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Chicago Lakefront Trail at Navy Pier and Chicago River

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Manager of Movable Bridges at WSP

Presented at
2020 NATIONAL AAAEA VIRTUAL CONFERENCE
November 14, 2020





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AGENDA

- Phase I – Segment I & II (North of the Chicago River)
- Peer Review of Phase II – Segment I & II
- Conceptual – Segment III (Over Chicago River)
- Phase I – Segment III
- Phase II – Segment III
- Phase III – Segment III Construction Status

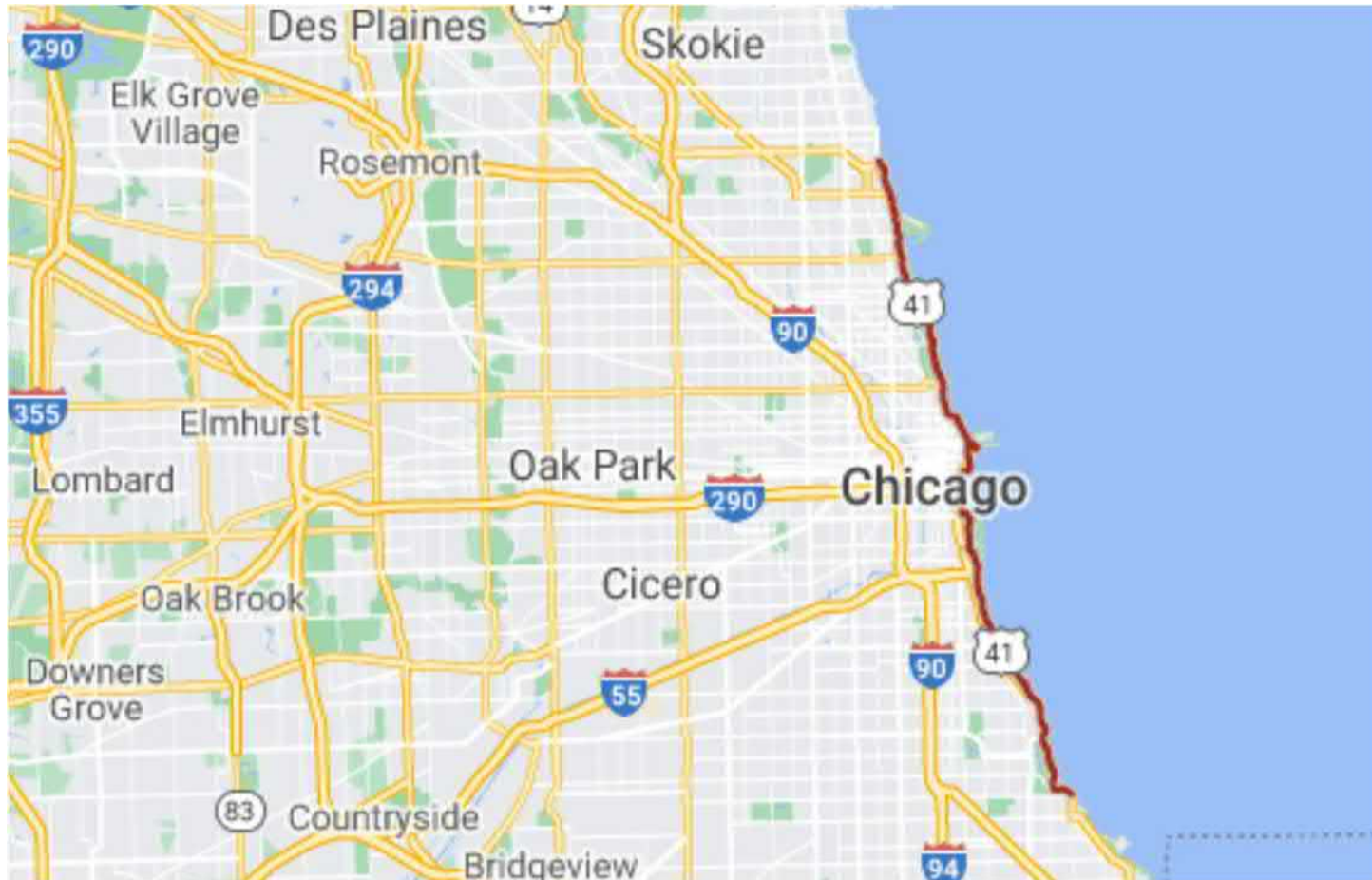




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PROJECT LOCATION





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PROJECT LOCATION

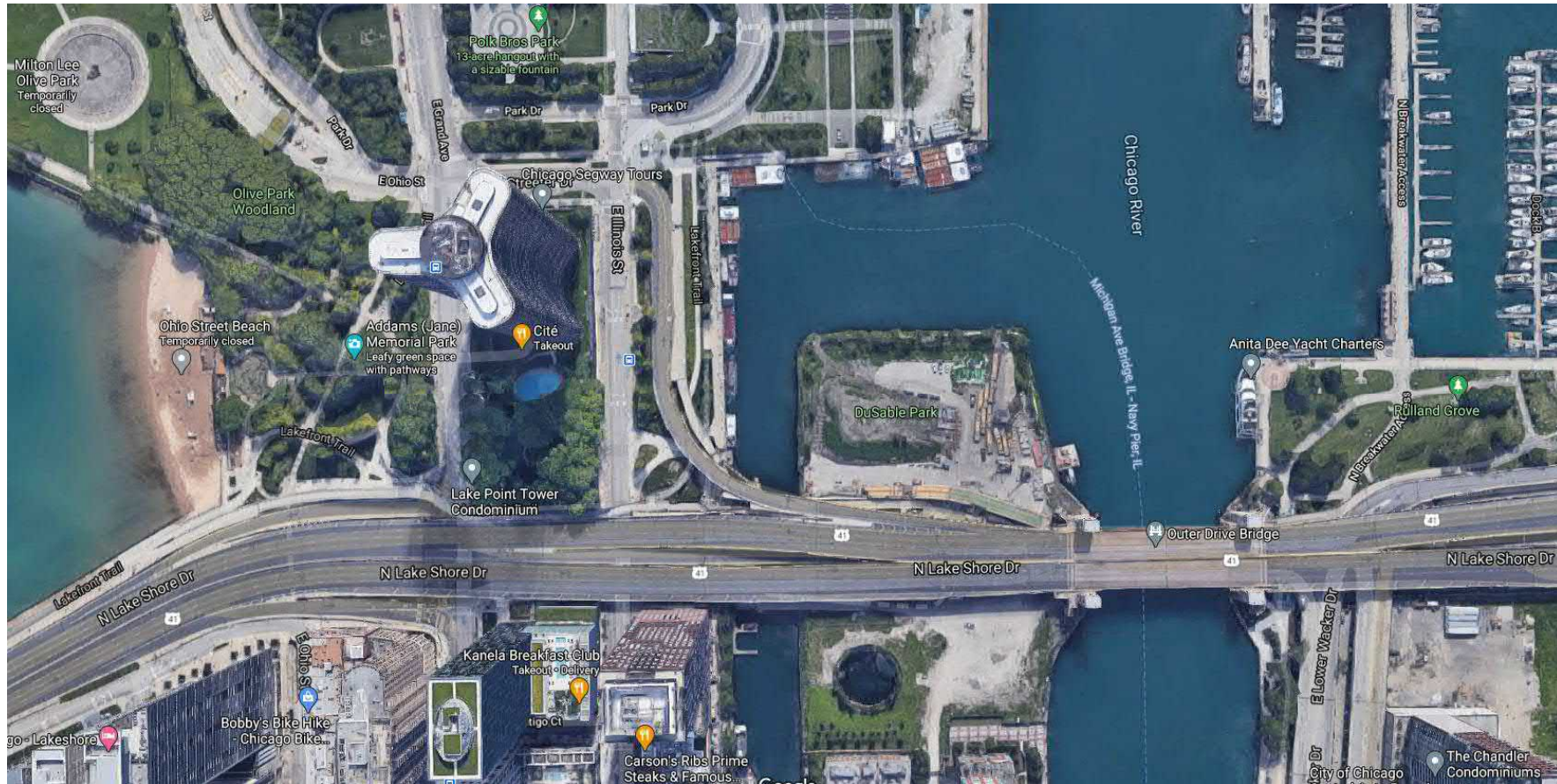




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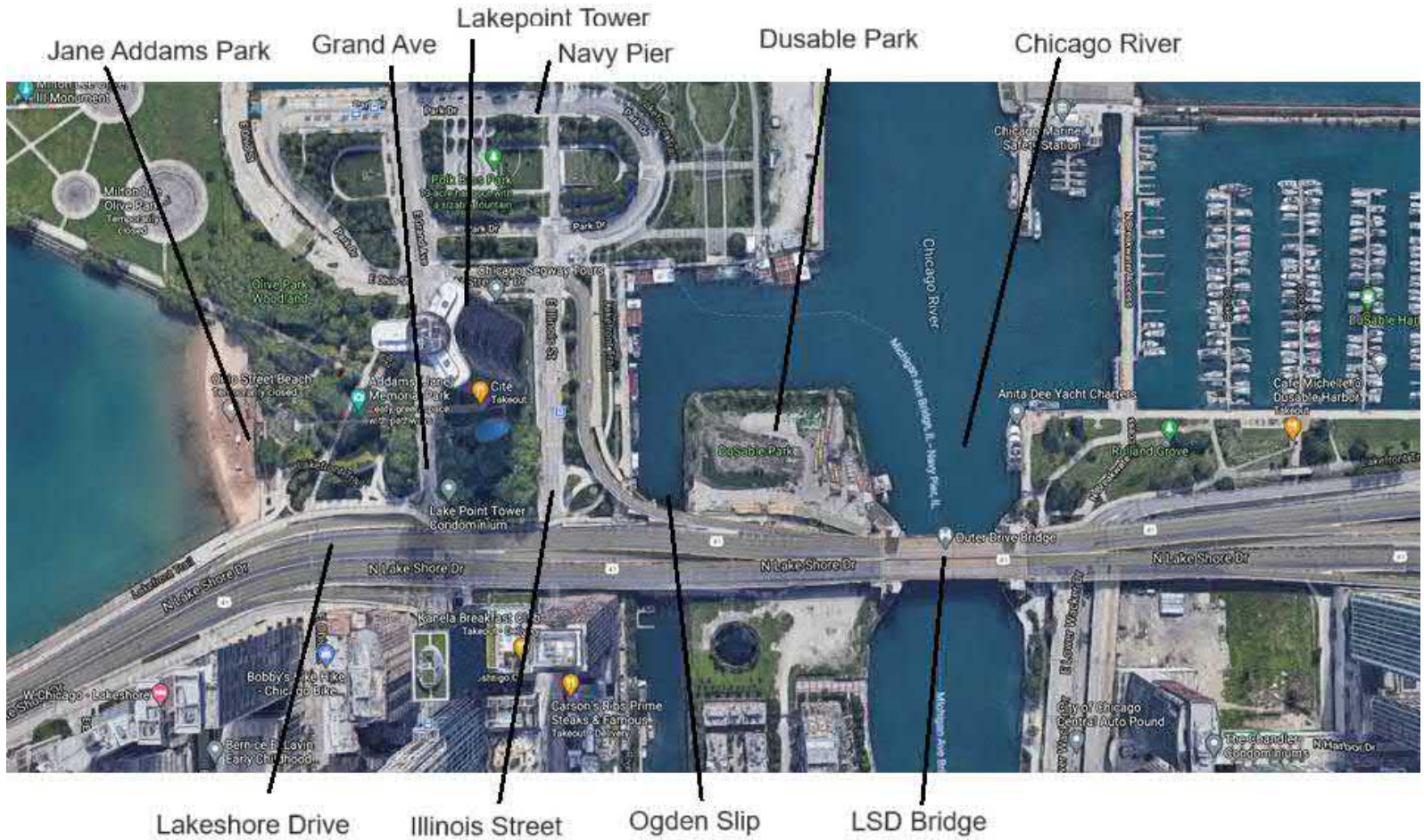




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PROJECT LOCATION





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EXISTING CONDITIONS – AT NORTH END OF PROJECT AT JANE ADDAMS PARK





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EXISTING CONDITIONS – AT GRAND AVE





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EXISTING CONDITIONS – AT LOWER-LEVEL LSD





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EXISTING CONDITIONS – AT LOWER-LEVEL LSD





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EXISTING CONDITIONS – AT DUSABLE PARK





