



program **document**



reuse



store



collect



compact

slope & garden



by **petar valkov**



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A Design Thesis Submitted to the
Department of Architecture and Landscape Ar-
chitecture
of North Dakota State University

By

Petar M. Valkov

In Partial Fulfillment of the Requirements
for the Degree of
Master of Architecture

Regin Schwaen
Primary Advisor



Mark M. Bambrone 4/20/2010
Thesis Committee Chair

may 2010
fargo, north dakota

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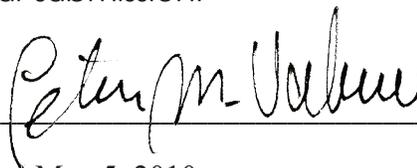
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dedication

To my family.

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abstract:

This thesis delivers, in an attempt to answer questions, how the solid waste may be affected by communities. The subject of this attempt is a local community waste field of Fargo, ND. The theoretical Premise / Unifying Idea guiding this work suggests optimization of solid waste treatment practices through architectural solutions while giving a new meaning of the site itself and to the community, creating a new direction of reuse. The project justification is that by changing the ways we deal with solid waste, we may bring a positive (or negative) impact to a community. Innovative way of turning a local landfill into a place with a double use, this project intends to create a novel solution plan for development and coordination, while making it a long term goal. As a design problem it may have urban and architectural solutions for the better future of many smaller or bigger communities. The final outcome intended is to create a Park / Ski Slopes with two upper and lower lift stations over the redeveloped landfill.

Upper Level Station - 8,030 Sq. Ft.

Lower Level Station - 16,324 Sq. Ft.

Key Words: **Solid Waste, Local Community, Park, Garden, Chalet, Ski Slope, Ski Center**

thesisproblemstatement

What is the relationship between a community and its solid waste?



statement of intent

statement of intent

Project Typology:

This thesis will explore creation of a recreation place that Fargo-Moorhead people can use to ski/snowboard and for summer activities during warmer seasons. A park area and a ski slope that is an element that is missing for the local people, in addition it will reclaim the local waste landfill mound.

The Theoretical Premise/Unifying Idea:

- **Claim:**

Solid waste has been produced by humans since ancient times. There is not a definitive answer to the question of how communities deal with solid waste treatment.

- **Supporting Premises:**

The community is producing, storing, and recycling its solid waste, building a compacted mound.

Arrangements and decisions to store and recycle solid waste produced by the community are made at different levels.

Solid waste was produced, is produced, and will be produced in the future, and most of it needs to be dealt with in a way that it will either reuse it or store it in order to minimize eventual concerns about its presence in the environment.

- **Conclusion:**

It is important to find an optimal manner of how to treat and reuse the solid materials thrown as a waste from any given community.

The Project Justification:

Changes in the way we deal with solid waste may, in return, be positive or negative for a community. As a design problem it may have urban and architectural implications for a better future for many smaller and bigger communities.



thesisproposal

Narrative
User | Client Description
Major Project Elements
Site Information
Project Emphasis
Plan for Proceeding
Previous Studio Experience

proposal narrative

Once in a while the local people would ask: "Do you ski?" The answer usually is an explanation that I like to downhill ski just not cross country style. People smile and would usually say something like: "Oh, we are so sorry, you see it is so flat around here, the only opportunity around is for cross country." Once in a while a person can hear the people in Fargo talking about the flat land and the missing opportunity to ski downhill. Is the cause lost?

Yes, it is flat here. It is cold in the winter too. But the people usually do not give up that easy. If they miss something they usually try to compensate for it. They struggle for a while but usually, in the end they get it their way. There is talk and stories are told about some attempts to create slopes around the area in the past. One can hear the story about a person that even started building a mound for downhill skiing. The problem was that the ground was so unstable, the more was piled up on the more the hill grew lower; it was sinking. Other story: here was a slope built out of wood in Fargo but happened that year was unusually mild and Fargo did not get any snow.

In the same time the city is growing rapidly. The population grows accordingly and there is a bigger and bigger quantity of solid waste generated, transported, compacted, and stored at the city's landfill. The shape of the landfill created is mound-like, a hill that grows and interestingly, does not sink. It is compacted, but it is relatively light. It stands and it grows.

Combining the above stories and facts, there comes an idea: why don't we try and turn all disadvantages into one advantage for this community: to create a slope, a park, a place, to reclaim the land back for the city while solving the need for downhill skiing, while use the solid waste that builds up anyway. At least the idea is worth an investigation. It is a different and new approach, but one that may prove vital for Fargo and may even help other communities having the same issues.

A vertical dashed line consisting of small, evenly spaced rectangular segments runs down the left side of the page.

Architecture has been a player in the solid waste scene as it has been involved in the designing of office facilities, transfer stations, some small recycling plants, incinerators and anaerobic digestion plants.

This thesis will try to take a different approach towards the solid waste the humankind produces, while using the local condition and architectural means. Through planning and design we intend to produce architectural results in a different way creating a place where the people of Fargo, Moorhead and West Fargo can get together, enjoy skiing, hiking, jogging, enjoying views while enjoying a cup of coffee, and creating a point of interest with specific spirit and meaning.

user|clientdescription

Owner/Client:

City of Fargo - Fargo Solid Waste is primary client.

The goal is to rebuild the place to provide a different meaning for the people of the local community. The whole community of Fargo / Moorhead / West Fargo is on focus and will be affected by the planning and changes. The existing landfill of Fargo will be used as a testing zone for the project.

User Groups:

1. Community - approximately 195,000
There will be place for every part of the community. Some may enjoy skiing or snow-boarding while others will enjoy the walk or taking the lift to look at the views from the top while enjoying a hot cup of cocoa.
2. Tourists and visitors - varies.
3. Employees - approximately 10 - 15.

Peak usage: Winter time, during weekends and winter holidays. Daytime. Otherwise year around use as a park and recreation point.

The project is intended to recreate parts of the Fargo landfill into recreational site / ski center for Fargo and the larger community including Moorhead, West Fargo, and smaller surrounding communities. It is intended to be an ever expanding project and develop in time.

Entry Pavilion / Lower Ski Lift Station

A gathering space,

Tickets,

Cafe / Tea / Restaurant.

Place to meet the visitors and to direct and guide.

Storage and renting for ski / snowboard, equipment.

Upper Ski Lift Station / Lounge

Gathering space chairs and tables.

Tea / Coffee / Restaurant Space.

Viewing Terrace

Other:

Circulation spaces

Mechanical Rooms

Electrical Room

Storage

Rest rooms

Maintenance Areas

Shipping/Receiving

Horizontal Circulation (Corridors)

Vertical Circulation (Stairs, Elevators, Ramps, Alleys)

Parking - 250 + 50 car spaces, handicap designation, staff

Maintenance building for large and small equipment, benches and machinery storage during different seasons.

site information



Macro - Region

North Dakota is a state located in the Midwestern region of the United States of America; it is located on the Canadian border, halfway between the Pacific and Atlantic oceans. North Dakota is the 19th largest state by area in the U.S.; it is the 3rd least populous, with just over 641,481 residents as of 2008. North Dakota was carved out of the northern half of the Dakota Territory and admitted to the Union on November 2, 1889.



Micro - City

Fargo is the largest city in the U.S. state of North Dakota and the county seat of Cass County. In 2008, its population was estimated at nearly 100,000(3) and it had an estimated metropolitan population of 195,685.



Micro - Area

Located on the corners of 45 th St. and 8th Ave. North the landfill, once outside of the urban area, is turning more and more into a spot within the city, while businesses are starting to surround its site.

photos: google

Place

Intention to create high mountain winter resort view and feel. Trying to bring the notion for a place and time as if in a high mountain. To create a point of interest and a start point to further develop, To correct the lack of ski slopes in the area, and to use the long winter seasons and snow accumulation in the area are some items that emphasize the importance of the idea to create ski center.. Architecturally stylish and well designed facilities will add to the idea and will help the destination to become popular not only within the local residents, but also visitors and tourists alike. Overtime the site will grow. New facilities and new paths will be created turning this not so popular corner of the metro area into a point of interest, and not only during winter periods, but eventually creating a park-like place for summer hiking and recreation.

Sustainability

Give a new meaning to the words "reuse" or "recycle", "utilize" and "green", while claiming back part of the town.

Challenge

To explore the possibilities of building and planting on this type of a site. How to and what is possible.

Direction of Research

Will explore possibilities and research will be made in the field of the unifying idea and the project typology, while considering historical context of the project site. It will also analyze and follow programmatic requirements. Using quantitative and qualitative information for the site, the potential growth and expansion potential will be used to emphasize and add to the theoretical premise. Study, theoretical modeling, and analysis on the site and on similar sites, as well as the possibilities and techniques for planting and building over this type of base condition will set a precedent, a formal initial point for further design opportunities. As this appears to be an innovative approach, it may lead to development of similar sites in other communities around the country.

Design Methodology

Mixed qualitative and quantitative methods of approach will be used to execute research for the thesis. A concurrent transformative strategy is intended to be guided by the unifying idea. Quantitative and qualitative information will be gathered in parallel. The unifying idea requirements will set a priority. The data should be integrated along the process of researching and will depend on the ways the unifying idea is examined. Analysis, interpretation, and discussion of the results will happen through the ongoing research process. Quantitative data will include statistical information, scientific research information gathered in our own libraries or at public archives, while qualitative information will come from personal decisions, observations, and survey.

