Summary of the Champlain Towers South NCST Investigation Progress

NCST Advisory Committee Meeting

September 9, 2025

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Associate Lead Investigator

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

1. Investigation Overview
2. Timeline of Site/Building History and Collapse
3. Failure Initiation and Progression Updates
4. Investigation Schedule
5. Next Steps and Conclusion

1 Investigation Overview

Source: NIST

NIST Engineering Laboratory (EL)

Structures Group (MSSD)
Infrastructure Materials Group (MSSD)
Earthquake Engineering Group (MSSD)
Community Resilience Group (MSSD)
Intelligent Systems & Fire Research Divisions
EL's Disaster Impact Reduction Office
EL's Data, Security, Technology Group
EL's Applied Economics Office

MSSD = Materials and Structural Systems Division

NIST

Physical Measurement Laboratory
Materials Measurement Laboratory
Public Affairs Office
Office of Chief Counsel
Program Coordination Office
Management and Organization Office
Acquisition & Agreements Mgmt. Office
ITL's Statistical Engineering Division

ITL = Information Technology Laboratory

Collaborate
Coordinate
Cooperate

Federal

Federal Emergency Mgmt. Agency
U.S. Army Corps of Engineers
U.S. Geological Survey
National Science Foundation
Federal Bureau of Investigation
Department of Defense
NOAA's National Weather Service
Bureau of Reclamation

NOAA = National Oceanic and Atmospheric Administration

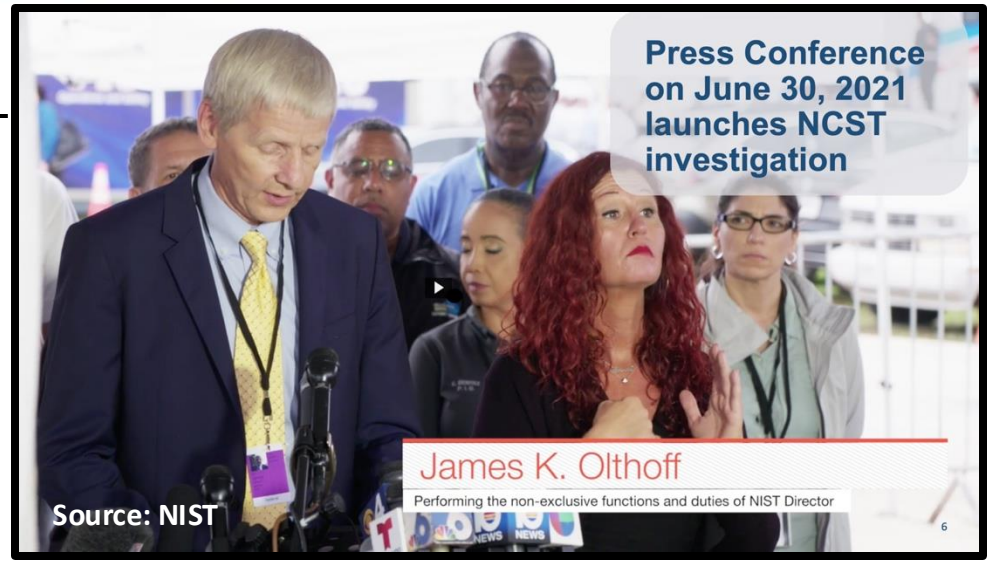
Local and State

Miami-Dade County Mayor's Office,
Fire, Police, and Building Departments
Town of Surfside
City of Miami Beach
Florida Division of Emergency Mgmt.
Florida DOT and State Attorney's Office
Virginia Beach Fire Department
USAR Task Forces

DOT = Department of Transportation
USAR= Urban Search & Rescue

1 Investigation Overview: Year One

- Launch NCST Investigation
- Establish Team
- Secure Funds
- Secure Local Workspace



YR 1	Jun-Dec 2021	Jan-Jun 2022	YR 2	Jul-Dec 2022	Jan-Jun 2023	YR 3	Jul-Dec 2023	Jan-Jun 2024	YR 4	Jul-Dec 2024	Jan-Jun 2025

- Custody of Building Evidence
- Collect Subsurface Evidence
- Conduct Non-Destructive Testing
- Secure Local Workspace

