our daily bread

challenging convention from grain to faith

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Master's Thesis - May 2016

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challenging convention from grain to faith

by John Taylor Gorski, Associate AIA

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see additional references section, AR01

the contents

the thesis

The motivation for this thesis project starts with a personal connection to industrial architecture and how it has impacted my life. I seek to expand the public's understanding of how important these structures are to the greater population as symbols of key industrial heritage to places like Milwaukee and cities everywhere. The building that I have selected as my case study is the Menomonee Valley's grain elevator known as Elevator E, or the "old Cargill Elevator."

The design challenges of this project are how to preserve the integrity of the grain elevator through thoughtful modifications, how to rehabilitate the grain elevator for an antithetical programmatic use, and how to advance the grain elevator into the relevance of the 21st century through sustainable practices and modifications. Areas of study include the embodied energy of these facilities, the inherent heritage value and social impact of grain elevators, and how to provide appropriate modifications to help retain them in our collective city fabric as key icons and place-making elements as an alternative to demolishing them "in the name of progress."

With this project I will study how grain elevators function, are built, can be rehabilitated, and how significant they are. Byzantine architecture will be explored and will help to explain how constructing the architecture is derived from faith and the religious experiences of sacrament, spirituality, and worship. This project will attempt to be as sustainable as possible through the model of the Living Building Challenge, not only for retaining a structure that has such an extensive entropic value, but from the mindset of enabling energy independence and autonomous performance, providing suitable habitat restoration of the South Menomonee Canal, constructing solutions to help preserve an ecologically juxtaposed building type, and all that is expected of an environmentally conscious architect of the 21st century.

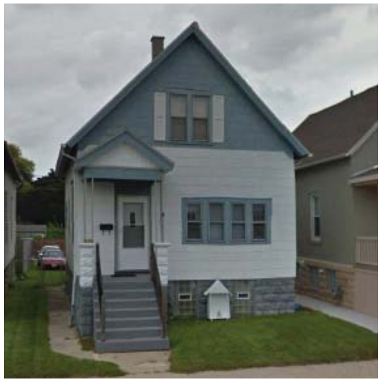
the introduction

Who am I?

My name is John Taylor Gorski. I am a Milwaukee native and born on the south-side at St. Luke's Hospital. My family and I used to live on S. 35th Street and W. Lapham St. in an old Polish flat. At the time I had no idea of the importance of that neighborhood or how it would affect my academic career later in life. When we lived there, my father would take me for walks or pull me in my coaster wagon around the neighborhood and, before Miller Park Way was redeveloped into what it is today, there were industrial structures everywhere. A particular fascination of mine at the time was with railroads and trains, so this strip of land became one of my favorite places to go. One of the industrial yards had a diesel locomotive almost perpetually nestled between its imposing warehouses, smokestacks, and grain elevators. I grew to love this area and became forever attached to industrial buildings and settings such as this one.

As time went on and we moved between houses, circumstances, and lifestyles the old house at 35th St. became a distant memory, but one that will always have a special impact on me. Currently we reside in Oak Creek on the same acre of land that my immigrant great-great grandparents first settled on when they arrived to the Milwaukee area. Now as part of my daily ritual of commuting to UW-M's campus I pass the shipyards and industrial facilities of the inner harbor on I-794.

Upon further research for this thesis project, I decided to find the old industrial site of warehouses, smokestacks, and grain elevators that I had come to cherish as a child.



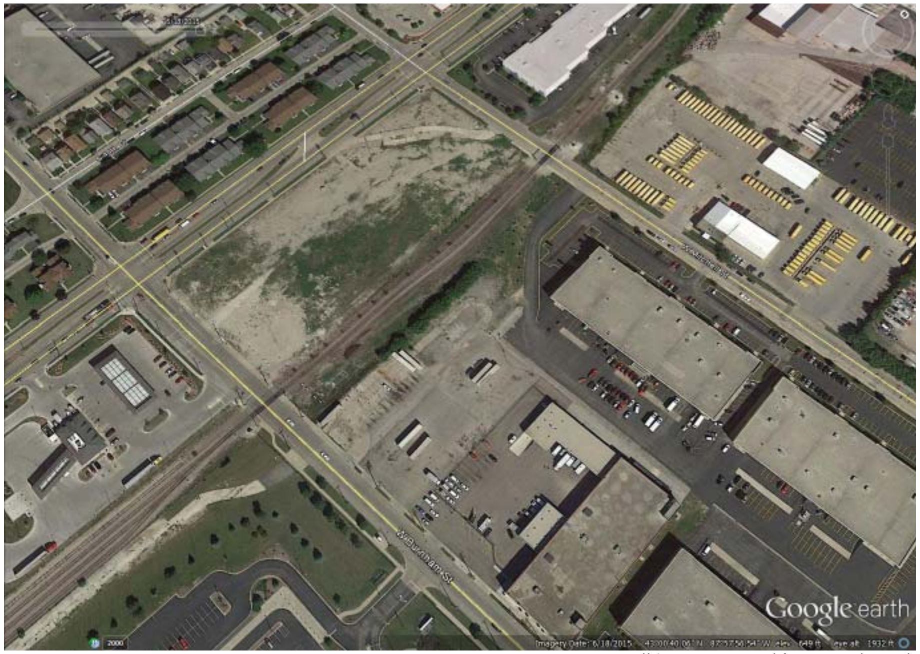
top + left images sourced from google earth, edited post-capture

bottom right image from personal collection

It is gone. All of it.

The warehouses have been demolished, the smokestacks raised, and the grain elevators have been ripped down to nothing but a plot of vacant land awaiting redevelopment. Discovering this hurt and still puts a strain on my heart. Those mere silos and concrete behemoths symbolized so much to me and who I have become as a person and as a future architect. Selecting a topic for my thesis became very clear to me as my academic career progressed.

I look upon structures like these as something to be cherished and protected. As the old industrial site by 35th St. left such a strong impression on a meager growing child, so too did these very same facilities play a more utilitarian role in shaping the great city of my birth. These icons of industrial might and progress now appear to be in the way of progress. Perhaps instead of clearing them, we as a city should save and rehabilitate them for future generations to acknowledge our heritage as an industrial hub and have a greater sense of place.



all images sourced from google earth

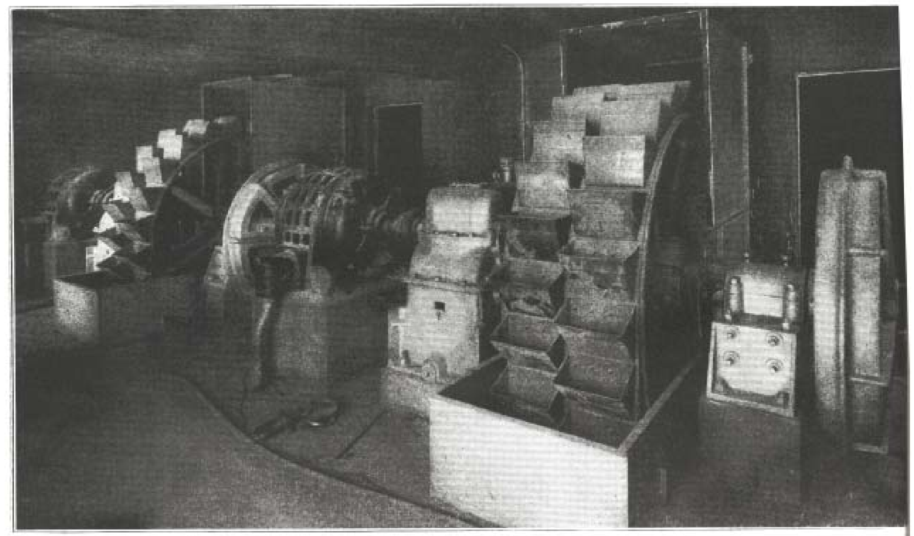
Why Grain Elevators?

Selecting grain elevators as a thesis project is a precarious endeavor. There are plenty of other industrial typologies that could be of interest as well. These could include but are not limited to warehouses, bottling plants, shipyards, marine slips, swing bridges, tanneries, and other eccentric building types. So why on earth would I be compelled to select a grain elevator for my thesis project?

In short and in my opinion, they are probably the most interesting industrial building type out there. Slips hold ships, warehouses are grids upon grids in three dimensions with limitless uses, bridges are meant to transport objects across gaps, but grain elevators are a more interesting and niched object.

Grain elevators take in a product, they transport it within the facility using an impressively complex series of chutes and ladders, they clean, weigh, grade, and disperse said product into storage tanks in which they remain until the product is purchased or an additional transfer to another facility is required. Grain elevators are very simple, yet hyper complex. With this in mind, I fell in love with the typology. The types of storage tanks can differ immensely from square bins, to circular silos, hexagons, and complex interstice bins. Grain elevators can be wooden, steel, ceramic, or concrete and are not limited to defined styles or forms. Every grain elevator system is different.

Grain elevators are an inherently difficult building type to rehabilitate or reuse. They can be salvaged and converted into apartments, hotels, or other uses but more often than not they come crashing down in a fury of controlled demolitions as crowds gaze at the spectacle, cheering on the loss of an industrial age icon. I value these icons and aim to use my thesis as a mechanism to help realize their embodied potential.



Top Floor of Working House of Katy Elevator at Kansas City, Mo., Showing Motors, Gear Speed Reducers, Elevator Heads, Bucket and Backstop.

GE08, pg. 58

GE20, pg. 1

Having a rudimentary understanding of these structures, I had no idea which grain elevators in Milwaukee to select. There have been a couple of thesis projects at SARUP that have been adaptive reuse projects of grain elevators in the recent past. With this in mind I battled with selecting those elevators or a totally different set of elevators somewhere else in the city.

At the time I would drive from a previous residence in New Berlin to UW-M's campus everyday along I-94. I would pass by a series of unique structures that lie to the South of the interstate and lie directly adjacent to the high-rise bridge. These grain elevators stuck out to me as different and unique in their own right. They had different appearances, heights, and a tall centrally placed work house. They were on a sliver of water and adjacent to a railyard. Almost instinctually, I selected them as my thesis project.

This grain elevator is known as "Elevator E."