Documentation of the Design Process:

Digital Photo Images, Scanned Imagery, Sketches, Digital Models and Drawings will be implemented in this process.

SECOND YEAR FALL 2006: Joan Vorderbruggen

Tea House
Fargo, ND
Rowing Club
Minneapolis, MN
Experimental / Science Center
Bear Mountain, CO.

SECOND YEAR SPRING 2007: D. Booker

Waldorf School
Moorhead, MN
Dance Studio,
Fargo, ND

THIRD YEAR FALL 2007: Ron Ramsay

Cinema Building for Agincourt,
Fictional town of Agincourt, IA
Summer Concert Hall for the Boston Symphony Orchestra
Stone barn by New Lebanon, NY

THIRD YEAR SPRING 2008: David Crutchfield

Structural Model for Store house
Mixed Greens - Housing / Commercial project
Fargo, ND

FOURTH YEAR FALL 2008: Bakr Aly Ahmed

Bioclamatic Sustainable Highrise Structure project
San Francisco, CA

FOURTH YEAR SPIRNG 2009: Frank Kratky / D. Booker

Urban Design Project for Santo Domingo slum area
Santo Domingo, Dominican Republic
Marvin Windows Competition, School in Africa
Africa

FIFTH YEAR FALL 2009: Regin Schwaen

Airport Hotel,
Fargo, North Dakota



programdocument

results from the theoretical premise research

theresearch

Landforms are so different. Landforms happen in all shapes and sizes in nature. Some are steep and bare, some are rising gradually, all green with vegetation. Some places just lack landforms all together. This research is based on the making up

for the missing land forms in Fargo, North Dakota.



How to create a slope for the inhabitants of Fargo-Moorhead area? The question stood for many years and few attempts to fill the missing element have been made so far. The research will investigate some already created man-made slopes and mounds. A

comparison with the main idea for this thesis will be made.

My parents live in a small town on the East side of the Mississippi river, right across from the city of Saint Louis. Two years ago they took me to a place a man made hill called Cahokia. At the museum next to it, one can watch a film and walk through a full scale replica depicting the life of the ancient mound builders.

The Cahokia Mounds, I found there, are located just outside of Collinsville, Illinois, a short distance off Interstates 55/70 and 255, just 15 miles from my relatives, along Route 40. The highway runs through the center of the area separating Monk's Mound from the Interpretive Center. It said that the complex covers more than 2,000 acres, Cahokia is the only prehistoric Indian city north of Mexico.

In the exposition one can learn that the large, man-made earthen structure, the city of Cahokia was inhabited from about A.D. 700 to 1400. Built by ancient people known as the Mound Builders, Cahokia's original population was estimated to have been only about 1,000 until about the 11th century when it expanded to tens of thousands.

Archaeologists have also excavated four, and possibly five, circular sun calendars referred to as Woodhenge. These evenly spaced log posts were utilized to determine the changing seasons, displaying an impressive example of scientific and engineering practices.

A gradual decline in the Cahokian population is thought to have begun sometime after 1200 A.D. and two centuries later, the entire site was abandoned. Though their fate remains unknown, theories include climate changes, war, disease, and drought. Archeologists continued to be puzzled by the fact that there are no legends, records, nor mention of the once-grand city in the lore of other

local tribes, including the Osage, Omaha, Ponca, and Quapaw. This strange silence has led some experts to theorize that something particularly dreadful happened at the site which other tribes wished to forget.

Many people still consider the Cahokia site a sacred place. Native Americans and metaphysical groups believe Cahokia is a source of powerful psychic energy. The Cahokia Mounds State Historic Site was designated a National Historic Landmark in 1964 and as World Heritage Site in 1982.



The site Cahokia Mounds Org states: "A 19-hectare (190,000 m²) Grand Plaza spreads out to the south of Monk's Mound. Researchers originally thought the flat, open terrain in this area reflected Cahokia's location on the Mississippi's alluvial flood plain. Soil studies showed that the landscape was originally undulating and had been expertly and deliberately leveled and filled by the city's inhabitants. It is part of the sophisticated engineering displayed throughout the site. The Grand Plaza of Cahokia measured

40 acres (16 ha). It was used for large ceremonies and gatherings, as well as for ritual games, such as chunky. Along with the Grand Plaza to the south, three other very large plazas surround Monk's Mound in the cardinal directions to the east, west, and north."

photos: <http://bitsandpieces.us>

"Beyond Monks Mound, as many as 120 more mounds stood at varying distances from the city center. To date, 109 mounds have been located, 68 of which are in the park area. The mounds are divided into several different types: platform, conical, ridge-top, etc. Each appeared to have had its own meaning and function. In general terms, the city center seems to have been laid out in a diamond-shaped pattern approximately a mile (1.6 km) from end to end, while the entire city is five miles (8 km) across from east to west" - finishes the explanation.

Another enthusiast of shaping the earth's surface is the land sculptor Michael Heizer. He started working on his project called "city." Somewhere between the 1970 as he claims and the 1972 as documented.

"As long as you're going to make a sculpture, why not make one that competes with a 747, or the Empire State Building, or the Golden Gate Bridge."

- says Michael Heizer in his web site.



This site is amazing about the scale associated Michael Heizer's project, one of the largest pieces of art ever created. There, I found out, is kind of secrecy related to his work and the project itself. Sources comment that not much is known about the project besides the fact that he works on it since the ninety seventies. Even the location is hard to disclose. I found some coordinates while researching it. Then zoomed and took a photo showing the site in google maps. Located in Nevada, City was planed on phases, each consisting of a number of structures referred to as complexes.

Phase One, about which most is known, consists of three complexes pictured. "Complex Two," the largest complex in the Phase One, is estimated to reach 70-80 feet in height and a quarter mile in length. The complexes are made mostly of earth, and were inspired in part by Native American traditions of mound-building and the ancient cities of Central and South America. They include massive decorations, such as "stele" on Complex Two, and large, geometrically shaped metal bars on Complex One.

Phase Five of City I found in my research, shows quite interesting shapes and structures which he named "45°, 90°, 180°" (that name Heizer has used in the past for works at The Museum of Contemporary Art, Los Angeles, CA and at Rice University, Houston, TX). The forms of "45°, 90°, 180°," like that "Complex One", are said to be a form of play with perspectives; when viewed from the front, those would appear as one simple shape; only from the side or above does its true complexity come to light. Learning about Heizer one would find out the experience of his art must be achieved from different perspectives and at different times.



photos 28 - 29: <http://doublenegative.tarasen.net>

The construction of City, I found out, was originally self-supported, with early funds from gallery-owner Virginia Dwan (who supported his work on Double Negative). Heizer now receives funding from the Dia Art Foundation through grants (of undisclosed amounts) from the Lannan Foundation, the Riggio family, and the Brown Foundation. With this more stable source of funding, work on City--the total cost of which may run to \$25 million--now progresses at a much more rapid pace, and should be completed sometime , before 2010.



photo: google

Interesting forms created in a desolate place in the desert, and because of the privacy of the author, it is hard to understand what the ideas behind this creation have been. The work, however, remains and because of the local conditions, the local weather and lack of moisture will probably preserve his work for the future. Thus, M. Heizer leaves something for the future civilizations...

"I'm building this work for later. I'm interested in making a work of art that will represent all the civilization to this point."

- Michael Heizer



Slopes are a part of the project. The other part are structures that will be placed, eventually, at the base and at the peak of the mound. To continue this research it is a natural next step to look for some possible buildings. The one that makes most sense in this case is the chalet.



It is true what it is said about the chalet: "The "Chalet" is by far the most famous product of Swiss architecture. The wooden dwellings with sloping roof and overhanging eaves, are as much a part of the Swiss landscape as the Alps themselves. The single storey bunkers traditionally served as seasonal farms for dairy cattle in the summer months, and haven't changed much since these humble beginnings. "



Webster's Dictionary defines a chalet as "A wooden dwelling with a sloping roof and widely overhanging eaves, common in Switzerland and other Alpine regions." The term is now also used to describe any cottage or lodge built in this style.

photos: www.furniturestoreblog.com

The term chalet stems from Arpitan speaking part of Switzerland and Savoy and originally referred to the hut of a herder. It derives from the medieval Latin calittum, which might come from an Indo-european root cala that means shelter. In French Quebec, any summer or vacation dwelling, especially near a ski hill, is called a chalet whether or not it is built in the style of a Swiss chalet.

Historically, most chalets in the European Alps were originally used as seasonal farms for dairy cattle which would be brought up from the lowland pastures during the summer months. The herders would live in the chalet and make butter and cheese in order to preserve the milk produced.

These products would then be taken, with the cattle, back to the low valleys before the onset of the alpine winter. The chalets would remain locked and unused during the winter months. Around



photo: www.chamonix.com

many chalets there are small windowless huts called mazots which were used to lock away valuable items for this period.

In North American ski areas, the word “Chalet” is also used to describe buildings that house cafeterias and other services provided by the resort, even though they often look nothing like the traditional Swiss chalet.

summary

The research that is presented justifies, to a certain extent, the proposed thesis project. The man-made slopes have been built in the past, and they are being built in different forms even now. The proposed thesis explores a new type of building material as a main difference. Another difference is the intended use of the slope: skiing and park recreation. The justification for my idea is that the slope is being built anyway and there are no intentions of use. It is, in a way, a burden for every community.