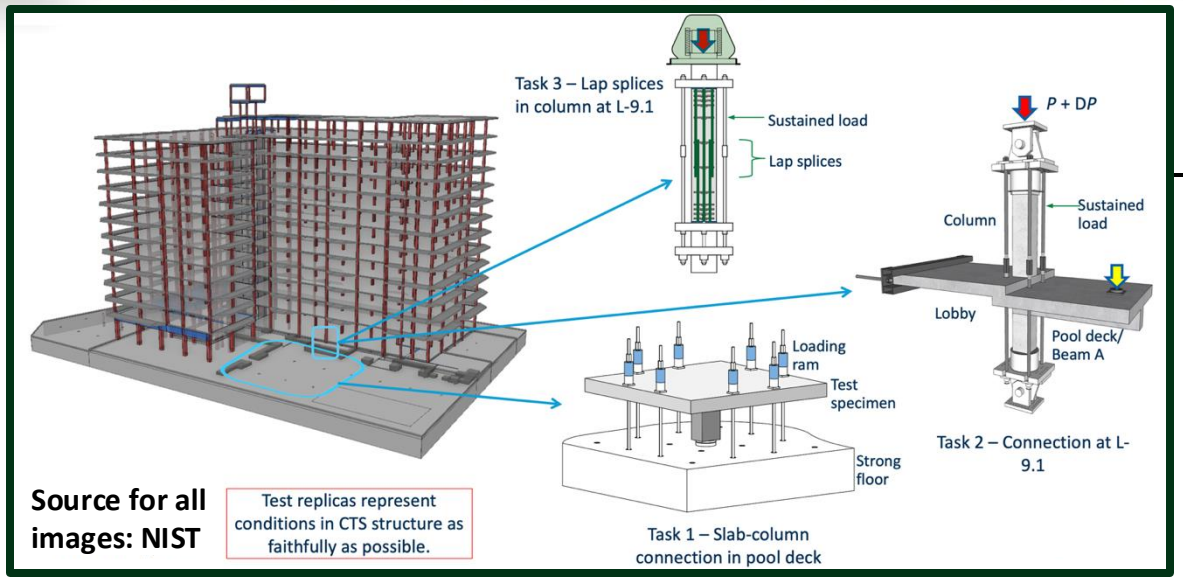
1 Investigation Overview: Year Two

- Complete Wave Propagation Tests
- Collect and Review Records
- Conduct Phase I Interviews
- Initiate Collapse Modeling

YR 1	Jun-Dec 2021	Jan-Jun 2022	YR 2	Jul-Dec 2022	Jan-Jun 2023	YR 3	Jul-Dec 2023	Jan-Jun 2024	YR 4	Jul-Dec 2024	Jan-Jun 2025

- Search for Video Footage
- Measure Physical Evidence
- Develop Prelim Code Check Analysis
- Initiate Corrosion Study

1 Investigation Overview: Year Three



Source for all images: NIST

- Launch Invasive Testing
- Launch Structural Testing
- Update Collapse Modeling
- Develop Soil-Structure Interaction 3D Model

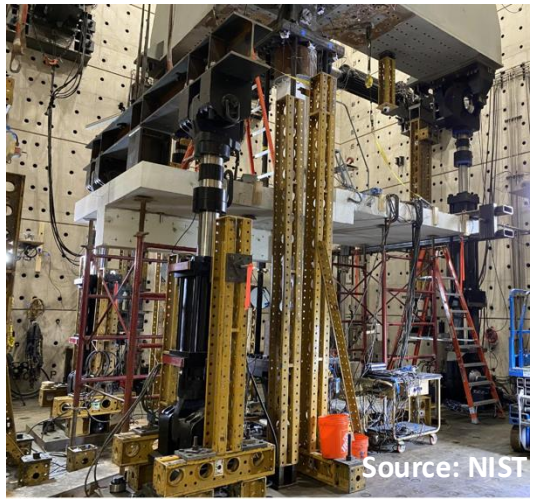
YR 1	Jun-Dec 2021	Jan-Jun 2022	YR 2	Jul-Dec 2022	Jan-Jun 2023	YR 3	Jul-Dec 2023	Jan-Jun 2024	YR 4	Jul-Dec 2024	Jan-Jun 2025

- Update Collapse Timeline
- Enhance & Analyze Videos
- Conduct Accelerated Corrosion Testing
- Conduct Mechanical Testing of Materials

1 Investigation Overview: Year Four

- Conduct Phase II Interviews
- Complete Column Tests
- Complete Mechanical Tests of Concrete Cores and Reinforcing Steel Bars
- Evaluate Recovered Hard Drives

YR 1	Jun-Dec 2021	Jan-Jun 2022	YR 2	Jul-Dec 2022	Jan-Jun 2023	YR 3	Jul-Dec 2023	Jan-Jun 2024	YR 4	Jul-Dec 2024	Jan-Jun 2025

