Architectural Design Thesis
1997/1998
Department of Architecture
Ball State University

Michael Decoster

The Myth of the American Skyscraper

"Speramus Meliora Resurget Cinerbus"
We hope for better things, it will arise from its ashes.
Detroit City Motto

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The Myth of the American Skyscraper

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Skyscrapers command the skylines of American cities. The skyscraper as a building type began in the United States in the late 1900's because of technological and economic pressures. However, one often overlooked influence is just as crucial as those two. The American skyscraper was developed in the United States because the country's culture encouraged a building of that type and has come to embody a myth of that same influence.

This thesis explores the issue of how and why the skyscraper has taken this meaning. Research has addressed the question of why, while the design project explores the nature of skyscraper design and the question of how.

The thesis project is the design of a multi-use skyscraper in downtown Detroit, Michigan on the current site of the Hudson's Department Store. The complex includes a Hudson's Department Store, retail space, office space, the headquarters for the Dayton/Hudson Corporation, hotel and apartments.

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Myth of the Skyscraper: Abstract
Ted Wolner for his time and criticism, but mostly for his enthusiasm for the project that helped me keep going when I was discouraged.

Meliene Fontaine at the Dayton/ Hudson Corporation for the invaluable information used to create the program

Myth of the Skyscraper: Acknowledgements
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Myth of the Skyscraper: Introduction
One of the forms that United States culture has given to architecture is the tall office building. The term skyscraper was used to describe these new buildings. Technological advancements and economic are undeniably two causes for this form, but a third issue also was needed to create the skyscraper. The skyscraper is not only a manifestation of American culture, but American culture allowed it to be created. The thesis explores this issue as well as general issues related to the design of skyscrapers.

The project that explored the design issues was a multi-use skyscraper in Detroit, Michigan. The site was the existing site of the original 22-story Hudson building that was the tallest department store in the world until it closed. It was appropriate to build in its place a skyscraper for the headquarters of the Dayton/Hudson Corporation and other uses.

The report covers these issues that were discovered and researched throughout the 1997-1998 school year, and give a brief overview of skyscraper design.
Myth of the Skyscraper: Subject & Issues
For the majority of its existence, the United States depended on Europe for its architectural forms and styles. In the late nineteenth century however, a new building type was born in the United States. The tall office building was created in Chicago and New York and soon proliferated all over the United States. The tall office building was built where the cost of land was high, and these buildings had a steel frame on which everything else was supported. Architectural critic Montgomery Schuyler eloquently explains "The elevator doubled the height of office buildings, and the steel-frame doubled it again." (Skyscraper 232). Many people have written about the importance of economics and technology as the impetus of the skyscraper (Bennett, Dupre, Frampton, Goldberger, Kostoff, Willis). Sullivan best explains the cause of the skyscraper in his famous essay *The Tall Office Building Considered* by

Let us state the conditions in the plainest manner. Briefly, they are these: offices are necessary for the transaction of business; the invention and perfection of the high-speed elevators make vertical travel, that was once tedious and painful, now easy and comfortable; development of steel manufacture has shown the way to safe, rigid, economical constructions rising to a great height; continued growth of population in the great cities, consequently congestion of center and rise in value of ground... Thus has come about that form of lofty construction called the 'modern office building' (104).

Undeniably, the role of technology and economics have played a vital role in the development of the skyscraper.
Although Sullivan explains the skyscraper as the result of the evolution of technology and rising land values, Americans construct skyscrapers for another reason as well. The high cost of land leading to the idea of concentrating people in a small area is usually unnecessary. In Chicago, the birthplace of the skyscraper, “was associated with the idea of unlimited space” (Van Leeuwen 82). It was not hemmed in whatsoever. At the time it certainly would have been easier to build a bridge across the Chicago River, which some say contain downtown, than to increase building height. In Kuala Lampor, where the world’s tallest skyscraper has just been completed, “Space is not an issue. Land for construction abounds” (Skyscrapers). Bob Fee of Turner Construction explains, “Some of them [Skyscrapers] make no economic sense whatsoever” (Skyscrapers). The Empire State Building when built doubled the amount of office space in New York during the depression and did not make a profit until 1951(Willis 90). The Singer and Woolworth Buildings only had a paltry two to three percent return on the investment (Willis 43), and “neither demand nor exorbitant land prices were factors for driving up the number of stories” for the Met Life Tower (Willis 43). The Sears Tower has been notoriously vacant. Skyscrapers from an urban point of
view concentrate thousands of people in one area while adding to congestion of the city; actually making it less desirable to live in the city. Although economics is a factor to the creation of skyscrapers, it clearly can not be the only reason.

"The skyscraper is a natural growth, and a symbol of the American spirit" (Van Leeuwen 115). Americans build skyscrapers because they are Americans. The myth of the individual who can, through hard work, overcome great odds and become a rich person is the reason Americans build skyscrapers. A myth, as described by Webster’s ninth new collegiate dictionary, is “a traditional story of ostensibly historic events that serves to unfold part of the worldview of a people or explain a practice, belief, or natural phenomenon.” It goes on to describe myth as “a popular belief or tradition that has grown around something or someone especially one embodying the ideals and institutions of a society or segment or.” The final part of this definition is that a myth is an unfounded or false notion.

The skyscraper in American culture has come to symbolize economic success. It embodies the American belief of equality of opportu-
nity. Through hard work anyone in America can be successful. Sears, Carnegie, and Woolworth were three examples that perpetuate the rags to riches myth. This belief is more often false than true, but is still associated with skyscraper as a building form due to the people who built many of these buildings played up the myth.

The freedom for an individual is also embodied in the skyscraper. When building codes were first put into place to limit skyscraper height, the main reason against this was it would limit economic growth. The placement of the 1916 building code to limit skyscraper height had been discussed years earlier (Schuyler To Curb). The reasons Schuyler gives to curb the height is not to protect the general public, but to protect the investment of the owner’s of skyscrapers. If someone builds a taller skyscraper next to an older one, the older one will have less light and air and consequently less leasers.