The communities usually consider it a fact that they just have to live with, even if they don't really like it for many reasons. Usually it is a burden because is considered dirty and it is built on valuable land. It grows bigger and bigger, threatening the lands that are in the immediate vicinity.

Conclusion

Currently the landfill is not assessed for its real potential. No one is making financial models for its possible uses. If a project is implemented that is similar to the thesis, then it may bring the process around and completely change the whole story of collection, compaction, and storage of solid waste.

All disadvantages actually turn into advantages if we consider the value added to a "simple pile of junk". It becomes a point of interest; the bigger it gets the better slopes it will have and the more interest it will draw. The community will not be displeased with building a pile of junk, but will have the noble engagement of supporting the project by simply paying their city taxes for trash. In time, the project itself may start generating a small revenue to be turned back to the community budget.

casestudies

casestudyone

Imperial Hotel

Location: Tokyo, Japan

Architect: Frank Lloyd Wright

Construction Timeline: Built 1914 - 1922 (demolished 1968)

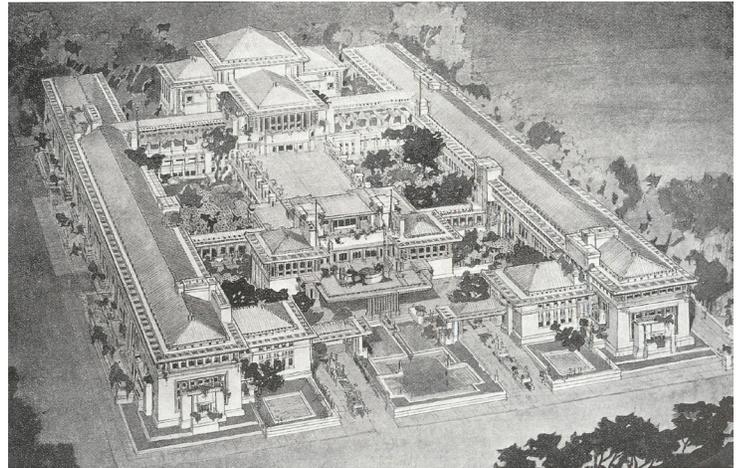


photos and quotations
this case study:
Copplesone Trevin
(1997), Frank Lloyd
Wright: A retrospective
view. Regency house
publishing Ltd. United
Kingdom.

One of Wright's most important projects is the Imperial Hotel, which made him a world-wide celebrity. Choosing this project for a case study in this thesis project is important because of the similarity in the ground conditions. The site, the hotels was built on, consisted of mud 50 foot deep. Frequent earthquakes made it even a harder place to build. Wright solved the problems,

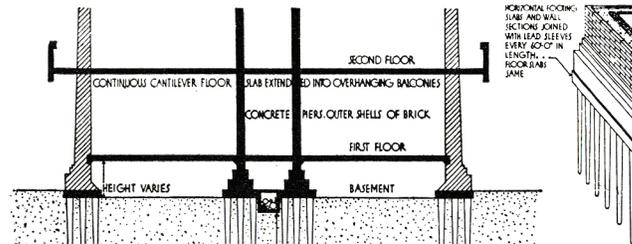
comparing the solution to a tray balanced on waiters fingers. Grouped tapered concrete supports were driven into the soil. Continuous concrete floors floating on a varied height base. The second floor carried cantilevered rooms and the walls tapered going up, thus providing lower center of masses points.

Frank Lloyd Wright's Imperial Hotel in Tokyo has been gone now for almost as long as it existed (1923 - 1968), yet it looms largely in the mythology about Wright. Finished just in time to weather



the great Kanto earthquake, waters from the reflecting pool enabled firefighters to douse the fires that threatened it as a result of the quake. Wright encouraged the notion that his building was unscathed;

A major collector of Japanese art, Wright came to design a hotel funded by the Imperial family of Japan. He chose a style that could be described as Mayan Revival. Romantic, to be sure, but there is something subversively romantic in the very notion of a hotel, the mixing of an ever-changing cast of transients, meeting promiscuously, observed only by the group of strangers that constitute the hotel's staff. The structure, completed in 1923, survived the magnitude

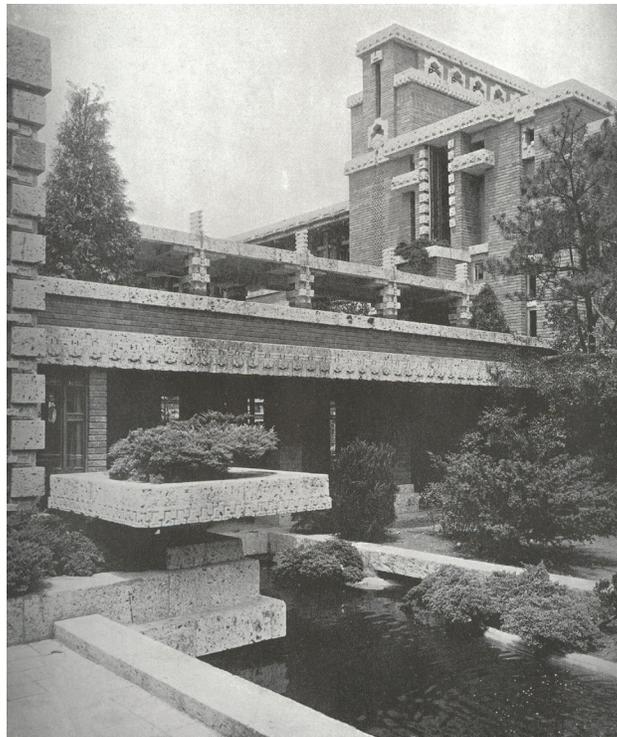


8.3 Great Kanto earthquake of 1923. A telegram from Baron Kihachiro Okura reported the following:

“Hotel stands undamaged as monument to your genius. Congratulations!”

Wright had intended the hotel to float on the site's alluvial mud “as a battleship floats on water.” This was accomplished by making it shallow, with broad footings. This was supposed to allow the building to float during an earthquake. However, the foundation was an inadequate support and did nothing to prevent the building from sinking into the mud to such an extent that it had to be demolished decades later. Furthermore, alluvial mud, which surrenders the hotel's site, amplifies seismic waves.

photos and quotations
this case study:
Copplesstone Trevin
(1997), Frank Lloyd
Wright: A retrospective
view. Regency house
publishing Ltd. United
Kingdom.



The hotel survived an earlier earthquake that struck Tokyo during its construction. While many buildings in the area were destroyed, the hotel itself — while shaken — stood completely undamaged. The hotel had several design features that made up for its foundation:

- * The reflecting pool provided a source of water for fire-fighting, saving the building from the post-earthquake fire storm;

- * Cantilevered floors and balconies provided extra support for the floors;

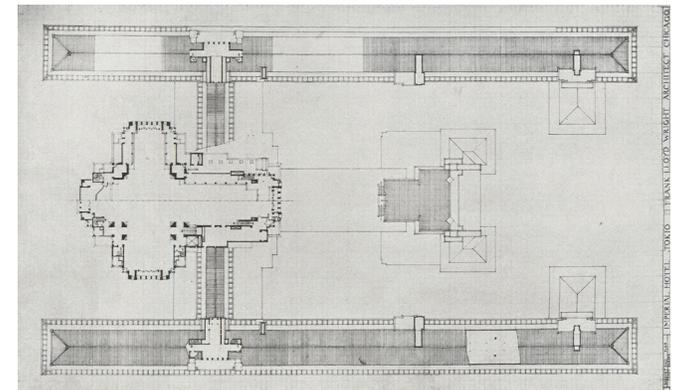
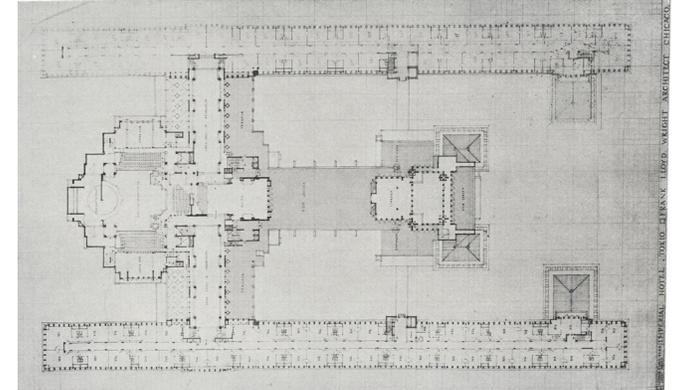
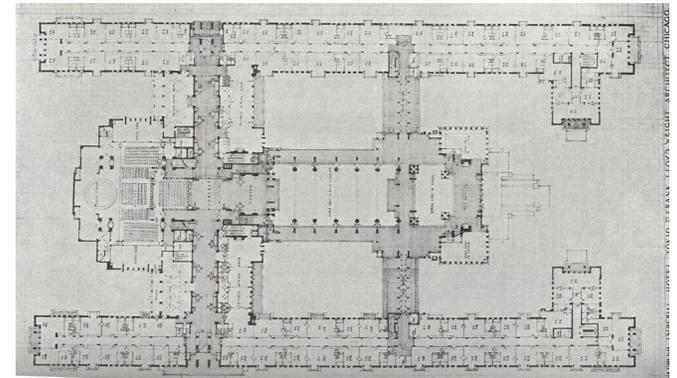
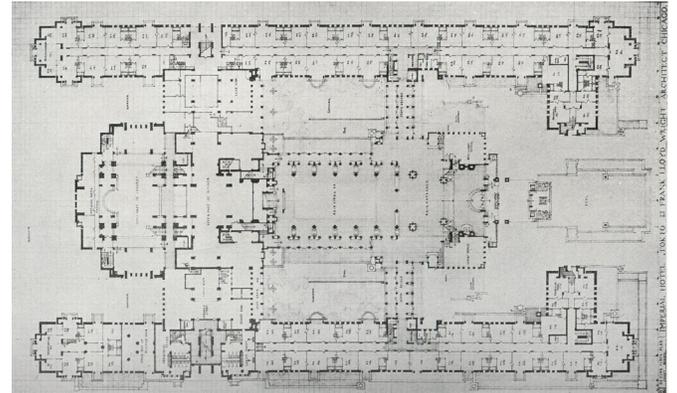
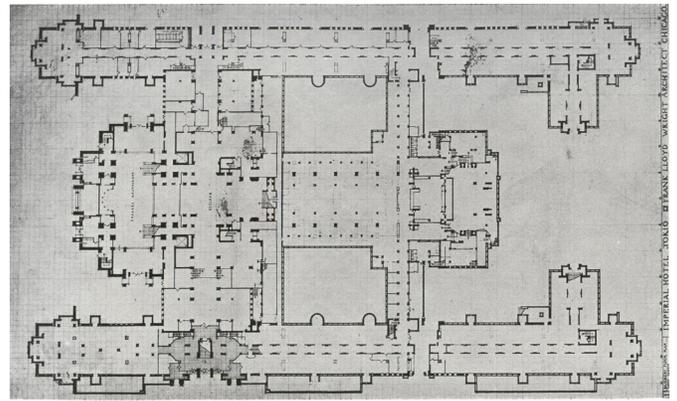
- * A copper roof, which could not fall on people below the way a tile roof could have;