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PROPOSED SOLUTION

**CREATE
SEPARATION**
BETWEEN
PEDESTRIANS
AND VEHICLES



**ELIMINATE
SHARED
CROSSING
POINTS**




**IMPROVE
ACCESS**
TO NAVY PIER FACILITIES

REDUCE
PEDESTRIANS
CONGESTION
AT JANE ADDAMS PARK



IMPROVE
RIDING SURFACES,
SIGNAGE AND
PAVEMENT MARKINGS



**DEVELOP
DUSABLE
PARK**



wsp

Source: CDOT Presentation






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PROJECT AERIAL & ALIGNMENT

CDOT *General Plan & Aerial*
NAVY PIER FLYOVER - LAKEFRONT TRAIL IMPROVEMENT
 CDOT # E-0-534 - SECTION # 00-E0534-00-BR



PROJECT NAME	BRIDGE CONDITION REPORT	ENVIRONMENTAL	PROJECT DEVELOPMENT REPORT
 1. OVER THE CHICAGO RIVER	NEW BCR FOR 016-6030	ESR 9898B	NEW STAND ALONE PDR
 2. OVER OGDEN SLIP AND DUSABLE PARK	ADDENDUM II FOR 016-6103 & 016-6104	ESR 9898C	ADDENDUM II TO ORIGINAL
 3. FROM NORTH OGDEN SLIP TO JANE ADDAMS PARK	ADDENDUM I FOR 016-6105 & 016-6106	ECOCAT	ADDENDUM I TO ORIGINAL



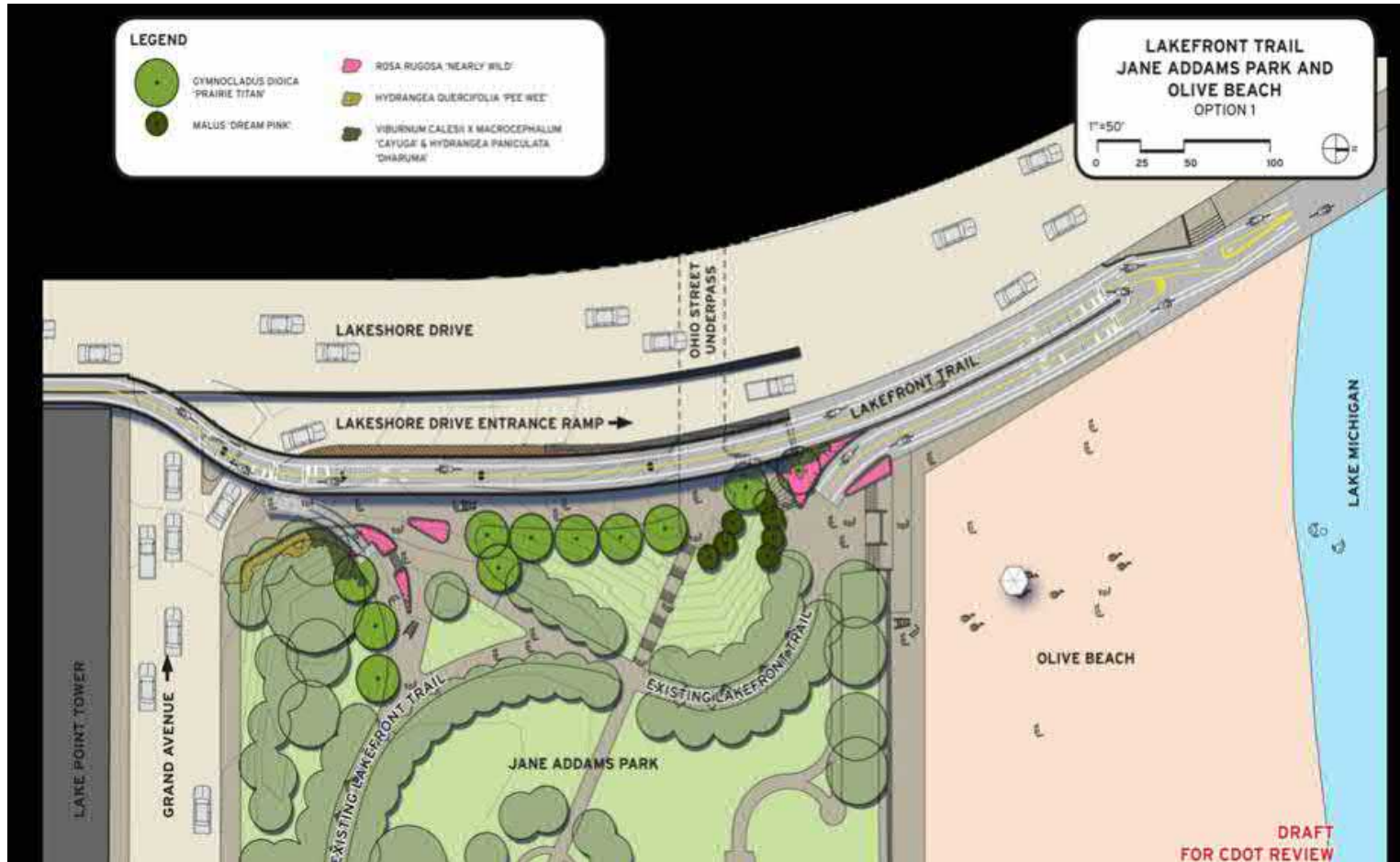


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PROJECT RENDERING





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Phase I Concepts





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Phase I Concepts





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Phase I Concepts





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PROJECT DEVELOPMENT REPORT COVER



