Eco-Effectiveness in Architecture
Designing a Day-Lit Courthouse
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I really want to thank everyone who has inspired, encouraged and supported me throughout the last five years.

First I would like to thank my studio advisor Bob Fisher. Bob was able to push me to be the best I could be, but also allowed me the freedom to trip over my own feet and for that I thank you.

My thesis advisor Harry Eggink who has taught me to question everything about the world of architecture I thank you for the all inspiration and all the encouragement.

I would like to thank my friends for keeping up with my crap, their ability to make me laugh and forget about how painful architecture can sometimes be.

Finally I would like to thank my family. Without their love and support none of this would have been possible. They provided me the opportunity to strive for excellence and sometimes, I was even able to reach.
"Projection of light in space, light in reflection, and light in shade and shadow is seen as a program to be achieved parallel to solving functional problems."

- Steven Holl
"A tree produces thousands of blossoms in order to create another tree, yet we consider its abundance not wasteful but safe, beautiful, and highly effective."
- William McDonough

Daylighting is one important area of focus in Sustainable Design. Effective daylighting provides numerous opportunities in design and provides benefits to the users and occupants of a building. In areas of the building that receive daylight an average of 75% of the typical lighting energy can be saved. In addition, by reducing the need for electric light the cooling load of the space is significantly reduced. Most importantly, workers are typically more productive and are absent less if the work place is daylit.

As we progress further into the 21st Century, the focus on this "Green" Architecture continues to grow. Still typically developed in high-end single family housing, corporate headquarters, and environmental centers, the strategies haven't been strongly incorporated into public works of architecture.

Courthouses have a strong history of representing cultural values through their symbolism, order, and power. They express the importance of the laws and justice in the society. People have always looked to government buildings like courthouses as a source of power and guidance. If public buildings start to have a strong sustainable message it will stress the importance of an Eco-Effective built environment to the community. My goal is to create an effective daylit Courthouse that clearly expresses its concept to the community and celebrates a range of cultural and natural pleasures in order to enhance the lives of community.

The design of a new Indiana Supreme Courthouse would provide an opportunity to achieve those goals. This courthouse will express to the community how one of its most valued government institutions can relate positively to its natural environment. It will not only provide for itself but also for the surrounding community. This sense of community spirit would be best expressed in a building owned, operated, and used by the state.

"Create buildings of unimpeachable integrity that reveals their structure and uses while simultaneously creating safe harbor for body, mind, and soul."
- Louis I. Kahn
“The earth belongs... to the living... No man can by natural right oblige the lands he occupied, or the persons who succeeded him in that occupation, to the payments of debts contracted by him. For if he could, he might, during his own life, eat up the usefulness of the lands for several generations to come, and then the lands would belong to the dead, and not to the living.” - Thomas Jefferson
The Indiana State Supreme Court Site is located on a prominent block immediately north of the State House in downtown Indianapolis, Indiana. The location allows the Justice Facility to engage the complex activities of a highly urban setting. Courthouses have always expressed strong symbolic meaning of the activities inherent to their program. An environmentally based courthouse would express the community's belief in environmental design.

This facility expresses a belief based on an understanding that a courthouse is no longer a house of ominous retribution, but it is a place that gives daily civics lessons in community standards. To achieve this goal Justice must be seen to be appreciated. The Judicial Center is a place where Day and Night are celebrated. During the day light is projected from the outside in and during the night, projected from inside out. Light becomes celebration. The power and control of that Light becomes the representation of law and justice. Its ability to be transparent and light up the surrounding community. These strategies bind the symbolisms of Light and Justice together to serve one purpose, allowing it to be effectively revealed and expressed to the community.

The Judicial Center will be the home for three types of court-sets; the Indiana State Supreme Court, the Indiana State Court of Appeals, and the Indiana State Tax Court. It includes all of the necessary administration, and support spaces for those courts. The building also includes public facilities such as, court clerks' offices, law libraries, general support offices, committee rooms, day care facilities, public eateries, and public galleries. It also includes several layers of underground parking for both the public and Justices.
### Zone A: Public Entry & Orientation
- Public Reception: 8,980
- Public Security: 350
- Group Reception: 950
- Entry Support: 695

GSF: 16,463

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### Zone D: Supreme Court
- Supreme Court: 6,565
- Chief Justice Chamber: 1,960
- Justices' Chambers: 13,056
- Supreme Court Administration: 3,120