"…the grain elevator is possibly the most challenging building type to a preservationist, but given its iconography, sheer size, and massive construction, its potentials are also extremely alluring." – Gerald Bauer (M.Arch 2014) GE02, pg. 13

GE10, pg. 1

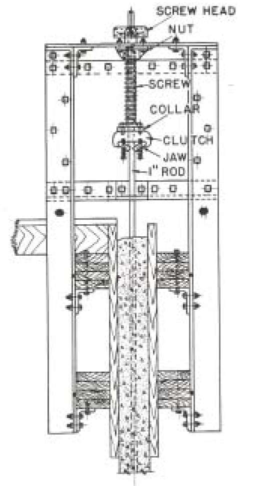
How are Grain Elevators Built?

There are various ways with which to construct a grain elevator which are dependant upon the type of grain elevator being constructed. For simplicity, we will assume the model here is of an urban concrete grain elevator.

Concrete grain elevator construction starts off with a series of vertical rods and horizontal reinforcing bars, shown at far right and middle. As the forms are built around these rods and bars, the formwork becomes attached to the reinforcing bars themselves, see Folwell-Sinks at right. The concrete then starts to be poured and shortly after the first few feet of concrete are strong enough, the formwork begins to "slip" up the structure. This process is known as "slip-forming." As the slip froms ascend higher and higher, as illustrated in the photographs at the bottom, the reinforcing bars are added and are then further reinforced by more horizontal members as the formwork climbs. The pouring of concrete does not stop until the structure is completed; the total pouring time for the *Grain Products Terminal Elevator* in Dodge City, Kansas, shown below, was 7 days non-stop (GE13 - pg. 97).

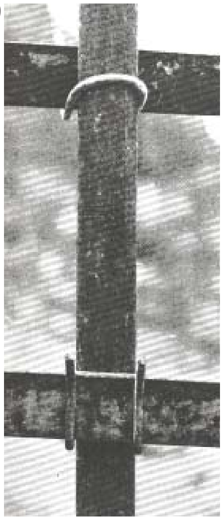
This process is repeated for other grain silos and the work house. The slip-formed structures can grow as fast as 18 feet every 24 hours, and a 220 foot tall solid-concrete work house can be completed in 12 days (GE13 - pg. 96).

GE08, pg. 10

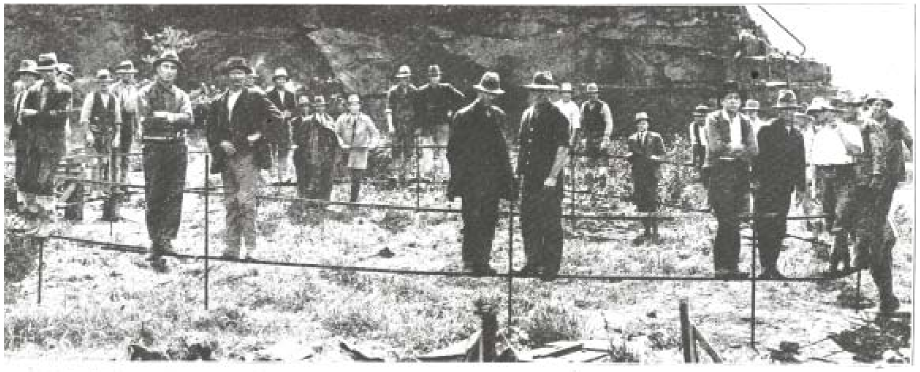


The Folwell-Sinks Hollow-screw Jack, Patented June 4, 1907, No. 856,452.

GE08, pg. 279



GE08, pg. 279



Horizontal Bars Held to Uprights by Steel Wire Clips Support the Weight of Two Men to a Clip Without Slipping

bottom images sourced from GE13 - pgs. 97-103
edited into a timelapse strip post-capture

How do Grain Elevators Function?

A typical grain elevator takes in its product from a rail yard receiving pit or scoops the product from ships in an extendable apparatus called a marine leg, shown at right.

The product is then carried from the elevator boot up to the elevator head at the top of the work house.

From here the product is weighed and sorted through the scale floor and distrib-uting floors, respectively. See Hopper Scales at far right.

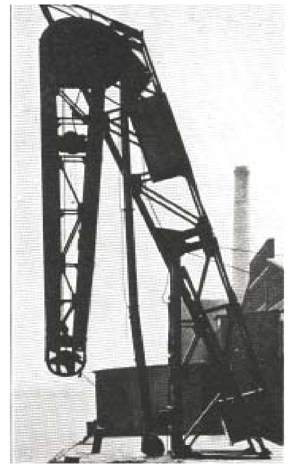
After this step the product is sent via conveyor belt to a machine called a movable tripper. The tripper then diverts the flow of product into the massive storage bins.

Once inside the storage silos, the product is held until further notice and then is diverted to another destination.

The product leaves the silos through belt loading spouts and the material is taken via conveyor belt down to the elevator boot again.

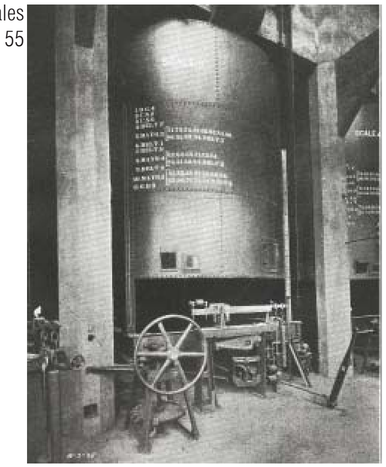
The product is then sent up once more to the elevator head at the top of the head house and then weighed again, sorted into large multi-level through bins within the work house, and then dispensed into waiting rail cars or ships at dock.

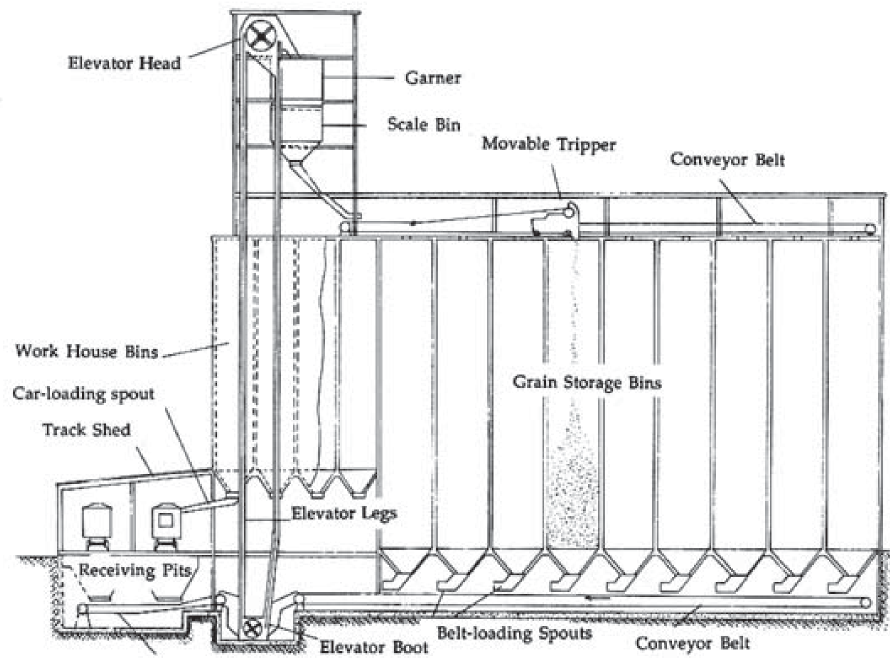
The product may also be sifted, cleaned, and dried within the head house before it is sent off to storage or is dispersed if it has not been done already.



Marine Leg
GE08 - pg. 11

Hopper Scales
GE08 - pg. 55



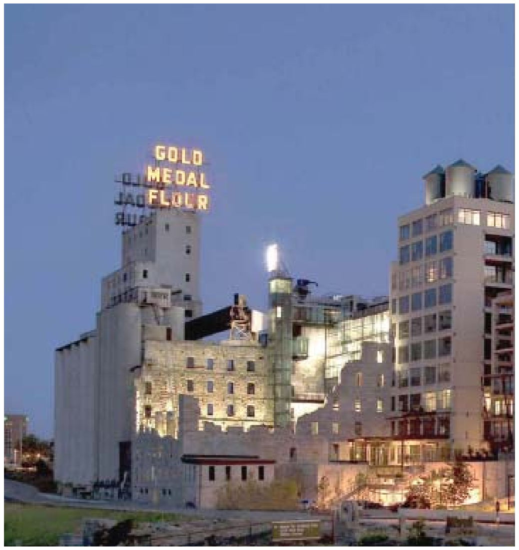


bottom image sourced from google images

Why a Church,
and why inside a Grain Elevator?

As mentioned earlier, grain elevators can be salvaged and used in a contemporary fashion. However, as I have seen, these uses typically gravitate around apartments, condominiums, or other forms of housing with a few projects pertaining to museums or public art installations. A few examples of these strategies are shown on this page. Strategies such as these involve minimal cutting of the existing fabric yet still provide users with an iconic structure and a compelling atmosphere.

A worship space is something that requires an enormous volume of space. I seek to push the limits of how a grain elevator can be carved and altered while still retaining much of the existing fabric of the complex. I believe that if the Milwaukee complex of Elevator E could be altered in such a way that would enable such a massive space to reside within the structure, a proposal that would alter the building on a lesser scale would appear more tangible to a real-world developer. Churches and worship spaces appear to not be a common theme, or even considered, for modern grain elevator rehabilitations.