The final aspect which is being embodied by the skyscraper is the American’s desire to better the world through the exportation of its values. Numerous examples exist throughout history of this belief. World War I was a war to “make the world safe for democracy.” Currently the Far East is building many skyscrapers designed by American architects. It seems that Americans have succeeded in exporting the belief that
skyscrapers symbolized success through a free market economy.

A tall building form naturally takes on the values of a society. Throughout history, people have constructed tall things to express their values. The pyramids and cathedrals are two such examples. Whether it is culturally ingrained in people or whether it is instinct, people want to build up. Many reasons could explain this belief. From Genisis in the Bible, the tower of Babel was built to touch heaven. The highest object attracts the eye's attention in a scene thereby giving it importance. From high above one can see over large areas giving an overall view, an omniscient position. The amount of work and energy required to create tall buildings shows that the owner has some type of economic success and power. Finally, human beings have tried throughout their existence to understand, control, and manipulate nature. The skyscraper is another expression of the technological conquering of nature. For several reasons, the tall building form naturally takes the role of holder of the culture's beliefs, or a myth.

Although myth is the primary issue the thesis will focus on, skyscrapers inherently bring other issues with them. Another issue will be the discovery of the design considerations that are associated with skyscraper design. Also the use of the computer in the design process will be explored.
The skyscraper as a building type began just over one hundred years ago. Economics and technology have been labeled as the cause of the building type. Although they are necessary for the skyscraper to be built, a third reason exists for the construction of these behemoths. These buildings symbolize the American ideals of economic mobility, individual freedom, and exportation of values. They are to the American culture what the pyramids were to the Egyptians, the Cathedrals to the medieval Europeans, and the temples to the Greeks.
Myth of the Skyscraper: History & Culture
The skyscraper as a building type has a relatively short history. In addition, its origins are undeniabley American. At the end of the American Civil War the tallest building in New York was only four stories tall (Fig. 5). For both technological and economic reasons the skyscraper began dotting the American cityscape in the late nineteenth century. From its beginnings in Chicago, the skyscraper continued to grow in height throughout the twentieth century.

The development of the Bessemer process in steel in the late 1800's and the invention of the elevator allowed builders and architects for the first time to develop practical buildings greater than five floors in height. The skeletal steel framework allowed the structure to take up much less space in the floor plan than loadbearing masonry. The Monadnock Building by Burnham and Root was one such tall masonry building, but the walls at the base were over six feet in width. The economics of the American real estate would never have allowed many buildings to devote that much usable floor space to structure.

Indeed, economics is one reason which created the skyscraper. With higher land costs, developers in the downtown areas of
American cities wanted to get the most return from their investment. Out of these main factors the skyscraper was born. A skyscraper is generally considered a multistory building with a structural frame, usually steel, of extraordinary height. Which building was the first skyscraper is still open to interpretation, but the building which is generally considered the first is the Home Insurance Building in Chicago by William LeBaron Jenny in 1883 (Fig 7). This building was the first to use a fireproofed metal frame supporting its own weight (Kostoff 661).

The history of skyscrapers is divided up into different periods by different authors. One repeating pattern, however, is the jump between the technological and the aesthetic. When a change in technology occurs typically the skyscrapers which follow for some length of time are ones which express this new found technology. Like a child when they get a new toy, the architects express what they can do because it is neat and new. After the new becomes second nature, the aesthetic or how the tall building should look like becomes the primary concern. Skyscraper history has gone through two such cycles of technology/aesthetic.

The first period which many refer to as the
functional generally goes from 1883 to 1905. This period includes the Chicago style architects Daniel Burnham, Louis Sullivan, and William LeBaron Jenny. The buildings of this time period typically were not taller than 10–20 stories. They are penetrated by light courts in the center or on one side. The expression of the frame and the importance of natural sunlight are primary design considerations at the time. The Reliance building is an clear example of this functional time period (Fig 8).

From 1905-1931, the importance of expressing the structure and other technical issues were secondary issues to how should the new skyscraper look. The first skyscrapers expressed the tall thin piers, large piers and a clearly defined base middle and top. The Wainwright building by Louis Sullivan best expresses this style. Other architects attempted to attach previous architectural styles to this new building type. The Flatiron Building by Daniel Burnham uses second empire style (Fig 9). The Met Life tower is nearly a duplicate of the campanile in Venice. The Gothic style became very popular with its sweeping upward lines of piers forcing the eye upward. The Woolworth Building by Cass Gilbert (Fig. 10) and the Tribune Tower by Hood (Fig 11) are both examples of the
gothic style.

The aesthetic period continued with a collection of different styles in the 1920's. Eilel Saarinen’s Tribune competition entry (Fig. 12) and recent changes in building codes changed the style of tall building construction. A stepped back tower became one such expression of the tall building. The David Scott Building (Fig. 26) in Detroit is an excellent example of this. Art Deco also became a popular style for the expression of tall buildings such as the Empire State Building (Fig. 14) and the Chrysler Building (Fig. 13).

By the end of the 1920's, the Depression had occurred and so ended the great boom of skyscraper construction. Very few skyscrapers were completed until the end of World War II. At that time many technological breakthroughs in windbracing, pressurized water systems, and ventilation had been discovered, and another period of expression of technology was ushered in. The development of the fluorescent light bulb and air conditioning made possible the building as a completely sealed and controlled environment. The Lever House by Skidmore Owings and Merrill and the Seagram building (Fig. 15) by Mies van der Rohe are two excellent examples of buildings that expressed their confidence in technology.
The end of the 1960’s lead to further technological developments in structural design allowing buildings of extremely tall height to be possible. The use of the exterior structural frame as a tube was a major discovery in the advancement of the structure. The exterior wall became essentially loadbearing again. The Sears Tower (Fig. 16) in Chicago that proudly displays its bundled tube structure is an example of this expression of technology.