GSF: 37,052

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### Zone B: Public Amenities
- Indiana Courthouses Exhibit: 5,000
- Indiana Cultural Theater: 4,480
- Archives: 1,500
- Public Dining: 6,980
- Daycare: 2,200
- Clerk of the Courts: 9,620
- Supreme Court Library: 12,156

GSF: 62,904

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### Zone E: Court of Appeals
- Court of Appeals: 4,585
- Conference Rooms: 1,725
- Senior Judges' Suite: 4,610
- Chamber Area: 52,224
- Court of Appeals Administration: 6,200

GSF: 104,016

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### Zone F: Tax Court
- Tax Court: 4,585
- Chamber Area: 6,528
- Tax Court Administration: 1,960

GSF: 19,610

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Total Building NSF: 216,269

Total Building GSF: 324,404

Mechanical Room: 8% 25,952

Total Building GSF: 350,356
**Indianapolis** is the capital of Indiana. The city sprawls across the flat landscape of Marion County, unimpeded because there are no environmental factors such as oceans, lakes, or mountains to shape the form of its growth. The downtown consists of a mile square grid that is centered on the Soldiers and Sailors Monument in Monument Circle. Monument Circle is an example of the spirit of place that stimulates civic pride and allows public spirit to flourish within its city center. There are many other examples of this located near or within the city center. Downtown Indianapolis image represents the mixed character of its use. The central business district contains high-rise office towers, sports arenas, convention center, government centers, and high-end hotels. Located adjacent to the downtown are the museums of White River State Park, Canal Walk, Indiana University, Purdue University Indianapolis (IUPUI) Campus, and the recently expanding campuses of Clarian Health Hospitals. This dense land use and scale of downtown makes an uneasy transition into these and other surrounding residential and industrial areas.

The site for the Indiana State Judicial Center is located in downtown Indianapolis, immediately north of the Indiana State House. The site is roughly 450 feet by 450 feet. The block is currently used as surface parking for state employees. It is part of a large expanse of surface parking that separates the dense land use of the downtown and the civic and residential areas of the Canal Walk. The site is surrounded by a mix of building types: to the north is surface parking, to the south is the State House, to the east is the AUL Tower, and to the west is a government parking garage. A building on this site will have to deal with the uneasy transition between the scale of downtown and the scale of the surrounding buildings.
Indianapolis is located in the central part of the state and is situated on level or slightly rolling terrain. The greater part of the city lies east of the White River which flows from north of Indianapolis to the south, coming close to the city center.

Indianapolis has a temperate climate with very warm summers and no pronounced wet or dry season. Occasional frigid temperatures are produced by polar air drawn in from northern latitudes. Tropical air from the Gulf of Mexico in the summer brings warm temperatures and moderate to high humidity. On average there are 5615 annual heating degree days and 1014 annual cooling degree days.

The climate holds great potential for passive design. Temperature and humidity produce significant cooling loads in the summer. Wind is a factor in design, decreasing comfort during winter months, but increasing comfort in the hot summer months.
A model of downtown Indianapolis was constructed to conduct beam daylighting studies. What became evident from these studies was that the high-rise buildings would have little effect on the daylighting potential of the site. Only in the early morning, when the Judicial Center is unoccupied, do shadows interfere with the ability to effectively daylight interior spaces.
**Sandra Day O'Connor U.S. Federal Courthouse**: Phoenix, Arizona  
Richard Meier + Partners: 1999

The U.S. Courthouse in Phoenix contains a grand civic hall, with a main public space 350 feet long by 150 feet wide and covered by a skylit roof. A landscaped plaza provides a transition zone between the harsh desert climate and the dramatic atrium space. The atrium uses a simple and effective evaporative cooling system. As air heats under skylights it rises through the roof vents and is replaced by air that is humidified as it enters through the bottom of the curtain wall. A glass ceremonial courtroom sits on an elevated platform and provides a focal point in the atrium. All program elements are clearly organized and separated by security zones, making all the different circulation paths highly effective.