Mill City Museum
Minneapolis, MN

Globe Mills Lofts
Sacremento, CA

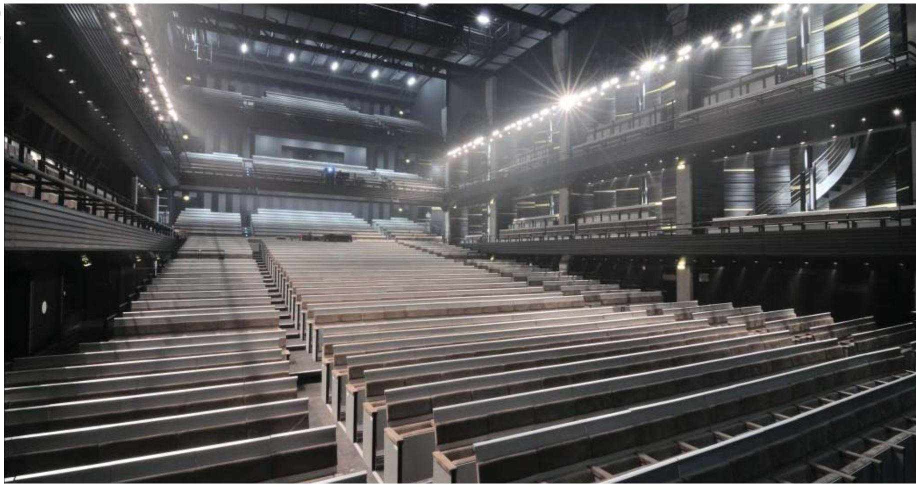
Quaker Square Inn
Akron, OH

Silo Point
Baltimore, MD

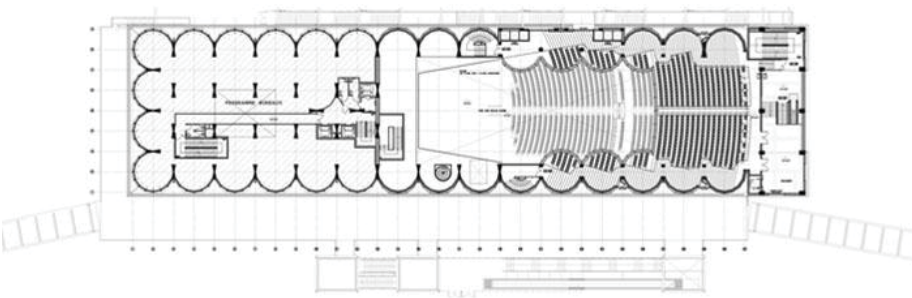
all images sourced from google images

case studies taken in part from GE02

Arenc Silo
Marseille, France

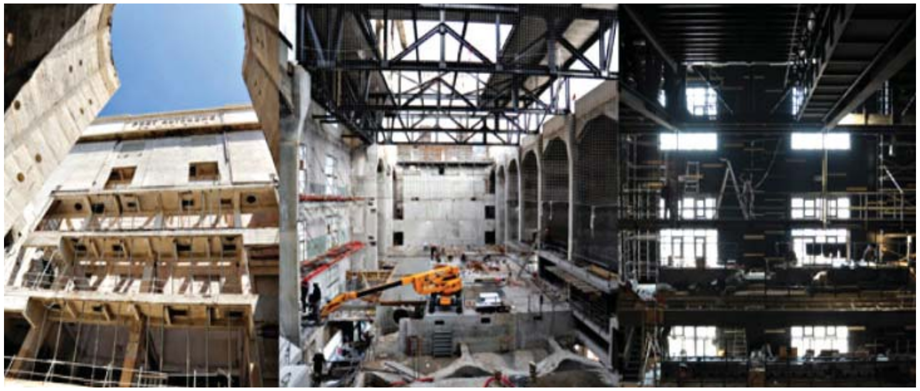


There is, however, an example of a successful conversion of a series of silos into a large auditorium space. This facility, Arenc Silo in Marseille, France, is a rehabilitated grain elevator that has been transformed into an opera house with supplemental programming including residential and restaurant spaces.



Arenc Silo was transformed by the population of Marseille when they decided to invest in the rehabilitation of an old elevator complex instead of constructing a new facility; this was deemed more favorable of an endeavor (GE15). Parts and visible reminders of the grain elevator's industrial past are still clearly visible from not only within the atrium spaces and stairwells, but also within the primary performance hall itself (GE15). The architects on the project were *C + T Architectes* and it was completed in September of 2011 (GE15). The opera house can seat up to 2,000 spectators and, as of 2004, has been listed as a "Heritage of the 20th Century" site (GE15). The silos were originally constructed in 1927 which is in the same time frame as Elevator E's construction from 1916, 1926, and 1930 (GE15).

Because of this project, I have a renewed faith that the metamorphosis of Elevator E is a more tangible endeavor.



all images sourced from google images

case studies taken in part from GE02

Why Orthodox Christianity?

Orthodox Christianity is a very specific type of faith. There is a deep rooted investment in tradition, knowledge of historical events, apostolic succession, mystical theology, and a plethora of saints.

Byzantine Architecture has a more established formula with regards to rules possessing more specifications in its architecture than most other Christian denominations. The Byzantine and Orthodox model of Churches is very particular, obeys certain rules and has more particularities than what most other churches involve; this, arguably, is due to a relatively unshaken tradition of liturgy. Because of these particularities and rules it makes for more of a challenge, not necessarily constraining the designer, but directing their creativity.

Orthodox Theology has a great focus on metamorphosis and change. A renovation project of an old structure into an Orthodox Church follows a great deal in the theology and tradition of Orthodoxy.

The Eucharist is at the center, and climax, of the typical Orthodox service, referred to as the "Divine Liturgy." Many Orthodox theologians talk about how, before the altar, wheat and grapes are not offered, but rather bread and wine as the Eucharistic offering to God. This means that we as humans are taking God's gift to mankind and applying our own creative power to transform it into something substantial and enjoyable. Through our creative power, a grain elevator can become a symbol of what happens during Divine Liturgy and has a direct correlation to the service proper.

The traditions within Orthodoxy focus heavily on bread and will be explored later in this booklet.

The mere shape of the existing building fabric of Elevator E plays heavily upon the usage of circles and Orthodoxy utilizes this shape in particular for various purposes, however, the most dominantly expressed form resides within the dome(s) that every Orthodox Church possesses. These complex geometries within Elevator E will also enable a more unique canvas for iconographers to transform the walls into a panorama of the saints.

Unfortunately, Orthodox Christianity is not as well-known of a faith in the United States and tends to stay within its own enclave of ethnicities. A project such as this one would help to shed light upon this relatively quiet faith and help it attract attention and interest.

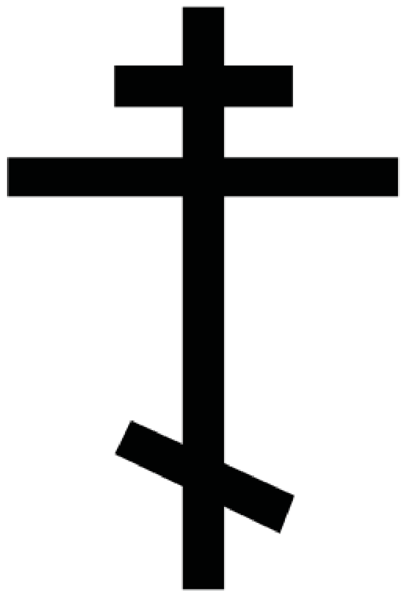


image sourced from google images

Why the Living Building Challenge?

The Living Building Challenge is an environmental rating system for buildings that is similar to LEED, in that it grades certain parts of the construction, but intensely more rigorous in that it evaluates buildings on a much steeper curve generally in an "all or nothing" fashion. Comparatively, LEED uses a point based system.

In order to be classified as a "Living Building" certain requirements must be met. These are referred to as the seven "petals," or pillars, of the Living Building Challenge. These petals include Place, Water, Energy, Health and Happiness, Materials, Equity, and Beauty and are further subdivided into 20 Imperatives (S05, pg. 21). Also in order to be classified as a Living Building, a period of analysis and data acquisition occurs in which the performance of the building is measured to make sure that it does indeed meet the specifications of the LBC (S05, pg. 64-65). This period, referred to as a "preliminary audit," can only occur after occupancy of the building reaches a certain level and lasts for 12 months (S05, pg. 64-65). Also a Final Audit of the project is undertaken to recognize it as a Living Building (S05, pg. 64-65).

The full status of "Living Building" is one of a few certifications offered by the LBC, the others are "Petal Certification" and "Net Zero Energy Building Certification" and have their own derivations of the LBC formula (S05, pg. 64-65).

I feel that the Living Building Challenge is an exceptional rating system and I will be using this system as a means to grade my project environmentally. I believe that LEED has an equal importance to architectural projects and rehabilitations, however, I feel that an LBC project evokes more careful thought and consideration with respect to sustainable architecture and the environment.

LIVING BUILDING CHALLENGE

image sourced from google images

an overview

The Menomonee Valley

“The Menomonee Valley has been one of Milwaukee’s distinguishing features since long before the dawn of urban time” writes John Gurda in his 2002 article titled *The Menomonee Valley: A Historical Overview* (P04, pg. 1). The Valley used to be an impassable marsh of rice and wildlife long before settlers began to transform it into what we now see it as.

During the transformation of The Valley into its current state, 1,400 acres of land was developed, many various rail lines were laid down, and miles upon miles of dock yards were constructed (P04, pg. 6). Grain elevators, including Elevator E, warehouses, processing complexes, and plenty of other industrial facilities became the primary landscape within the Menomonee Valley replacing the aforementioned “impassable march of rice and wildlife” (P04, pg. 6). The Valley then became an easily traversable land devoid of native life.

After its development and plentiful years of use, the Menomonee Valley became more and more barren of these industrial icons and structures as industry began to decline in the mid to late 20th century. Rail lines were removed, complexes were shut down, and entire factories and industrial plants were leveled to ground level.

John Gurda continues to write in his article about how the Menomonee Valley, through all of its hardships, successes, and trials “...is, and will be for years to come, a work in progress” (P04, pg. 12). There are programs, groups, and a strong emphasis on “renewing The Valley,” and one such group is known as *Menomonee Valley Partners, Inc.*

AR01, port0116

Menomonee Valley Partners, Inc. is a nonprofit organization that aims to revitalize and recreate the Menomonee Valley into a prosperous urban industrial district that will advance economical, ecological, and social equity for the benefit of the city of Milwaukee (P06). There are projects geared toward active recreational environments, habitat restoration, stormwater management, new construction, and industrial renewal.

With projects, interests, and organizations like these, the Menomonee Valley is well on its way to joining the Historic Third Ward, the Fifth Ward, Walker's Point, and other districts on the list of Milwaukee's great urban renewal projects.

