CIV_ENV 385-3
ARCHITECTURAL ENGINEERING & DESIGN
Quarter - Spring 2023
Northwestern University - Tech L441
Tues/Thurs, 4pm-6pm

Professors:
Laurence O. Booth
lbooth@boothhansen.com
Mark Frisch
mark.frisch@scb.com
Scott Cyphers
scyphers@boothhansen.com

3/23/2023

The goal of this 2-year program of Design Studio/Seminars/Research is to give students a strong, comprehensive and broad understanding of architecture, design, and engineering in the context of our present world. The program will focus on integration of design + engineering, design methods, history, creative thinking, and research while requiring students to realize designs individually as well as working in teams. The program seeks to reinforce creative engineering for future engineers or lead to a Masters in Architecture at an Architecture Graduate Program.

1. History

A few informal history discussions will begin developing a value system by identifying and judging the best buildings that will help decision-making. History of architectural design will seek to develop methodologies and process for useful work approaches.

2. Urbanization

Using the development of Chicago infrastructure and architecture since 1850, students will gain an understanding of the forces at work in our environment.

3. Integrated Design Studio

Design exercises will require students to create buildings ranging from simple to complex; developing graphic and modeling skills, three dimensional representation, energy analysis, design thinking, structure, and mechanical concepts. Graphic and verbal presentations will be required.

4. Teamwork

The complexity of our modern world requires teams of professionals to work together to address building design. Students work in collaborative, exploratory environments in the second quarter followed by a third quarter team project for the design of a tall building.

5. Structural Engineering

Professors from Engineering will interact with the studio design work with engineering analysis and calculations of engineering aspects of the design solutions.

6. Building Information Modeling

Student Designs will be developed using 3D modeling program Rhino and REVIT (a BIM platform). Students will utilize advanced modeling techniques to study building form and optimize building massing.

7. Free-Hand Drawing

Students will develop their individual skills of free-hand drawing that will enable them to see, communicate, and to conceptualize. Students will execute several assignments in an iterative process that sharpens their design drawing communication.

8. Seminars/Lectures

Practicing professionals will present case studies of architectural, engineering, contracting, management, and development, that will provide the student with a foundation; for understanding the complexity of architectural practice; and a general appreciation of the modern design world.

9. Readings and Reports

Various reading assignments, group discussions and reports.

Northwestern Architecture Engineering & Design 385-3-20

Revised 2023.03.27.

SEMINAR / STUDIO APPROACH: APRIL 2023 - JUNE 2023

Quarter 3
Class Meets: Tu/Th 4:00pm – 5:50pm
Location: In class – Studio at Tech L441
Instructors: Larry Booth, Mark Sexton, Mark Frisch, and Scott Cyphers
Class Hours: 40 hrs. Lectures, Seminars, Critiques and Presentations
164 hrs. minimum student time

Date	Instructor	Course Topic	Requirements
Th 03/30	MS	Course Introduction Lecture: High-Rise Design	Introductions, review syllabus and discuss studio project Topic: Sexton lecture on high rise & office design considerations
Tu 04/04	Don Semple - KSP	Lecture: Rhino Software 3D Printer Hardware	Topic: Rhino training session with modeling techniques for tall buildings Review 3D Printing process
	Larry Booth - BH	Lecture: Design Thinking	Topic: "Team Thinking" - Compass Points (*Synopsis due 04/06)*
Th 04/06	Jay Longo - SCB	Lecture: US Dept Forestry Research Site Introduction	Topic: Timber Tower Design (*Synopsis due 04/011)* 400 N Elizabeth Site Orientation and Context Begin work on 3D Site Model (Rhino)
Tu 04/11	Susan A. Brown LB/MF/SC	Lecture: Studio Project Structures Critiques Full Class: Program + Site	Topic: Structures Project #1 assigned. Timber tower design considerations **Deliverables: Program and Site Concept Plans**
Th 04/13	LB/MF/SC	Critiques Full Class: Site Design	**Deliverables: Site Analysis & 3 Site Concepts**
Tu 04/18	Erik Olson - Transsolar LB/MF/SC	Lecture: Climate Engineering Critiques Groups: Program	Topic: Sustainability considerations in high rises *(Synopsis due 04/25)* **Deliverables: Program Stacking Plans & Building Section**
Th 04/20	LB/MF/SC	Critiques Groups: Building Shape	**Deliverables: 3D Rhino Massing - Foam or 3D Print**
Tu 04/25	LB/F/SC	Critiques Full Class: Plans & Structure	**Deliverables: Building Core Concepts w/ Stairs, Elevators and Shear Walls**
Th 04/27	Mark Sexton LB/MF/SC	Lecture: High Rise Elevators Critiques Groups: Elevation & Structure	Topic: Typical high rise elevator analysis calculations **Deliverables: Building Elevations, Rhino/Revit, Drawing Assignment #1 due**
Mn 05/01	Erik Olson - Transsolar	Lecture: NU McCormick Talk	Topic and Time: TBD (please try to attend)
Tu 05/02	LB/MF/SC	Critiques Groups: Plans w/ Elevators	**Deliverables: Typical Office Floor Plan w/ Core & Elevator Layouts**

Th 05/04	Scott Murin - SOM Susan A. Brown - NU	Lecture: Timber Structures	Topic: SOM research into timber structures *(Synopsis due on 05/09)* Structures project review (sign up for individual crits with Susan Alexis)
Tu 05/09	TBD - Lend Lease LB/MF/SC	Lecture: Timber Construction Process Critiques Full Class: Midterm Prep	Topic: Review of Timber Construction Projects in Midwest *(Synopsis due on 05/16)* **Deliverables: Massing, Elevations, Floor Plans & Structure**
Th 05/11	LB/MF/MS/SC	**Midterm Presentation**	**1. Site Plan with surrounding buildings, Metra, streets and context** **2. Plans of Ground Level and Typical Office Floors** **3. Minimum one full building section through elevators.** **4. Minimum three perspectives - Ground Level, Bird's eye view from Metra** **5. Structural plan with core and lateral systems** **6. 3D Axon of highlighting structural elements** **7. Physical model - Strathmore or 3D Print** **8. Drawing Assignment #2**
Tu 05/16	LB/SC	Group Book Discussion Critiques Full Class: Midterm download	Topic: Conversation about The Sense of Beauty by George Santayana Next steps in design development
Th 05/18	Tom Leslie - Iowa State	Lecture: History of Chicago High Rise II	Topic: Development of the 21st Century Chicago Tall Building *(Synopsis due on 05/23)*
Tu 05/23	LB/SC /MF	Critiques Groups: Bldg. Structure Coord.	**Deliverables: Building Structure Coordination with Floor Plan**
Th 06/25	LB/MF/SC	Critiques Groups: Bldg. Facade	**Deliverables: Exterior building envelope materials and detailing**
Tu 05/30	MF/SC	Critiques Groups: Bldg. Floor Plans	**Deliverables: Floor plan layouts for Office & Public Spaces**
Th 06/01	LB/MF/SC	Critiques Full Class: Final preparation	**Deliverables: Design progress for Final**
Tu 06/06		**Final Jury Presentation**	1. **Structures Project #2.** 2. The required drawings are similar to the Midterm. However, they should exhibit a much higher degree of quality - detail, color, shadows, materials, furniture etc. • **Site plan with surrounding buildings, Metra, streets and context** • **Floor plans detailing each specific floors, including furniture layouts** • **Minimum three exterior perspectives - Ground, Metra and Bird's eye** • **Minimum three interior perspectives – Lobby, Office, Public Spaces** • **Structural plan with core and lateral systems** • **3D Axonometric highlighting the structural elements** • **Physical model - 3D Print** 3. **Drawing Assignment #3** All drawings to fit 11 x 17 horizontal layout with graphic scale and north arrow. Verbal presentation to be 1-2 minutes and describe the main idea / concept.