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**Provincial Law Courts, Robson Square**: Vancouver, British Columbia  
Arthur Erickson: 1991

The Law Courts are distinguished by a sloping glass roof that serves as a major symbol of publicness. Its transparency invites the public to enter, enjoy the public surroundings and join in the judicial procedures. The glass roof provides a visual connection the outdoors and provides daylight to the courtroom and public galleries. The terraced public galleries provide public access to the courtroom, public waiting areas and serve as exhibition and education spaces. The public space is naturally conditioned by capitalizing on the natural circulation of air. Water is warmed and stored in an 840,000-gallon tank during off-peak hours, which is then used to heat the complex during the day. Water is also used to create waterfalls in the public plaza and in the interior galleries.
**Lloyd D. George United States Federal Courthouse:** Las Vegas, Nevada
Cannon Design Group: 2000

The Lloyd D. George Courthouse is an eight-story L-shaped building featuring an expansive plaza in downtown Las Vegas. The public space is elevated above the street and is shaded from the sun by a large cantilevered canopy supported by a gigantic 175 foot tall articulated column. The public entry is through a four story tall cylinder located at the intersection of the “L.” The entry rotunda has a cable supported, clear glass dome. Public galleries overlook the plaza and have views of downtown Las Vegas. The courthouse is built of limestone, marble, granite, glass, and aluminum, materials that reflect the permanence of the courts.

**U.S. Courthouse and Federal Building:** Islip, New York
Richard Meier + Partners: 1999

In Islip, the familiar classical courthouse with heavy stone walls and grand colonnades is transformed into a civic structure that is light and transparent. It is a building that exemplifies the openness and accessibility to justice in our democratic society. It is a building that dominates the skyline giving itself a monumental presence. The main façade is a curtain wall covered by a horizontal brise-soleil, providing sunlight and views of the ocean from the public corridors. The entry rotunda and special proceeding courtroom are projected elements from the main rectilinear form. The rotunda is cone projected to the south and the special proceeding courtroom is a projected cube to the north. A central atrium separates the District and Magistrate Courtroom and provides a space for public events.
An environmental challenge faces us now. The tree is a model and metaphor for a new design protocol that honors nature's highly successful systems. We are trying to design buildings that act like trees. Imagine this design assignment: design something that makes oxygen, fixes nitrogen, sequesters carbon, accrues solar energy for food and fuel, makes complex sugars, distills water, creates habitat, changes with the seasons, builds soil, creates microclimate, and self-replicates. Why can't we create a building as intelligent as a tree?

- William McDonough
In the beginning of the design process three main concepts were developed to shape the evolution of the project. These concepts were based on research completed during the previous semester. As with any design process these approaches modified themselves throughout the course of the project.

1. Justice has to be seen to be appreciated / Justice is transparent in a democratic society.
2. The Judicial Facility has specific layers of Security / Light / Permanence.
3. The Building's Skin should actively engage with the environment Sun, Wind, & Light / Deal with Monumentality and Scale.

The first series of design decisions dealt with incorporating concepts of day lighting, security, and providing an apparent transparent Judicial Center into one agreeable form. Out of these studies came a scheme containing a large centralized atrium.
Creating a large central atrium space, "Hall of Justice", provides an opportunity to draw daylight deep into the interior spaces. The atrium creates a dramatic interior public courtyard with the courtrooms located at the center, with support space flanking them. Creating the boundaries of the atrium are two north / south facing offices bars and two service elements that anchor the courthouse to its base. Voids between these elements allow the interior courtyard to connect visually with the outside. In contrast with the Statehouse, the courthouse at night lights up from within because of the voids created between the program elements. The skin of courthouse is formed to deal with environmental factors of sun, wind, and light. All of the facades act differently to deal with their individual environmental factors. They allow the sun to penetrate the building skin when allowable and the wind to enter through vents to cool the double skin and atrium spaces.

