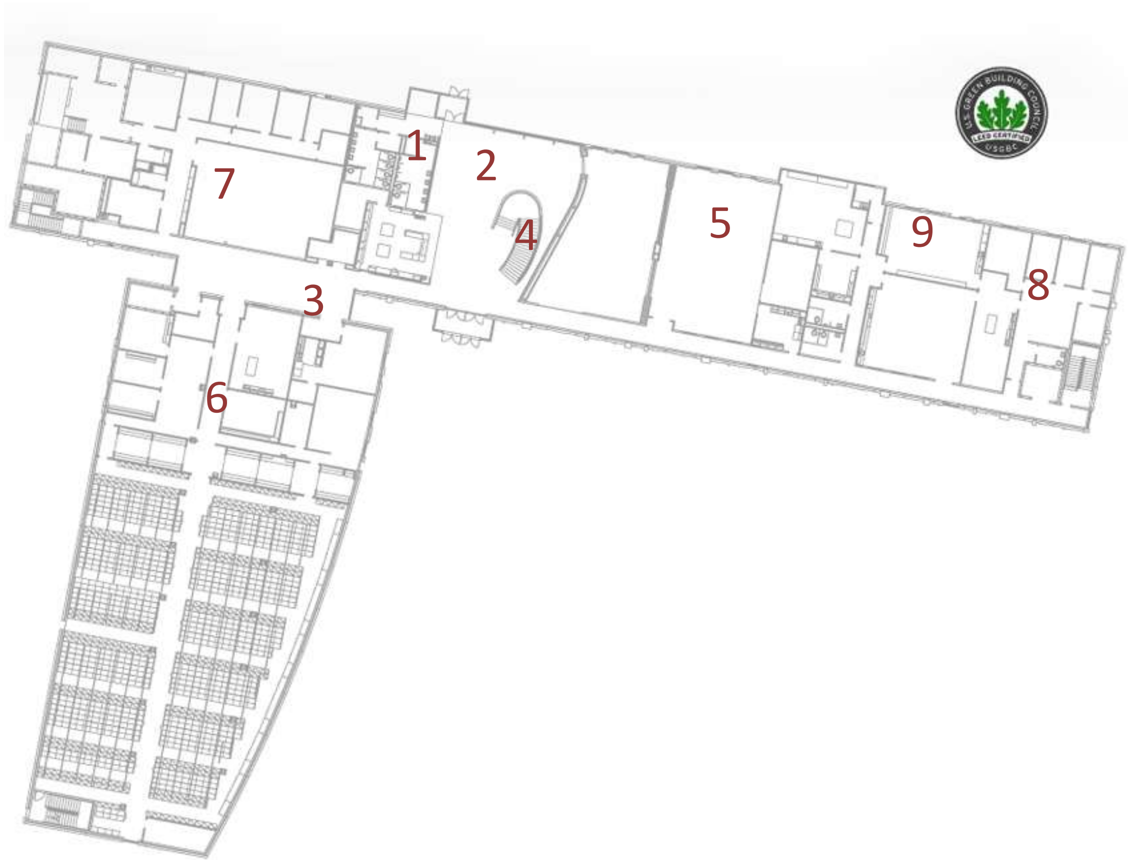
Introduction

1. Rain Gardens
2. Dedicated Low-Emissions Vehicle Parking
3. Restored Prairie Habitat (76%)
4. Vegetative Roof
5. LED Exterior Site Lighting
6. Indigenous Plant Material
7. Retention Pond
8. Cistern
9. Geothermal Well
10. Rooftop Solar Panels
11. Heat Absorption by Vegetation and Heat Reflection by Light Colors

Site Plan: Sustainable Features

Source – http://www.brit.org/visit/sustainable

1. Low-Flow Fixtures
2. Daylighting and Views
3. Recycling Bins
4. Reclaimed Materials
5. Rapidly Renewable Materials
6. Recycled Building Materials
7. Low VOC Materials
8. HVAC System Cleaning
9. Fluorescent and LED Interior Lighting



North

Building: Sustainable Features

Source – http://www.brit.org/visit/sustainable

First Floor Plan

Source – http://www.archdaily.com/217435/botanical-research-institute-of-texas-h3-hardy-c%E2%80%8Bollaboration-architecture/plan-02-394/