PROJECT ASSIGNEMENTS

Individual Studio Design Project

- High Rise Tower: Office use
- Site: Chicago West Loop, 1310 West Kinzie , bordered by the Metra and West Kinzie Steet
- Program: 500,000 GSF. Lobby, Retail, BOH, 'Class A' Office, Roof Deck and other office amenities.
- Structure: Utilize mass timber with CLT.
- Building Height: Maximum 24 (TBD) stories
- Site: 400 N Elizabeth frontages on Ogden, West Kinzie St., N. Elizabeth St.
- Teams: Students will work together in teams of two or three
- *PROJECT GOALS: Design Thinking and Synthesizing, Critical Judgment, Graphic Skills, Digital and Spatial Visualization, Decision Makin & Teamwork*

Freehand Drawing Assignment - Building Exterior Perspectives

- Study your building's exterior massing, envelope and details through freehand drawings
- Perspective drawings should focus on materiality, light, shadow, texture and mood
- Drawings should be hand drawn at various scales on 11"x17" paper
- *PROJECT GOALS: Seeing and Communicating Materiality and Detail*

3D Modeling

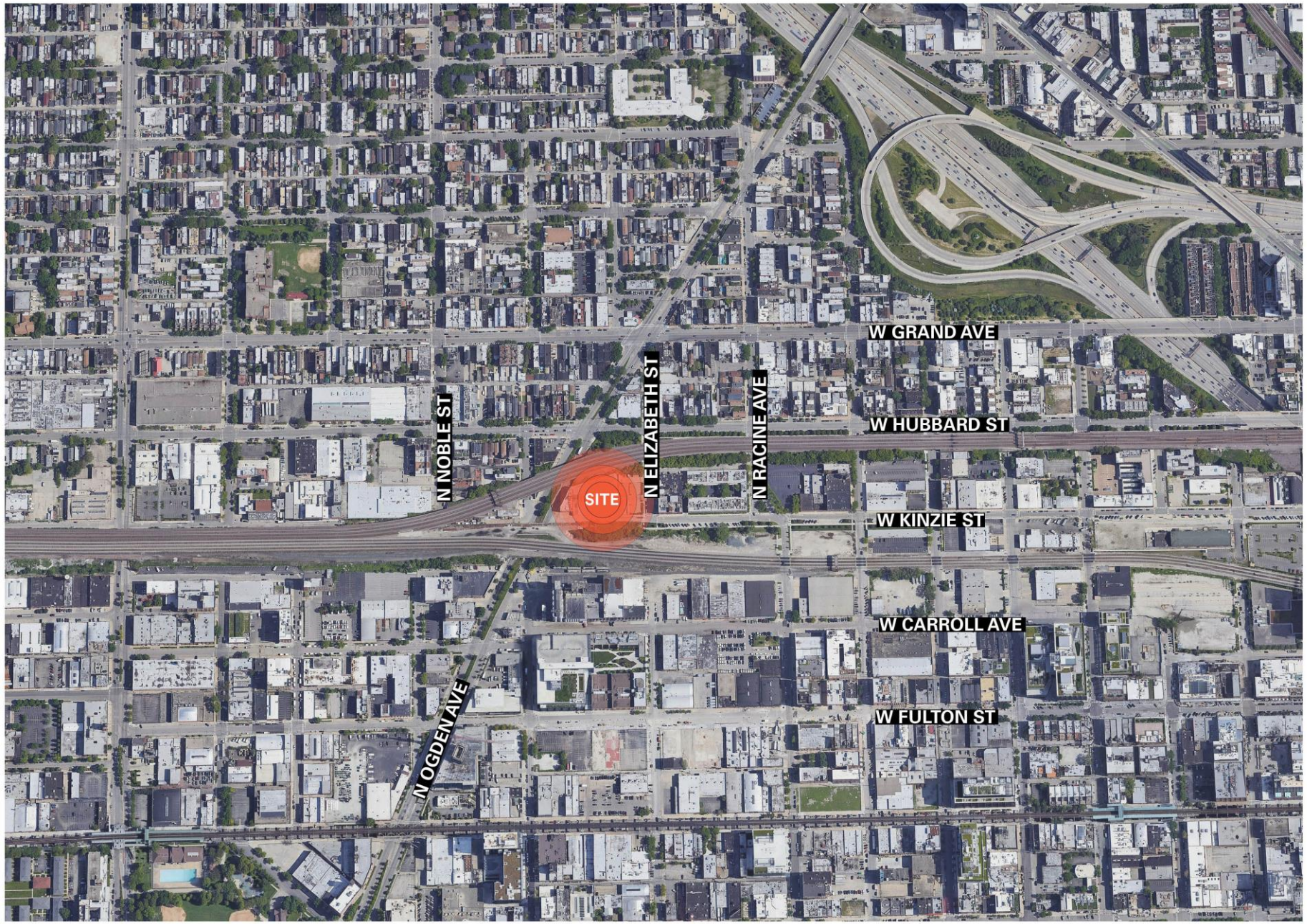
- Students will work with the Rhinoceros and Revit software to assist in building modeling and design
- *PROJECT GOALS: Advanced Digital Technologies to Aid Form Making*

Structural Engineering Assignment

- Two assignments focusing on the development of the structural system
- Students interact with Engineering Faculty, Susan Alexis Brown
- Complete engineering analysis and calculations
- *PROJECT GOALS: Quantitative analysis and Integrating Design + Engineering*