Computer Rendering of Flyover near Ohio St. Underpass

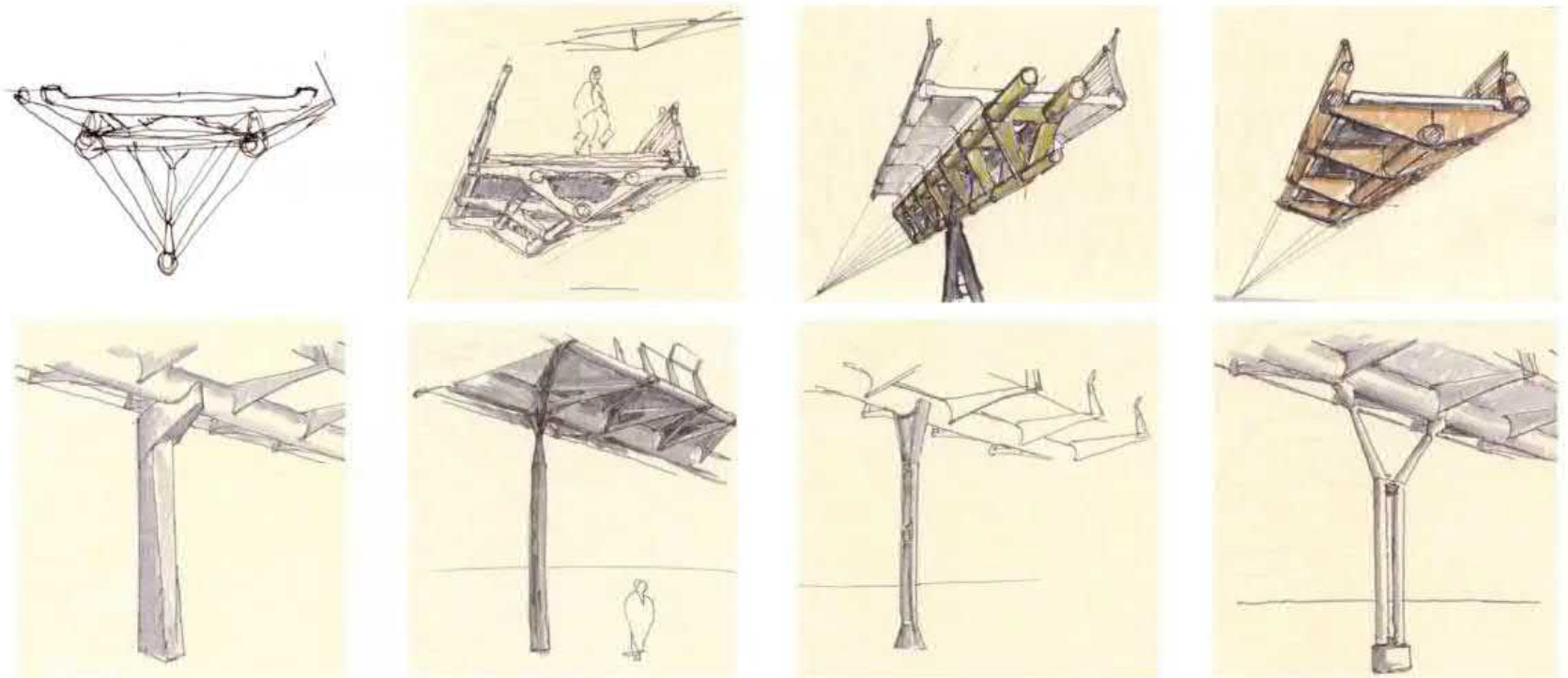


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PHASE II ARCHITECTURAL CONCEPTS

CONCEPTION OF THE FORM – HOW, WHAT, WHY?





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PHASE II FINAL SECTIONS

THE PIPE DOES IT ALL

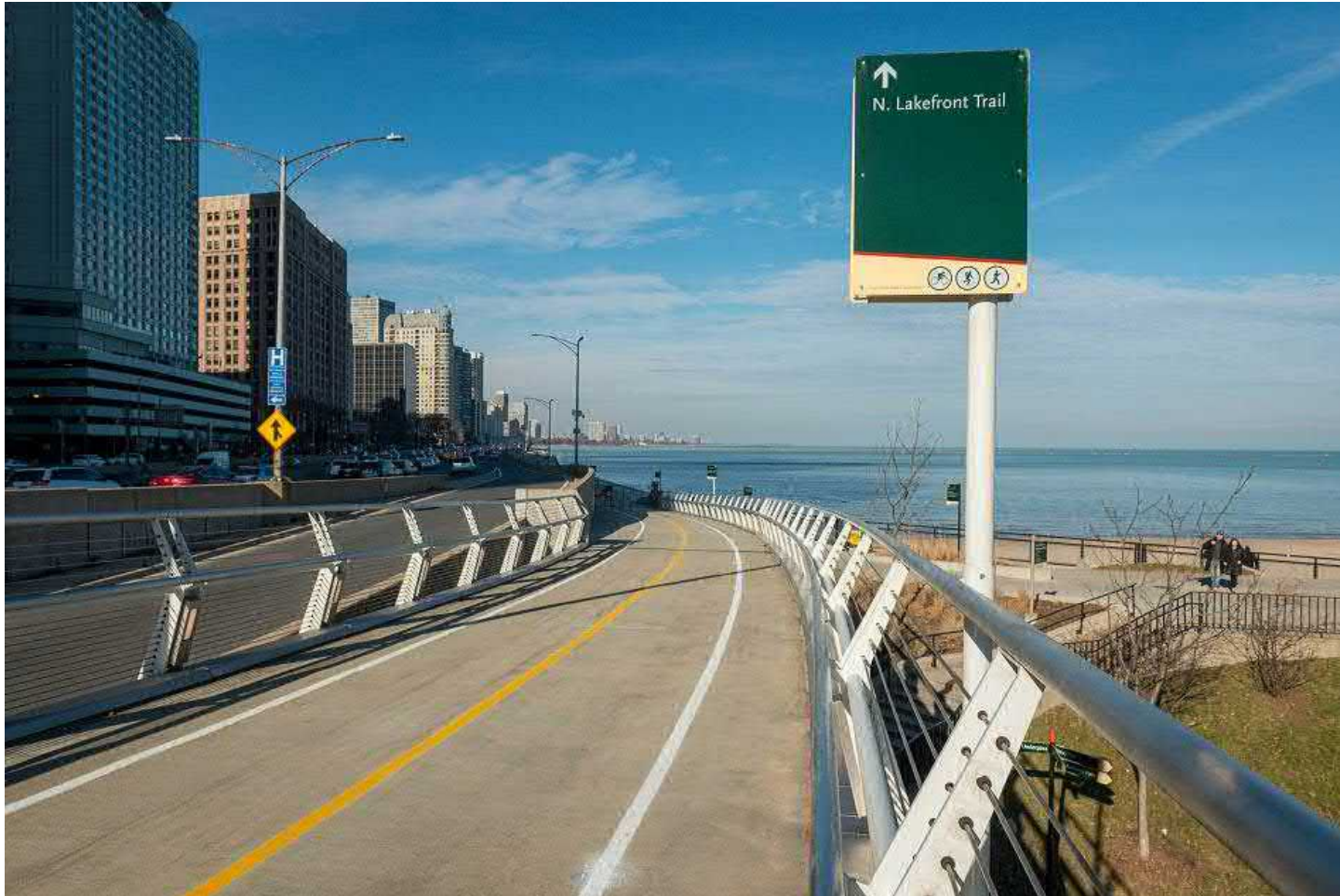




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Completed Segment 1





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Completed Segment 1

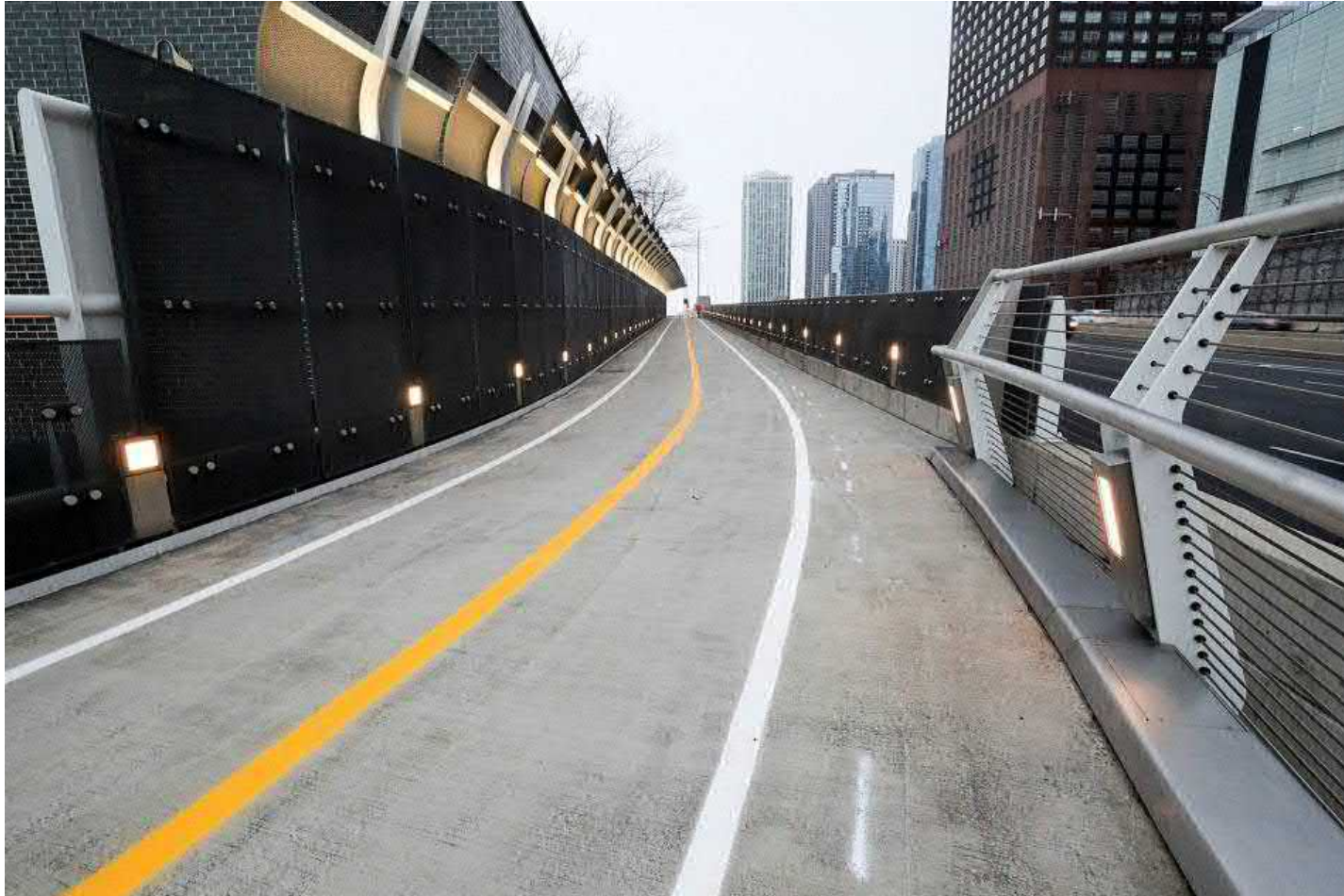




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Completed Segment 1





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Completed Segment 1





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LSD BRIDGE OVER THE CHICAGO RIVER