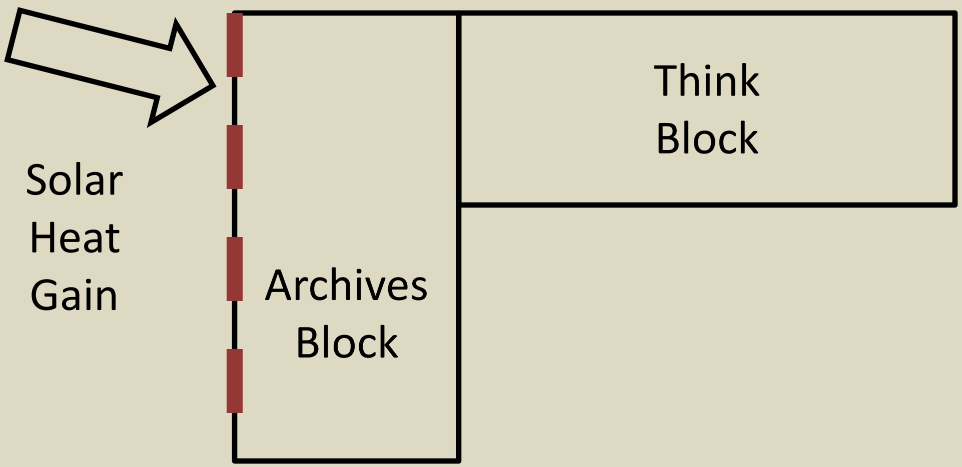
Second Floor Plan

Source – http://www.archdaily.com/217435/botanical-research-institute-of-texas-h3-hardy-c%E2%80%8Bollaboration-architecture/plan-03-227/

And now for a quick discussion on energy. This site was particularly challenging because of the intense Texas heat and lack of surrounding structures to provide shade. Even though the project is in an urban setting, there are no structures close enough to provide any cooling shade. To help mitigate this the project incorporated several passive systems to reduce solar heat gain and glare. For example, the building is constructed mainly of tilt-up concrete panels. This material serves as a thermal mass, absorbing the heat and keeping it from being emitted into the interior of the building. There is more solid concrete surface on the western façade, which gets the most solar heat gain throughout the year.

Addressing Energy Issues

The building's "L" shaped plan and orientation are also due, in part, to the architect's desire to mitigate solar heat gain. The "Archives Block" is oriented with its longest side facing the east and west. This portion of the building helps provide shade for the "Think Block", which is oriented perpendicular to it.



Addressing Energy Issues

The shape of the windows is also essential in energy conservation. The north façade boasts large floor-to-ceiling glazing to allow in natural light. However, the windows on the south façade are skinny and tall, and have vertical shading elements which help reduce solar heat gain in the interior of the building. There is also a pergola at the main entrance which provides shade for the glazed vestibule.