Reports and Readings

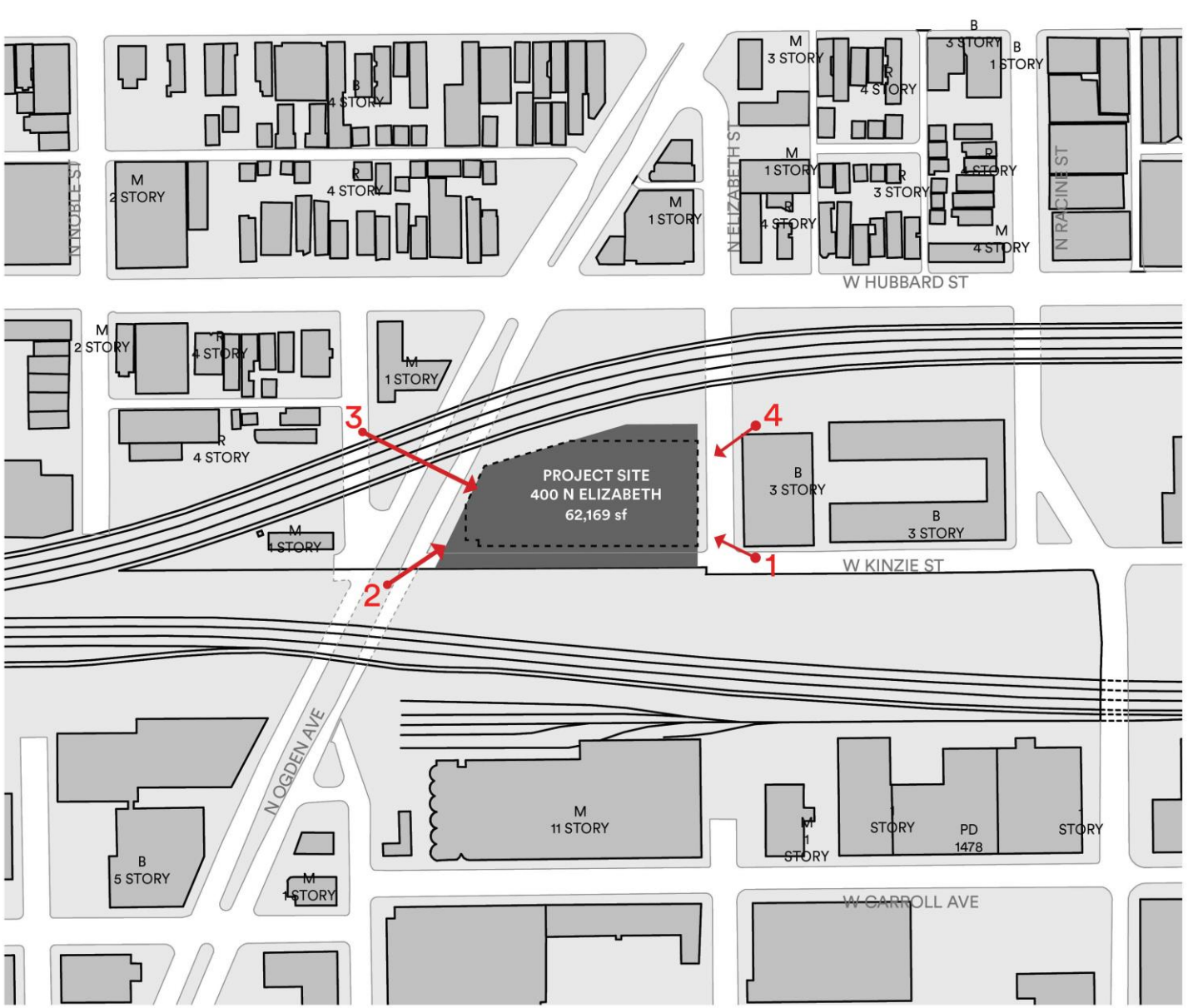
- Visitor Lectures - One Page Synopsis
- One Page Report and in Class Discussion about The Sense of Beauty by George Santayana
- *PROJECT GOALS: Listening, Understanding and Communicating*



NOT TO SCALE

N

SITE LOCATION + CONTEXT



1

2

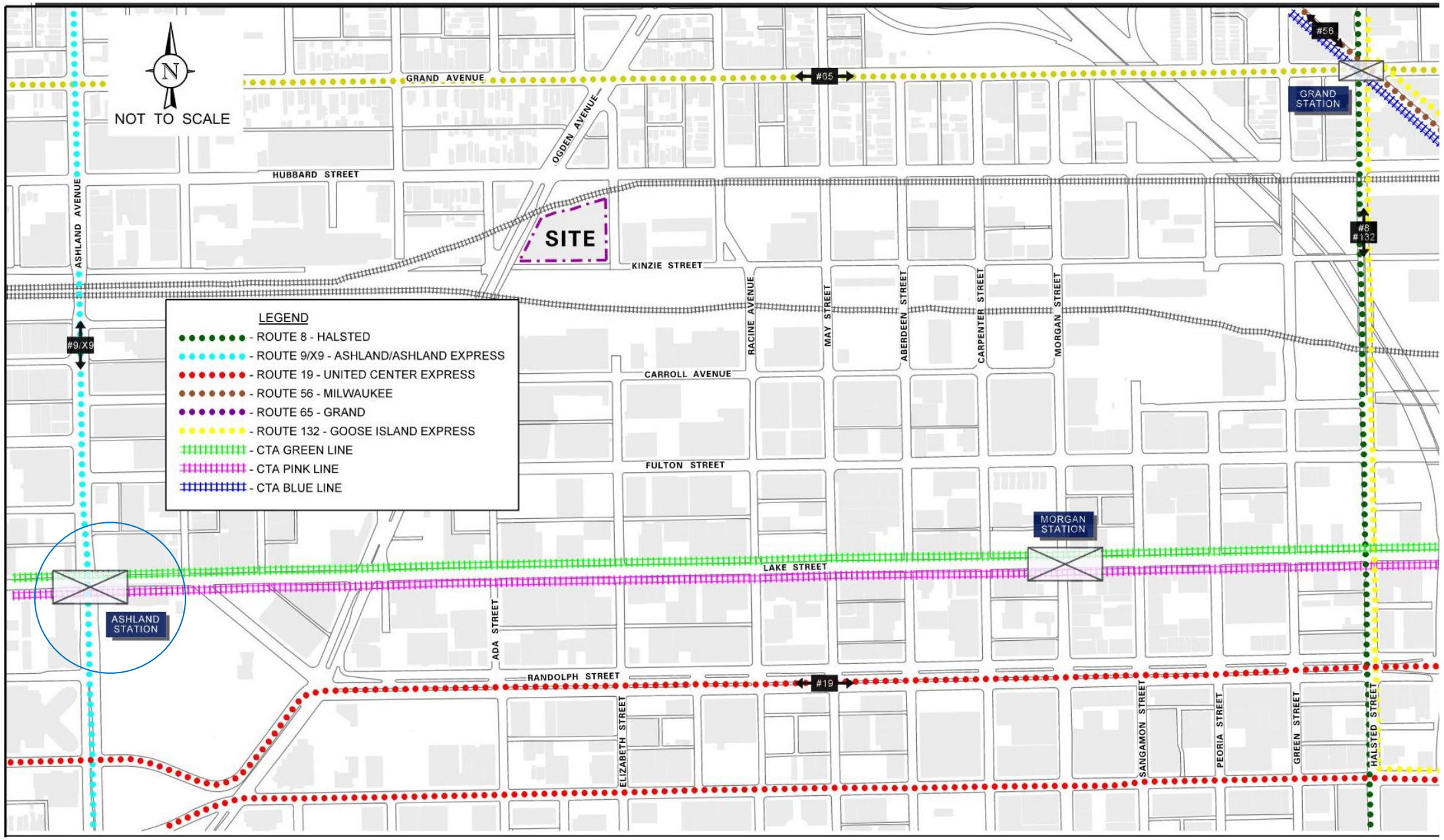
3

4

NOT TO SCALE

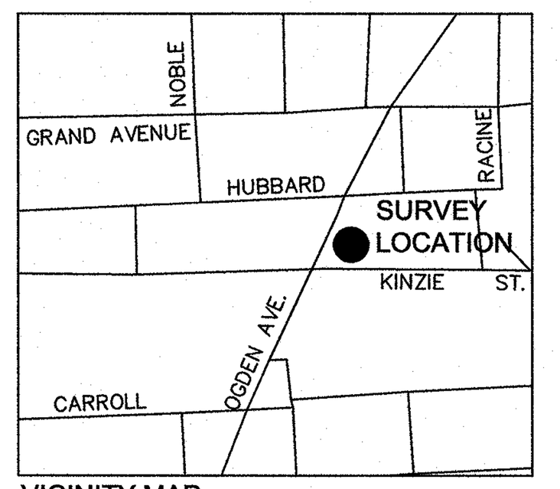
N

EXISTING LAND USE PLAN



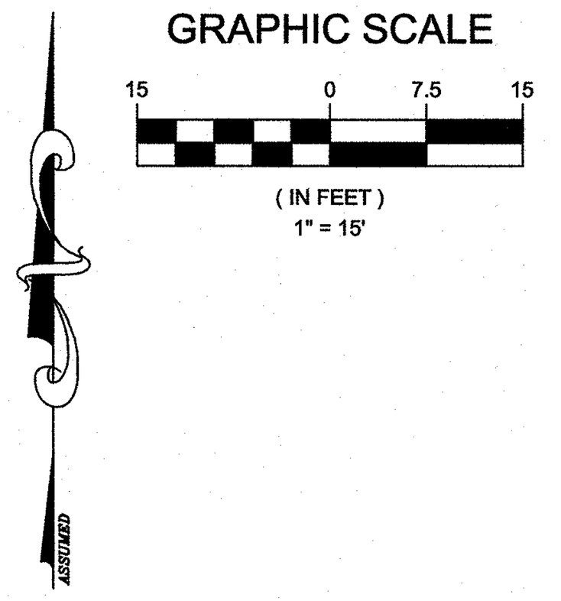
STREETS, TRANSIT, AND STATIONS

AERIAL VIEW LOOKING EAST



VICINITY MAP

GRAPHIC SCALE



GREMLEY & BIEDERMANN

A DIVISION OF
PLCS Corporation
LICENSE NO. 184-005322
PROFESSIONAL LAND SURVEYORS
4505 NORTH ELSTON AVENUE, CHICAGO, IL 60630
TELEPHONE: (773) 685-5102 FAX: (773) 286-4184 EMAIL: INFO@PLCS-SURVEY.COM