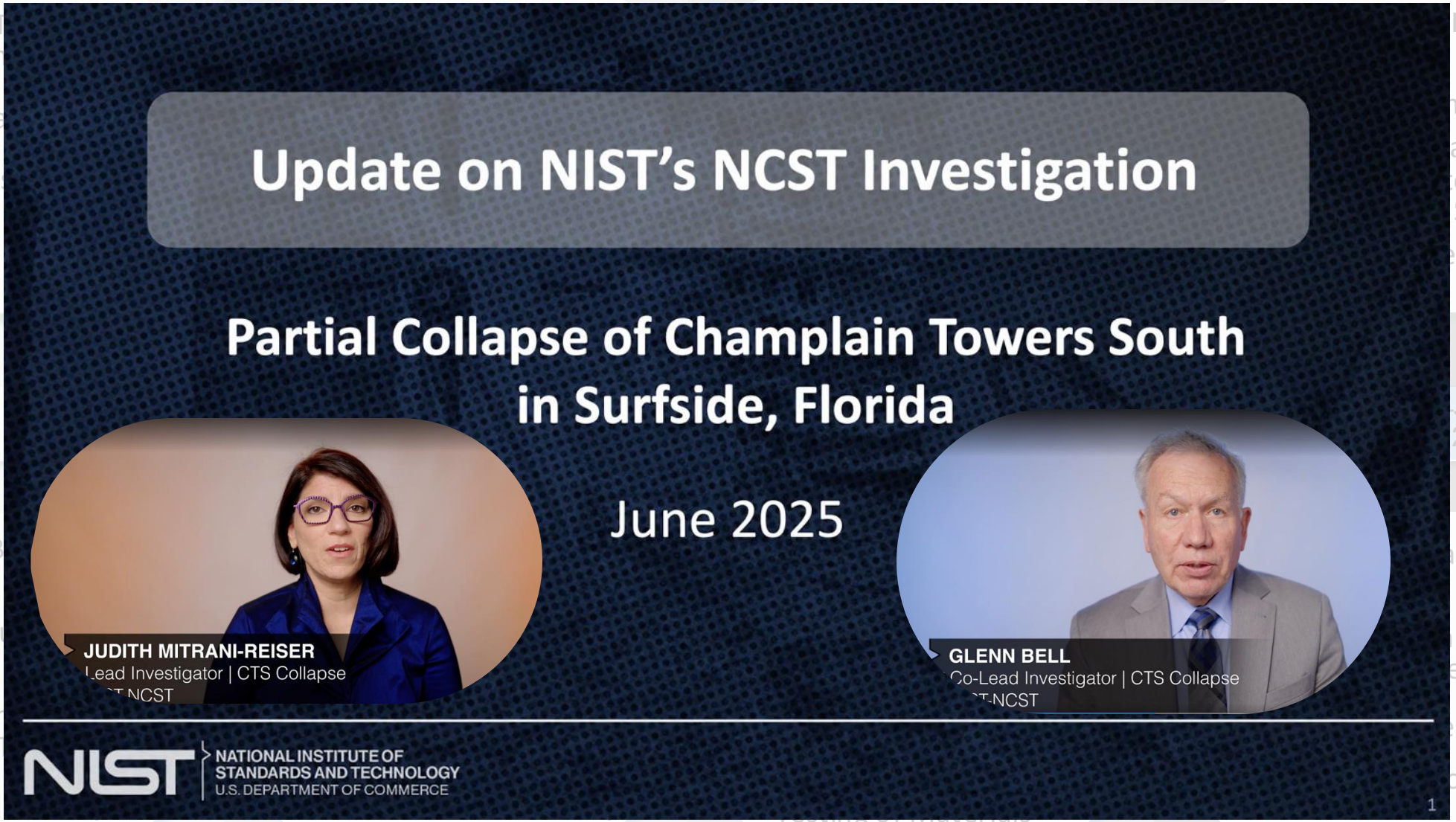


- Launch Subsurface Materials Tests
- Complete Testing of Full-Scale Building Replicas
- Update Collapse Timeline
- Assess Failure Scenarios