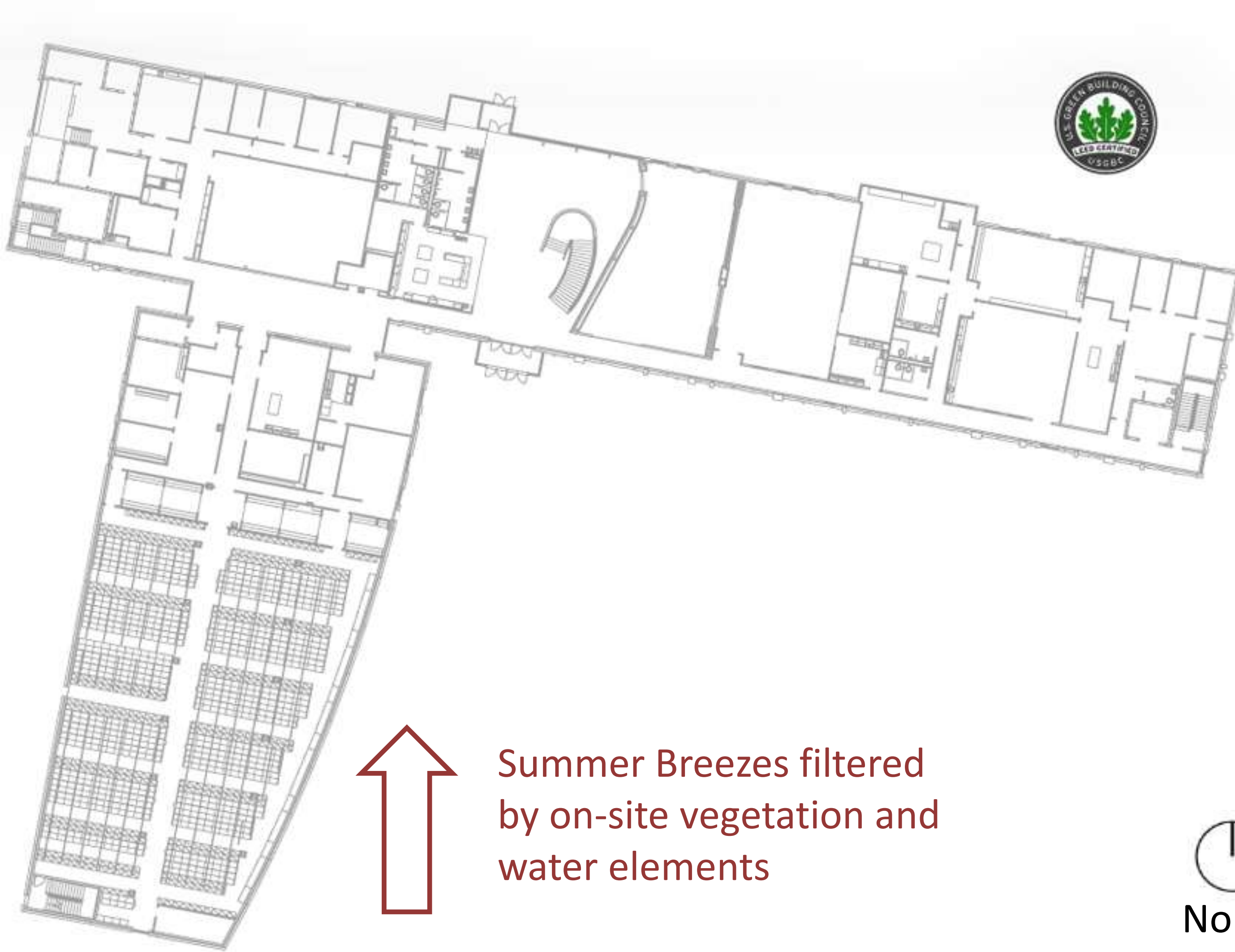
Addressing Energy Issues

In addition to these features, one can see a network of thin metal wires running across the building's façade. These wires provide support for climbing vines which, when fully matured, will serve as further shading for the building, keeping the sun from reaching the building's wall surfaces.