ALTA/NSPS Land Title Survey

PARCEL 1:
THAT PART OF BLOCK 7 IN GEORGE S. ROBBINS SUBDIVISION OF BLOCKS 6 AND 7 IN THE ASSESSOR'S DIVISION OF THE EAST 1/2 OF THE NORTHWEST 1/4 OF SECTION 8, TOWNSHIP 39 NORTH, RANGE 14 EAST OF THE THIRD PRINCIPAL MERIDIAN, IN COOK COUNTY, ILLINOIS, BOUNDED AS FOLLOWS: ON THE SOUTH BY THE NORTH LINE OF KINZIE STREET, ON THE WEST BY THE SOUTHEASTERLY LINE OF OGDEN AVENUE AS NOW ESTABLISHED, ON THE EAST BY THE EAST LINE OF LOT 59 IN BLOCK 7 OF GEORGE S. ROBBINS SUBDIVISION AFORESAID AND ON THE NORTH BY A STRAIT LINE DESCRIBED AS: BEGINNING AT A POINT IN THE EAST LINE OF LOT 59 AFORESAID, 176.40 FEET NORTH OF THE SOUTHEAST CORNER OF SAID LOT RUNNING WESTERLY TO A POINT IN THE EASTERLY LINE OF OGDEN AVENUE 131 FEET NORTHERLY FROM ITS INTERSECTION WITH THE NORTH LINE OF KINZIE STREET.

PARCEL 2:
LOTS 43 TO 49, BOTH INCLUSIVE, IN BLOCK 1 IN HAMBLETON SUBDIVISION OF LOT "E" CIRCUIT COURT PARTITION IN THE EAST 1/2 OF THE NORTHWEST 1/4 OF SECTION 8, TOWNSHIP 39 NORTH, RANGE 14 EAST OF THE THIRD PRINCIPAL MERIDIAN, IN COOK COUNTY, ILLINOIS.

PARCEL 3:
ALL THAT PART OF WEST KINZIE STREET LYING SOUTH AND ADJOINING PARCELS 1 AND 2 ABOVE, AS VACATED BY ORDINANCE RECORDED NOVEMBER 28, 2017 AS DOCUMENT 1733234090 AND PLAT OF VACATION RECORDED NOVEMBER 28, 2017 AS DOCUMENT 1733234091, IN COOK COUNTY, ILLINOIS.

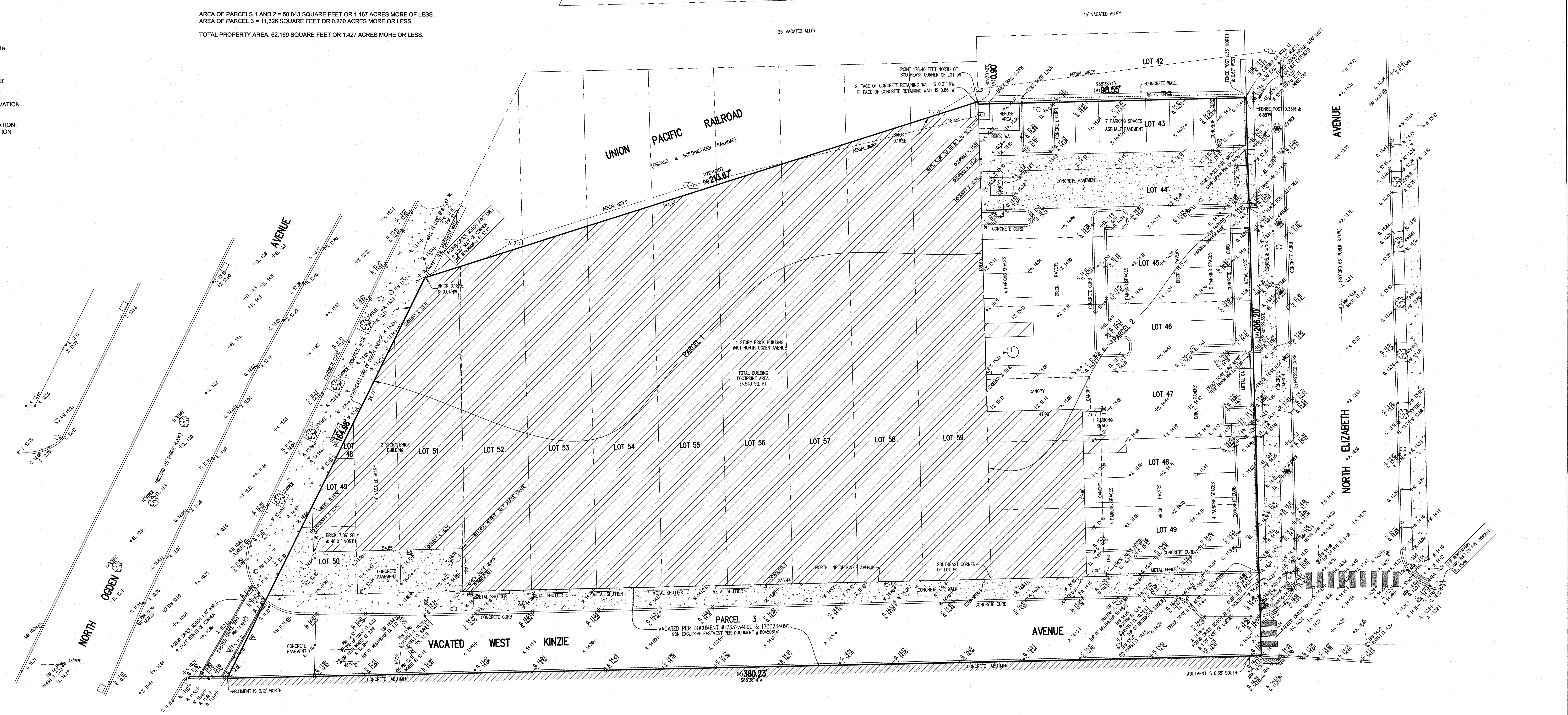
AREA OF PARCELS 1 AND 2 = 50,843 SQUARE FEET OR 1.167 ACRES MORE OF LESS.
AREA OF PARCEL 3 = 11,326 SQUARE FEET OR 0.260 ACRES MORE OR LESS.

TOTAL PROPERTY AREA: 62,169 SQUARE FEET OR 1.427 ACRES MORE OR LESS.