The technology became secondary by the end of the 1970’s, and again the question changed to what a tall building should look like. Philip Johnson’s eclectic designs began this period. Technologically speaking, the AT & T headquarters is nothing to speak about, but its importance to the aesthetic of the skyscraper is undeniable. Currently, skyscraper construction is still in this phase of questioning what a skyscraper should look like. The skyscrapers of the Pacific ring are basically explorations on what form the tall building should take. Buildings such as the Commerzbank by Norman Foster and super tall structures like millenium tower in Japan could bring skyscraper design back to technological expression.
History and Culture-Detroit

Detroit has had a long and eventful history. The town was founded by Antoine Laumet de la mothe Cadillac on July 24, 1701. The French had an extensive fur trading system in the Great Lakes region, and to protect this trade from the encroaching British colonists, Cadillac proposed a fort and town be constructed at the Detroit River (Fig. 17). Louis XIV agreed to the undertaking and the expedition was set out to build Detroit, meaning “the straits” in French. St. Anne church was constructed, which is the second oldest continuously used parish in the United States; and Fort Pontchartrain was built. The fort was named after the secretary Pontchartrain who helped the expedition gain acceptance. The French created a series of ribbon farms along the river, and fur trade was the major industry.

After the French and Indian War, Detroit became a British possession. From 1760 to 1796 it was under British control. The largest event was Pontiac’s uprising. Chief Pontiac decided that the Native Americans must stop the westward expansion by a combined attack on the western towns. Detroit was attacked by Pontiac himself, but after a six month stalemate he was unable to take Detroit and ended the war. Detroit was the only outpost that was not captured during this uprising.

Quite out of the way from the front lines in the American revolution, Detroit did not see much action. On July 11, 1796 Detroit was handed over to the Americans. Wayne County was established that year, and the government of the Michigan territory was set up. A series of governors and
judges were appointed, the most famous being Judge Augustus Woodward. In 1805 a fire engulfed the city and left only two buildings standing. Judge Woodward redesigned the city based on a plan like that of Washington, D.C. The Woodward plan, as it is known, was to create a series of grand circuses and radial streets (Fig 18).

The War of 1812 saw Detroit on the front lines of the battle. Detroit was captured by the British during the war and has the honor of being the only American city to be occupied by another country. The city was liberated by a group of Kentucky militia led by Shelby later in the war.

Following the war Detroit had a population of 850, and Lewis Cass became governor. Through his political connections and the invention of the steamship, the state began to grow. In addition, the opening of the Erie Canal allowed goods from Detroit to be shipped directly to the east coast. The discovery of copper in 1841 and iron in 1844 in the upper peninsula caused Detroit to become a major shipping point in the Great Lakes. Due to its location, Detroit was poised to become an industrial city.

Many industries began in Detroit during the mid nineteenth century. The Pullman sleeping cars
were manufactured there. Steamships that sailed the great lakes were repaired or serviced in Detroit. Pharmaceutical businesses sprang up during the time period including the Park-Davis Company. By 1870 the population of Detroit had reached 206,000 people. The Civil War helped the industry of Detroit by the sheer number of war materials needed to be produced.

1880 begins Detroit's period as a major city in the United States (Fig. 19). In 1889 it held an International Fair and Exposition. The city was filled with immigrants and had a cosmopolitan air to it. Thirty percent of the population were foreign born, and twelve percent did not speak English. Michigan and Woodward was considered one of the businesses intersections in the world and received the first stoplight in Michigan in 1920.

The automobile has been both a blessing and a curse for Detroit. The automobile was not first invented in Detroit, but the city did have the know-how for the industry, the raw materials from the upper peninsula, and exporting capabilities to the east coast via the Erie Canal. Charles King first built and drove a car in Detroit on March 6, 1896 (Fig 20). He later moved on to other hobbies, and other men tinkered with the automobile. Olds first builds a factory dedicated to creating automobiles, which he called Oldsmobiles. They were hand-made and expensive. A fire destroyed his first factory and he was forced to outsource much of the manufacturing of the car. From these other sources many other people got their start in the auto industry.

Henry Ford built his first car in 1896 shortly after Charles King. He started
two other automobile businesses, and on his third attempt he was successful. In 1901 he began the Ford Motor Company, and began to produce inexpensive cars available to the general public by his use of the assembly line. Ford was also offering five dollars a day to factory workers, and in 1914, where the average wage was $2.75 a day, five dollars was an amazingly high wage. People wanting to get into the auto industry and the promise of work lead to a huge growth in the population of Detroit. World War I also encouraged the growth of the city by such a high demand on Detroit’s industrial strength. In 1900 the population was 285,704; twenty years later the population had surged to 993,678.

The 1920’s saw the construction of many of Detroit’s skyscrapers including the Penobscot Building, the Fisher Building, David Scott, and the Guardian Building (Fig. 21). The second biggest industry in Detroit during the Depression was the importation of Canadian liquor. People estimate hundreds of millions of dollars of alcohol poured into Detroit in the bootlegging industry. Nearly eighty-five percent of the alcohol brought from Canada came through Detroit.

Detroit had grown to the fourth largest city in the United States by 1930 and remained there until 1960. World War II saw another period of growth in Detroit with twelve billion dollars in war contracts given to Detroit factories. After World War II a series of events led to the decline of the city.
The car is what brought success to Detroit, but it is also brought about its demise. After race riots in 1943 and in 1967, the middle class fled from Detroit to the surrounding suburbs. With highways providing direct access to the city, it was easy for people to escape the problems of the big city and still work downtown. Mayor Coleman Young was elected in 1968 and ran the city for twenty-four years. During his time as mayor he did very little to solve the problems of Detroit; he kept things pretty much the same, helping further the deterioration.

Detroit has a population of 992,000 in 1994 and is the center of a metropolitan area of 4.3 million (United States 40,44). It has dropped to the tenth largest U.S. city, but is still the sixth largest metropolitan area.
History and Culture-J.L. Hudson

Joseph L. Hudson was an English immigrant, and began working in department stores in Ionia, Michigan. His first attempt at running a department store in Ionia failed, and many of his creditors lost most of their money. He promised them that he would pay all of them back in full. Hudson moved to Detroit and continued working in department stores. He opened the J.L. Hudson's Department store in 1881. After a couple successful years, he repaid all his original creditors back in full with interest. That story gave Hudson an unlimited line of credit with practically anyone.