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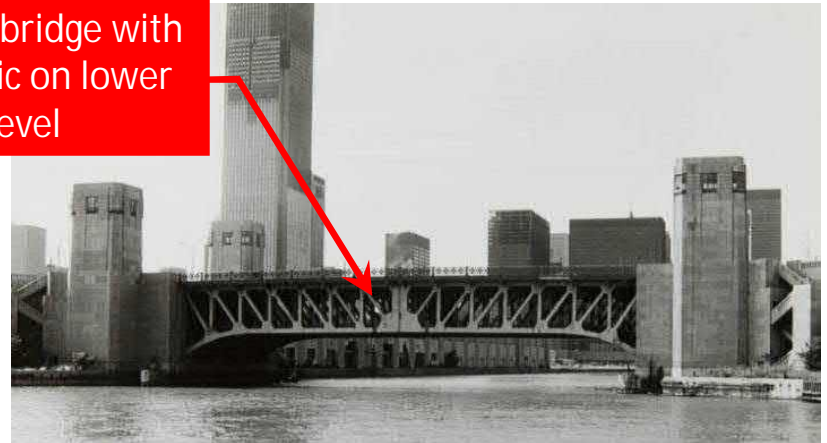
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Existing Bridge and Its History Original Construction

- Construction started in 1929 and finished in 1937
- It was the longest bascule when constructed: 264-feet
- It was the widest bascule when constructed: 108-feet



Original bridge with
no traffic on lower
level



East elevation of the Lake Shore Drive Bascule Bridge

(Bridges, viaducts, and underpasses: Lake St. Bridge through Ogden Slip Bridge, Image 9. (1971-1973). Copelin Commercial Photographers (James S. Parker Collection). Chicago - Photographic Images of Change, University of Illinois at Chicago. Library. Special Collections Department)

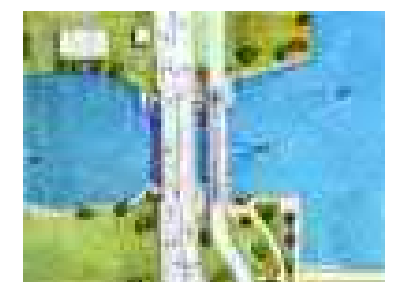
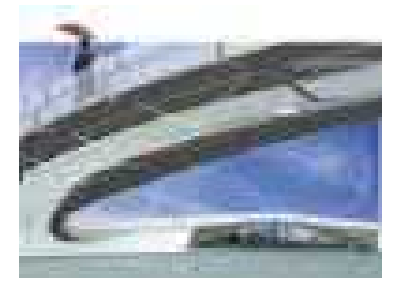
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CDOT BRIDGING THE DRIVE COMPETITION



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The Need to Widen the Trail at the Bridge



Project Location
Segment III

Navy Pier Flyover
Segments I & II

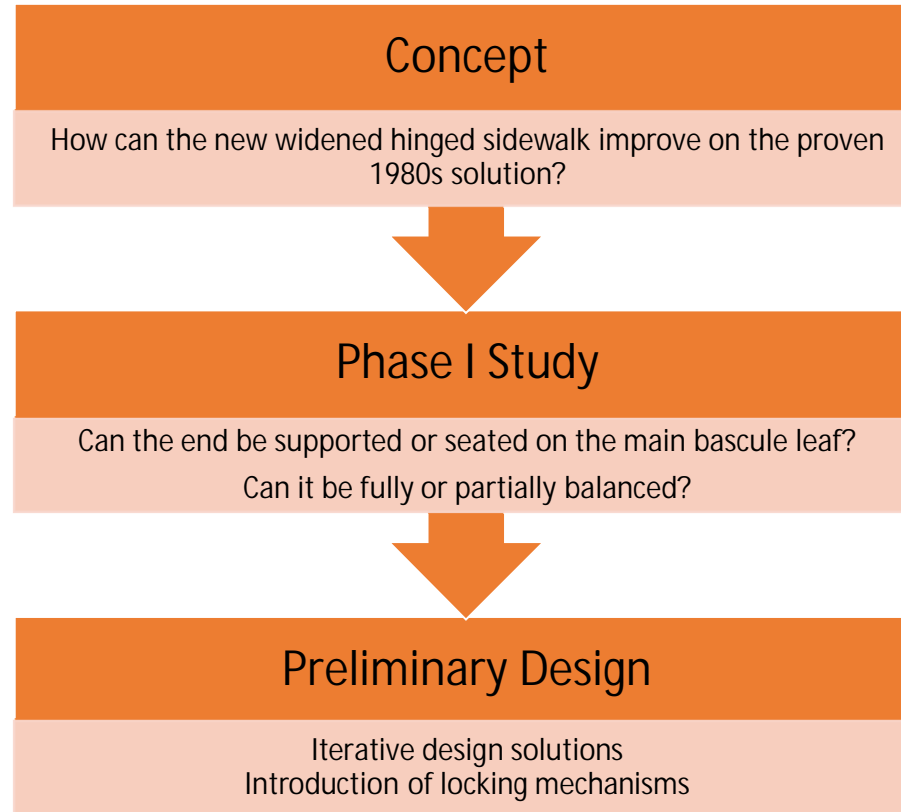




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Concept & Preliminary Design





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EXISTING CONDITIONS – AT N. APPROACH LSD BRIDGE





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EXISTING CONDITIONS – AT N. APPROACH LSD BRIDGE





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EXISTING CONDITIONS – AT N. TOWER- LSD