LEGEND

- Storm CB
- San Storm Combo MH
- San Clean Out
- Water MH
- Water Buffalo Box
- Water Fire Hydrant
- Telephone MH
- Utility Pole
- Electric MH
- Electric Light Pole
- Gas Buffalo Box
- Gas Meter
- Gas Valve
- Tree — Deciduous
- Tree — Evergreen
- Sign Post
- Unclassified Manhole
- Auto Sprinkler
- Hose Connection
- Cut Cross
- JULIE Mark — Water

A.=ASPHALT ELEVATION
GR.=GRAVEL ELEVATION
FFE.=FINISHED FLOOR ELEVATION
W.=WALK ELEVATION
X.=CONCRETE ELEVATION
TOE.=TOP OF SLOPE ELEVATION
TOB.=TOP OF BANK ELEVATION
C.=CURB ELEVATION
G.=GUTTER ELEVATION
EL.=ELEVATION



REVISED AREAS MAY 24, 2021

REVIEWED WITH TITLE AND REVISED MAY 24, 2021
PER ORDER #2021-28899 [RL]

ADDITIONAL WORK ADDED MAY 20, 2021 [RL]

ORDERED BY:	MARK GOODMAN & ASSOCIATES, INC.	CHECKED: LB	DRAWN: AJM/RL
ADDRESS:	401 NORTH OGDEN AVENUE		

GREMLEY & BIEDERMANN
A DIVISION OF
PLCS, CORPORATION
LICENSE NO. 184-005322
PROFESSIONAL LAND SURVEYORS
4505 NORTH ELSTON AVENUE, CHICAGO, IL 60630
TELEPHONE: (773) 685-5102 FAX: (773) 286-4184 EMAIL: INFO@PLCS-SURVEY.COM

ORDER NO.	DATE: APRIL 28, 2021	PAGE NO.
2021-28768-001	SCALE: 1 INCH = 15 FEET	1 OF 1

G:\CAD\2021\2021-28768\2021-28768-001.dwg

SURVEY NOTES:

SURVEYOR'S LICENSE EXPIRES November 30, 2022

Note (R&M) denotes Record and Measured distances respectively.

Distances are marked in feet and decimal parts thereof. Compare all points BEFORE building by same and at once report any differences BEFORE damage is done.

For easements, building lines and other restrictions not shown on survey plat refer to your abstract, deed, contract, title policy and local building line regulations.

NO dimensions shall be assumed by scale measurement upon this plat.

Unless otherwise noted hereon the Bearing Basis, Elevation Datum and Coordinate Datum if used is ASSUMED.

SURVEY NOTES:
PRIMARY BENCHMARK:
CITY OF CHICAGO STANDARD BENCHMARK #588
ELEVATION= 15.815
5.0 FEET NORTH OF THE NORTH LINE OF W WASHINGTON BOULEVARD
(PRODUCED EAST)
50.0 FEET EAST OF THE EAST LINE OF N ASHLAND BOULEVARD

SECONDARY BENCHMARK:
CITY OF CHICAGO STANDARD BENCHMARK #322
ELEVATION= 21.645
11.2' SOUTH OF NORTH LINE OF RICE STREET
36' WEST OF WEST LINE OF FIRST ALLEY EAST OF NORTH WESTERN AVENUE

UTILITY WARNING

The underground utilities shown have been located from field survey information and existing drawings. The surveyor makes NO guarantee that the underground utilities shown comprise all such utilities in the area, either in service or abandoned. The surveyor further does not warrant that the underground utilities shown are in the exact location indicated although he does certify that they are located as accurately as possible from information available. The surveyor has not physically located the underground utilities.

Call DIGGER - (312) 744-7000 within the City of Chicago.

Outside of the City of Chicago call J.U.L.I.E. (800) 892-0123 prior to construction or excavation.

SURVEY NOTE:
THIS SURVEY WAS PREPARED BASED ON NEAR NORTH NATIONAL TITLE
COMMITMENT NUMBER: IL2016325
COMMITMENT DATE: OCTOBER 21, 2020 AS TO MATTERS OF RECORD.

ITEMS LISTED IN SCHEDULE B:

15. NON-EXCLUSIVE ACCESS EASEMENT RECORDED FEBRUARY 14, 2018 AS DOCUMENT NO. 1804506141 IN FAVOR OF UNION PACIFIC RAILROAD COMPANY, A DELAWARE CORPORATION, TO REPAIR, REPLACE, MAINTAIN AND RECONSTRUCT A WALL, OVER, UNDER, ACROSS AND UPON THAT PART OF THE LAND AS IDENTIFIED ON EXHIBIT "B" THEREIN. [PLOTTED]

16. RIGHTS OF UTILITY COMPANIES TO MAINTAIN THEIR AERIAL WIRES LOCATED ALONG THE NORTHERLY PORTION OF THE PREMISES, AS SET OUT ON THE PLAT OF SURVEY MADE BY GREMLEY & BIEDERMANN LAST REVISED DECEMBER 11, 2014, JOB NO. 2014-20051-001.

17. ENCROACHMENT OF WALL LOCATED MAINLY ON THE LAND ONTO PROPERTY NORTH AND ADJOINING BY APPROXIMATELY 0.52 FEET, ONTO THE PROPERTY EAST AND ADJOINING BY BY APPROXIMATELY 0.18 FEET AND 0.30 FEET, AND ONTO PROPERTY NORTHWESTERLY AND ADJOINING BY 0.31 FEET, AS SET FORTH ON PLAT OF SURVEY MADE BY GRIMLEY & BIEDERMANN LAST REVISED DECEMBER 11, 2014, JOB NO. 2014-20051-001.

18. ENCROACHMENT OF BUILDING LOCATED MAINLY ON THE LAND ONTO PROPERTY NORTHWESTERLY AND ADJOINING BY 0.04 FEET, AS SET FORTH ON PLAT OF SURVEY MADE BY GREMLEY & BIEDERMANN LAST REVISED DECEMBER 11, 2014, JOB NO. 2014-20051-001.

19. ENCROACHMENT OF BUILDING, METAL SHUTTERS AND DOWNSPOUTS LOCATED MAINLY ON THE LAND ONTO THE PROPERTY SOUTH AND ADJOINING BY VARYING DISTANCES, AS SET FORTH ON PLAT OF SURVEY MADE BY GREMLEY & BIEDERMANN LAST REVISED DECEMBER 11, 2014, JOB NO. 2014-20051-001.

20. RIGHTS OF THE MUNICIPALITY, STATE OF ILLINOIS, THE PUBLIC AND ADJOINING OWNERS IN AND TO SAID VACATED STREET AND ALLEY.

21. RIGHTS OF PUBLIC OR QUASI-PUBLIC UTILITIES, IF ANY, IN SAID VACATED STREET AND ALLEY FOR MAINTENANCE THEREIN OF EXISTING UTILITY FACILITIES.

ALL REMAINING ITEMS ARE NOT A MATTER OF SURVEY.

SURVEY NOTES:

PROPERTY ADDRESS: 400 N. ELIZABETH STREET, CHICAGO, ILLINOIS 60642
AND 401 N. OGDEN AVENUE, CHICAGO, ILLINOIS 60642

PROPERTY APPEARS IN "OTHER AREAS" ZONE X, AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOODPLAIN, PER FLOOD INSURANCE RATE MAP COOK COUNTY, ILLINOIS, MAP NO. 17031C0418J, EFFECTIVE DATE AUGUST 19, 2008.

REGARDING TABLE A ITEM 16 THERE IS NO OBSERVED EVIDENCE OF RECENT EARTH MOVING WORK, BUILDING CONSTRUCTION, OR BUILDING ADDITIONS.

REGARDING TABLE A ITEM 18 THERE ARE NO OFF-SITE EASEMENTS INDICATED IN PROVIDED TITLE COMMITMENT.