The Hudson's department store moved to its location on Woodward and Gratiot in 1891, and it successively was added on to. By 1927, Hudson's owned the entire block on which the vacant building now stands. In its heyday Hudson's had sales of over one million dollars in a day and over 100,000 shoppers. It was known for their excellent customers service and developed a credit system prior to the widespread use of credit cards. Stores Magazine in 1976 stated "Hudson's is one of the three great stores which emerged with the advent of the city and downtown shopping." It was the tallest department store in the world and second only to Macy's in New York in size.

Hudson's did several things for the city of Detroit as well. To show patriotism during World War I it had the world's largest American flag hung from the side of the building. For well over fifty years, Hudson's displayed the flag from its building on Flag Day. It donated plaques commemorating historic places in the city prior to the National Register. It also organized a Thanksgiving parade that runs every year to the Hudson's Building to announce the beginning of the Christmas season.

Hudson's merged with Dayton's of Minnesota and created the Dayton/Hudson Corporation. Currently the Corporation owns Dayton's, Hudson's, Marshall Field's, Target and Mervyn's stores across the country.
Myth of the Skyscraper: Site & Context
The site for this skyscraper is just north of downtown Detroit on the site of the old Hudson's Department Store. It is on the east side of Woodward Avenue between Woodward and Farmer Street. It is bounded on the north and south by John R Avenue and Gratiot respectively. BOCA is the applicable building code. The site is zoned B-5, which is heavy retail or office use. Like most of the Detroit area the site is flat.

The views from the site are best when looking toward the river. The park to the south of the site, Campus Martius, allows views of many of the Detroit skyscrapers of the 1920's. Looking up Woodward one sees a variety of eight-story buildings that once held shops, but now mostly are vacant. To the east one sees more low-rise structures including the old county building (Fig. 23).

The transportation to and from the site is varied and abundant (Fig. 24). Just to the south of the site is the point where the major roads in Detroit meet. These radial roads where once Native American trails, and all lead from Detroit to major cities. Woodward travels north to Pontiac. Gratiot leads to Mount Clemens and Port Huron. Grand River goes to Lansing and Grand Rapids.
Michigan Avenue leads to Chicago. The beginning point of these roads is just south of the site at Campus Martius and Cadillac Square. These are the major surface streets that lead to the suburbs. Highways hem in the downtown area, but are not near the site. Most people use the highways to get to and from Detroit and therefore are an important part of the transportation system.

The public transportation is not as abundant. The Southeast Michigan Area Rapid Transit, or SMART, runs busses up the major streets. The busses were only started again in the past two years, and have never had a large use once the highways were in place. Detroit's series of streetcars and busses were heavily used until they were stopped through pressure from the automotive companies and lack of use in the late fifties. An elevated light rail system that travels around the downtown was built in the 1980's. The People Mover, the name of the rail system, only connects downtown locations. Therefore, one must drive into downtown to use this public transportation, and once downtown most of its stops are within walking distance of each other. My site has a People Mover stop across the street and two bus stops on the site on Woodward Avenue.

Many historical towers and other significant locations surround the site (Fig. 25). In fact, Detroit has the third largest concentration of pre-Depression skyscrapers after only New York and Chicago. Smith Hichman and Grylls designed many of the tallest buildings which are just south of the site. The Buhl Building and the Gaudian Building are two examples. The Penobscot Building, also
designed by SH&G, was the tallest building in Detroit for over forty years. John Portman’s Renaissance Center dominates the skyline now, and unfortunately is separated from the city by several drives and huge berms. The David Scott Building directly across Woodward is an example of the influence of Saarinen’s Tribune Competition entry (Fig. 26). Daniel Burnham designed three skyscrapers in the general vicinity of the site, and the first skyscraper in Detroit was on the site where the NBD Bank building now stands. The most recent addition to Detroit’s skyline is Philip Johnson’s Comerica Tower to the south of my site.

Campus Martius is a ground where originally the soldiers going off to war would first assemble. This area used to be more heavily developed, and included the Kern Department Store that only the clock now stands to mark its location (Fig. 27).

Detroit currently is planning on constructing some major buildings. The new Detroit Lions Stadium and new Tiger Stadium are being built to the north of the site near the Fisher Freeway. A growing theater district is developing in that area north of Grand Circus Park. Recently, people have been talking about building a eighteen story and a forty story hotel in the area.
The climate of Detroit is generally temperate. With temperatures ranging from 23 in January to 72 in July. Detroit typically receives 32 inches of rain a year spread out evenly over the course of the year. It also typically receives approximately 36 inches of snow a year. The average windspeed is 10 miles an hour and it is clear or partly cloudy fifty percent of the time. The summers are usually hot and humid followed by a mild autumn. Heating is a major requirement for much of the winter and spring months and is reflected by the 6,569 heating degree days recorded by the US Census.

The Hudson’s Department Store was the place to go shopping in Detroit until 1960 when the suburban shopping malls arrived (Fig. 28). The area directly around the site is filled with mostly vacant storefronts that derived most of their business from the people visiting Hudson’s. The area around Hudson’s has people still around during the daytime although the building itself has been subject to much vandalism.
Fig. 29 Securing a bolt

Myth of the Skyscraper: Spatial & Functional
Many of the self-made men have a sense of gratitude to the country or city that gave them the opportunity to become wealthy, and the creation of a multi-use skyscraper is their gift to the community. They create these skyscrapers as cities built to improve the quality of life of the city. In a sense, they are creating a city after their own image, a utopian city within a building. Rockefeller Center an example of a complex of skyscrapers creating a smaller city within Manhattan. After the New York Opera pulled out of the project, John Rockefeller, one of America’s self-made men, took over. Two such skyscrapers were proposed in Detroit but never built. The Fisher brothers in Detroit envisioned such a multi-use tower a mile north of the existing downtown (Fig. 30). They attempted to create a “New Center Area” away from the congestion and pollution of downtown. The 26 story Fisher building is just one tower of the total complex that was to culminate in a 51-story tower. The Depression stopped the project before it could be completed. The Fisher brothers’ multi-use project was not the first proposal for Detroit. Eelil Saarinen also proposed in the 1920’s a multi-use complex along the Detroit River that was never completed.