- * Seismic separation joints, located about every 20 m along the building;

- * Tapered walls, thicker on lower floors, increasing their strength;

- * Suspended piping and wiring, instead of being encased in concrete, as well as smooth curves, which made them more resistant to fracture.

Most importantly, the hotel passed the most crucial test for any structure during an earthquake: It stayed standing.



casestudytwo

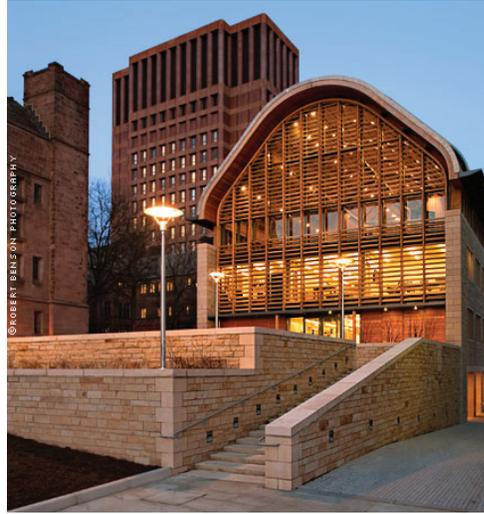
Kroon Hall
Yale School of Forestry

Location: New Haven, Conn.
Design Architect: Hopkins
Architects, London, Sir Michael
Hopkins
Executive Architect: Centerbrook
Architects and Planners,
Centerbrook, Conn.
Sustainable design: Atelier Ten
Size: 58000 Sq. Ft.
Cost: \$33.5 Million

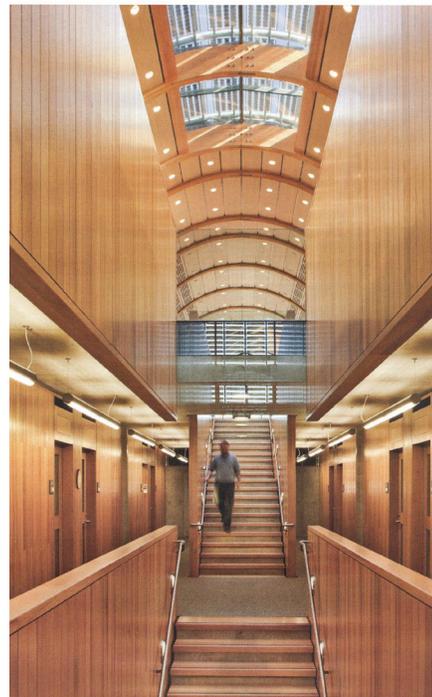
LEED Rating
Seeking Platinum Rating

Sustainable/Climate Neutral features

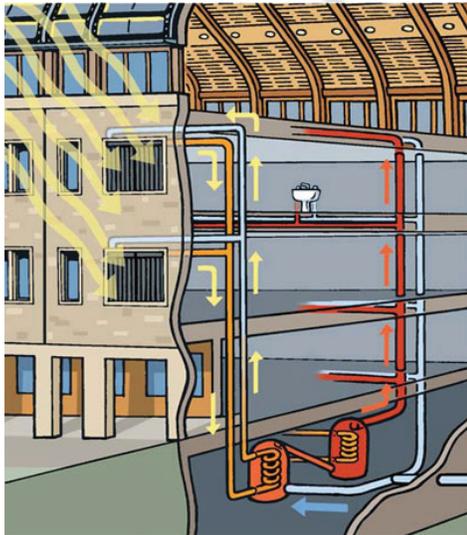
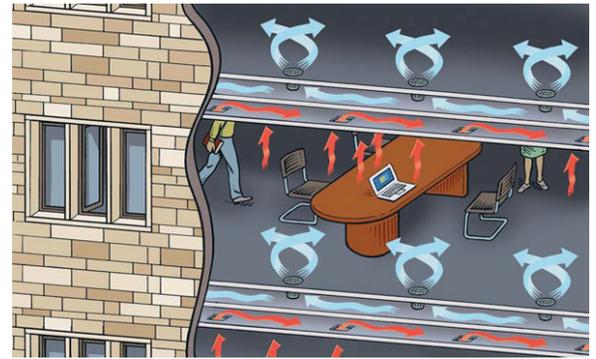
- * Demolition and construction waste is being recycled
- * Geothermal benefit from the underground placement of the north side of the lowest level
- * Solar heat gain in winter and natural lighting year round along the long, unobstructed south-facing wall
- * Rooftop solar panels facing south
- * Solar hot water heaters
- * Geothermal energy system
- * Natural light and ventilation
- * Natural light will be augmented with artificial light to maintain a constant lighting level; the latter is also controlled by sensors that shut off automatically if no one is present
- * Manually operable windows utilize natural air circulation
- * Green construction materials including “thermally inactive” concrete, low-E glass, and insulation, waterless urinals and low-impact paint
- * Recycled, recyclable, sustainably harvested, or manufactured nontoxic materials



photos this case study: Architectural Record Magazine

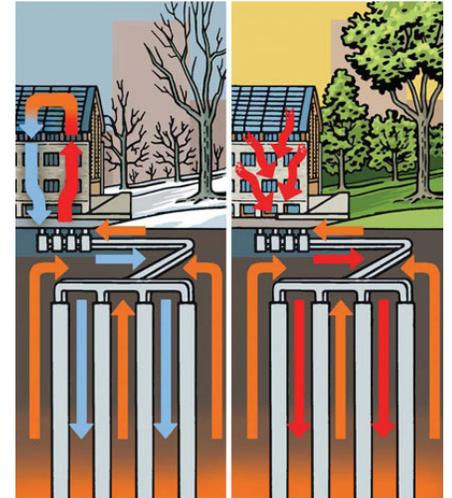


- * Sustainably harvested wood
- * Exterior stone quarried within 500 miles of campus
- * Rainwater harvesting system and cleansing pond

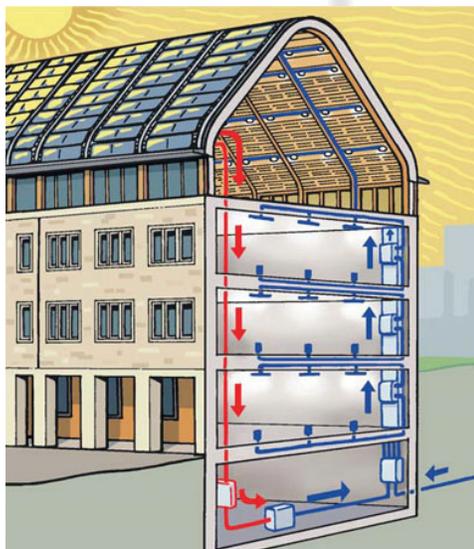


Interior Spaces

- * Office space for more than 50 faculty and staff members
- * Three Classrooms
- * 175-seat Auditorium
- * Environment Center
- * Learning Center
- * Library

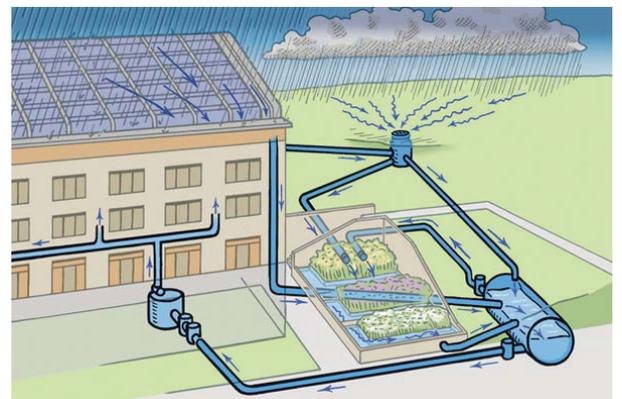


Rainwater captured on the building's roof and grounds is cleansed by aquatic plants and used for toilets and irrigation.