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EXISTING CONDITIONS – AT N. TOWER LOOKING NORTH – LSD BRIDGE



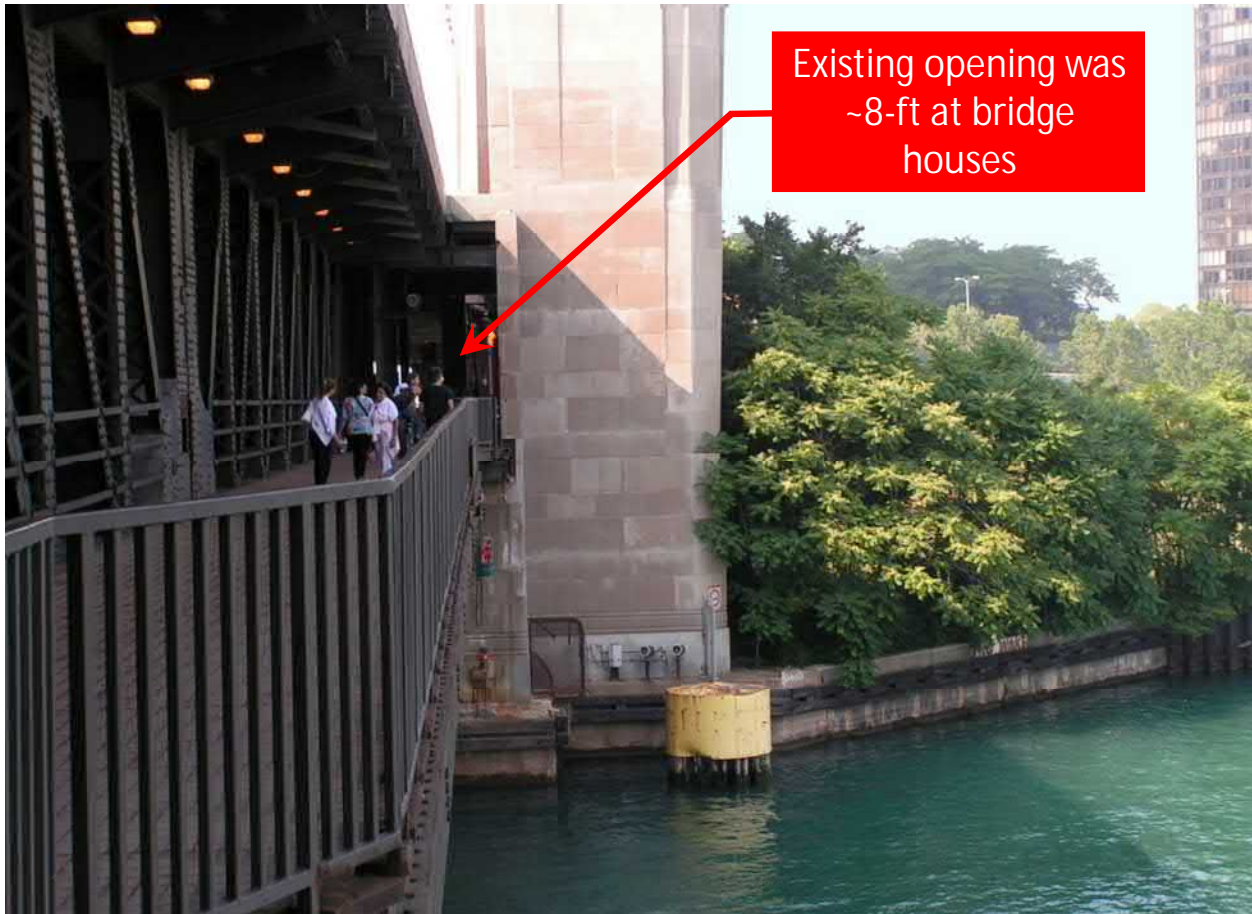


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EXISTING CONDITIONS – AT N. TOWER LOOKING NORTH – LSD BRIDGE





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RENDERING – AT N. TOWER LOOKING NORTH – LSD BRIDGE - FROM PHASE I



The Need
to Widen
the Trail at
the Bridge
More Work
than a Trail
Widening



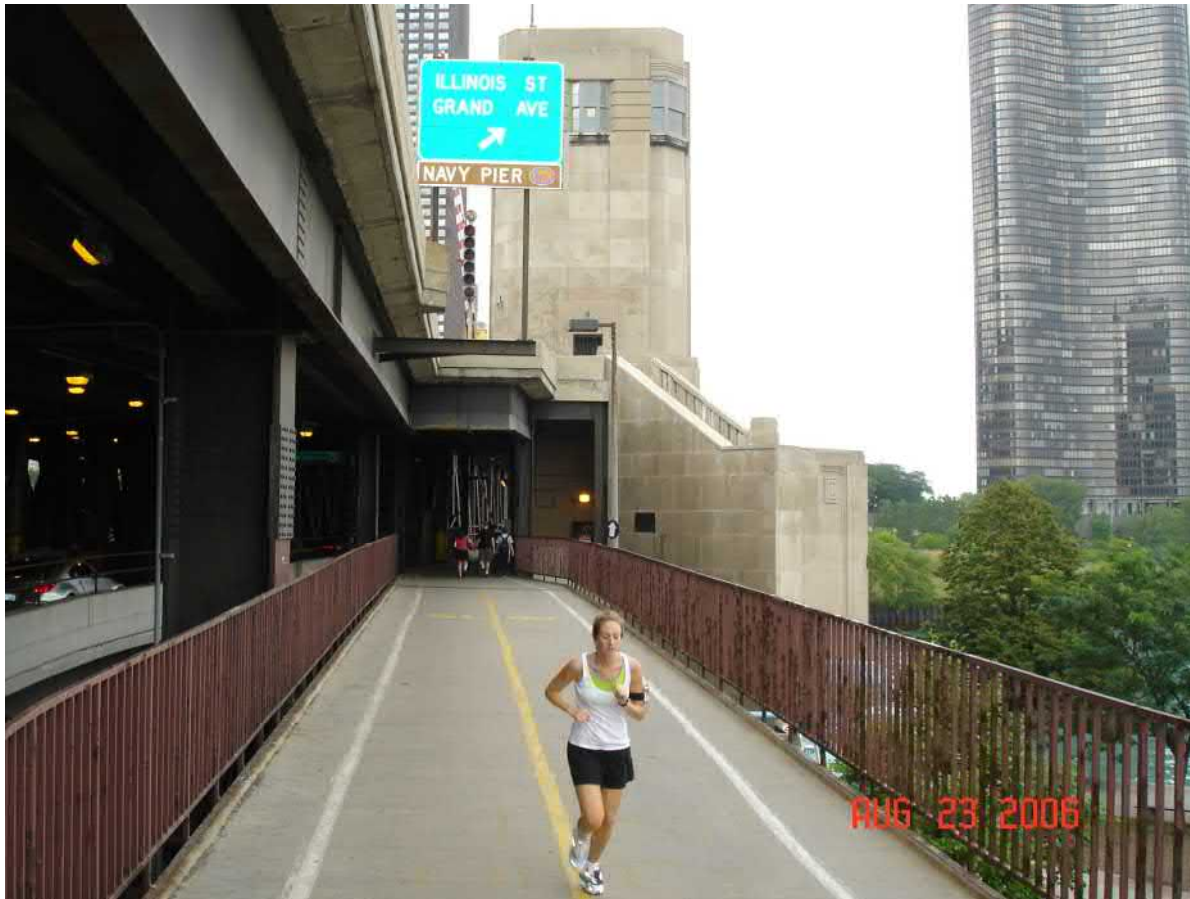


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EXISTING CONDITIONS – AT S. APPROACH LSD BRIDGE





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EXISTING CONDITIONS – AT S. APPROACH LSD BRIDGE





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EXISTING CONDITIONS – INSIDE S. TOWER OF LSD BRIDGE





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Innovating on a Validated Solution





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Existing Bridge and Its History 1980s Modification

Cantilevered
W12 support
framing



1980s hinged sidewalk, closed position

HSS 10x10 with 3"
diameter pin into a
pillow block bearing
(each side)



1980s hinged sidewalk, fully-open position, ~75deg



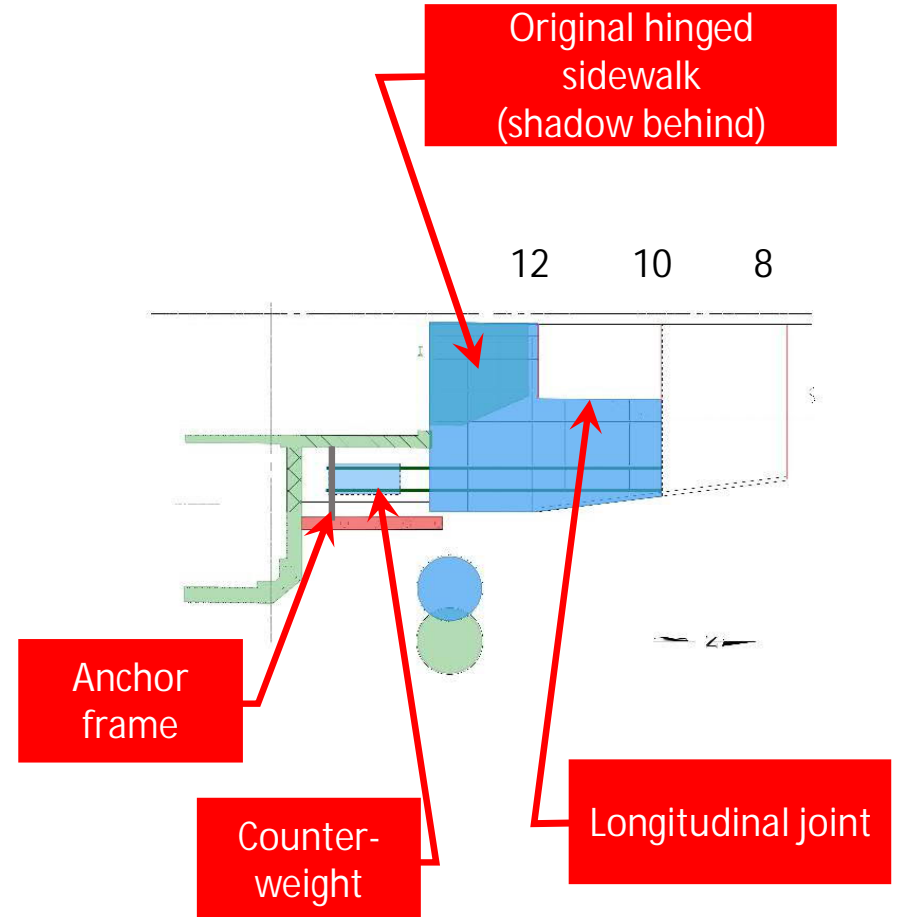


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Concept Design Phase I Study

- Type, Size and Location Plans were approved in October 2013
- Phase I study completed in April 2014
- Concept for hinged sidewalk similar to existing with addition, but with the addition of counterweight at outer two girders



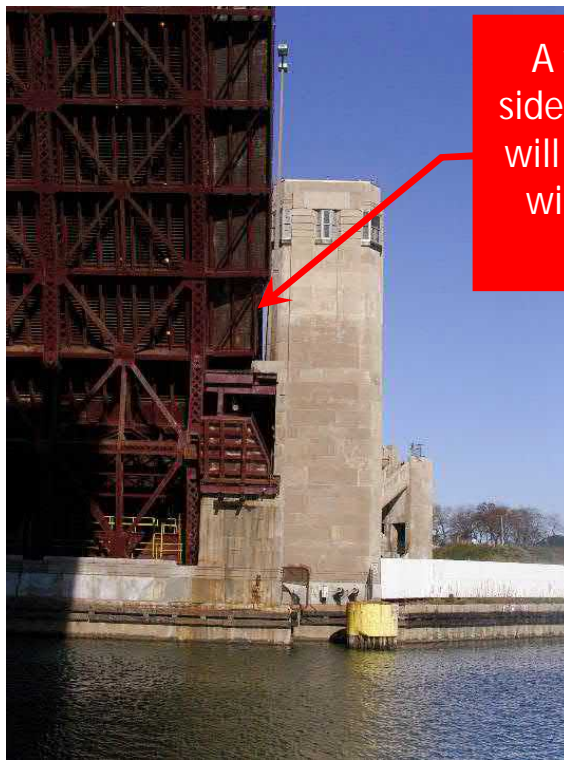


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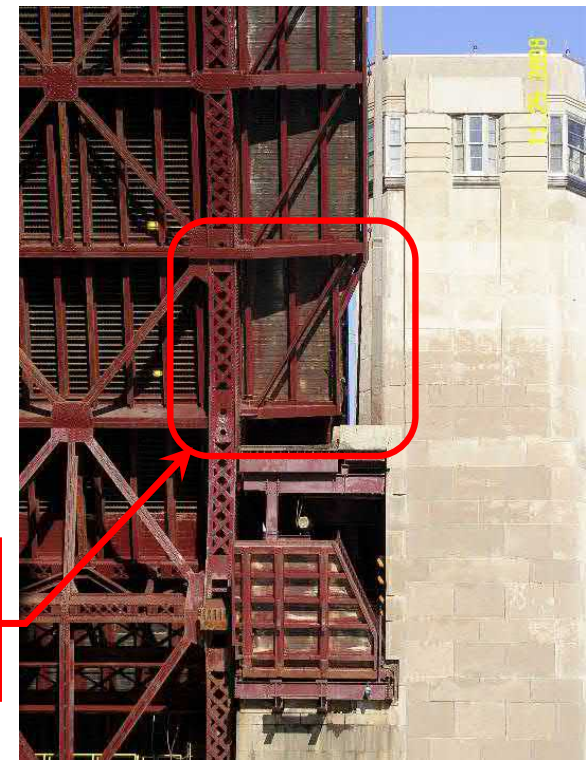