Addressing Energy Issues

Cold northern winds deflected by roof profile

Scorching afternoon Texas sun blocked by solid massing on west façade

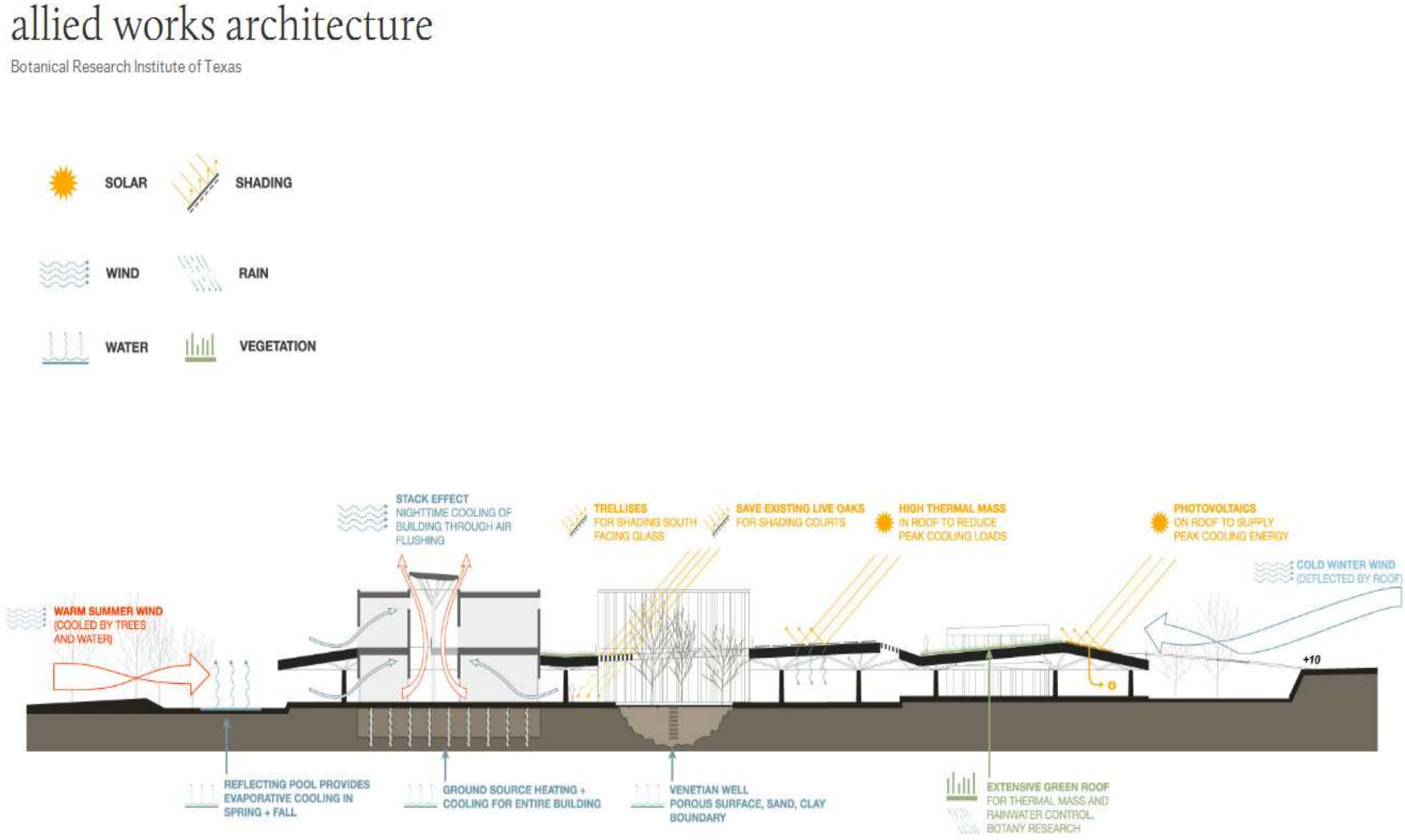


Summer Breezes filtered by on-site vegetation and water elements

North

Passive Energy Strategies

Floor Plan Source – http://www.brit.org/node/188



Energy Flow

Source – http://www.alliedworks.com/projects/botanical-research-institute-of-texas/#/analysis/4

Now that we have covered some of the general sustainable features at the Botanical Research Institute of Texas, let's return to the Historic Precedent aspect and see how sustainable techniques from thousands of years ago have benefited us today.

Historic Precedents

A cistern is basically defined as a storage tank for water that is lined with waterproof material, such as lime plaster. Typically cisterns were located underground in ancient times so that they could keep the water cooler, though today we see many cisterns above ground.

Cisterns work by collecting and storing rainwater. Sometimes aqueducts or channels were used to divert water to cisterns for storage. But often the water delivery system was much less complicated.

They also have served as settling tanks to filter the water, allowing larger debris and sediments to sink to the bottom.

Historic Precedent 1:

Ancient and Modern-Day Cisterns

Photo Credit: A cistern plus an element of a pipe line of the water supply of the House of Eustolios in Kourion, Cyprus.

http://www.romanaqueducts.info/aquasite/kourion/foto37.html

Cisterns have been in use for thousands of years. The earliest archaeological finds date back over 10,000 years ago to Levant, in the eastern Mediterranean. Cisterns were also used in the first century A.D. at Pompeii.

Photo Credit: VI.5.17 Pompeii. March 2009. Cistern in atrium area, near west wall.

http://pompeiiinpictures.com/pompeiiinpictures/R6/6%2005%2017.htm

Historic Precedent 1:
Ancient and Modern-Day Cisterns

BRIT has a cistern on site to collect and store nonpotable stormwater runoff for use as irrigation. The above-ground tank serves as an educational tool for the community.

Historic Precedent 1:
Ancient and Modern-Day Cisterns

Floor coverings have been used for many centuries as a protection from cold, hard earth. In addition to providing a softer, warmer living surface, floor mats also help to keep dust and dirt particles out of main living spaces.

The Japanese developed a tradition of removing the shoes before entering a building.