Effective daylighting is achieved in the office blocks because of their narrow floor-plates and the ability to bring light in from both their northern and southern facades. The atrium roof is covered in translucent PV panels which allow the atrium to be filled with indirect light. By placing the PV panels on the exterior of the space frame, heat gain is reduced through the double-skin. The atrium is conditioned with natural ventilation. Air heated up beneath the PV panels is expelled through vents in the double-skinned roof. This causes air to be pulled in through vents in the east and west façade of the atrium. The atrium is shaded from excessive heat gain by the external PV's on the roof and the external louvers on the facades. The indirect light is brought down through the center of the building and filters into the office spaces and into the courtrooms. Beneath the waffle-slab structure of the office blocks, a reflective drop ceiling is placed to reflect light deeper into the space.
The Four Elements in the courthouse signify destination and points of interest. The two on the east and west facades help reduce the buildings' exposure to low-angle sunlight in the morning and at night. The eastern element contains spaces for public circulation and services. Both elements provide the necessary mechanical space for the building. Systems branch out from the elements and connect to the adjoining office blocks and courtrooms. The western element contains spaces for private circulation and services. This element also contains spaces that are connected to judicial proceedings. The element to the south is the entry pavilion and the central element contains the courtrooms. The entry pavilion provides an area for people entering from street level and from the underground parking garage to gather before going through the security check point and entering the atrium space. There angular form comes from the desire to articulate light as it changes throughout the day and year. The form of the elements changed from a more randomly angled form to a more controlled and articulated form throughout the design process. This was done to relate to the order and rationalism of law and justice, but still allow the forms to change with the qualities of light. Made of reflective materials such as glass, metal and polished stone panels, their reflective qualities will change as one moves about the space, creating an added sense of interest. They provide a contrast to the rectilinear office blocks and a sense of permanence since their functions will not fluctuate. The different departments and users of the office blocks will change as Justices change the program over time. The heavy angular elements provide a transition between the classical statehouse, made of heavy stone walls and grand columns, to this civic structure which is light and transparent.
The Courtrooms are the most sacred spaces in the courthouse. They are spaces where the law, justice, and order in our society are upheld. They are spaces that need to be protected, sheltered, and served by surrounding spaces. In this design the courtrooms are pulled away from their service spaces and pushed into the center of the public atrium. They form one of the four elements in the courthouse. It is placed off center to create unique space in the atrium, some more private and some more public. This allows the Court's relationship to an individual occupant to change as they move through the building. The entry element is kept on axis as a formal gesture to the statehouse. The placement of the courtrooms causes the placement of east and west elements to be pushed off axis. The courtrooms are pushed up into the atrium to allow daylight to filter into the individual courtrooms. This altitude allows them to have a sense of dominance in the atrium. They become a source of reflected light, in a light filled atrium. The activities surroundings specific proceedings in the courtroom are visible through its glass skin, while the courtroom is skinned in paneled wood. The glass skin allows the system of justice to be visible to the public. The courtrooms are protected through their elevated positions and are connected by secure public and private walkways. The three individual courtrooms stack in double-height spaces on top of one another. First, is the Tax Court, then the Indiana Court of Appeals, and on top, in the most prominent position, is the Indiana Supreme Court. The Supreme Court is capped with a frosted cable supported glass roof which allows an abundance of natural light to flood the space. The courts expand in size as they go up, following the scale of their individual proceedings.
East-West Section through Office Space, Courtrooms, and Atrium
Diagram of Section

North-South Section through Entry, Atrium, Courtrooms, and Offices
**SOUTH FACADE**

A series of horizontal louvers was developed to shade the south facing glazing throughout the year. Light shelves reflect light from the clearstory windows deep into the space. The drop ceiling also helps reflect light deep into the space and also provides a location for the mechanical and electrical systems.

**EAST/WEST FACADE:**

A series of horizontal and vertical louvers was developed to block low angle sun on both the east and west facades. Horizontal louvers vary according to functions accruing on individual floors. The double skin protects the interior spaces from the fluctuations in temperature.
**NORTH FACADE:**
On the north facade the louvers are removed because there is no need to shade the façade. The light shelves are kept to help bounce reflected sky-bulb light further into the space. The glazing area is reduced to lower the potential thermal lose through the building skin.
At the end of this long, but short, thesis year, I look back and wonder, “Where did it all go?”

I was warned about doing a project too big, a project too small. Now after working on one too big for so long I realized I should have listened. While I am very proud of what I’ve accomplished, I realize that the journey would have been more fruitful had I reconsidered a couple of early decisions. A project of this scale complicated many thesis issues I had chosen to explore. The scale and complexity of the project scared me, causing the thesis issue to suffer as a result.

I feel that I accomplished a lot of my goals and aspirations I had entering this year. I focused and continued to learn a great deal more about environmental design, especially the complications of environmental design in an urban setting. While no images of computer models are included in this book, I was proud to bring a project off the drawing board and into the computer and not lose the vitality of the design. Now that this is done I am excited and ready to move on to whatever is next.

So, until we meet again... GOD BLESS TEXAS.