Concept Design Phase I Study



A widened
sidewalk (trail)
will now clash
with bridge
house

1980s hinged sidewalk, fully open at
NE Bridge House



This section was
added to moving
piece

Closer view of 1980s hinged sidewalk,
fully open at NE Bridge House

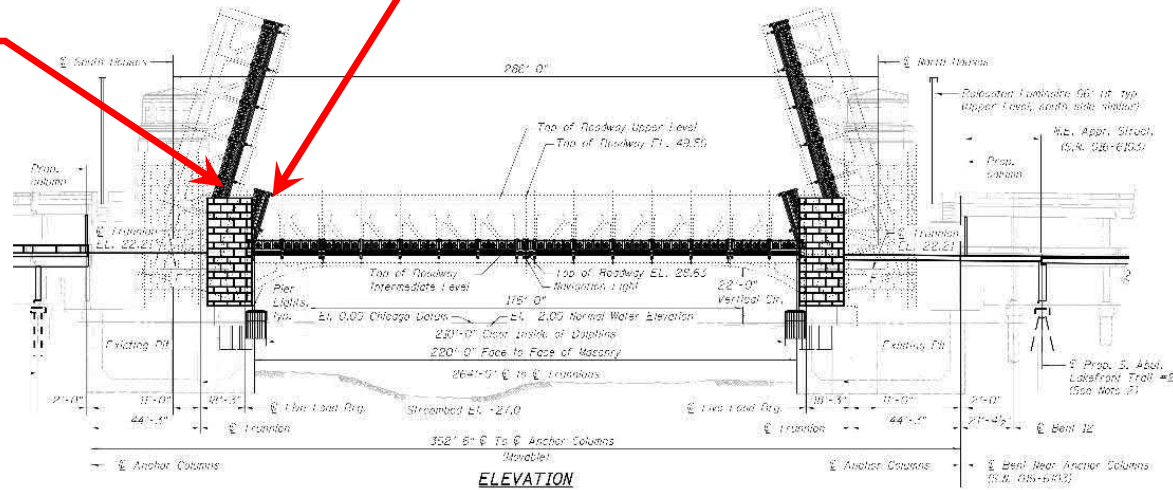


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Concept Design Phase I Study

Railing would
hit house at
full open

Moving hinged sidewalk
allows for navigation
clearance to remain



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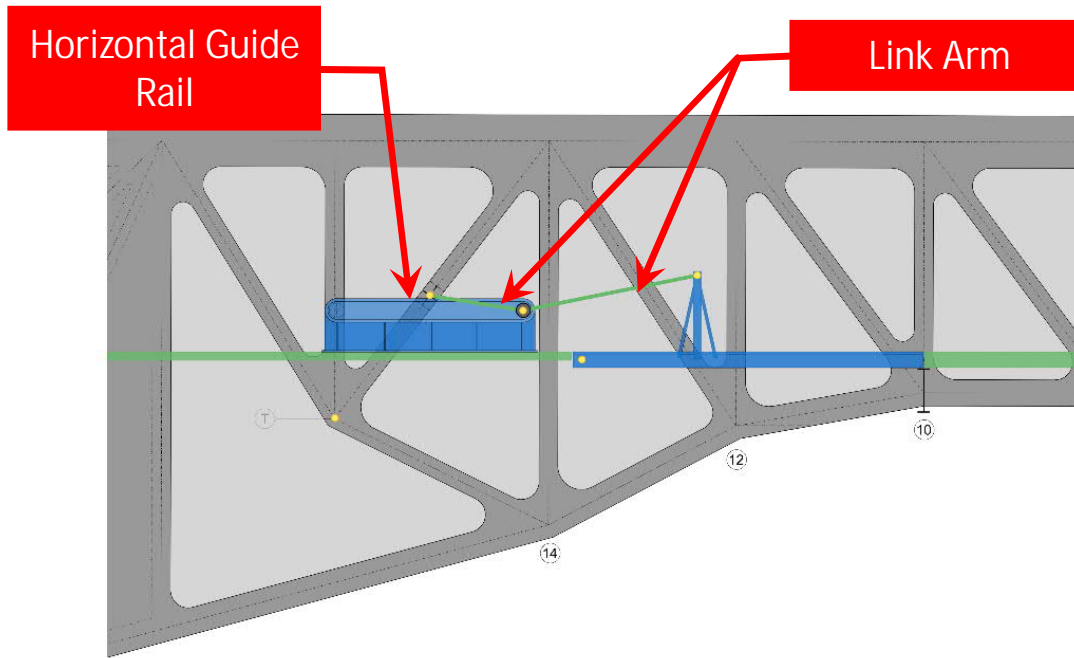




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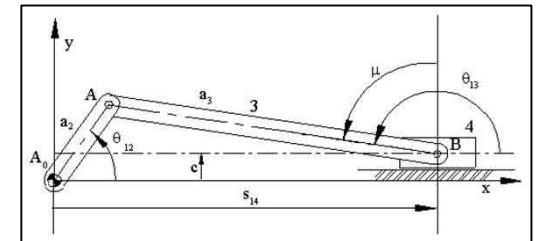
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Preliminary Design Slider Crank Mechanism



Modifications:

1. Double Link Arm
2. Slider Rail
3. Link Arm Post Location
4. Truss Connection Point



Slider Crank Mechanism

(Image Source:
https://ocw.metu.edu.tr/pluginfile.php/6885/mod_resource/content/1/ch7/7-2.htm)

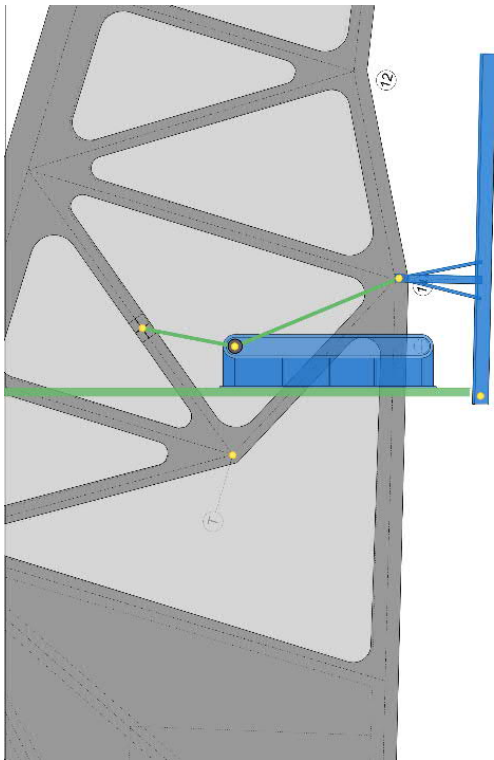




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Preliminary Design Too Fast, Too Furious?



Angle = 73.50°

Bridge Operation: **Solved**

New Concerns:

- Maintenance
- Slider Rail Anchorage
- Performance
- Constructability

Decision Time:

- Add Linear Span Lock

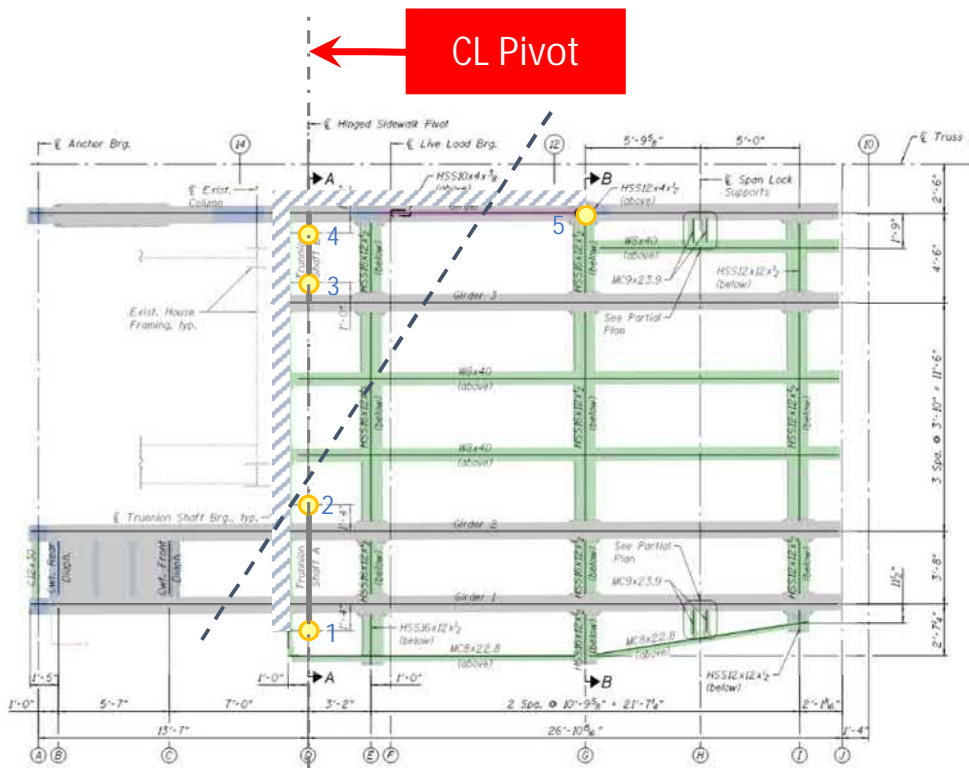




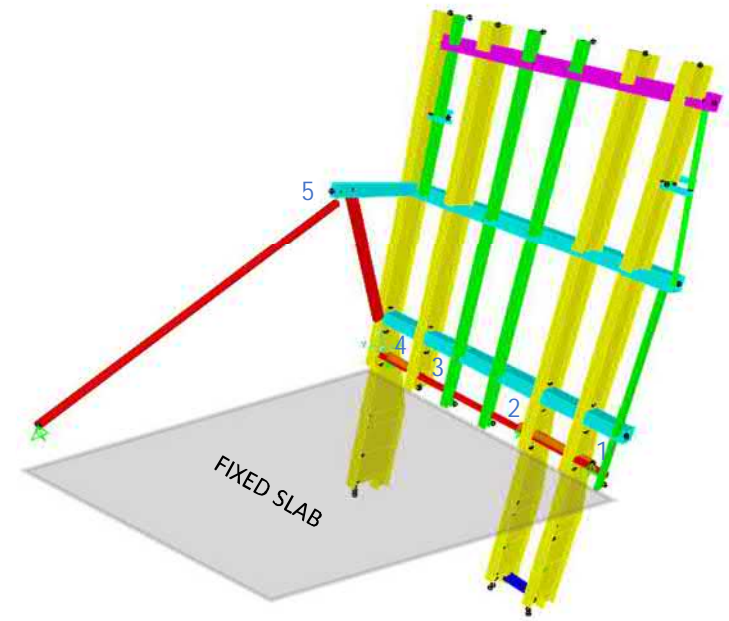
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Final Design Tackling Eccentric Lift



Plan View of Hinged Sidewalk



SAP2000 Analytical Model (Fully Open Position)

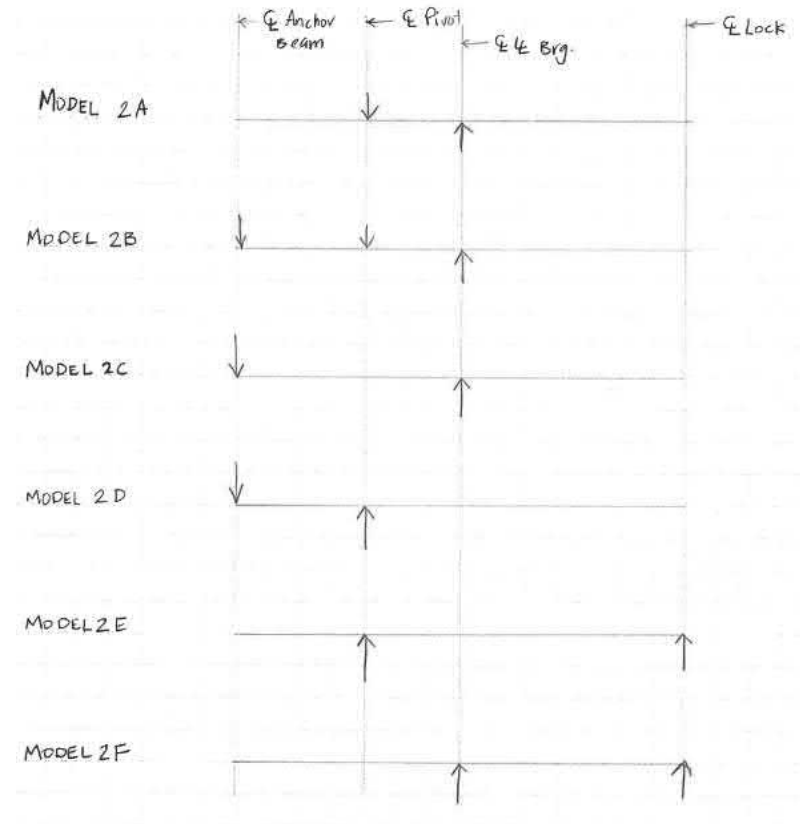
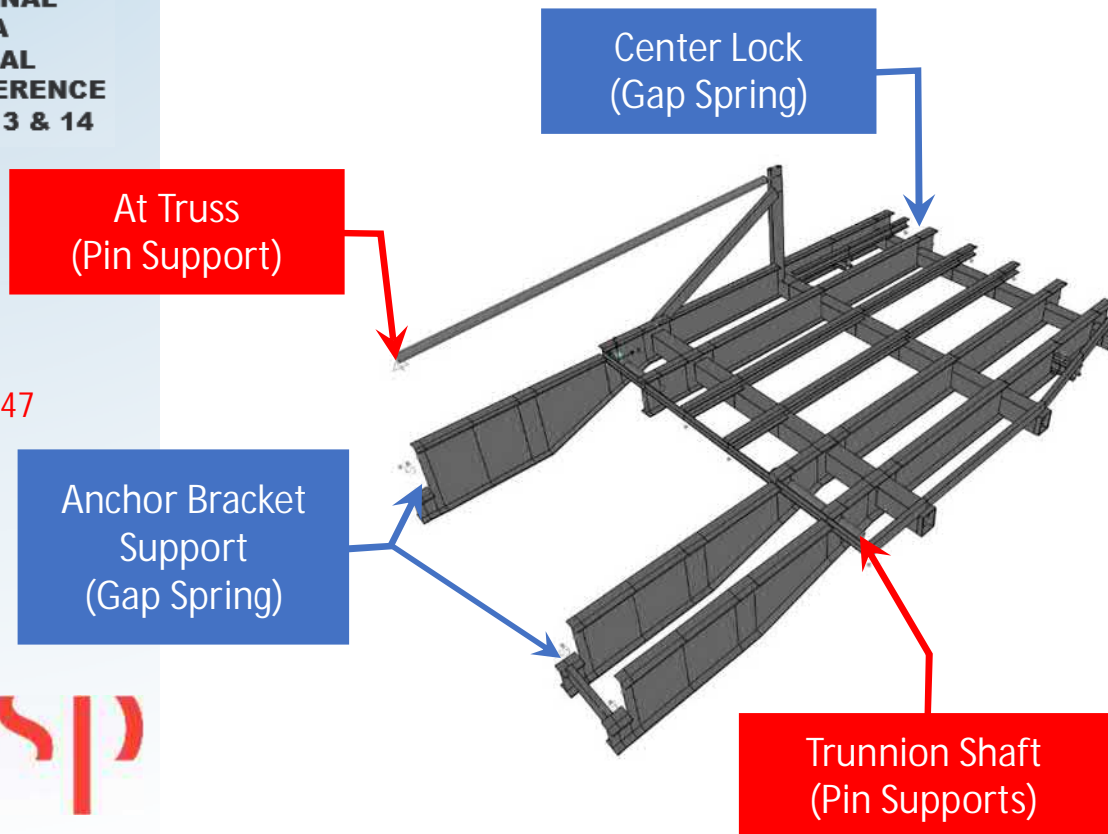




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Final Design 3D Modeling and Analysis



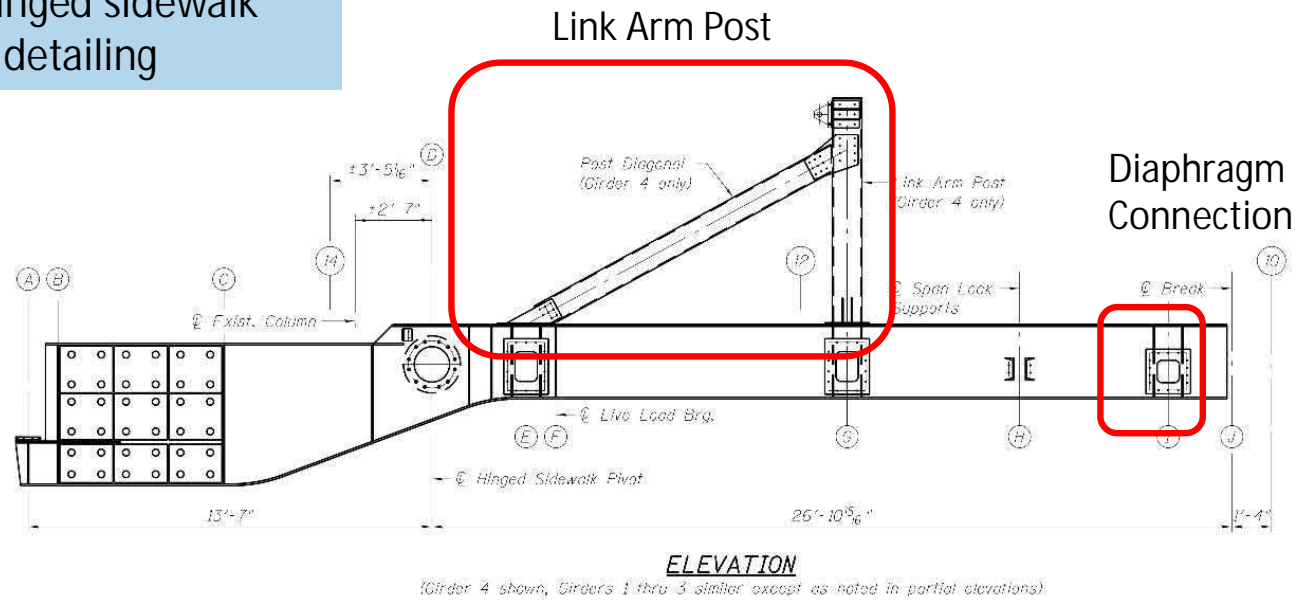


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Final Design Details of the Final Solution