AR01, port0455

image sourced from google images

the site

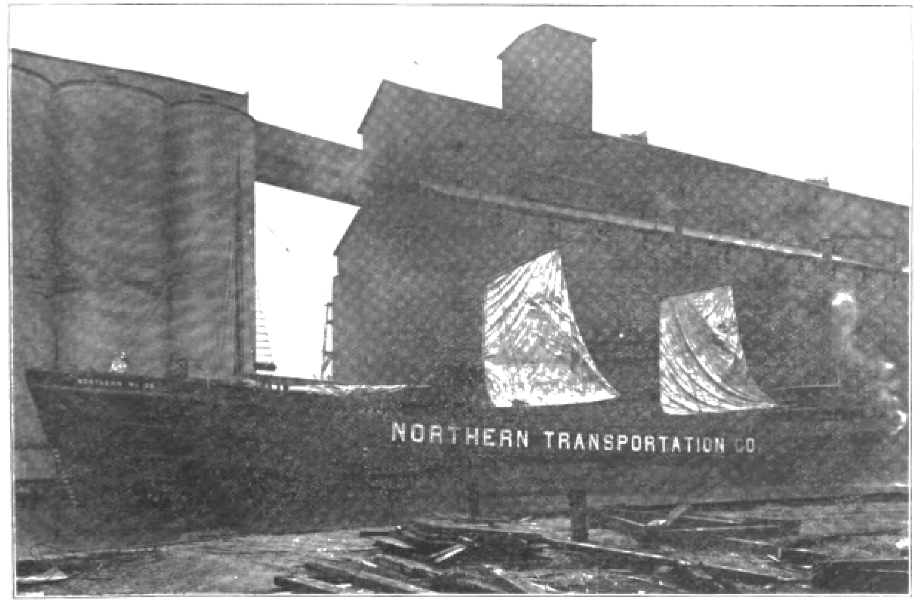
a brief history

Elevator E

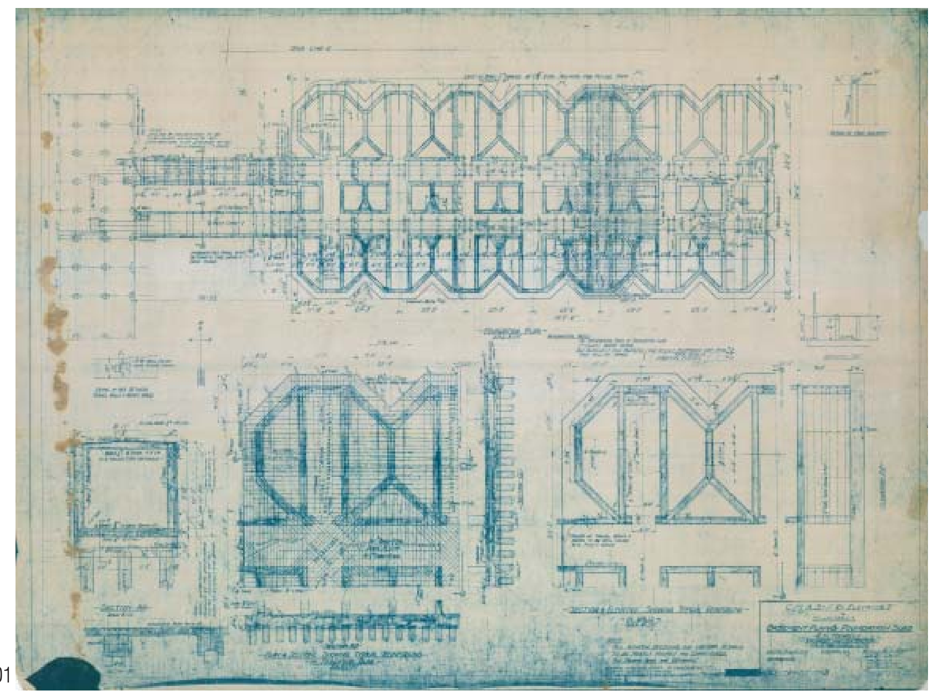
The grain elevator known as Elevator E, began life as a wooden grain elevator, similar to Elevator A, shown on the opposite page. Both grain elevators, along with at least one more known as Elevator B, were owned by the Chicago, Milwaukee, & St. Paul Railroad and were leased out to various companies throughout the years (AR05 - 8589F).

Wooden Elevator E resided along the South Menomonee Canal directly North of the C.M. & St. P. R.R. yards and had a capacity of 1,200,000 bushels of product (AR03). Elevator A had a capacity of 1,500,000 bushels and was along the same canal, roughly opposite of the current location of the Harley Davidson Museum (GE16 - pg. 175). Over the years, it is evident through the Sanborn Maps, that modifications and additions were made to the facility of Elevator E.

One of the modifications to Elevator E came in the form of a series of new concrete storage tanks that were designed and added from 1916 through 1917, refer to images at right (GE08 - pgs. 177-179). These storage tanks were designed by a Chicago man named R.H. Folwell, an important figure in the world of grain elevator design and construction (GE08 - pgs. 177-179). R.H. Folwell was responsible for designing and patenting a system of “Hollow-Screw Jacks” known as the “Folwell-Sinks” (GE08 - pgs. 6-11). These Folwell-Sinks became essential to the slip-formwork that was required in the generation of concrete grain elevators (GE08 - pgs. 6-11). Folwell’s silos at Elevator E had an interesting octagonal basement and foundations with natural light flooding into the belt conveyor corridors via dead-end corridors under the silos (AR04).



GE16 - pg. 100



AR04, 1916 - Storage Tanks - Basement Plan + Foundation Slab 01

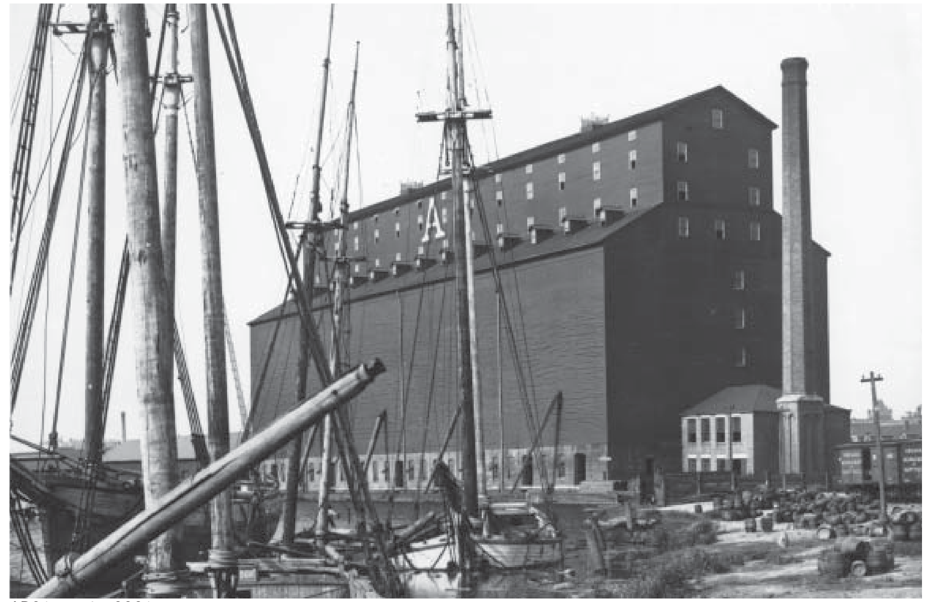
In June 1924 a wooden elevator leased to, what is now the large industrial grain company known as, Cargill caught fire and burned down (GE04 - pg. 286). The fire was caused from a short that had occurred during an electrical wiring replacement recommendation from the insurance company (GE04 - pg. 286). The $225,000 loss of grain within the facility was covered by the insurance company, however, the C.M. & St. P. R.R. was in financial difficulty and was unsure of the prospects of rebuilding the elevator (GE04 - pg. 286). Upon further research, the elevator that burned to the ground was found out to be Elevator A and "was [apparently] destroyed by one of the most spectacular fires ever witnessed in [Milwaukee]" (GE16 - pg. 245).

What was Cargill at the time, negotiated and eventually got the lease to use Elevator E as a substitute for the damage caused by the fire of Elevator A (GE04 - pg. 286). Cargill remained the most well-known tenant of Elevator E and many people still refer to the complex as "the old Cargill Elevator" and not Elevator E.

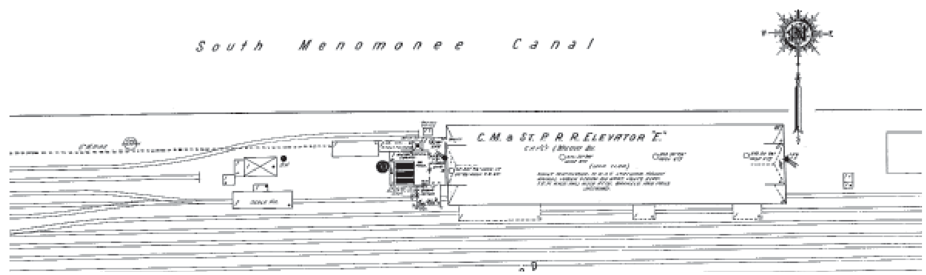
According to *Grain Elevators of North America*, the wooden Elevator E was also burned down and the work house and new 1926 silos were simply erected upon the foundations of the old facility to match the character of Folwell's 1916 silos (GE08 - pg. 177). This fiery demolition appears to be a desired result of needing "a grain terminal worthy of a transcontinental line" (GE08 - pg. 177)

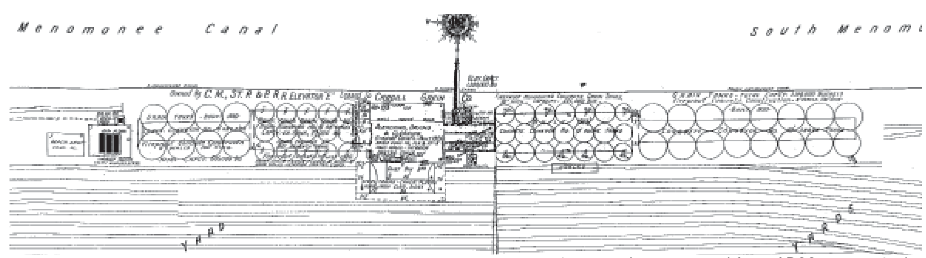
The designer and builder of the 1926 additions to Elevator E was the Chicago-based firm known as Burrell Engineering and Construction Company (AR04). The designer and builder of the 1930 additions on the far East and West portions of the facility remains unknown and no historical plans have been found.