In addition to the history of the multi-use skyscraper, the Detroit zoning ordinance for towers also encourages multi-use buildings on large sites. The zoning ordinance for towers states,

No building or structure, or part thereof, shall be erected, altered, or enlarged to such a size or height that the cubical content of such a building or structure above the average established grade shall exceed the volume of a block or prism having a height equal to three times the width of the widest street abutting the zoning lot. (Detroit 133)
In addition, the zoning ordinance goes on to explain about towers that,

Towers may be erected over and above the cubical content limit established herein, provided that the greatest horizontal dimension of any such tower does not exceed sixty feet, that the total gross area of all such towers on any one building or structure at any horizontal plane does not exceed twenty-five percent of the area of the zoning lot . . . and that each tower shall be at least sixty feet distant from any other tower on the same building lot. (Detroit 133)

For the Hudson block site, twenty-five percent of the gross area is 22,550 square feet. Each tower is limited to approximately 3,600 square feet. The zoning ordinance encourages the construction of six to seven towers of small area. The small floor area also encourages hotel and residential uses. John Portman’s Renaissance Center is a building that exemplifies this zoning ordinance (Fig. 31).

From an urban design point of view, it is better to have several uses on the site, so it does not become deserted at certain times of the day. An office building is occupied during the day, but on weekends and at night the area becomes useless. An active program would include a place where people can live, work, and play.

The history, zoning, and effect on the urban environment lead to the development of a multi-use skyscraper. Therefore, it is appropriate for the program for the skyscraper for this thesis to be a multi-use project built in Detroit by one of its self-made men. The new Hudson building will be the completion of the Fisher brothers’ dream, a symbol of the rebirth of the city, and the headquarters for the company built by one of Detroit’s department stores. The Dayton-Hudson Corporation
headquarters will be the dominant feature in the building due to the importance of
Hudson to Detroit and to the entrepreneur ideal.

The general overview of the program consists of five basic areas. An office
component will contain the corporate headquarters of the Dayton Hudson Corporation
and rental office space. A Hudson's department store will again be created on this
site along with other space for smaller shops. A hotel will be added for at least one
of the 3,600 square foot towers. The demand for additional hotel space is needed
with the creation of the casinos and stadiums in downtown. The remaining towers
could be developed will be for apartments. The final general area is the public
space that connects these separate functions. The following table should explain
the general size required for the different functions.

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<td></td>
<td>1.74 million square feet</td>
</tr>
</tbody>
</table>

**Proposed Areas**

![Pie chart showing the distribution of proposed areas: office 41%, retail 23%, hotel 11%, residential 25%]

*Fig. 32 Proposed uses as a percentage of total area*
**Dayton/Hudson and rental office space**

**Space:**
An estimated 3500 employees will be with the Dayton/Hudson corporation. They will require an estimated 200 square feet per employee (Yeang 19), a total of 700,000 square feet.

**Equipment:**
Personal workstations, desks, printers, computers, files, connections for computers and telephones

**Description:**
With the widespread use of the computer many changes have come about in the workspace. One such change is the rapid change and the ability to adjust to that change. For that reason, the majority of the office space will be open and flexible as possible. With more people using flexible work schedules and telecommuting, the office has become more of a flexible resource center for the company. The office space will contain one or two meeting rooms, a kitchenette, and storage for files. Other floors may be opened up for atriums and meetings can be held there as well. The office function is the largest area and will be the most dominant feature in the complex.
Per Floor Requirements (office/retail)

Electrical closets:
Each floor should have one 2'-6" by 5'-0" closet
to distribute electrical services to the floor.

Telephone closets:
Each floor should have one 64 square foot room
to distribute communication wiring.

Janitor's closet:
Each floor should have one 35 square foot room
for janitorial storage and a service sink.

Mechanical/Electrical shaft space:
An estimated 20 square foot duct will be required
for main ventilation, and a total of approximately
4 percent of the floor area should be allowed for
water, air, electrical, and telephone services.

Stairs:
Each floor will be required to have two exit stairs
spaced as widely as possible and contained in a
smoke proof enclosure. The stairs need to have
a minimum 44" clear wide.

Elevators:
The elevators will be divided into different zones.
Express elevators will take people to the local
elevators. One elevator will be required for every
35,000 square feet served, and one service
elevator will be required for every 265,000 square
feet served.
Toilet Rooms:

Each floor will need two toilet rooms. These rooms can be placed on the exterior for ventilation and daylight. The number of fixtures and size of room will be determined by the occupant load. From BOCA's use group B, the toilet rooms will require 1 water closet for every twenty-five people, one lavatory for every forty people, and one drinking fountain for every hundred people.
Retail

Space:

300,000 square feet for the Hudson's Department store and another 100,000 square feet for the rental shops.

Description:

The Hudson department store is the anchor store to a place for people to shop and have a good time. It is the play space of the live, work, play equation. It will draw on the apartment buildings and the rest of downtown. The majority of the space will be left open to designed for the particular store to develop. Therefore an open space which is easily subdivided is the main requirement for this area. The circulation will connect to the urban space and provide a connection to the city. The mechanical and maintenance requirements for this overall area have been added to the office space. The office space is anticipated to be built nearby and therefore can share the loading.
Hotel

The hotel provides people who have arrived in Detroit for business or pleasure a place to stay. The restaurants and shops of the retail area will support the hotel. The following functions are needed for a functional hotel. Approximately 330 rooms will be provided in the building. Every fifth floor will service the floors between them, and on this floor will be larger suites available.

Bedrooms: 105,000 square feet
Corridors, service: 50,000 square feet
Total residential 155,000 square feet

Hotel operations and services:
(including Lobby, Reception, Administration, Meeting rooms, Maintenance, Mechanical, and Storage)

45,000 square feet

Total 200,000 square feet
Per floor requirements (Hotel)

Electrical closets:
Each floor should have one 2'-6" by 5'-0" closet to distribute the electrical services to the floor.

Janitor's closet:
Each four floors should have a janitor closet (35 square feet) for janitorial storage and sink.

Maid service:
Each floor should provide a 60 square foot room for the storage of supplies for the housekeeping.

Mechanical/Electrical shaft space:
30 square feet duct space will be needed for main ventilation, and a total of 4 percent of the floor should be set aside for vertical transportation of telephone, water, air, and electrical services.