PARKING SUMMARY:

27 STRIPED REGULAR PARKING SPACES
1 STRIPED HANDICAPPED PARKING SPACE

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2021 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 1, 2, 3, 4, 7(A), 7(B)(1), 7(C), 8, 9, 13, 14, 16, 18 AND 19 OF TABLE A THEREOF.

THE FIELD WORK WAS COMPLETED ON APRIL 28, 2021.

DATE OF PLAT MAY 24, 2021.

BY:

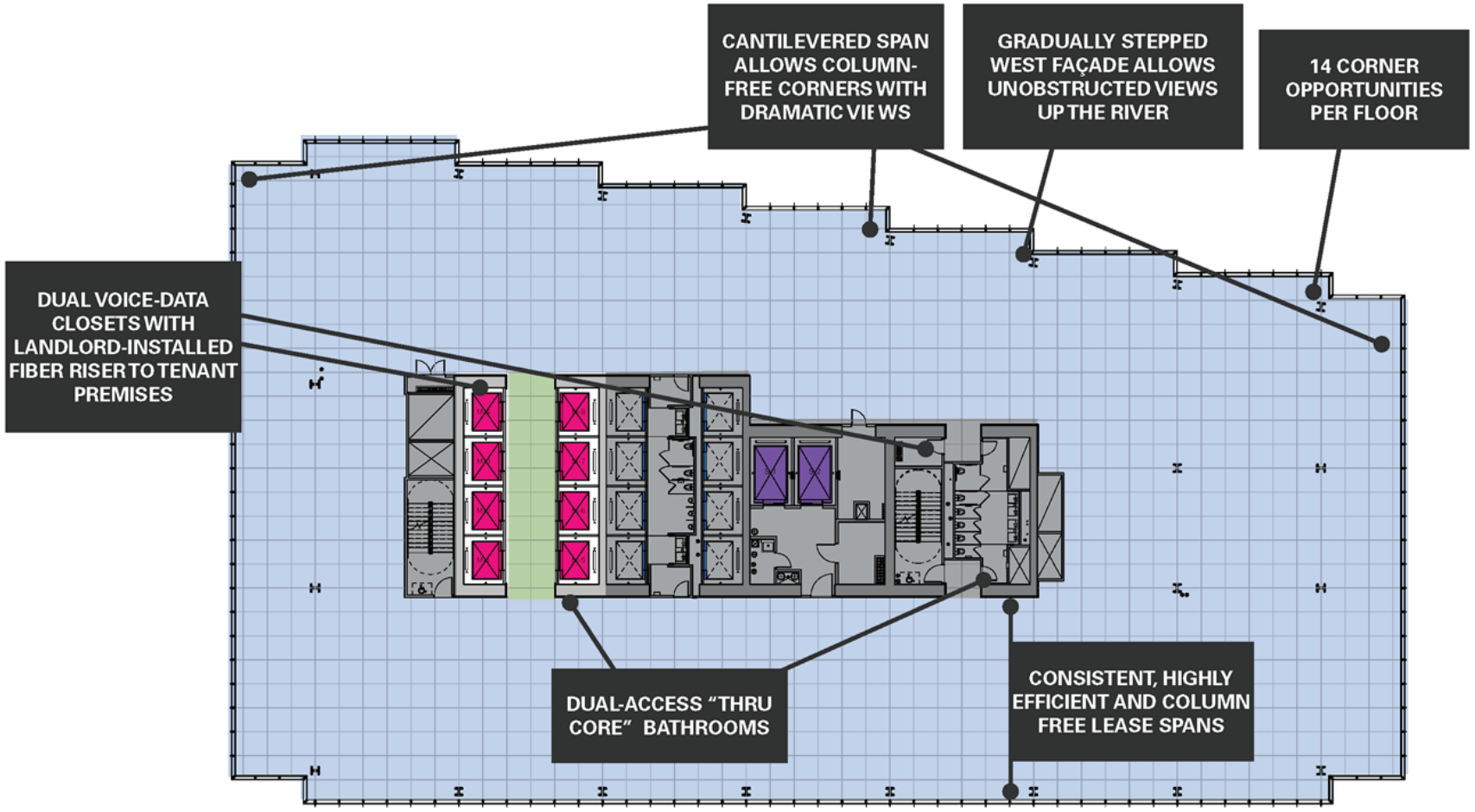
ROBERT G. BIEDERMANN
PROFESSIONAL ILLINOIS LAND SURVEYOR NO. 2802

ROBERT G. BIEDERMANN 2802 PROFESSIONAL LAND SURVEYOR STATE OF ILLINOIS CHICAGO, ILLINOIS

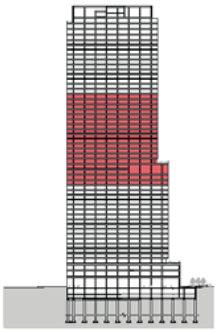
TYPICAL - MID-RISE PLAN (29,000 RSF)

FINISHED CEILING HEIGHT OF "9'6" ON TYPICAL FLOORS (WITH 10'3" OPPORTUNITY FOR THE MAJORITY OF THE FLOOR); SELECT FLOORS OF 12' FINISHED CEILING HEIGHT

NORTH WACKER DRIVE



30 FT COLUMN GRID + 5 FT PLANNING MODULE



OPEN CONCEPT – MIXED BENCHING & CUBICLES

PROVEN EFFICIENCY - MID-RISE PLAN

NORTH WACKER DRIVE

SPACE	SEATS
PRIVATE OFFICE	16
BENCHING	204
CUBICLE	52
CONFERENCE	12
"WE" SPACE	16
TOTAL RSF / EMPLOYEE	101

FLOORED

3.0 System Organization and Examples

3.1 System Development

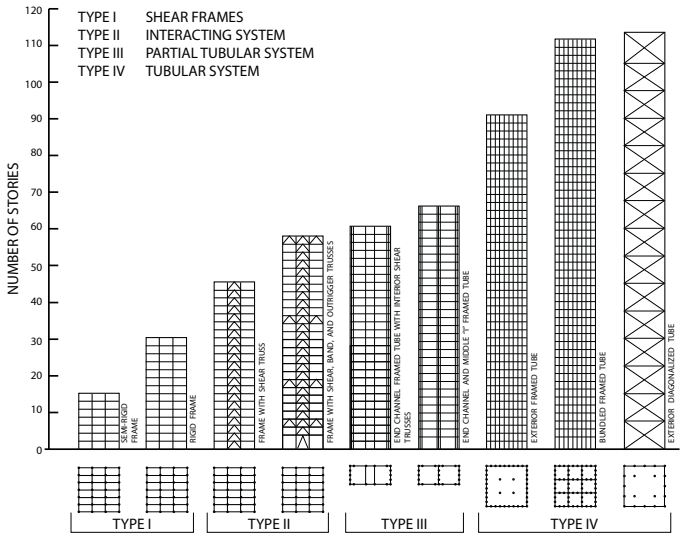
As core-and-outrigger systems were developed in the 1980s and 1990s, it became clear that core stiffness was critical to successful outrigger systems. While cores can be steel braced frames or concrete shear walls, concrete provides stiffness economically while providing fire-rated separations. In contrast, steel core columns sized for stiffness can grow large enough to adversely affect space planning where they protrude into corridors and elevator hoistways. Large central cores encompassing elevator shafts and stair wells, combined with the development of higher strength concretes and high-rise forming and pumping technologies, have led to concrete as the dominant choice for core structures in very tall towers employing outriggers today. Another widely-used approach is composite construction, with continuous steel columns embedded within concrete columns and sometimes in core walls as well. Composite construction will typically be more expensive than conventional reinforced concrete construction, but offers benefits that include smaller plan dimensions of columns and walls, reduced creep and shrinkage, direct, reliable steel-to-steel load paths at connections, and the means to distribute forces into concrete encasement gradually rather than all at once at the connection.