Both warmed and cooled air move almost imperceptibly through an air plenum and multiple diffusers in elevated floors so that it envelops people in a room. The air then exits through vents located above office doors. Low-velocity fans in the basement keep the air moving throughout the building.

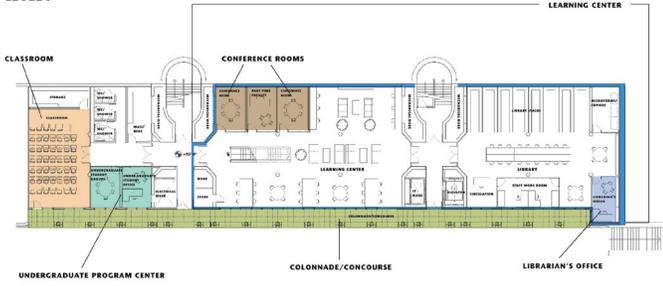
Four solar panels embedded in the southern facade provide the building with hot water. On days when there isn't enough sun, fluid in the evacuated tubes runs through externally powered coils that warm incoming city water.



photos this case study: Architectural Record Magazine

Kroon Hall

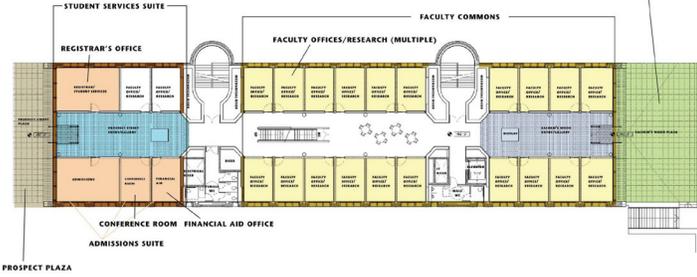
LEVEL I



Kroon Hall

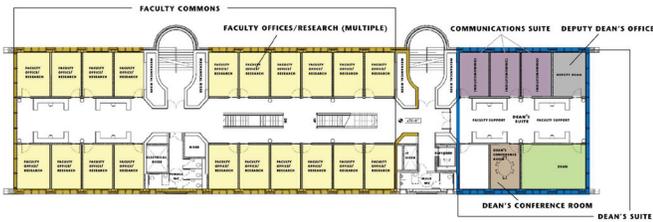
LEVEL II

SACHEM WOODS PLAZA



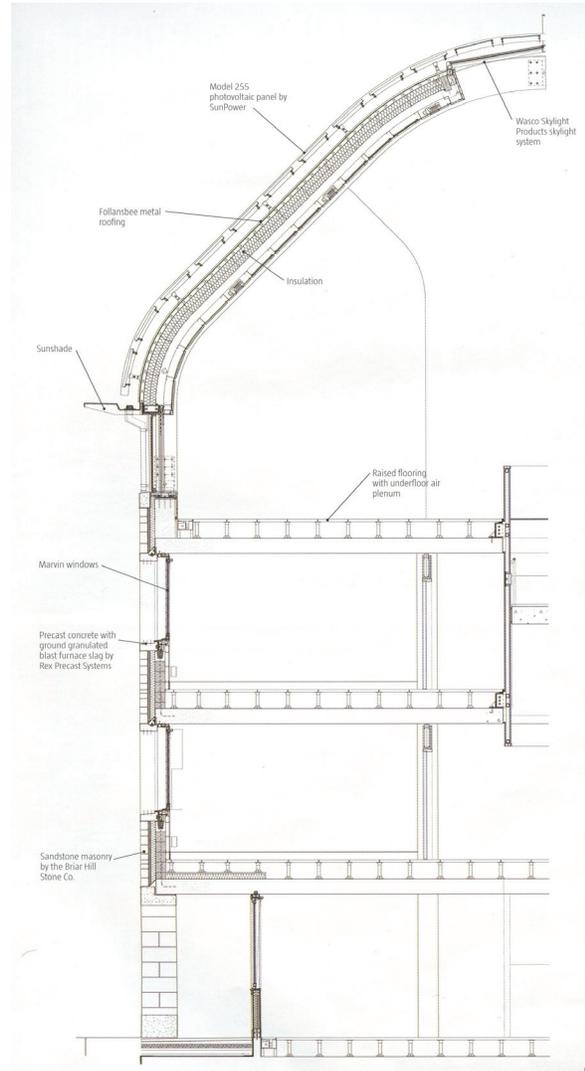
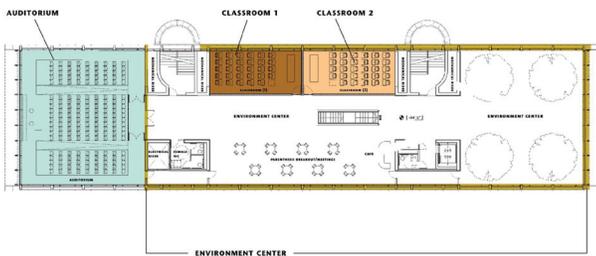
Kroon Hall

LEVEL III

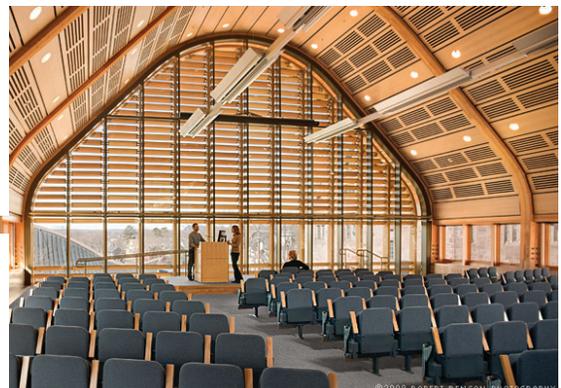


Kroon Hall

LEVEL IV



photos and drawings: Architectural Record Magazine



A casual visitor to the new home of the Yale School of Forestry & Environmental Studies might not consider it radically different in appearance from some other buildings. The photovoltaic panels on the roof's south side turn sunlight into DC electricity, which is converted in a transformer box to AC. The AC is used in conjunction with AC power from the Yale grid and then goes to outlets and lighting throughout the building.

In winter, ground-source heat pumps draw 55 to 60-degree water from four 1,500-foot-deep wells in Sachem's Wood. The heat is removed from the groundwater by the heat pumps and is transferred to a separate water loop through the radiators. Then, the groundwater is pumped back into the wells and absorbs heat from the earth, ready to begin the cycle again. In summer, the process is reversed. The heat pumps take the cool from groundwater to cool the air, and then the water is pumped back into the wells.

At first glance, Kroon Hall is simple—a blend of a cathedral nave and a barn, just 57 feet wide, with high barrel-vaulted gable ends, set back from Prospect Street and running 218 feet east into the heart of Science Hill.

But from the start, more than ten years ago, proponents of the building set out to achieve an unconventional, even audacious, agenda, focused on building social capital, breaking with the past, and speaking to the future of environmentalism. They wanted a healthy place to study and work, of course, but they also wanted what Stephen Kellert, Professor of Social Ecology, calls it "restorative environmental design," in *Architectural Record Magazine*, bridging the gap between nature and people even in the middle of the city. That was going to mean demolishing at least one corner of the Science Hill landscape of driveways, dumpsters, parking lots, a power plant, and bringing the place back to life as a campus for people.

They also wanted the new building to be energy-efficient, and they set out to achieve a platinum rating in the green-building certification program, Leadership in Energy and Environmental Design (LEED). But, they aimed to do much better than that. The typical LEED gold or platinum building performs only about 28 percent better than conventional buildings on energy efficiency, according to a 2007 survey. Kroon Hall planners set out to achieve something more like the architectural Holy Grail, a modern building that wasn't merely efficient, but carbon-neutral. Dean Gus Speth, who together with Kellert was the driving force behind the project, promised a building that would be "a symbol of the school's ideals and values and a powerful expression in beautiful form of our relationship to the environment." (*Arch. Record Mag.*)

The high, barrel-vaulted ceiling on the third floor draws air naturally upward via a “stack effect,” through the long open staircase in the middle of the building. Then, the air travels back down via passageways in two stairway towers on the north side of the building. In the basement, banks of big orange air handlers from the German manufacturer Menerga use heat exchangers to pull the warmth out of the exhaust air in winter, shifting it over to the incoming stream of fresh air, so what gets vented is just stale air, not BTUs. In summer, water sprayed into the exhaust air causes evaporative cooling and drops the temperature by 10 degrees or more. Then heat exchangers pull this cool out of the exhaust and into the incoming fresh air. The exhaust system also runs throughout the night in summer to purge heat.