The old wooden Elevator E and the current Elevator E can be compared through the Sanborn images at right, images not to scale.



AR01, marine0061



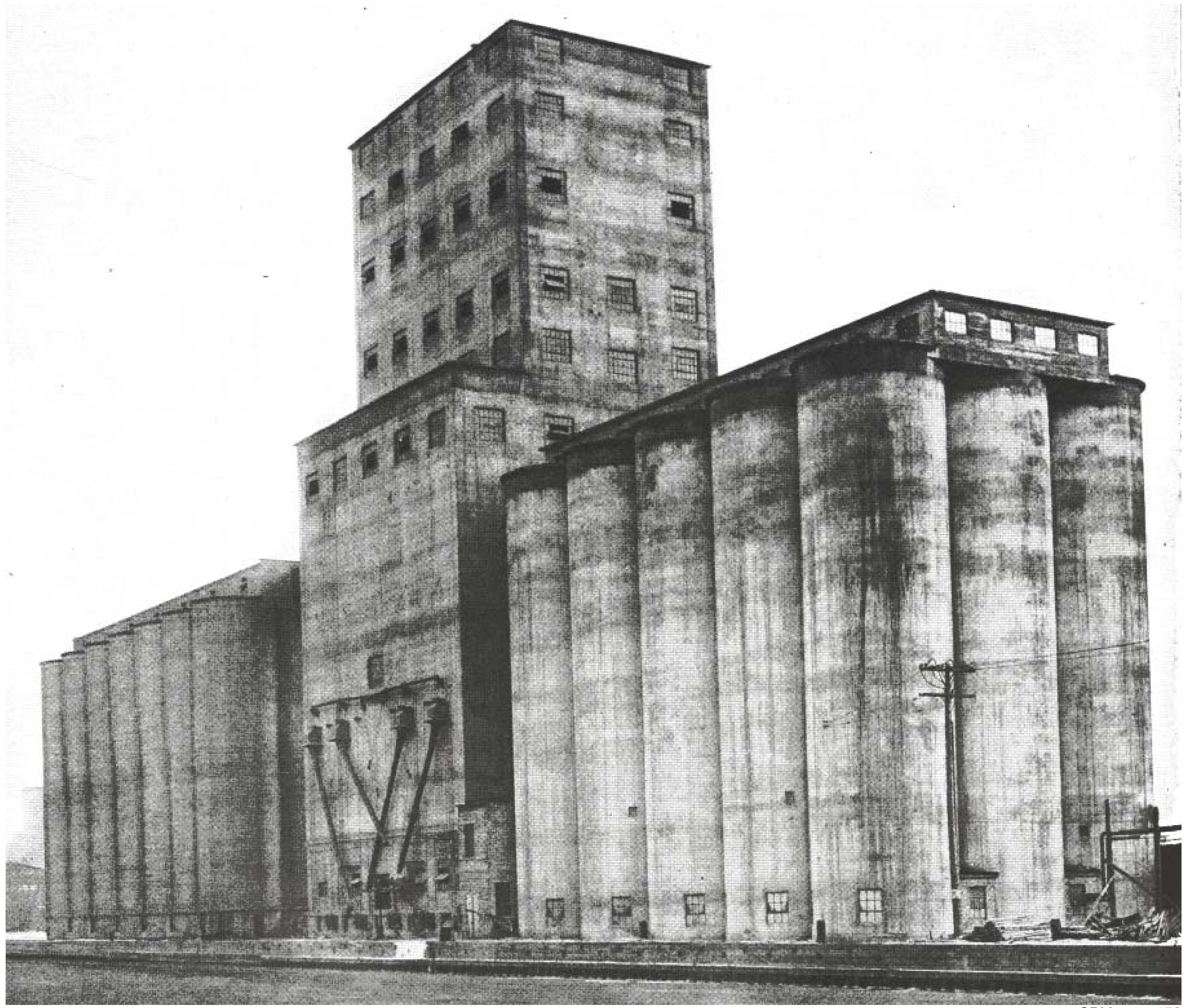


two images above sourced from AR03, respectively:
Milwaukee, 1910-1937, vol.4, 1910, Sheet 388
Milwaukee, 1910-Dec. 1951, vol.4, 1910-Dec. 1951, Sheet 388 AND Sheet 389
both edited post-capture

a brief history

Elevator E (cont.)

Elevator E before the
1930 annex additions.



GE08 - pg. 178

Elevator E after the
1930 annex additions,
note new marine leg added.

AR01, marine0400

Elevator E

The Site Visit

Currently Elevator E remains empty and has been inactive for many years now. I was able to tour the facility in December of 2015 with help from the Wisconsin Operations Manager of the company that owns it currently. For reasons of privacy, this company and my tour guide will remain anonymous. My tour of Elevator E lasted for approximately 4 hours. The visit was the most exhilarating thing that I have personally done in my 7.5 years of college schooling and left me wanting to return to the facility.

The spaces within the facility are extremely well lit and relatively free of clutter. The building appears generally intact, with slight repairs needed because of the years of service and inherent entropy of the almost 100-year-old facility.

The 1930 annex silos were discovered to have flat bottoms, instead of the traditional cone-shaped design common to grain elevators, and the basements of these silos are particularly tight quarters with very little room to maneuver.

all images taken with verbal permission from Elevator E site visit - 12-21-2015

all images taken with verbal permission from Elevator E site visit - 12-21-2015

Elevator E

The Site Visit (cont.)

Without enabling bin-entry, my guide and I orchestrated a carefully snapped photograph of the interior volume of Bin 281 of the 1930 annex silos. It was edited post-capture to lighten up the image and help reveal more about the volume of the space. This image is shown below, the perspective is looking up from the bottom of the silo to the underside of the roof.

From the top to the bottom of the work house, a massive series of elegant yet nauseating space-saving spiral staircases aided in the flow of workers up and down the 201-foot-tall facility, shown at right.

all images taken with verbal permission from Elevator E site visit - 12-21-2015

all images taken with verbal permission from Elevator E site visit - 12-21-2015

Elevator E

Embodied Energy Analysis

Because Elevator E is an existing building, a brief feasibility analysis comparing the cost of having the facility demolished against the cost of saving it is required. During a site visit and tour of the facility in December of 2015, a conversation between myself and my guide was had about a previous estimate conducted for the demolition Elevator E down to grade, not including removal of the footings or foundations. The estimated cost of removing Elevator E was in the approximate area of 1.4 million dollars, again this is not including the removal of anything below grade and the salvaged metal from the removal would be sold as scrap by the demolition contractor.

With this in mind, not only is demolishing Elevator E detrimental to Milwaukee's industrial heritage, but also a colossal impact on the environment with respect to demolition waste removal and transportation but also furthermore damaging to the pocketbook of whoever would front the bill for the demolition. That amount of 1.4 million dollars could be better reinvested into the grain elevator for a future use or rehabilitation.

This vast amount of material, that is Elevator E, has a calculable cost and that is referred to as the "embodied energy" of the facility. Embodied energy is collectively the amount of energy consumed by creating the building physically, producing the materials used in the construction, the energy cost of extracting the materials from the earth and refining them, and transportation of those materials to the job site along with removal of the construction waste. Demolition of an existing building to allow for a new construction is also calculated with an embodied energy analysis.

In order to undertake an embodied energy analysis, certain calculable statistics must be known. Essentially, these numbers include the volume of the selected material, the mass of the material, and the embodied energy and carbon coefficients of the material. These numbers change based on the material or product in question.

The University of Bath in the United Kingdom has produced a free-to-use Inventory of Carbon and Energy Summary, commonly referred to as an ICE; the version to be utilized in this thesis is ICE version 2.0.

The primary areas of concern for an embodied energy analysis of Elevator E include the steel reinforcing bars and the concrete.

Upon successful completion of the digital model of Elevator E's rebar and concrete, the numbers are staggering.

The amount of steel rebar within the structure is at least 1,612,343 feet in length, assuming a diameter of 1/2" rebar, equating to approximately 37,162,166,273.50 BTU's of Embodied Energy and 6,494.39 Tons of CO^2 produced in the fabrication of the steel only (not including transportation to the job-site and final assembly).

The amount of concrete within the structure is at least 629,820 cubic feet, equating to approximately 30,462,086,684.25 BTU's of Embodied Energy and 10,413.85 Tons of CO^2 produced in the fabrication of the concrete only (not including transportation to the job-site and final assembly).