Photo Credit: Modern-Day Genkan

http://en.wikipedia.org/wiki/Genkan

Historic Precedent 2:

Entrance Mat | Genkan

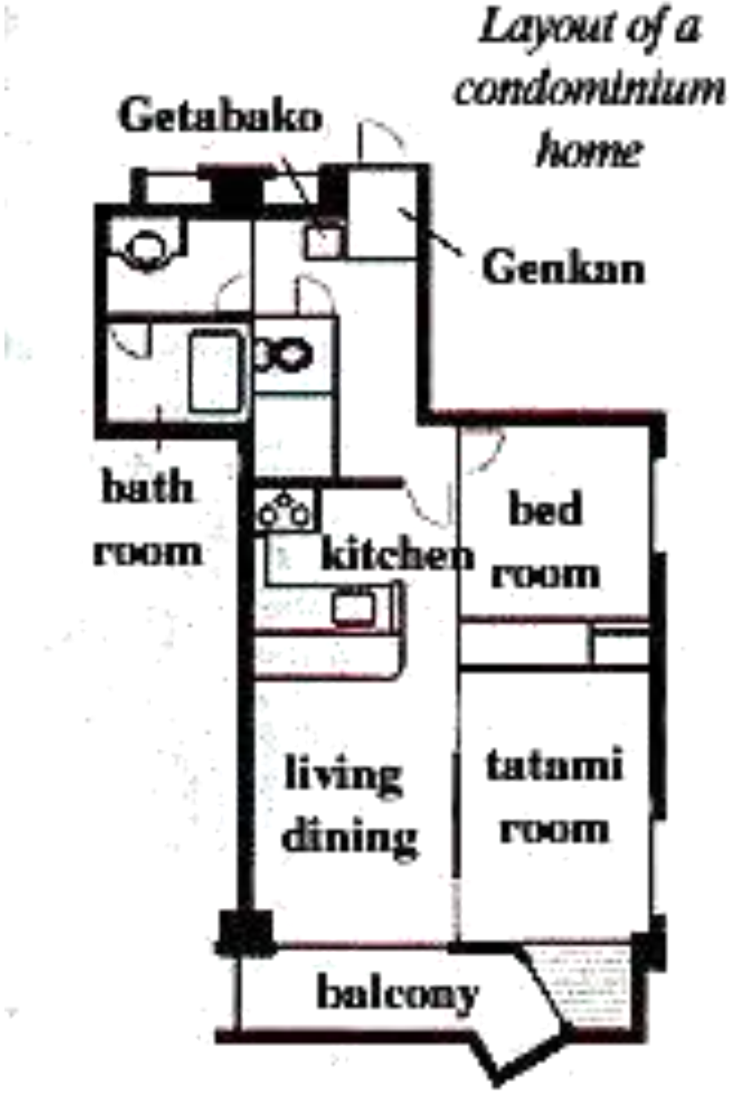
"Inside the door of a Japanese house or dwelling, you find an entrance way called the *genkan* is considered an important place, perhaps not so much in a small apartment, but very much so in ordinary condominiums or single family dwellings, as the " face " the household shows the world outside. There are many kinds and sizes of *genkan*, and usually the hallway or entrance hall beyond it is one step higher. As a general rule the smaller the *genkan* the lower the step. When there is frequent traffic in and out of a house, shoes mat be lest right in the *genkan*, and usually it is equipped with a *geta-bako*, or shoe cupboard to put away unused shoes. Nearby, as one steps up into the house, there is likely to be a slipper rack, holding pairs of slippers to be worn in the house. The survey showed that 98.9 percent of respondents use slippers in their homes, although they are not worn into the rooms floored with tatami because the scuffing easily damages the surface of the mats. A separate set of slippers is provided for use in the toilet. In this way, not only is there a clear distinction between inside and outside of a home, but within the home as well between tatami rooms and wood or carpeted floors, and between the toilet and other parts of the house."

Historic Precedent 2:

Entrance Mat | Genkan

http://www.tjf.or.jp/eng/content/japaneseculture/02kutsu.htm

"The custom of removing outside footwear within the house goes back at least as far as the Heian period (794 - 1192) among the upper classes and gradually spread thereafter throughout society. One of the reasons that footwear was shed in this fashion was because of the high rainfall and the generally very damp climate. A house would be quickly dirtied if people walked in wearing mud-covered shoes or sandals. But probably what came first was the custom of both sitting and sleeping directly on the floor on straw mats or cushions laid over it. Footwear was removed at the entrance to help keep the house clean."



Historic Precedent 2:

Entrance Mat | Genkan

Photo Credit: Genkan Floor Plan

http://www.tjf.or.jp/eng/content/japaneseculture/02kutsu.htm

It is not practical to have each visitor to a public building remove his or her shoes before entering. The adaptation of this ancient custom comes in the form of entrance mats at major and minor entrances which help keep shoe-tracked pollutants out of the HVAC system.

The LEED prerequisite for Indoor Environmental Quality (IEQ) credit 5: “Indoor Chemical and Pollutant Source Control “ requires an entrance mat of at least 10’ in the direction of travel at all major entrances of a building.