“Right now, we think this is one of the most sustainable buildings in the country. But six months from now, we hope that new buildings will surpass it. It will get less expensive, and the marginal cost for having these green buildings will go down.” - says Deputy Dean Alan Brewster

The case study of Kroon hall at Yale supports the unifying idea of this thesis by using natural sources and natural sustainable materials from local sources and reflecting the immediate environment is the best possible way.

Based on this case study, the unifying idea of this thesis remains intact as stated previously.

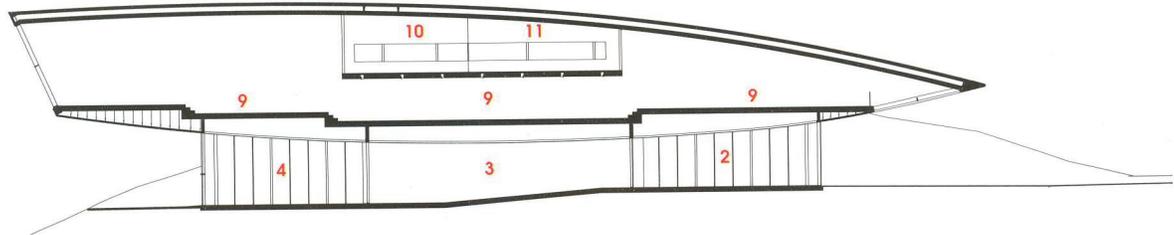
case study three



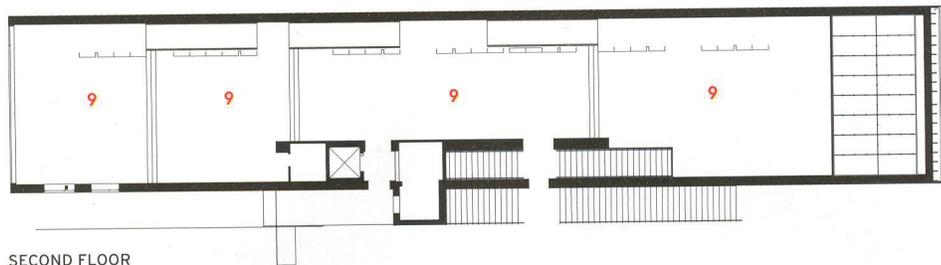
Peter Dass Museum
Location: Alstahaug, Norway
Design Architect: Snohetta -
Craig Dykers, AIA, Kjetil Thorsen
- principals

Size: 14500 Sq. Ft.

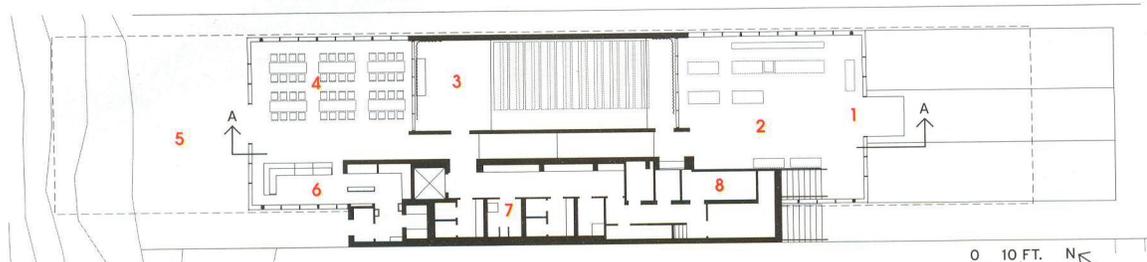
photos and drawings: Architectural Record
Magazine



SECTION A-A



SECOND FLOOR



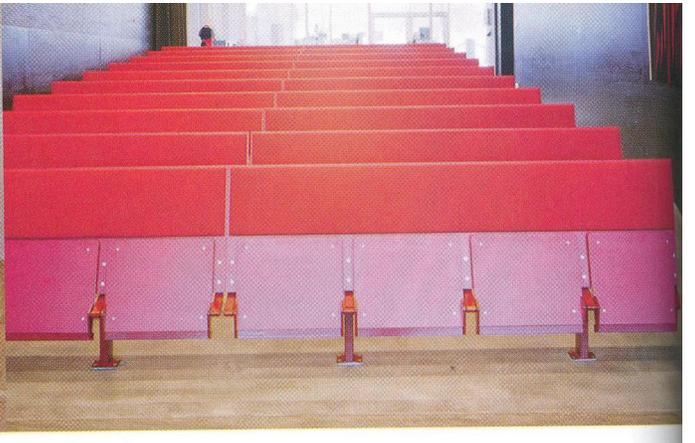
FIRST FLOOR

1. Entrance
2. Gift shop
3. Auditorium
4. Café
5. Terrace
6. Kitchen
7. Restrooms
8. Meeting room
9. Exhibition
10. Library
11. Offices

0 10 FT. N
3 M.



photos: Architectural Record Magazine



This building creates a response to the site it was built.

This case supports the unifying idea of this thesis project. The study shows that the building's tectonics can respond to the needs and also shows specific characteristics that are important in designing buildings with regard to the terrain.

In 1707, poet Peter Dass died. But until then he wrote prolifically from a medieval church in the small shoreline farming community of Alstahaug by the western slopes of Norway's dramatic Seven Sisters mountain range, celebrating the sacred virtues of what inhabitants refer to as "the kingdom of the thousand isles."

"It seems that, far out on the edge of the Earth
Old nature has found its good way to give birth
To rare and splendid abundance needs .."

- Peter Dass

Three years later, Dass's life and work are dramatically celebrated and exhibited in Snohetta's Peter Dass Museum in Alstahaug. Addressing the growing tourist and visitor needs of the existing church, now one of the only seven such preserved medieval churches in Norway, and an adjacent 18th century personage, the New building's linear volume is boldly set within an excavated cleft of the site's dominant granite ridge. Its curving, winglike roof projects out from the ridge to overlook the fjord waters beyond.

Currently, Norway is a nation still acutely conscious of its natural beauty and of the relationship between the natural environment and its cultural identity. The strong topography of the near and distant landscape, the presence of historic churches, as well as the animating character of the museum program, posed challenging and intriguing questions of sitting construction and representation.

An exceptional poet and considered Norway's greatest writer at this time, Dass has also become the subject of folklore, remembered now as a person who outwitted the devil.

"Certainly the history and character of Peter Dass led the initial discussion of how to approach the project"

"The choice of connection the building to the sea through the nearby ridge was in part a means of releasing the site to the unrestrained character of the waters beyond. The integration of the building with the land allows the site of the past - the historic church - to merge the undefined nature of the future in the sea."

- Craig Dykers, AIA.

The building reveals spiritual aspects in the building's geometry in combination with the horizontal axiality of the museum.

In the new, 14,500 square foot building of the museum, visitors are immediately confronted with the complementary forms of the structure upon arrival. Yet, the boldness of the design's singular siting gesture unbalances the relationship; the contained volume is the set between an artificial cleft created by 230-foot-long, wire-cut rock walls that are 50 feet apart. This type of excavation technique is a common one in Norwegian construction, owing to the rugged character of the country's terrain. The building itself is 37 feet wide within the clearance, providing for 6 1/2-foot-wide passages on either side, a walkway through the ridge, and a stairway to its summit, where a monument to Petter Dass is erected.

The granite walls frame the glass-enclosed ground floor, which is level with that of the medieval church. There is no disputing the hovering, dynamic quality of the museum's curving form; its zing-sheathed, steel-framed upper level cantilevers out 23 feet at front and back, arching upward to a height of 32 feet above grade, in resonance with the curvature of ridge terrain, but clearly rising above it.

Inside, the museum program is transparently organized and presented in both plan and section. A simple three-tier staircase indicates circulation and services organized against the southern wall, leaving the bulk of the rectangular volume for public spaces. A reception and gift shop area just past the entry doors lead to a glass-enclosed, red-seated auditorium, and on through to the café, and outdoor terrace beyond. A polished-and-coated concrete floor throughout further reinforces spatial continuity. Detailing throughout is spare and minimal, although much attention has been paid to the necessities of exterior wall construction, owing to the harshness of the northern climate.

This case study clearly shows a good consideration of the local conditions and embraces the local values. It certainly could be considered when designing a structure for this thesis project.

casestudyseries

typological summary

My case studies focus on three aspects that would help me build my thesis project. The Japanese project, the Imperial Hotel, is an example of how a massive structure could be built on an unstable ground condition and withstand time and local conditions. The special care and attention paid to the geological conditions in the project is a key to the structure I propose in my thesis to be constructed on the slopes.

The whole design Frank Lloyd Wright completed for the Japanese Imperial family registered the need for a stable and secure building. I am not, as of now, sure if I am going to use the same principles of foundation design on the mound (created by compacting solid waste), yet it is a good design and a great idea, and the more I become informed about ways of building over unstable ground, the better outcome I would reach in my design.

Structural stability is a security issue not only for the building on the top of the slope, but I would also need to design the supports for the lift that will span the distance between the bottom and the top of the mound.