For supertall towers using outrigger systems without a complete perimeter moment frame, a large core size is critical to provide great building torsional stiffness since the exterior frame contributes relatively little. Wind tunnel testing and monitoring of actual occupied tall buildings has confirmed that torsional motions have potential for being the most perceived by building occupants, so torsional stiffness for motion control can be important.

Horizontal framing is also a consideration in outrigger systems, as outrigger truss chords that are deeper and heavier than typical floor framing can affect headroom below and may lead to non-typical story heights to compensate for such conditions.

Core-and-outrigger systems can generally be categorized based on their structural material. Examples of various system assemblies in the following section highlight the ways the core-and-outrigger system has been adapted to a wide variety of building types and architectural design concepts, including some of the tallest towers in the world, both constructed and proposed.

As core-and-outrigger systems were developed in the 1980s and 1990s, it became clear that core stiffness was critical to successful outrigger systems.



▲ Figure 3.1: Structural systems comparison table from the 1970s © CTBUH

Collaborative Research: Enabling Innovation in Sustainable Structural Building Systems Through Multiscale Modeling and Experimentation of Mass Timber

Overview.
Interest in engineered wood composites in architecture and structural engineering is at a new high due to the convergence of several factors. First, wood-based composites are among the most sustainably produced building materials thanks to the low energy content relative to structural properties. They are the very essence of a green material. Second, new innovations in wood product development have opened up new opportunities for structural applications. Cross laminated timber (CLT), often referred to as mass timber, has proven to be a viable alternative for structural applications previously only open to steel and concrete. Furthermore, innovations in mass timber modular building systems provide architects and engineers with building blocks for extremely creative, esthetically appealing and structurally efficient solutions. Despite the vigorous interest, there are still many barriers slowing innovation and adaptation. Some barriers are professional, such as building code acceptance, but others are technical, including but not limited to, our current inability to adequately predict the mechanical properties of complex, hierarchical material systems such as wood and wood composites, thus forcing a reliance on simplistic empirical relationships and high factors of safety.

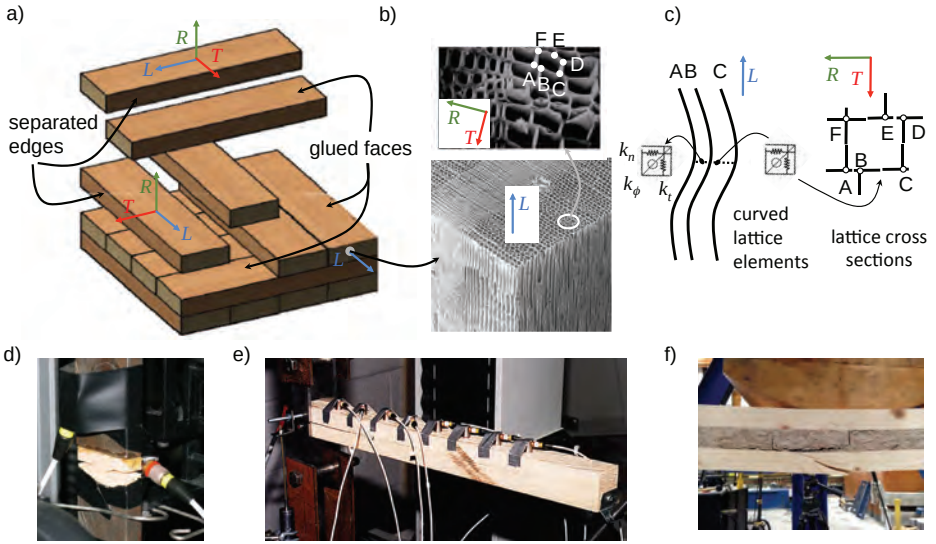
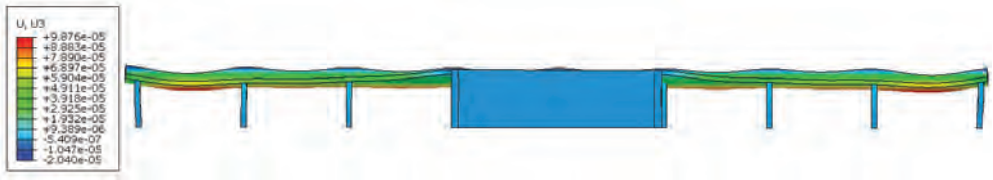
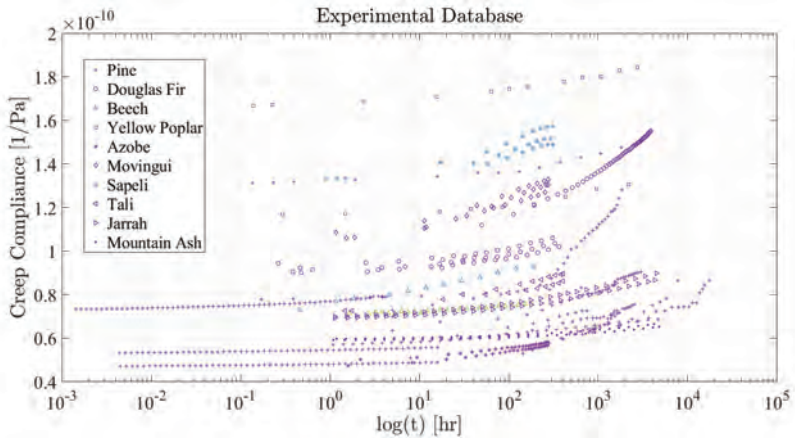
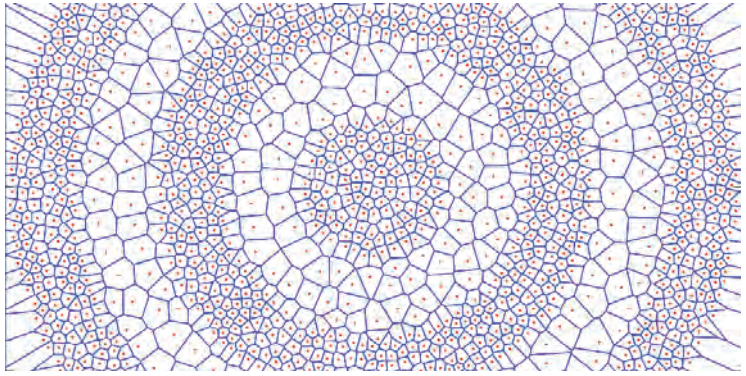
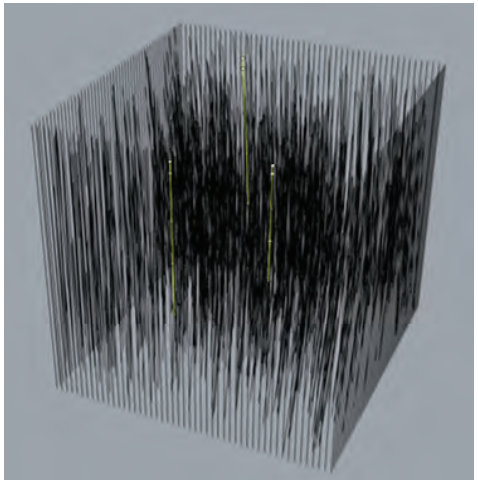


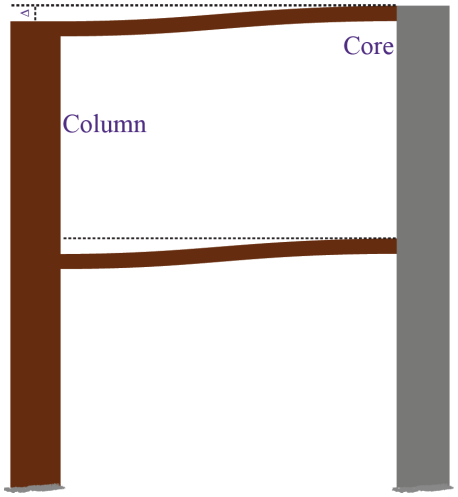
Figure 1: a) Simplified CLT structure; b) Cellular structure of wood; c) Isogeometric Lattice (IL) model schematics; d) Meso-scale experiments; e) Laboratory-sample scale experiments; f) Structural-scale experiments.