Historic Precedent 2:

Entrance Mat | Genkan

Historic Precedent 3:
Geothermal Wells and the Anaszi

The interior of the Earth remains at a constant temperature, despite seasonal fluxuations above the crust’s surface. Geothermal wells function by tapping into this constant heat (approximately 50°-70°F). Wells are drilled and piping is laid deep into the Earth’s crust. There are two ways in which geothermal wells operate:

1. The system can utilize steam from the Earth and use that steam to power turbines or other electrical generators.
2. Water can be piped through the hot regions beneath the Earth’s surface. This causes the water to heat before it is recirculated into the building and used to heat the building’s interior.

Photo Credit: Underground City of Derinkuyu

http://www.ancient-wisdom.co.uk/turkeyderinkuyu.htm

The concept of using the earth's constant temperature to provide comfortable settings year-round for a building's inhabitants is not new. One group that focused on excavated architecture is the Anasazi.

- Pithouses
- Kivas
- Cliff Dwellings

Historic Precedent 3:

Geothermal Wells and the Anaszi

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

"Over a shallow pit in the earth the Ancient Ones built semi-permanent houses of poles and brush plastered with mud. These pithouses were essentially the same as those first built in northeastern Europe 25,000 years ago. Pithouse technology was probably transmitted east through Siberia, across the ice bridge between Asia and North America about 12,000 to 14,000 years ago, down through Alaska and Canada to the American Southwest."

Pithouse

Historic Precedent 3:

Geothermal Wells and the Anaszi

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

Pithouse

"From about A.D. 500, as pithouse design and construction evolved, the shallow pits grew deeper — more like three to five feet deep. Often, the sides of the pit were plastered with clay or lined with stone — either large slabs wedged upright in the soil or courses of smaller stones laid around the inside perimeter. Generally, pithouses were round, and between nine and twenty-five feet in diameter. Later, around A.D. 700, many new pithouses were square, rectangular or shaped like the letter D."

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

Historic Precedent 3:

Geothermal Wells and the Anaszi

Pithouse

"Usually, four posts were positioned upright in the pit, joined at the top by four horizontal beams and crossed with ceiling joists. The outer skin of the pithouse was made of branches, brush and grass or a matting of tree bark. Construction was completed with a layer of mud on the outside of the roof and walls for protection from the weather. Inside was a central fireplace, used for heating and cooking. Side vents and a hole in the roof provided fresh air and evacuated smoke."

Historic Precedent 3:

Geothermal Wells and the Anaszi

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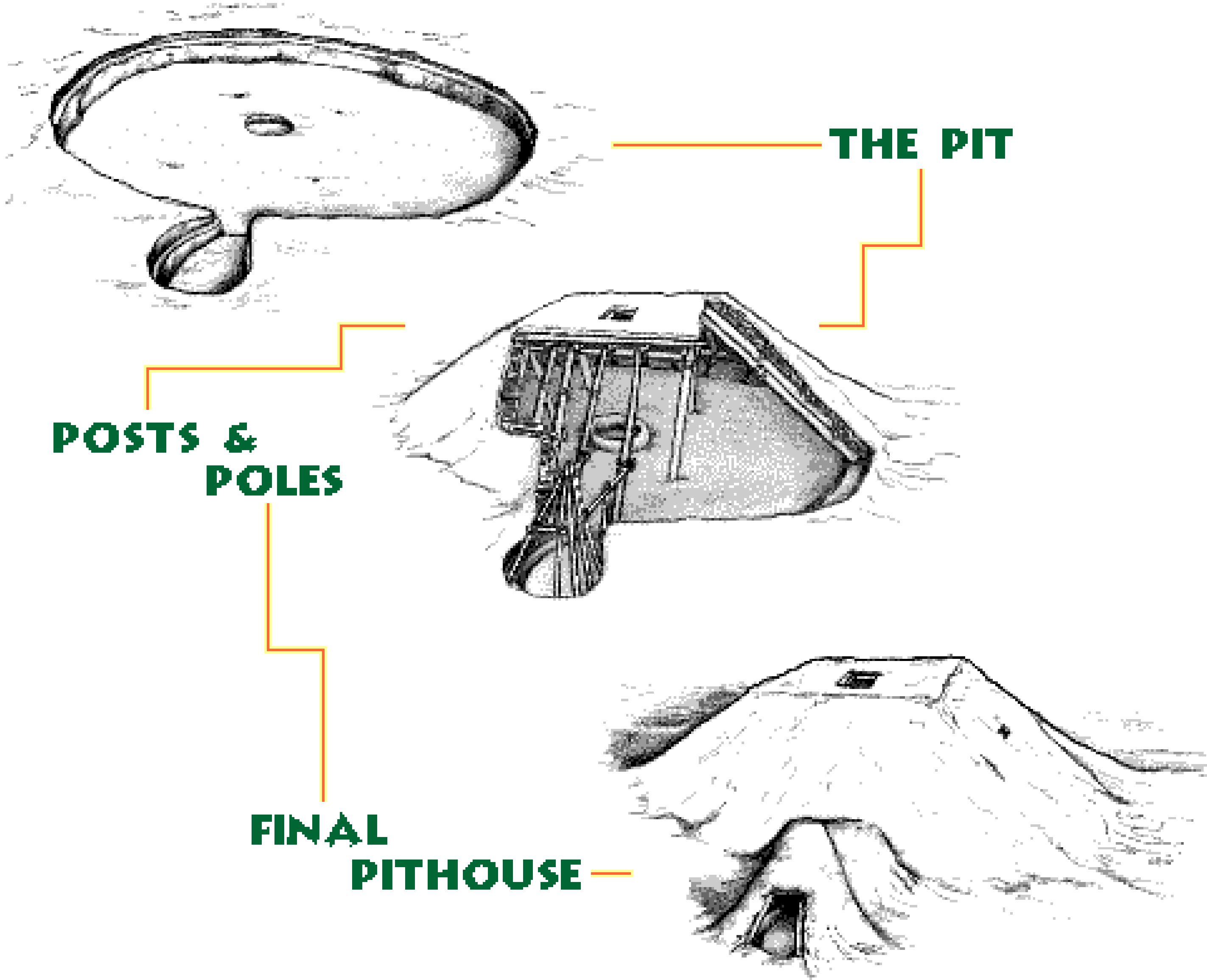