Elevator E Material Analysis : Existing Steel Rebar

1916 Addition	
/ Foundation	23,659.00 ft
/ Basement	58,350.00 ft
/ Slab	21,616.00 ft
/ Tanks	233,281.00 ft
/ Gallery Slab	43,509.00 ft
/ Gallery	10,488.00 ft
/ Gallery Roof	36,729.00 ft
TOTAL :	427,632.00 ft

1926 Addition	
/ Foundation	14,767.00 ft
/ Basement	22,693.00 ft
/ Slab	14,767.00 ft
/ Tanks	173,119.00 ft
/ Gallery Slab	14,767.00 ft
/ Gallery	7,941.00 ft
/ Gallery Roof	25,463.00 ft
TOTAL :	273,517.00 ft

1926 Headhouse	
/ Basement	21,122.00 ft
/ 1st Floor	20,618.00 ft
/ Bin Level 01	69,697.00 ft
/ Cleaner Floor	27,262.00 ft
/ Bin Level 02	49,536.00 ft
/ Conveyor Floor	15,031.00 ft
/ Distributing Floor	20,092.00 ft
/ Distributing Mezzanine	9,300.00 ft
/ Scale Floor	27,579.00 ft
/ Garner Floor	17,542.00 ft
/ Top Floor	11,409.00 ft
/ Head Floor	7,850.00 ft
/ Roof	21,225.00 ft
TOTAL :	318,263.00 ft

1930 Annex Tanks East	
/ Foundation	24,304.00 ft
/ Basement	13,531.00 ft
/ Tanks	305,315.00 ft
/ Gallery Slab	24,303.00 ft
/ Gallery	4,355.00 ft
/ Gallery Roof	21,759.00 ft
TOTAL :	393,567.00 ft

1930 Annex Tanks West	
/ Foundation	11,403.00 ft
/ Basement	6,539.00 ft
/ Tanks	158,098.00 ft
/ Gallery Slab	11,403.00 ft
/ Gallery	2,571.00 ft
/ Gallery Roof	9,350.00 ft
TOTAL :	199,364.00 ft

Total Embodied Energy (EE) :	37,162,166,273.50 BTU - Assumed Elevator E Steel
NOTE :	
"Total Embodied Energy" values only represent the manufacturing of the material and does NOT include transportation of the material to the job site OR the actual building construction.	65,449,785,377.21 BTU - If Virgin Steel Were Used 17,379,321,540.84 BTU - If Recycled Steel Used

Total Embodied Carbon (EC) :	6,494.39 Tons of CO^2 - Assumed Elevator E Steel
NOTE :	
"Total Carbon Emissions" values only represent the manufacturing of the material and does NOT include transportation of the material to the job site OR the actual building construction.	12,988,787.01 lb. / CO^2 - Assumed Elevator E Steel 25,693,148.02 lb. / CO^2 - If Virgin Steel Were Used 4,171,581.23 lb. / CO^2 - If Recycled Steel Were Used

Collective Length of Material :	1,612,343.00 ft
Radius of Rebar :	1/2 inch
Collective Volume of Material :	8,793.95 ft^3
Density of Steel :	489.024 lb. / ft^3
Collective Weight of Steel Rebar :	4,300,453.79 lbs.

VALUES FROM I.C.E. DATABASE	
Assumed Elevator E Steel :	20.10 MJ / kg.
Converted into BTU / lb. :	8,641.45 BTU / lb.
Virgin Steel :	35.40 MJ / kg.
Converted into BTU / lb. :	15,219.27 BTU / lb.
Recycled Steel :	9.40 MJ / kg.
Converted into BTU / lb. :	4,041.28 BTU / lb.

VALUES FROM I.C.E. DATABASE	
Assumed Elevator E Steel :	1.37 kg.CO^2 / kg.
Converted into BTU / lb. :	3.02 lb.CO^2 / lb.
Virgin Steel :	2.71 kg.CO^2 / kg.
Converted into BTU / lb. :	5.97 lb.CO^2 / lb.
Recycled Steel :	0.44 kg.CO^2 / kg.
Converted into BTU / lb. :	0.97 lb.CO^2 / lb.

Elevator E Material Analysis : Existing Concrete

1916 Addition	
/ Foundation	26,629.00 ft^3
/ Basement	21,807.00 ft^3
/ Slab	14,822.00 ft^3
/ Tanks	76,361.00 ft^3
/ Gallery Slab	5,553.00 ft^3
/ Gallery	2,104.00 ft^3
/ Gallery Roof	12,126.00 ft^3
TOTAL :	159,402.00 ft^3

1926 Addition	
/ Foundation	16,874.00 ft^3
/ Basement	8,697.00 ft^3
/ Slab	3,929.00 ft^3
/ Tanks	54,666.00 ft^3
/ Gallery Slab	3,804.00 ft^3
/ Gallery	1,536.00 ft^3
/ Gallery Roof	8,675.00 ft^3
TOTAL :	98,181.00 ft^3

1926 Headhouse	
/ Basement	25,771.00 ft^3
/ 1st Floor	12,746.00 ft^3
/ Bin Level 01	24,624.00 ft^3
/ Cleaner Floor	9,982.00 ft^3
/ Bin Level 02	18,244.00 ft^3
/ Conveyor Floor	5,580.00 ft^3
/ Distributing Floor	7,420.00 ft^3
/ Distributing Mezzanine	4,397.00 ft^3
/ Scale Floor	8,279.00 ft^3
/ Garner Floor	6,605.00 ft^3
/ Top Floor	4,394.00 ft^3
/ Head Floor	3,183.00 ft^3
/ Roof	5,570.00 ft^3
TOTAL :	136,795.00 ft^3

1930 Annex Tanks East	
/ Foundation	31,882.00 ft^3
/ Basement	14,865.00 ft^3
/ Tanks	95,200.00 ft^3
/ Gallery Slab	7,652.00 ft^3
/ Gallery	2,066.00 ft^3
/ Gallery Roof	4,495.00 ft^3
TOTAL :	156,160.00 ft^3

1930 Annex Tanks West	
/ Foundation	15,748.00 ft^3
/ Basement	7,246.00 ft^3
/ Tanks	49,046.00 ft^3
/ Gallery Slab	3,780.00 ft^3
/ Gallery	1,192.00 ft^3
/ Gallery Roof	2,270.00 ft^3
TOTAL :	79,282.00 ft^3

Total Embodied Energy (EE) :	30,462,086,684.25 BTU - Assumed Elevator E Concrete
NOTE :	
"Total Embodied Energy" values only represent the manufacturing of the material and does NOT include transportation of the material to the job site OR the actual building construction.	

Total Embodied Carbon (EC) :	10,413.85 Tons of CO^2 - Assumed Elevator E Concrete
NOTE :	
"Total Embodied Energy" values only represent the manufacturing of the material and does NOT include transportation of the material to the job site OR the actual building construction.	20,827,706.53 lb. / CO^2 - Assumed Elevator E Concrete

Collective Volume of Material :	629,820.00 ft^3
Density of Concrete :	150.000 lb. / ft^3
Collective Weight of Concrete	94,473,000.00 lbs.

VALUES FROM I.C.E. DATABASE	
Assumed Elevator E Concrete :	0.75 MJ / kg.
Converted into BTU / lb. :	322.44 BTU / lb.

VALUES FROM I.C.E. DATABASE	
Assumed Elevator E Concrete :	0.10 kg.CO^2 / kg.
Converted into BTU / lb. :	0.22 lb.CO^2 / lb.

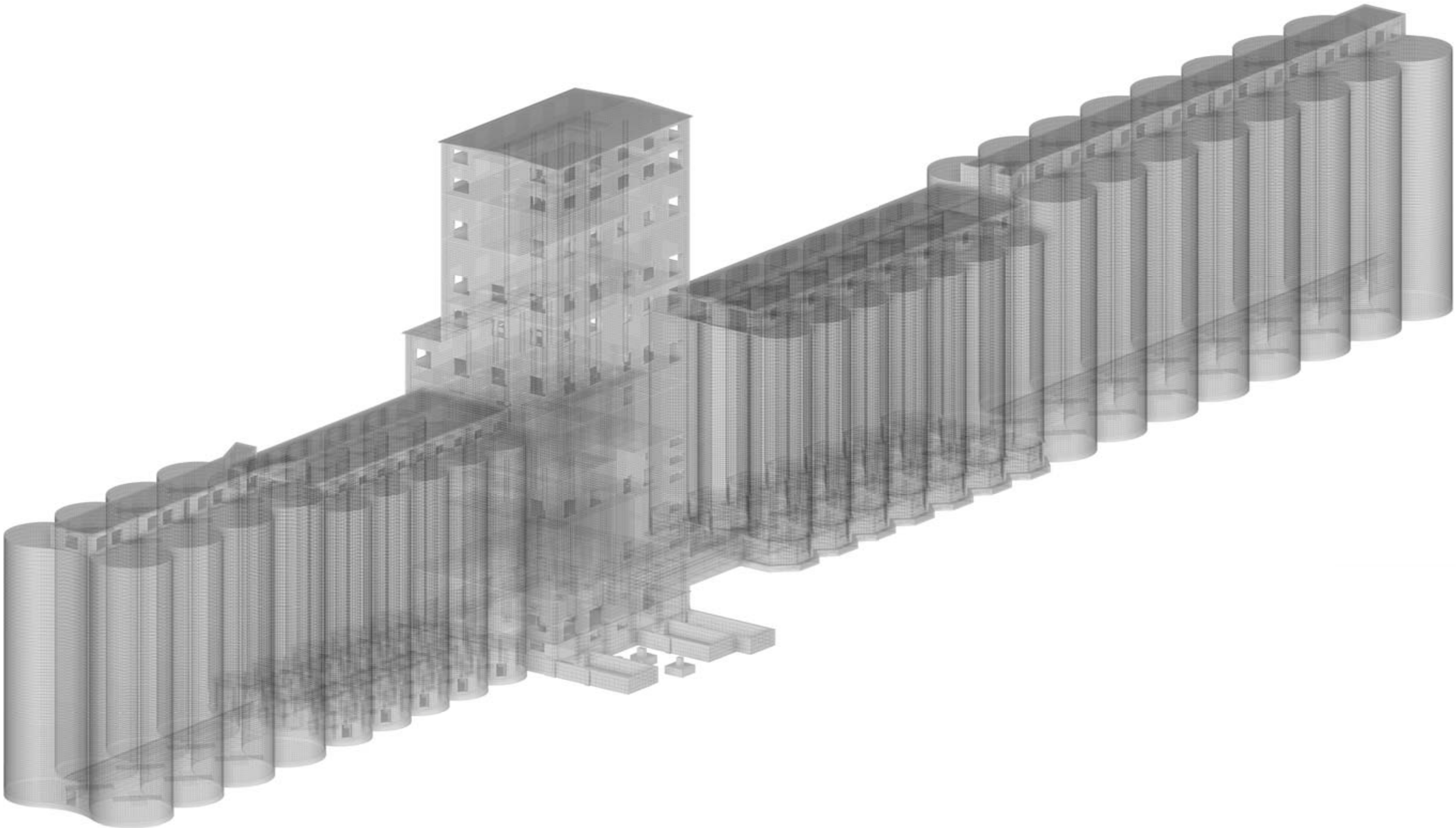
Elevator E

Embodied Energy Analysis (cont.)