Final hinged sidewalk
design detailing



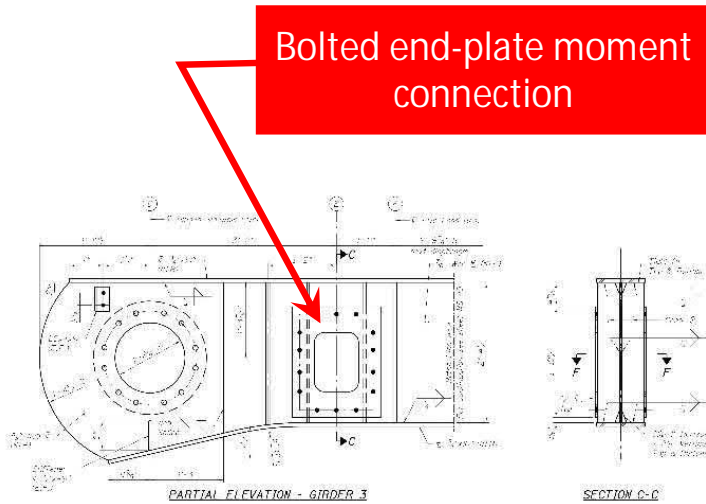


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Final Design Details of the Final Solution



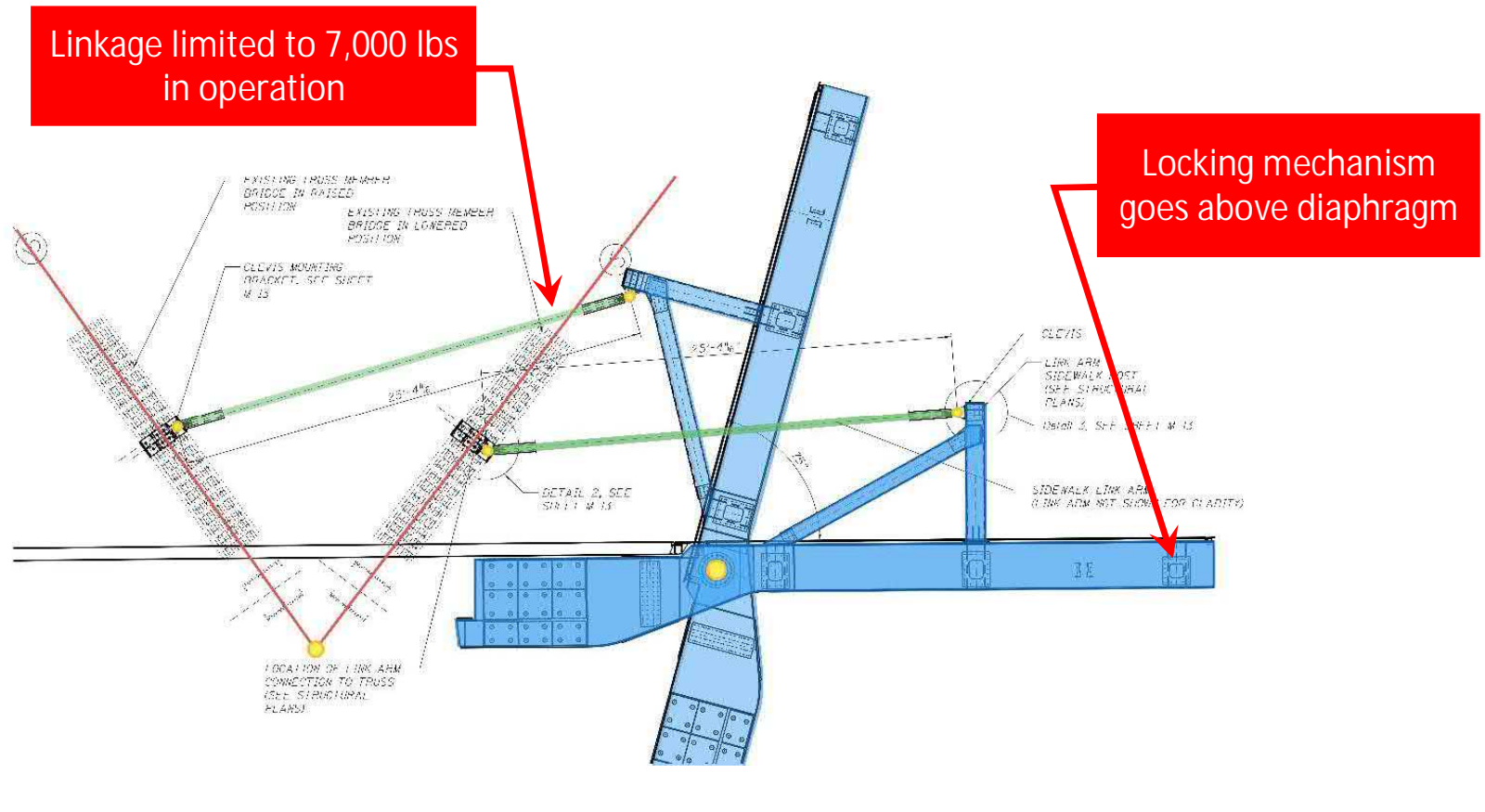
Hinged Sidewalk Girder 2 with end plate moment connection (October 2020)



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Final Design Details of the Final Solution





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Building the New Bascule Structures for the Trail - Fabrication

- Steel fabrication was completed by Hillsdale Fabricators, in St. Louis, Missouri
 - 3D BIM software was used the new hinged sidewalk pieces
- Machined parts were completed by Lemke Industrial Machine, in Marathon, Wisconsin

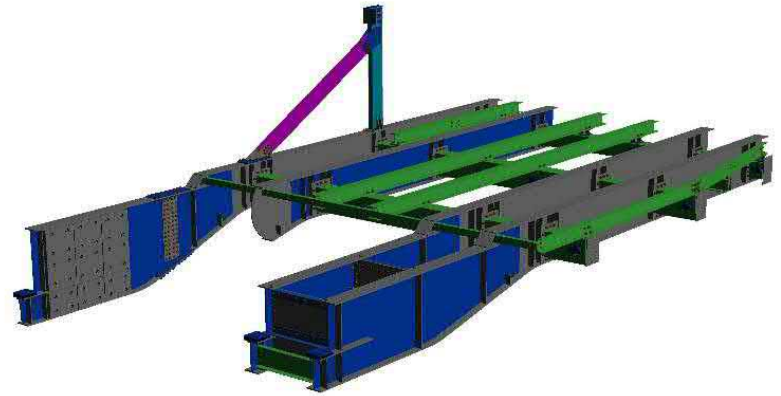


Image from steel fabrication 3D model

Source: Hillsdale Fabricators





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Building the New Bascule Structures for the Trail





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Building the New Bascule Structures for the Trail - Erection

- Erection took place in September 2020 for the SE Hinged Sidewalk and October 2020 for the NE Hinged Sidewalk



SE Hinged Sidewalk (Girders 1 & 2) being erected

Source: TY Lin Intl.





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Building the New Bascule Structures for the Trail Erection



- Erection took place in September 2020 for the SE Hinged Sidewalk and October 2020 for the NE Hinged Sidewalk

SE Hinged Sidewalk (Girders 1 & 2) being erected

Source: TY Lin Intl.





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Fire along Chicago River temporarily closes Lake Shore Drive Monday afternoon –October 7, 2019





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Concluding Remarks Lessons Learned

WHY WAS PROJECT NEEDED?

- Trail safety and flow
- More economical than separate bridge, maintains historic entry to the City

WHAT LESSONS WERE LEARNED FROM THE PAST?

- Look for simple solution
- Include adjustments in the design

HOW WERE NEW TECHNOLOGIES USED?

- Computer modeling with large displacement capabilities
- 3D analysis is warranted on complex projects





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Acknowledgements

ACKNOWLEDGEMENTS

CDOT
CHICAGO DEPARTMENT OF TRANSPORTATION

CHICAGO PARK DISTRICT ASSOCIATION
ORGANIZED 1916

Illinois Department of Transportation

HNTB

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KOWALENKO CONSULTING GROUP, INC.
ENVIRONMENT · PLANNING · MANAGEMENT

C N + A

THEATRE PLANNERS LIGHTING DESIGNERS
Schuler Shook

TYLIN INTERNATIONAL GROUP

GEC

Dynasty Group
Engineers & Surveyors

W.E.B.

Hillsdale Fabricators
AN ALGERIENI ENTERPRISE

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Concluding Remarks Acknowledgements

- WSP wishes to thank:
 - 2020 National AAAEA Virtual Conference organizing committee
 - Chicago Department of Transportation (CDOT), Division of Engineering
 - The WSP design team and subconsultant team:
 - HBM Engineering, Ross Barney Architects, AAA Engineering, EJM Engineering (now Transmart), Kowalenko Consulting Group, Bloom Companies and SAM Consultant
 - TY Lin Intl. (construction manager)
 - Hillsdale Fabricators and Lemke Industrial Machine for sharing photos of the project