WoodWorks™
WOOD PRODUCTS COUNCIL

Tall Wood Buildings in the 2021 IBC
Up to 18 Stories of Mass Timber

Scott Breneman, PhD, SE, WoodWorks – Wood Products Council • Matt Timmers, SE, John A. Martin & Associates • Dennis Richardson, PE, CBO, CASp, American Wood Council

In January 2019, the International Code Council (ICC) approved a set of proposals to allow tall wood buildings as part of the 2021 International Building Code (IBC). Based on these proposals, the 2021 IBC will include three new construction types—Type IV-A, IV-B and IV-C—allowing the use of mass timber or noncombustible materials. These new types are based on the previous Heavy Timber construction type (renamed Type IV-HT) but with additional fire-resistance ratings and levels of required noncombustible protection. The code will include provisions for up to 18 stories of Type IV-A construction for Business and Residential Occupancies.

Based on information first published in the Structural Engineers Association of California (SEAOC) 2018 Conference Proceedings, this paper summarizes the background to these proposals, technical research that supported their adoption, and resulting changes to the IBC and product-specific standards.

Carbon12
Portland, Oregon I Eight stories of mass timber
Kaiser Group and Path Architecture
Munzing Structural Engineering

Photo: Andrew Pogue

Background: ICC Tall Wood Building Ad Hoc Committee

Over the past 10 years, there has been a growing interest in tall buildings constructed from mass timber materials (Breneman 2013, Timmers 2015). Around the world there are now dozens of timber buildings constructed above eight stories tall. Some international examples include:

Building Name	Location	Stories	Completion Date
Stadhaus at Murray Grove	London, UK	8-over-1	2008
Forté	Melbourne, Australia	8-over-1	2012
Via Cenni	Milan, Italy	9	2013
Treet	Bergen, Norway	14	2015
UBC Brock Commons	Vancouver, Canada	18	2016
Mjøstårnet	Norway	18	2019
HoHo Wien	Vienna, Austria	24	2019

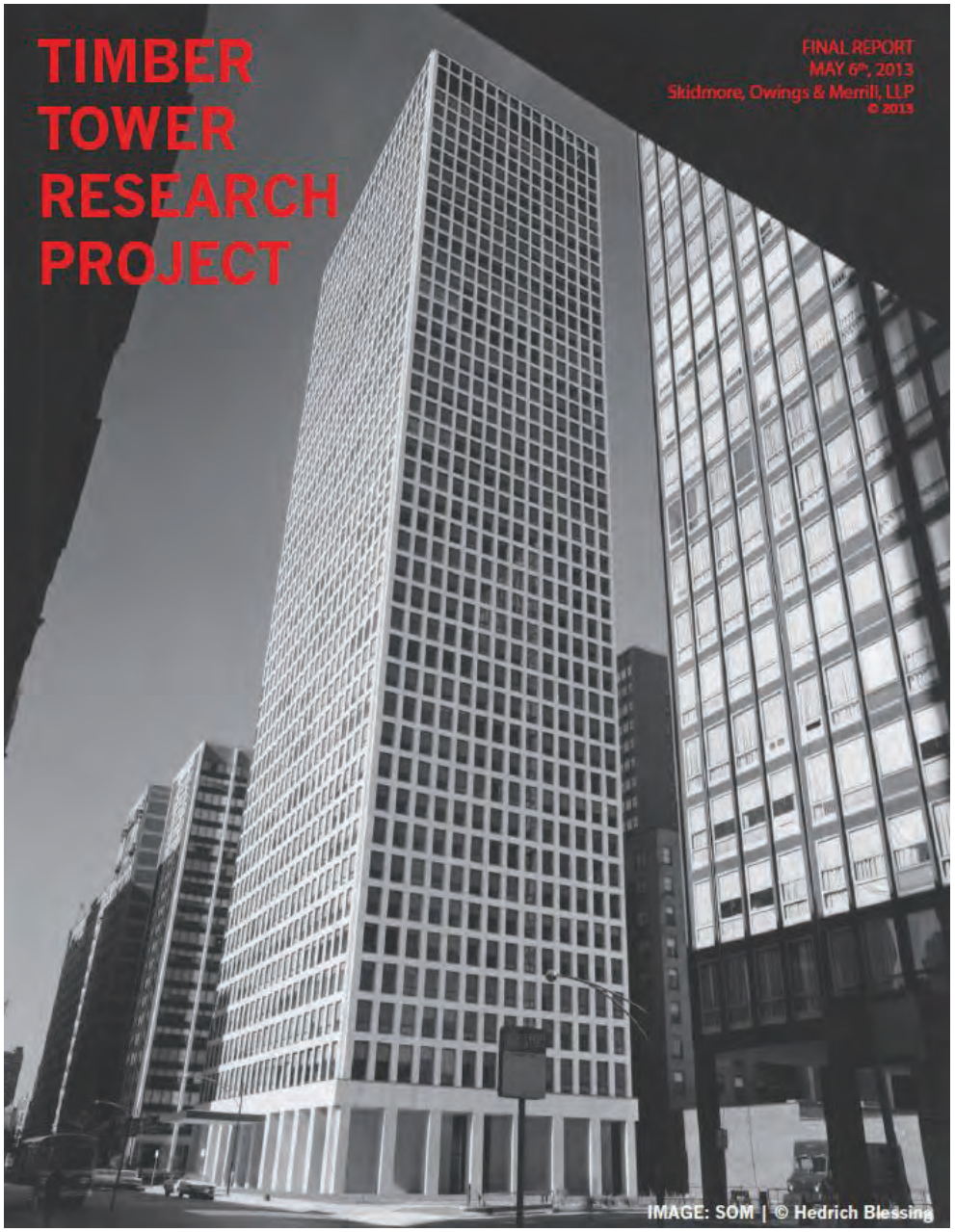
TREET - NORWAY

FORTE - AUSTRALIA

BROCK COMMONS - VANCOUVER

MJØSTÅRNET - NORWAY

BROCK COMMONS - DETAIL


TIMBER
TOWER
RESEARCH
PROJECT
FINAL REPORT
MAY 6th, 2013
Skidmore, Owings & Merrill, LLP
© 2013
IMAGE: SOM | © Hedrich Blessing


Timber Tower Research Project
Physical Testing Report #1
Composite Timber Floor Testing at
Oregon State University
Final Report
December 4th, 2017
© Skidmore, Owings, and Merrill, LLP 2017
224 S. Michigan Avenue Suite 1000
Chicago, IL 60604

OAKWOOD TOWER - LONDON

TREE HOUSE - ROTTERDAM

RIVER BEECH TOWER - CHICAGO

RAINBOW TREE - PHILIPPINES

HAUT TOWER - AMSTERDAM