It was unfortunate to discover that the building has been destroyed. As Trewin Cooperstone states in his book "Frank Lloyd Wright - Retrospective View" (p. 87), "it is an act of architectural vandalism" when describing the fate of the Imperial Hotel in Tokyo. It is a case of "short sight" and certainly a great loss, not only for the state of Japan, but for all humankind, to let a building of this magnificent quality to go away. It was probably true that after years and many earthquakes, the building was sinking a little. The photos I saw of the devastation after the earthquake in 1923 when everything around was ruined and the only building standing was this one, tells something about the systems and the design genius of its creator. The use of special foundations was not enough for Lloyd. There were special joints, walls, special construction, the use of materials and combining those elements was brilliant. The style and the impression, as Cooperstone (p. 123) states is exactly that, "stunning!"



The second case study is important in the way it shows methods and techniques of using natural resources to gain sustainability and independence of energy sources, and water use. Also, addressed are: minimizing of the energy waste and resources, and optimizing the interior climate. It is a simple design, yet when one starts looking at it there are so many levels of discovery and enjoyment to be had from work well thought over. The choice of materials, especially for the interior, is very pleasing. It creates warmth and is inviting. The openness of the floor plans, and the simple rectangular layout with stairs, which are working as convection stacks in the same time, is original even not a new idea.

The third structure, in Norway, certainly has many sides, details and ideas to be admired about. It is a clear example of work well done, considering the area heritage. The contemporary Norwegian visions are combined with rational thinking to reach a clear and pure outcome. Consideration of shapes, materials, and systems is worth admiring, while the functionality is obvious.

While looking for case studies for my project, it was obvious, that the topic I have chosen is not explored. My plan then was to work around existing projects and to pick case studies which in certain way add, extend and inform my design intentions.

historical**context**

history of skiing

Different sources (Allen for history of skiing) tell different stories of how the downhill/alpine style of skiing developed. The modern downhill skiing was developed around 1850 by the Norwegian Sondre Norheim, who constructed a pair of short birch ski binding them enabled skiers to ski without the risk of losing their skis. Norheim's bindings were perhaps the first stiff bindings which tied his boots to his skis and provided more control than leather straps. While others had built devices similar to this before Norheim paired his birch binding with shorter, curved skis that enabled him to win the first Norwegian downhill skiing competition. Most historians believe that Norheim's method of skiing is similar to the modern day form of telemark, or "free heel" skiing.



Image: Free Software License Co.
Lappish woman Olaus Magnus (1553)

In 1868, with a couple fellow skiers, Norheim attended the "second annual Central Ski Association" open ski competition whose object was to demonstrate skill at descending a particular slope in the city." At the competition, Norheim demonstrated groundbreaking techniques that set the ideal benchmarks for skiing in Norway and the European Continent: the arc-like sweep of the "telemark turn" along with the skidded "stem" stop turn (commonly known as the "parallel" stop turn), which was initially known as the "Christiania" turn (original name for modern day Oslo). The "Christiania" came to be known simply as the "Christi" turn with the formalization of ski rules in 1901. Both turns, which originated in Telemark, marked the distinction between Telemark and Alpine skiing.

Other Skiing enthusiasts marked the development of modern Skiing. In 1896 Mathias Zdarsky of Austria introduced the technique of pushing one Ski at an angle to the fall line in order to control speed. During the early part of 1900s, Hannes Schneider, also of Austria, was inspired by Zdarsky's technique and developed new stopping and turning maneuvers, which he organized into the first formal method of Ski instruction. It was later known as the Arlberg technique, in which most modern Skiing techniques were based.

In the early 1900s, Skiing became a very popular competitive sport. The first Slalom race was held in 1921 at Switzerland. After three years, Nordic competitions became part of the first Winter Olympic Games as well as the Alpine events, which were included in 1936.

In the early part of World War II (1939-1945), Finland troops used Ski patrols to resist the Russian intruders, and in 1945, Ski troops of the U.S. army fought the Germans in the mountains of Italy.

After the war, skiing was seen in a whole new perspective. Skiing winners of international competitions got increasing publicity. This publicity, as well as the extensive television coverage of different Ski meets and exposure to other forms of media, have stimulated the fascination of recreational Skiing. In fact, around 400 Ski resorts were built in the United States in 1960.

Currently, skiing is the most popular winter sport with about 45 million fans and thousands of ski resorts worldwide. The sport has developed itself in a couple of ways, resulting in a number of variations, of which snowboarding is the largest.

It is easy to understand that the Alpine skiing is vastly affected by the development of the ski lift infrastructure at mountain resorts to tow skiers back to the top of slopes, thus making it possible to repeatedly enjoy skiing down steep, long slopes that would be otherwise tiring to climb. The towing also allowed for development of equipment and technique, as it eliminated the need for cross-country capability, most notably allowing the use of hard boots and fixing the heel down for better ski control.

history of fargo

Early history

The area that is present-day Fargo was an early stopping point for steamboats floating down the Red River during the 1870s and 1880s. The city of Fargo was originally named "Centralia," but was later renamed to "Fargo" in honor of Northern Pacific Railway director and Wells Fargo Express Company founder, William Fargo. Fargo was founded in 1871. The area started to flourish after the arrival of the Northern Pacific Railroad and the city became known as the "Gateway to the West".

A major fire struck the city on June 7, 1893 when the proprietor of a grocery store accidentally started the blaze as she emptied ashes behind her store on a windy day. The fire destroyed 31 blocks of downtown Fargo. However, Fargo was quickly rebuilt with new buildings made of brick, new streets, and a water system. Over 246 new buildings were built within one year. The North Dakota State Agricultural College was founded in 1890 as North Dakota's Land-Grant University, becoming first accredited by the North Central Association in 1915. In 1960, NDAC became known as North Dakota State University.

The 20th century

Early in the century, the automobile industry flourished, and in 1905, Fargo was home to the Pence Automobile Company.

Fargo-Moorhead boomed after World War II and the city grew rapidly despite being hit by a violent tornado in 1957. The tornado destroyed a large portion of the north end of the city. Dr. Ted Fujita, famous for his Fujita tornado scale, analyzed pictures of the Fargo tornado, which helped him develop his ideas for "wall cloud" and "tail cloud." These were the first major scientific descriptive terms associated with tornadoes. The coming of the two interstates (I-29 and I-94) revolutionized travel in the region and pushed growth of Fargo to the south and west of the city limits. In 1972, the West Acres Shopping Center, currently the largest shopping mall in North Dakota, was constructed near the intersection of the two Interstates. This mall would become the catalyst for retail growth in the area. It would also mark the beginning of decline for the downtown area of Fargo.



Grand stand at N.D. State Fair grounds, Fargo, N.D. Date:1910 Image of grandstand crowded with people. The Classical Revival structure has a hipped roof, crowned by a dome. The roof is held up by Ionic columns.



Broadway looking north from Front St., Date ca. 1929, depicting a view looking north on Broadway from the intersection with Main Avenue. Most prominent in the image is a street railroad car .



100 block of Broadway, Fargo, Date ca. 1910. View looking north on Broadway from the intersection with 1st Avenue No., showing the east side of the street. Business signs



8th Street looking north, Fargo, Date ca. 1930s View looking up 8th Street. Several houses visible. Numerous adult trees in the image. Globe style street lights line the street. House on right side is 808 8th Street S.

all photos: www.fargo-history.com

history of ski resorts

In 1461, the scapegrace Francois Villon wrote a hauntingly wistful short poem about the fate of beautiful, beloved women, and it ended with the wonderful line, *Ou sont les neiges d'antan?* Where are the bygone snows?

The history of ski resorts could be described by an example of one. I would like to look close at one of the most famous and oldest ski places, Chamonix-Mont-Blanc, France.

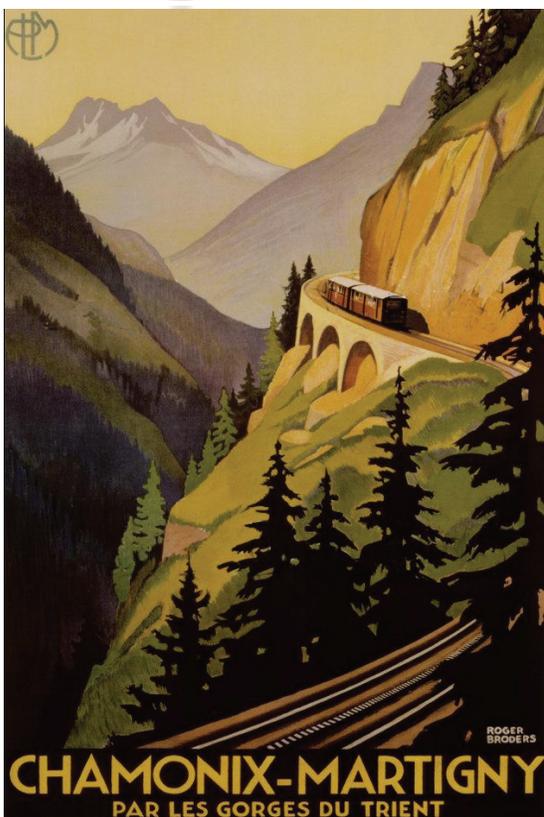
Commonly called only Chamonix, it is a commune in the South-Eastern France. The commune of Chamonix-Mont-Blanc includes 16 villages and hamlets. From north to south: Le Tour, Montroc, Le Planet, Argentière, Les Chosalets, Le Lavancher, Les Tines, Les Bois, Les-Praz-de-Chamonix, Chamonix-Mont-Blanc, Les Pècles, Les Mouilles, Les Barrats, Les Pèlerins, Les Gaillands, and Les Bossons.