Historic Precedent 3:

Geothermal Wells and the Anaszi

Photo Credit: Pithouse

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

"Usually a pueblo had at least one …kiva, sometimes up to 60 feet in diameter. Most were entered through a hole in the roof. A stone bench for sitting lined the perimeter. There was a hole in the floor — now called a sipapu — symbolizing the people's connection from birth with Mother Earth. Near the center was a fireplace. Ventilator shafts on the sides made the kiva more livable.The first kivas appeared at the beginning of the Pueblo I period, about A.D. 750. While most ancient kivas are round, some are D-shaped or square. From the 10th Century on, many kivas included a small room opening out from the perimeter on the south or southeast, creating a sort of keyhole design. The side room is believed to have been used for the storage of ceremonial items."

Kiva

Historic Precedent 3:

Geothermal Wells and the Anaszi

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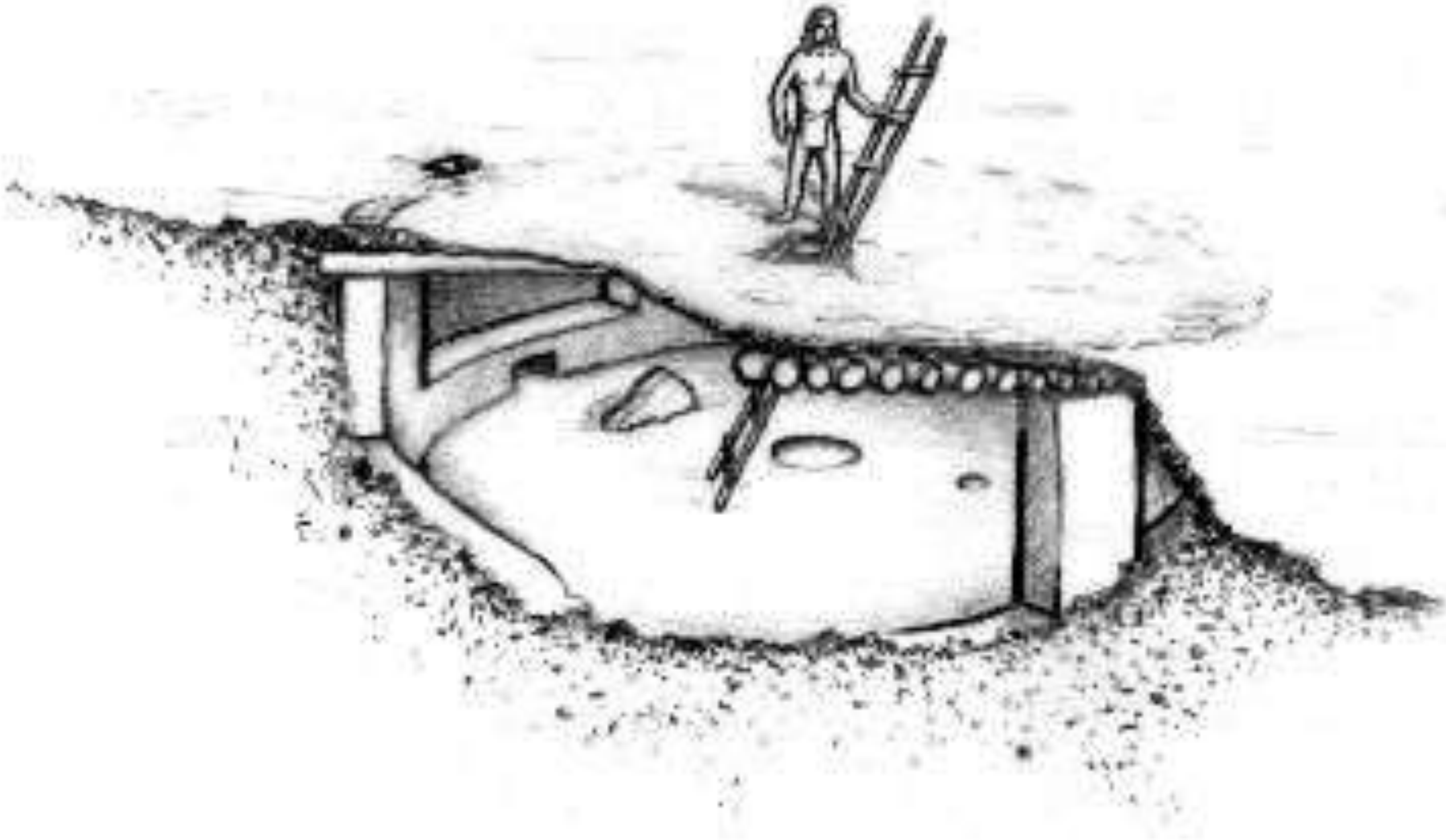

Historic Precedent 3:
Geothermal Wells and the Anaszi

Photo Credit: Kiva

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

"Cliff dwellings — stone houses, villages and towns built in caves or on large shelves in sheer rock canyon walls — are generally considered most representative of Anasazi architecture. Most cliff dwellings were built on south-facing ledges in deep sandstone canyons….The low-riding sun provided heat in the winter. The overhanging lip of the cliff offered cool shade from the high summer sun. Agricultural fields were maintained on the mesas above and, sometimes, in broader canyons below the dwellings. The Anasazi built cliff dwellings before the 13th century. One of the oldest of the important cliff dwellings, Keet Seel, was originally inhabited around 950. Redesigned in 1272 to include 160 rooms, it is the second largest cliff dwelling. The largest is Mesa Verde's Cliff Palace."