629,820 cubic feet of concrete

305.37 miles of rebar

over 16,908 tons of CO2 emitted in making the materials alone
(not including transportation and construction assembly)

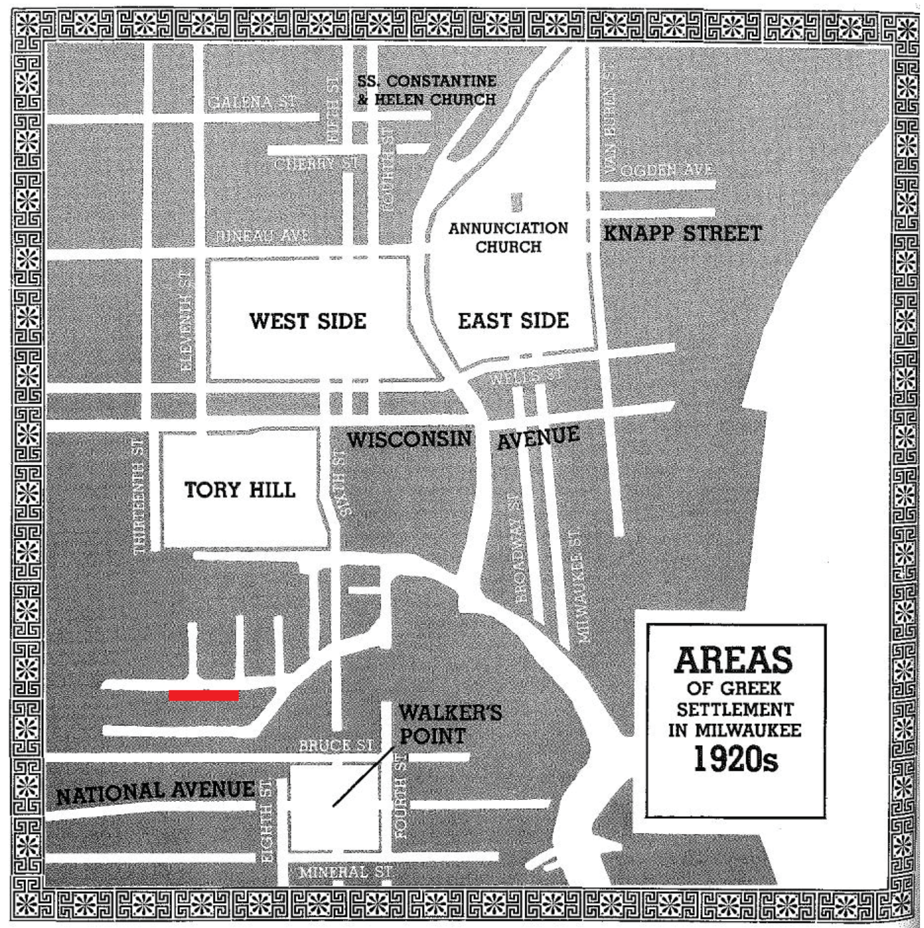


the site

Annunciation and Sts. Constantine + Helen

Greek Orthodoxy in Milwaukee

Greek Orthodoxy in Milwaukee began around 1900 with the arrival of mostly male Greek immigrants who came to make their fortunes here in America and then return home to Greece (P03 - pg. 177). These young bachelors generally applied for industrial jobs within Milwaukee's tanneries or started up their own restaurants and smalls stores if they could afford it (P03 - pg. 177). As time went on, the Greek immigrants came to love their new Milwaukeean homes and most stayed here in the city (P03 - pg. 177). Generally, the Greek immigrants settled down in the areas of Milwaukee's West and East sides, Tory Hill, and Walker's Point, as shown by the map at right (O05 - pg. 16). Elevator E is represented by the red rectangle on the map.



O05 - pg. 18 - edited post-capture

As the Greeks in Milwaukee gained permanence, they were able to form their own churches, the first being Annunciation Greek Orthodox church in 1906, later built in 1914 on the corner of Broadway and Knapp (P03 - pg. 177). Sts. Constantine and Helen Greek Orthodox Church was later formed in 1922 at Fifth Street slightly North of Cherry Street in an old Beth Irael synagogue (O05 - pg. 30). In 1961 Annunciation moved from the East Side to their current Frank Lloyd Wright built home at 9400 W. Congress St. and in 1968 Sts. Constantine and Helen followed their sister parish to Wauwatosa and laid claim to their current residence of 2160 N. Wauwatosa Ave. (O05 - pgs. 106-107).

At the time that Annunciation was moving Westward, there were different talks about what to do with the old Annunciation building in the East Side. There were conversations about Sts. Constantine and Helen purchasing the structure, selling it to a Russian Orthodox parish, and even 300 members of Annunciation breaking off, obtaining it, and starting a third congregation (O05 - pgs. 106-107).

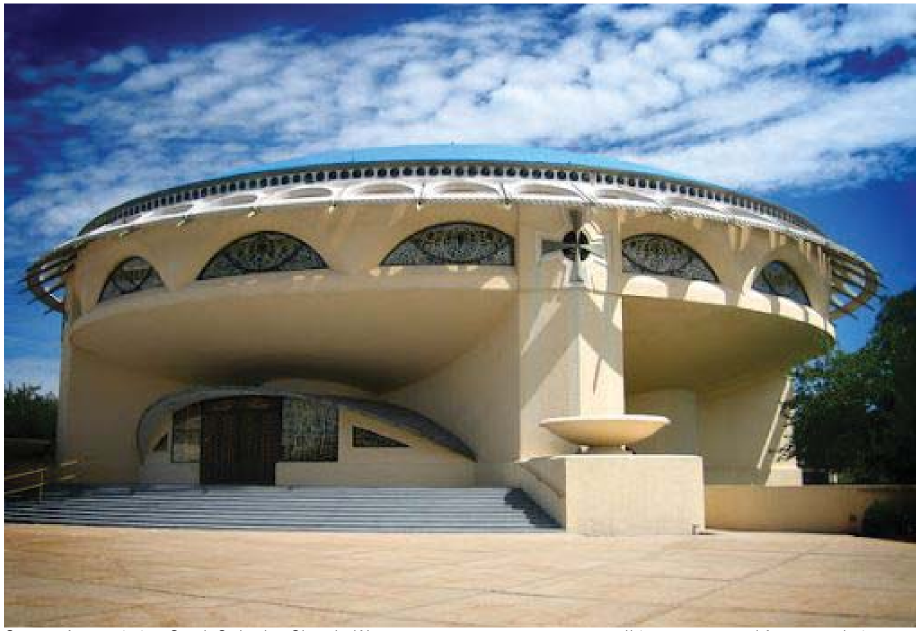
Eventually, through an overwhelming vote, the committee in charge of the old building decided to sell it (O05 - pgs. 107). The old Annunciation building was sold to a printing firm who demolished it to put in a surface parking lot in 1963 (O05 - pgs. 107). The pews and pulpit were sold to a parish from the inner-city and a Serbian Orthodox parish purchased an assortment of the furnishings, however, Annunciation kept the icons (O05 - pgs. 107).

One of the goals with the rehabilitation of Elevator E into a Greek Orthodox Church is to reestablish an Orthodox Church within the area of the Greek's original settlement area. As evident by the map on the opposite page, Elevator E lies roughly in-between all of the original areas of Greek settlement in Milwaukee. Elevator E may not only be a way to add new members to the Greek Orthodox faith, but also a way to help reunite the Orthodox Churches of Annunciation and Sts. Constantine and Helen.

From the twenties onward, various differences between the two churches developed and ultimately became differences with lasting effect (O05 - pgs. 30-40). Not to say that the churches appear as rivals, but more or less in a rough competition with the other on a social level. Uniting these churches together with a third church in the Menomonee Valley may help this churlishness to subside.

Current Sts. Constantine + Helen Greek Orthodox Church, Wauwatosa

The Old Annunciation Greek Orthodox Church, Milwaukee
O05 - pg. 64



Current Annunciation Greek Orthodox Church, Wauwatosa

all images sourced from google images
unless otherwise stated

to find Christ in all things

Introducing Orthodox Christianity

In order to first prove the feasibility of introducing an Orthodox Church into the fabric of Elevator E, a brief study of 10 existing Orthodox Churches throughout the world was conducted that measured approximate footprints and volumes. Utilizing a previous thesis project completed at UW-M: SARUP by Mr. Nathan Elliot (M.Arch 2009), 10 Orthodox Churches of various sizes, locations, and dates of construction were selected and reviewed for this study.
The churches selected are as follows:

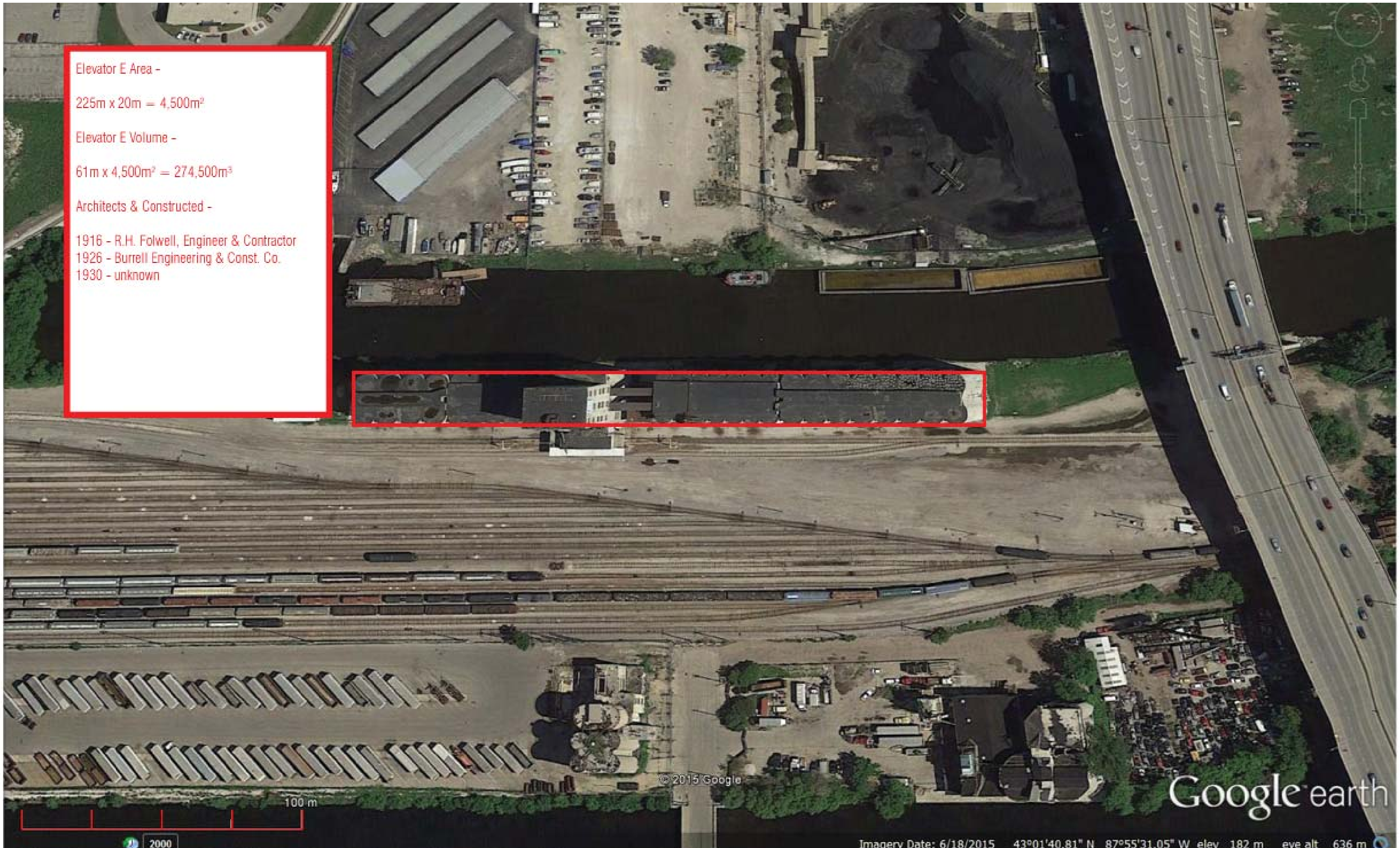
The study of Elevator E provided that the collective structures have an approximate area and volume of:

area: 4,500 m^2 volume: 274,500 m^3

The churches studied provided approximate values as shown below:

01 - *Annunciation* Greek Orthodox Church - Wauwatosa, WI	002, pg. F31	area: 1,110 m^2	volume: 16,650 m^3
02 - *Hagia Sophia* Greek Orthodox Church - Istanbul, Turkey	002, pg. F1	area: 5,986 m^2	volume: 329,230 m^3
03 - *Sts. Peter + Paul* Russian Orthodox Church - St. Petersburg, Russia	002, pg. F65	area: 1,250 m^2	volume: 25,000 m^3
04 - *Virgin of Ljevisa* Serbian Orthodox Church - Prizren, Kosovo	002, pg. F85	area: 250 m^2	volume: 2,500 m^3
05 - *San Vitale* Greek Orthodox/Roman Catholic Church - Ravenna, Italy	002, pg. F39	area: 900 m^2	volume: 18,000 m^3
06 - *St. Demetrius* Greek Orthodox Church - Thessaloniki, Greece	002, pg. F38	area: 1,800 m^2	volume: 54,000 m^3
07 - *St. George* Greek Orthodox Church - Montreal, Canada	002, pg. F36	area: 875 m^2	volume: 8,750 m^3
08 - *Holy Wisdom* Russian Orthodox Church - Kiev, Ukraine	002, pg. F12	area: 2,035 m^2	volume: 81,400 m^3
09 - *St. Symeon* Greek Orthodox Church - Kalat Siman, Syria	002, pg. F25	area: 4,500 m^2	volume: 112,500 m^3
10 - *Alexander Nevsky* Russian Orthodox Church, St. Petersburg, Russia	002, pg. F20	area: 2,100 m^2	volume: 84,000 m^3

As a result of this analysis it has been determined that most conventional churches fall short of the existing values for Elevator E, however, some churches do exceed, match, or come close to the values associated with the grain elevator. With the programmatic elements of a traditional church supplemented with additional elements that reinforce the worship space with community outreach and care facilities, as well as other functions, the massive size of Elevator E now seems appropriate.

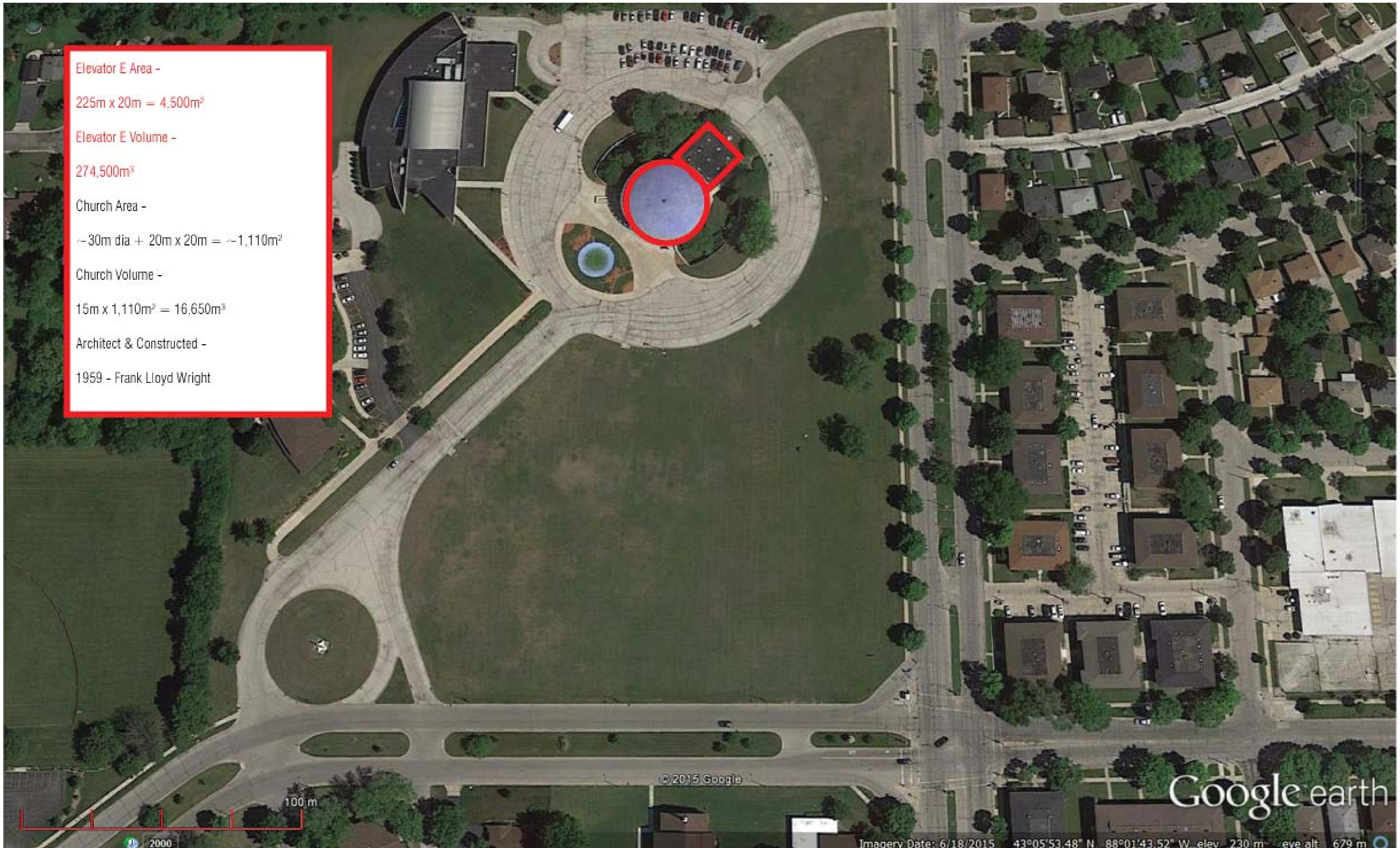


00 - Elevator E - Cargill Grain Elevator Complex - Milwaukee, WI

image sourced from google earth, edited post-capture

the metamorphosis

to find Christ in all things



01 - Annunciation - Greek Orthodox - Wauwatosa, WI

image sourced from google earth, edited post-capture

02 - Hagia Sophia - Greek Orthodox - Istanbul, Turkey

image sourced from google earth, edited post-capture

the metamorphosis

to find Christ in all things

03 - Sts. Peter + Paul - Russian Orthodox - St. Petersburg, Russia

image sourced from google earth, edited post-capture

04 - Virgin of Ljevisa - Serbian Orthodox - Prizren, Kosovo

image sourced from google earth, edited post-capture

the metamorphosis

to find Christ in all things

05 - San Vitale - Greek Orthodox/Roman Catholic - Ravenna, Italy

image sourced from google earth, edited post-capture

06 - St. Demetrius - Greek Orthodox - Thessaloniki, Greece

image sourced from google earth, edited post-capture

the metamorphosis

to find Christ in all things

07 - St. George - Greek Orthodox - Montreal, Canada

image sourced from google earth, edited post-capture

08 - Holy Wisdom - Russian Orthodox - Kiev, Ukraine

image sourced from google earth, edited post-capture

the metamorphosis

to find Christ in all things

09 - St. Symeon - Greek Orthodox - Kalat Siman, Syria

image sourced from google earth, edited post-capture

10 - Alexander Nevsky - Russian Orthodox - St. Petersburg, Russia

image sourced from google earth, edited post-capture

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T10 - Towards a New Architecture. (1986). New York, New York: Dover Publications.

additional references

(all sources unordered)

AR01 - Proof of Purchase + Reproduction Permission of Historic Photographs

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November 17, 2015

John Taylor Gorski

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Jennifer Pahl
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RECEIPT No. 870425
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FROM John Taylor Gorski $6.00
Six 00/100 DOLLARS
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AR04 - Original Plans + Documents of Elevator E
Acquired 12-21-2015 from current owner of facility, anonymous
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Documents consist of:
1916 Silos - Foundation, Tanks, + Gallery;
1926 Work House - Various Floors + Sections;
1926 Silos - Tanks + Gallery;
along with miscellaneous drawings and plans of facility.

AR05 - Proof of Purchase of Historic Drawings

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