The site dedicated to Chamonix mentions some facts of its history. This valley is mentioned as a settlement first in 1091 when it was in fact enslaved to a Benedictine house. Later, the people bought back their freedom. In 1530 the area obtained rights for two fairs a year. At that time only religious visitations are recorded, visitors for pleasure were still rare. The first visitors to record their travels to Chamonix were a group of Englishmen in Mer de Glace in 1741.

The influence of pre-romantic and romantic writers also helped to alleviate the fear of the unknown and consecrates the mountains as being an expression of nature totally preserved.

The first luxury hotel was built in 1816, and the hotel industry continued to thrive through the 1800's, crowned by 3 splendid palaces built in the early 1900's. Certain dates are synonymous

with the development of summer tourism : the creation of the Compagnie des Guides in 1821 and the inauguration of the Montenvers Mer de Glace cog railway in 1908.



all photos: stock vintage posters, Internet

However, the major turning point in Chamonix's development was the creation of road and rail access. In 1866, under the reign of Napoleon III, the first horse-drawn coaches alighted in the village square, and in 1901 the railway line between St Gervais Le Fayet and Chamonix was inaugurated. The arrival of the train much improved access to Chamonix in winter and opened the way to winter-sports tourism.



all photos on this page: www.chamonix.com

The first Winter Olympic games were hosted by Chamonix in 1924 and consecrated the valley as a winter Mecca, with an important number of lifts being built in the ensuing years. First were the Glacier cable cars (no longer existing) and Planpraz, followed by the Brevent, the Aiguille du Midi and the Flégère. Chamonix today is not only an important tourist destination but it is also a strategic link with Italy via the Mont-Blanc tunnel.



The town strives to maintain a healthy balance between tourist and transport demands and the preservation of an exceptional natural environment.

goalsforhethesisproject

To continually develop the theoretical premise based on research findings of the program.

To develop the design in a way which shows the importance of developing the theoretical premise.

To develop clear descriptions of the social, economic, and regional impact of the design.

To create a clear, understandable, well organized, and functional program for the thesis project.

To incorporate superior graphics and knowledge with which to display and emphasize the importance of the project.

To reach professional and personal satisfaction with the thesis project as my last design at North Dakota State University.



To explore new possibilities.

To create a precedent on a professional level.

To serve as a base for further future development and study on the topic.

To gain additional collective knowledge on a subjects related to the building typology of this thesis.

To create an architectural objects / assembly of objects while registering the unique conditions on the site.

To explore personal research and design limits and challenge own creative self.



siteanalysis

site analysis | qualitative aspects

Narrative



Photo this page: http://www.dickersongroup.co.uk/img/frim/large/capping_landfill.jpg

When driving North on 45th Street in Fargo, passing an underpass on your left hand side, you can see an impressive mound growing. There is an entrance on the south side of the site on 7th St, North where the garbage trucks enter, then take a winding road, climbing up the hill. Trucks dump their cargo on the top. Nationwide statistics

show that every American uses about 20 tons of raw materials annually. Every college student alone produces 640 pounds of solid waste, including 500 disposable plastic cups and about 320 pounds paper material.

Fargo continually grows and as of 2008 it had 90,600 inhabitants. Naturally we should expect a proportional to the population growth of the amount of discarded solid waste. This solid waste is the building material for the solid waste mound - base for the Fargo ski and recreational center. The mound grows and there is enough build-up and usable height for the first phase of the project. The next step should include a plan to form the mound in accordance with the project and the estimated further growth in order to form the a real ski slope.

Visual qualities

The site is a dynamic entity changing rapidly, growing and shaping as an ever higher mound. The hill slopes are about 30 to 40 degrees and covered with low growing grasses and little shrubs over reclaimed top soil placed over special fabric covering the compacted solid waste underneath. Compared to some other solid waste mounds, it has not reached full potential in height and capacity. It is very well situated within the urban setting of Fargo - West Fargo - Moorhead. Having a good perspective for additional growth makes it an ideal base for a ski / winter sports set. It already stands about 60 - 70 feet tall. Potentially, it may reach 100 - 150 feet and even more (some mounds reach 300 feet and more). The vistas even now are one of the best possible for the metro-area. Chalet type of structure on top will create a great gathering point.

It sits on the original Fargo - West Fargo grid and only need is for the design to address shade and shadow issues in section and as well in plan. It will also be essential to plan for wind, water, erosion control , and snow collection. The planned coniferous vegetation on site will add to the shadow / shade and needs some further investigation. Potentially, planting will solve issues of snow collection on site and will decrease strong winds. Corresponding landscape and slope planning, creating paths will add to the project - creating a holistic solution.

The main program aims at two main buildings on the site. The focus will be placed on the upper and lower stations as main architectural elements in this project. The two will be equally important as the lower is intended to reflect more of the business and storage needs while the upper will be more of a pleasure area, vistas and entertainment.

The light in North Dakota is suitable for the intended project. Different in color, compared to high mountain winter resorts, it creates a notion of place and special identity.

siteanalysis | quantitative aspects

The web site EPA.gov's statistics show that the Americans as a nation produce and throw away big amounts of waste. In comparison to China - ten times more, compared to India - seventy times more. That sounds a little scary and not pleasing. However, in this thesis project it actually helps. Bigger amounts of solid waste, at least for a while will make a bigger project slope and faster.

Survey	Population U.S.	General Waste
		(Tons)
1990	245,819,230.00	269,000,000.00
1991	249,439,545.00	293,613,000.00
1992	252,124,362.00	280,675,000.00
1993	255,001,827.00	291,742,000.00
1994	257,752,702.00	306,866,000.00
1995	260,292,437.00	322,879,000.00
1996	262,760,639.00	326,709,000.00
1997	265,179,411.00	327,460,000.00
1998	267,636,061.00	340,466,000.00
1999	272,690,813.00	374,631,000.00
2000	280,000,000.00	382,594,000.00
2001	286,345,000.00	409,029,000.00

Data: www.epa.gov

In order to visualize the population growth in Fargo I have pulled Historical data for the population through the years:

Census	Pop.	%±
1880	2,693	—
1890	5,664	110.3%
1900	9,589	69.3%
1910	14,331	49.5%
1920	21,961	53.2%
1930	28,619	30.3%
1940	32,580	13.8%
1950	38,256	17.4%
1960	46,662	22.0%
1970	53,365	14.4%
1980	61,383	15.0%
1990	74,111	20.7%
2000	90,599	22.2%

Data: www.cityoffargo.com

Climatic Advantages:
 Extreme continental climate - the place is know for long and

Weather data for Fargo, North Dakota													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °F (°C)	16 (-6)	23 (-5)	35 (2)	55 (13)	70 (21)	77 (25)	82 (28)	81 (27)	70 (21)	55 (13)	35 (2)	21 (-6)	51.8 (11)
Average low °F (°C)	-2 (-19)	0 (-14)	19 (-7)	32 (0)	45 (7)	55 (13)	59 (15)	67 (14)	48 (8)	24 (1)	19 (-7)	4 (-16)	31.2 (0)
Precipitation inches (mm)	0.78 (19.3)	0.59 (15)	1.2 (30.5)	1.4 (35.6)	2.6 (66)	3.5 (88.9)	2.9 (73.7)	2.5 (63.5)	2.2 (55.9)	2.0 (50.8)	1.1 (27.9)	0.57 (14.5)	21.2 (538.5)
Snowfall inches (mm)	8.6 (218.4)	5.9 (149.9)	6.7 (170.2)	3.1 (78.7)	0.1 (2.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.7 (17.8)	5.8 (147.3)	7.1 (180.3)

Data: www.noaa.gov

snowy winters, a fact that helps and supports the idea, that the mound should be used. The only missing link is the slope with all necessary infrastructure that gives ski opportunities to all the ski enthusiasts around the area.

programmatic requirements

Lower Ski Station

Administration	700 SF
Entrance	100 SF
Food Service	1,100 SF
Lounge / Gathering	1,300 SF
Locker Room	500 SF
Men Restroom	400 SF
Women Restroom	400 SF
Ski Rental	2,000 SF
Ski School	300 SF
Ski Shop	800 SF
Storage	500 SF
Tickets	150 SF
TOTAL	8,250 SF

Mechanical: 10%	850 SF
Circulation 10%	850 SF

Total Area: 9,950 SF

Upper Ski Station:

Lounge / Gathering	3,000 SF
Food Service	1,100 SF
Men Restroom	400 SF
Women Restroom	400 SF
Ski Wardrobe	500 SF
Storage	200 SF
TOTAL	5,600 SF

Mechanical / Elec.	560 SF
Circulation	560 SF

Total Area: 6,720 SF

Upper Lift Station total: 500 SF

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personal information

a. Picture



b. Permanent Address:

**2901 34th. Ave. South,
Apt. 261
Fargo, North Dakota 58104**

Telephone:

701.729.1118

c. e-mail address:

pvalkov@gmail.com

d. Your home town

**Varna, Bulgaria
&
Fargo,
North Dakota, the U.S.A.**

e. A quote about NDSU:

**“At the turn of the century,
NDSU began a phase of
growth...”**