Stairs:
Each floor will be required to have two exit stairs spaced as widely as possible and contained in a smoke proof enclosure. The stairs need to have a minimum 44" clear width.

Elevators:
The elevators will be divided into different zones. Express elevators will take people to the local elevators. Six passenger elevators will be needed to serve the rooms and 3 service elevators.
Apartments

The apartments represent the living part of the multi-use building. The residents will live in the complex year round and have the most direct connection to the site. With the exception of the mechanical and first floors these buildings will be made up of two apartments per floor.

Per floor requirements (Apartments)

Electrical closets:

Each floor should have one 2'-6" by 5'-0" closet to distribute the electrical services to the floor.

Mechanical/Electrical shaft space:

30 square feet duct space will be needed for main ventilation, and a total of 4 percent of the floor should be set aside for vertical transportation of telephone, water, air, and electrical services.

Stairs:

Each floor will be required to have two exit stairs spaced as widely as possible and contained in a smoke proof enclosure. The stairs need to have a minimum 44" clear width.

Elevators:

The elevators will be divided into different zones. Express elevators will take people to the local elevators. Six passenger elevators will be needed to serve the rooms and 2 service elevators.
**Mechanical floors (office and retail 4 zones)**

**Space:**

The equipment for these floors will require use of the entire floor and typically are double height.

**Equipment:**

- **Chilled water plant and boiler:** 13,000 square feet/zone (4)
  
  The chilled water plant and boiler are best adjacent to one another and with access to the exterior wall. They need access to the exterior for air and ease of replacing equipment. They are typically noisy spaces.

- **Cooling towers:** 6,000 square feet
  
  The cooling towers should be placed on the ground or on the roof. They need direct access to outside air and should not be near people for the exhausted air.

- **Fan room:** 10,000 square feet per zone (4)
  
  The fan room will require 1200 square feet of fresh air louvers and 1000 square feet of exhaust louvers. The main duct size is estimated at 120 square feet.

- **Transformer vault:** 1600 square feet

- **Switch gear room:** 2400 square feet
  
  The transformer vault and the switch gear room need to be adjacent to one another and well ventilated. A major electrical room (84 square feet) will be needed every ten floors and a minor
one (15 square feet) on every floor.

**Water pumps:** 1500 square feet per zone (4)

The water pumps pump the water up from the street and back down to the lower floors using gravity. The sprinkler system will also work off of pumps in the same area.

**Description:**

The skyscraper will have four major zones for mechanical equipment. Each zone will have a fan room, chilled water plant, and boiler room. The ground floor will have water pumps to pump the city water up to the higher levels. It will also include the electrical transformer and switch gear rooms. The cooling towers may go on either the top zone or bottom. The retail will occupy the lower floors of the office tower and were added in to this part.
Mechanical Floors (Hotel and Residential 11 zones)

Space:

The equipment for these floors will require use of the entire floor and typically are double height.

Equipment:

- Chilled water plant and boiler: 4,000 square feet per zone
- Cooling towers: 800 square feet per zone
- Fan room: 1,500 square feet per zone
- Transformer vault: 1600 square feet (2)
- Switch gear room: 2400 square feet (2)
- Major electrical room (84 square feet) will be needed every 10 floors, and a minor one every floor
- Water pumps: 1500 square feet per zone

Description:

The skyscraper will have four major zones for mechanical equipment. Each zone will have a fan room, chilled water plant, and boiler room. The ground floor will have water pumps to pump the city water up to the higher levels. It will also include the electrical transformer and switch gear rooms. The cooling towers may go on either the top zone or bottom. The retail will occupy the lower floors of the office tower and were added in to this part.
Actual Design Areas

![Pie chart showing the distribution of areas: Apartments 10%, Offices 45%, Hotel 13%, Retail 32%](image)

*Fig. 33 Final design areas as a percentage of the total area*

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<th>Category</th>
<th>Area per Floor</th>
<th>Number of Floors</th>
<th>Total Area</th>
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<td>Height</td>
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**Vertical Diagram of Program**
Myth of the Skyscraper: Systems
A skyscraper, like any building, is a overlaying of systems. The coordination of these systems is incredibly important in the design of skyscrapers. The circulation, mechanical, and structural systems are incredibly complex in a building this size. To go into any detail into any one of those systems would an expert. I did not attempt to deal with specific solutions, but rather prescribed overall strategies, and moved on. This section describes a little of the history of the development of the steel frame and the general solutions for the systems of the skyscraper including a study of the apartment tower.

The technological developments behind the structural design of tall buildings has a history as long as the building type. The steel frame obviously allowed the construction of tall buildings. The vertical structure of a tall building is not that different to smaller buildings regarding gravity loads. For skyscrapers, however, the primary consideration are wind loads attempting to topple the building over. The skyscraper is basically a vertical cantilevered beam. Early solutions to the wind problem included adding shear walls, adding a rigid core, or making all the connections moment connections. These solutions are still used and are economical for buildings between 10-40 stories in height.

During the 1970’s, buildings again began to
reach the height of the Empire State Building and the Chrysler Building. A new concept in structural design allowed the Sears Tower and buildings like it to reach that height with much less steel than before. The solution was to think of the entire building as a beam. Architects began using the outside wall as loadbearing again, but this time for wind loads. By creating tube structures through rigid connections as in the Sears Tower, exterior wind bracing as in the John Hancock Center, or closely spaced columns as in the World Trade Center, engineers were able to use the entire depth of the building as a beam to counteract the force of the wind. Using tube structures is still being used today in the tallest buildings being built, and the maximum height for skyscrapers today is limited by their economic use rather than structural capabilities.

The foundations for many skyscrapers typically are made up of two sections. Directly below the basement, a series of grade beams reaching from twenty to forty feet in depth are used to support and disperse the non-loadbearing weight as shown in Figure 35. Below this raft foundation is a series of caissons which are driven either to bedrock or until friction forces are adequate. These caissons are the foundation for the columns.

For the Dayton/Hudson skyscraper a high-strength reinforced concrete structure will be used. The
estimate sizes were determined by the fire code rather than the structural requirements. Due to the small size of the towers, a traditional rigid frame system will be used. A post-tensioned floor slab will help tie the entire structure together (Fig. 37). Reinforced concrete will also give the slender towers more mass and less likely to sway in the wind. Furthermore, recent skyscrapers in the Detroit area also have employed reinforced concrete rather than a steel frame.