Historic Precedent 3:

Geothermal Wells and the Anaszi

Photo Credit: Cliff Dwelling

http://www.cliffdwellingsmuseum.com/anasazi/digging-deeper-into-the-anasazi/architecture

166 geothermal wells under the landscaped and parking areas help maintain constant temperatures and reduce heating and cooling loads by over 50%. During the winter the geothermal wells are used to help heat the interior of the building. During the summer the geothermal wells are used to remove heat from the interior of the building.

Historic Precedent 3:

Geothermal Wells and the Anaszi

Lessons Learned:

Practical Application

The techniques employed at the Biotanical Research Institute of Texas are very valuable. At work we do a lot of federal projects, which often either require LEED certification or require that a project is LEED *certifiable*, even if the application is not submitted. I learned a lot about seeing these systems in place, how they interact with one another, and still create a functional, technologically advanced building that combines state-of-the art features with traditional passive energy-saving techniques, such as photovoltaic panels, solar water heating, and geothermal wells. We will continue to employ these methods in future projects, as hopefully the price of newer technologies will decrease and popularity increases.

- http://en.wikipedia.org/wiki/Cistern#Famous_cisterns
- http://www.archaeology.org/interactive/pompeii/field/6.html
- http://www.britannica.com/EBchecked/topic/447584/Pazyryk
- http://www.britannica.com/EBchecked/topic/210566/floor-covering
- http://www.wisegeek.com/what-are-geothermal-wells.htm

Additional Sources