The mechanical system for skyscrapers is in many ways similar to the mechanical system of any large building. One concern in skyscraper construction is the minimization of floor to floor height. To this end, for the skyscraper design, I plan on using radiant heating and cooling with an underfloor air plenum (Fig 36). This method can be accomplished in 8 inches and provides a good quality of air due to the natural convection air floor which occurs. The air rises as it stays in the room, and takes with it all the containments toward the ceiling. Furthermore, the skyscraper will be divided up into smaller zones that will make the loads smaller (Fig. 35).

The windows will be operable to provide natural ventilation whenever possible. This will lessen the load on the building’s systems and provide individual control of the environment. Foster’s
Commerzbank and all of the early skyscrapers use this principal.

Most large buildings are internally load-dominated buildings, and the skyscraper will be no different. The best way to lower the amount of energy the building uses is to utilize the resources which are already there. By making sure not space is more than twenty-five feet from any window, the building will lessen the need for artificial light and the added heat.

Through the systems chosen for lighting, electricity, and ventilation, the skyscraper responds to the contemporary concerns of flexibility and the environment.

The systems for the apartments were looked at more in detail (Fig 37-40). A central core will provide added structural support and be the transportation of the systems. Heating ducts and other pathways for electrical systems will be built in a dropped ceiling over the hallways making the hallways eight feet tall (Fig 38). In addition to defining the circulation space, this minimizes the overall floor to floor height while still providing a ten foot ceiling in most living spaces. A final system of prefabricated wall panels will be developed to speed construction (Fig 40).
The design study of the skyscraper began in the fall semester by looking at the hypothetical skyscraper. By looking at the skyscraper form in general, a broader foundation was created for the design of the specific skyscraper in the spring. The major benefit of this approach was to eliminate redundancy; if something had already been tried why should I spend my time redesigning it. Three specific studies were used in the fall: a study of the technical aspects, a precedent study, and the design of four ideal skyscrapers for the site in Detroit.

The technical study of the skyscraper dealt with the structure, systems, and circulation on a typical office floor plan (Fig. 42). The skyscraper in this study was assumed to have 10,000 square feet per floor and to be fifty stories tall. The distribution of the service cores was studied. After 16 floor plan variations, the service core arrangement was determined to have two major decisions. It could be concentrated or dispersed, or it might be on the exterior or in the center. The success of each plan was contingent upon the criteria and values used to evaluate it. An environmental solution lead to placing cores on the exterior. The exterior cores create a buffer zone and can utilize natural ventilation. A solution derived from the renting of floor space suggests a single central core. In that case, economies of scale are created and the rentable floor area is increased.

The second study during the fall semester was a sketching and analyzing of earlier notable skyscrapers both in history and in downtown Detroit. Older periodicals were invaluable in this search. I sketched the building and
plans, and I answered some standard questions about each building such as number of elevators and type of structure (Fig. 43). By looking at the previous solutions, I was able to ground myself in some real projects quickly. In this way, I was able to further my generalizations about the technical aspects of the skyscraper. I also realized at this point that the technical aspects of the skyscraper were not too difficult to generalize, but to go into any type of depth into things like the structure or elevators got complex quickly.

The final design study in the fall used some of these technical aspects to design some hypothetical skyscrapers for the site in Detroit. Four skyscrapers were designed dealing with one or two concepts to discover some important issues to be dealt with in the spring. The concepts that were designed for included a “typical” skyscraper, a skyscraper addition, an environmental solution, and a Sears Tower size skyscraper (Fig. 44). By comparing the common issues to each skyscraper, I found some issues that were essential to the general skyscraper design. The designer has little leeway in the design of many of the aspects of skyscrapers because many issues are prescribed by zoning ordinances, fire codes, life safety issues, and economics. Therefore, the designer must concentrate on the items are not dictated by code. These decisions carry the meaning of the individual skyscraper. Some of these decisions are the repetition of a system of smaller parts, an assignment of hierarchy, massing, and material placement and selection.

The design of the skyscraper began the spring semester with a clean slate. The first decision was the enlargement of the program from the single use office building to the multi-use and multi-tower complex as
described in the Spatial and Functional section. From that point, a decision needed to be made on what form these towers were to take. To accomplish this I first sketched out many different variations that the skyscraper could take. Practical considerations were secondary at this point. As you can see from figures 45-47 the rising form became a recurring theme.

Then, I took five of the conceptual sketches and created a study model for each of them (Figs. 48-52). The five I chose each seem to embody a concept used in multiple sketches theme. At this point, I also began to apply a general program to the form to give it some sense of reality. Four of the concepts were more difficult to carry their theme into the model form and the idea of a phoenix rising from the ashes seemed to be the most appropriate and applicable concept.

The metaphor of a phoenix is appropriate to the project in several ways. It is not meant to be a literal interpretation of a phoenix, but to embody the idea of succeeding after failure, rising above one’s past. The self-made men all failed at various times before their success. Henry Ford started two automobile companies before his third was successful. J.L. Hudson went bankrupt with his first department store. In addition, the Detroit city motto “We hope for better things, it will arise from its ashes” again refers to the idea of the phoenix. Detroit is also currently going through a rebirth of its downtown, and this building would be a physical manifestation of this rebirth after years of hard times. Therefore, I looked at the concept of towers rising from the base.

These site models also led to the discovery that skyscrapers are in fact public buildings. Even though they are owned by individuals, they are adopted by the
city and the public. People identify a city with its skyline and its skyscrapers. One cannot think of the Empire State Building without thinking of New York City. To the residents of the city, skyscrapers are a reminder of the possibility of the self-made man, and an important landmark. Furthermore, skyscrapers are public buildings because they are likely to exist in perpetuity. No skyscraper has been torn down except to construct a larger building. The skyscraper is indeed a public building.

Furthermore, skyscrapers affect their surroundings, but they are not influenced much by them. A skyscraper is defined by the time and place in which it is built. A fifty story building in Muncie, Indiana is certainly a skyscraper, but in Manhattan it would not deserve that title. A skyscraper defines the place in which it stands. It will redevelop the micro weather patterns in that area of the city. The winds will be altered and affect the surrounding buildings differently. The shadows skyscrapers cast and the views they block also affect the surrounding area. From the economic point of view,

On the other hand, the context has very little influence on the skyscraper itself. The pedestrian will not care about things above the 7th or 8th floor. Above that point the scale of the building is much larger and built towards the audiences that can see the building as a whole. The pedestrian next to the building
can not perceive the building as a whole. The surrounding context also will have little effect. A room 500 feet up from the ground has the same relationship to the building across the street as a building 500 feet down the street. Therefore, the base of the skyscraper is scaled to the surrounding context and pedestrian scale, but above that it is inconsequential to that audience.

From this point, I went about developing the hierarchy of the different towers. Through a series of isometrics, I looked at the number and arrangement of the towers (Fig. 53). Six towers fit the program and the Detroit Zoning Ordinance. The towers used containing living uses took the form of two slabs cut by a rising glass slab in the center. The center slab contained the mechanical and service requirements of the buildings. The displacement of the slabs gives the structure a more dynamic attitude and infers motion. The office towers at this point were merely rectangular prisms, and was the next item that was focused on.

The massing of the office towers is the next item I studied. I again drew a series of isometrics to attempt to find the best solution. The final design included asymmetrical setbacks to continue that the same sense of motion implied by the taller towers (Fig. 54). In addition, the setbacks included a continuous vertical line. Although it was set back at different places and overlapped at points, the horizontal line of the setback was cut in deference to the vertical line in all the cases. The smaller office tower on the Woodward side took the same approach at a smaller scale.

I looked at using different materials using a computer model. After several studies, I determined only major changes of material such as glass to masonry
are visible at a large scale. Figure 57 shows a study of creating the apartment and hotel towers out of glass rather than masonry. Due to the slender floor area, the glass only makes the towers look thinner. Only at the intermediary scale is the differentiation of similar materials possible. To differentiate the base and the vertical towers, different colors of brick was used. A darker color brick was used on the towers to help stabilize the slender towers while a lighter colored brick was used at the base. The base then read as a single element with the towers rising from it.

One of the unique aspects of the skyscraper is the repetition of a single cell or group of items. Due to the size of such projects, skyscrapers are the development of smaller elements that are repeated in various combination. The design of the skyscraper is therefore involved in two parts: the development of those repeated elements, in this case the floor plans, and the arrangement of those repeated elements.

Several other aspects of the design enforce this differentiation of the base and the towers. The windows have a similar proportion on the base, which is different from that on the towers. The window proportion was looked at in a study of the middle of the apartment tower (Figs. 55, 56). Again the concept of a small idea repeated was discovered. In addition to the floor plan, the fenestration develops the repetition of a simple idea.

The canopy at the base also reinforces the base, tower split (Fig. 59). The canopy uses the opposite idea that the Empire State Building employs. The Empire State Building’s first setback is lower than necessary, but it frees the pedestrian from feeling there is a towering mass overhead. The canopy defines its own space and one does not consider that the building continues up
above. In both cases the pedestrian is considered. The canopy breaks at the points where the towers are. At this point the passer-by on the street realizes what exactly they are walking by.

The massing and materials of the skyscraper serendipitously describe the essence of skyscrapers. It is a combination of the 20's carved mountain skyscrapers and the glass box. The base and lower levels of the towers are made up of masonry setbacks that infer the 1920's type of buildings. The skyscraper by its sheer mass wants to be a large mountain, but in reality it is the skin and frame system revealed when the setbacks are peeled away or pulled apart. At that point the scale of the building is more appropriate for the industrial glass and metal, while the base is more for the scalable masonry materials.

The final discovery during the investigation of the skyscraper, is they are designed from the top down. During the development of the floor plans for the office, residential, and hotel the lower levels became more defined. In fact, it was necessary to design these upper stories before the lower stories could be defined. Those floors above determined the placement and number of elevators, structure, and mechanical systems. Like buildings designed from the inside out, skyscrapers are designed from the top down in order to support those upper floors. Additional images of the final design may be found in the appendix.
Myth of the Skyscraper: Conclusion
The thesis has covered many aspects of skyscraper design. It looked at the causes of the skyscraper and contends that American culture is just as important to the rise and continued construction of the skyscraper as economics and technology. Without any of those three crucial elements skyscrapers would not be built.

The thesis has looked at the history of the skyscraper and divided its history into two major categories: the expression of the technical and the search for a form. It has delved into the history of the city of Detroit and one of its self-made men, J.L. Hudson.

The thesis project discovered major issues that are unique to skyscraper design. Economics, technology, building codes, and ordinances dictate many aspects of the skyscraper’s form. The designer must therefore direct his or her energy toward the aspects that give each skyscraper its individuality. Those aspects that are left to the designer include hierarchy, massing, and materials. The skyscraper is made up of many small, individual decisions that are repeated over and over again in differing variations. The designer’s responsibility is to develop that system and orchestrate its variations. The lack of context is another aspect that makes skyscrapers unique. Above six to eight stories, the surrounding context is irrelevant to the building, although the building profoundly affects its surroundings.

One aspect that has not been addressed, but of massive importance to this project was the use of CAD. The computer has given my thesis process many advantages. They include longer design time, better quality progress work, and invaluable help in material studies. The computer became helpful only once a
database of information was first created.

The project in this thesis has reached a point of overall completion. At this point, it is a matter of looking at smaller parts of the skyscraper and developing each almost independently from the rest of the building. The street level and the interior retail areas are two such areas that could be a thesis in and of itself. The goal of this thesis was to get an overall understanding of skyscraper design; and like any design, the more developed it becomes the more areas appear that need to be addressed. The subjects and issues that this thesis deals with provide a good starting point for skyscraper design.


Myth of the Skyscraper: Bibliography
Books-Skyscrapers


**Periodicals-Skyscrapers**


**Detroit**


Myth of the Skyscraper: Appendix
Fig. A-1 Farmer Street Isometric

Fig. A-2 Woodward Street Isometric