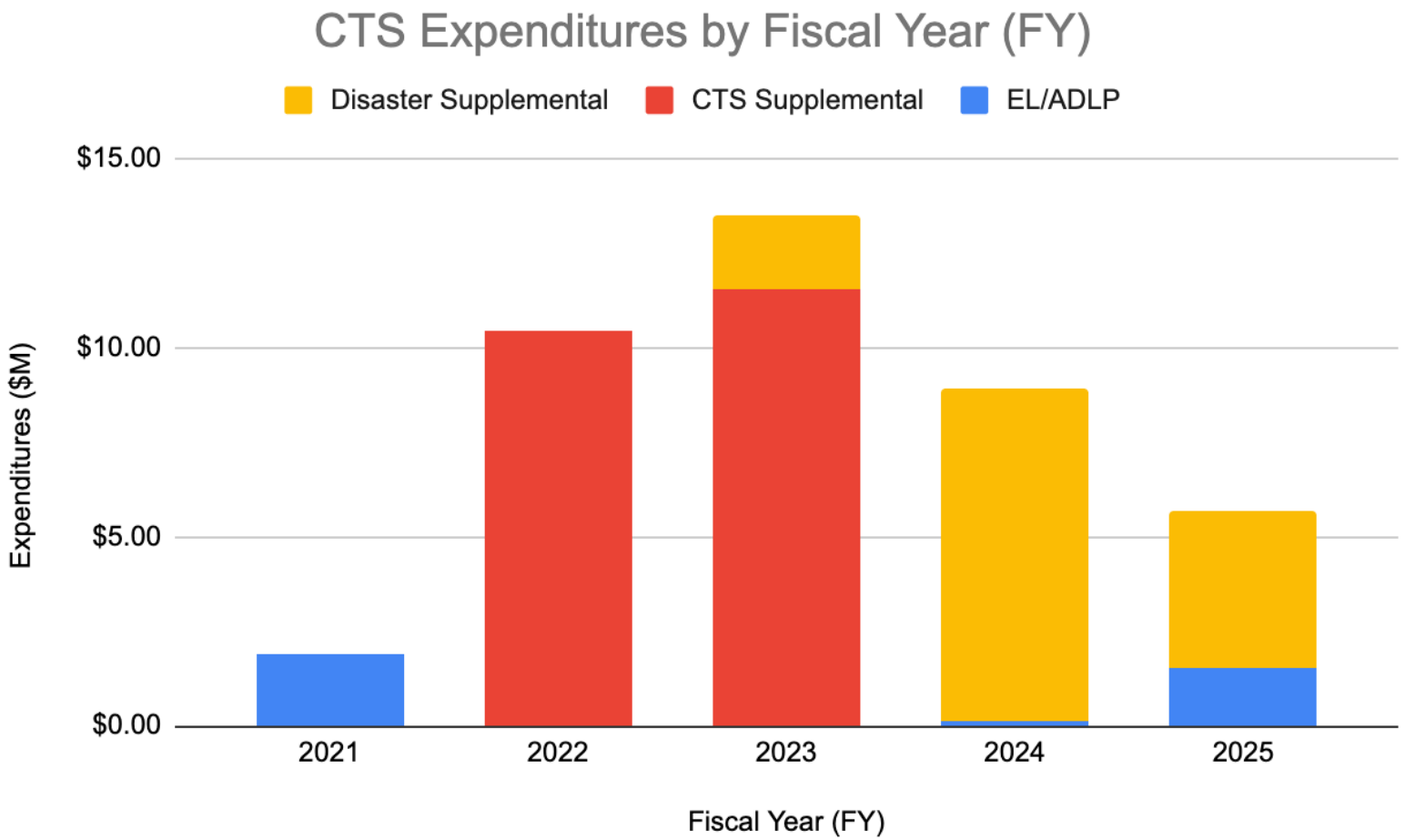
1 Investigation Overview

YR 1	YR 2	YR 3	YR 4
• Launch NCST Investigation • Establish Team • Secure Funds • Secure Local Workspace	• Complete Wave Propagation Tests • Collect and Review Records • Conduct Phase I Interviews • Initiate Collapse Modeling	• Launch Invasive Testing • Launch Structural Testing • Update Collapse Modeling • Develop Soil-Structure Interaction 3D Model	• Conduct Phase II Interviews • Complete Column Tests • Complete Mechanical Tests of Concrete Cores and Reinforcing Steel Bars • Evaluate Recovered Hard Drives
Jun-Dec 2021	Jul-Dec 2022	Jul-Dec 2023	Jul-Dec 2024
Jan-Jun 2022	Jan-Jun 2023	Jan-Jun 2024	Jan-Jun 2025
• Custody of Building Evidence • Collect Subsurface Evidence • Conduct Non-Destructive Testing • Secure Local Workspace	• Search for Video Footage • Measure Physical Evidence • Develop Prelim Code Check Analysis • Initiate Corrosion Study	• Update Collapse Timeline • Enhance & Analyze Videos • Conduct Accelerated Corrosion Testing • Conduct Mechanical Testing of Materials	• Launch Subsurface Materials Tests • Complete Testing of Full-Scale Building Replicas • Update Collapse Timeline • Assess Failure Scenarios

1 Investigation Overview: Video Update on June 23rd



1 Investigation Overview: Budget & Dissemination



- Technical work concludes this calendar year, and is focused on closing out assessments of failure scenarios
- A new contract was awarded to Fed Writers in Dec 2024, and modified in Aug 2025, to support CTS NCSTAR report
- New contracts planned to support NCST outside members and dissemination of findings

Investigation Overview: Potential Topics for CTS NCST Recommendations

Design

Code Enforcement

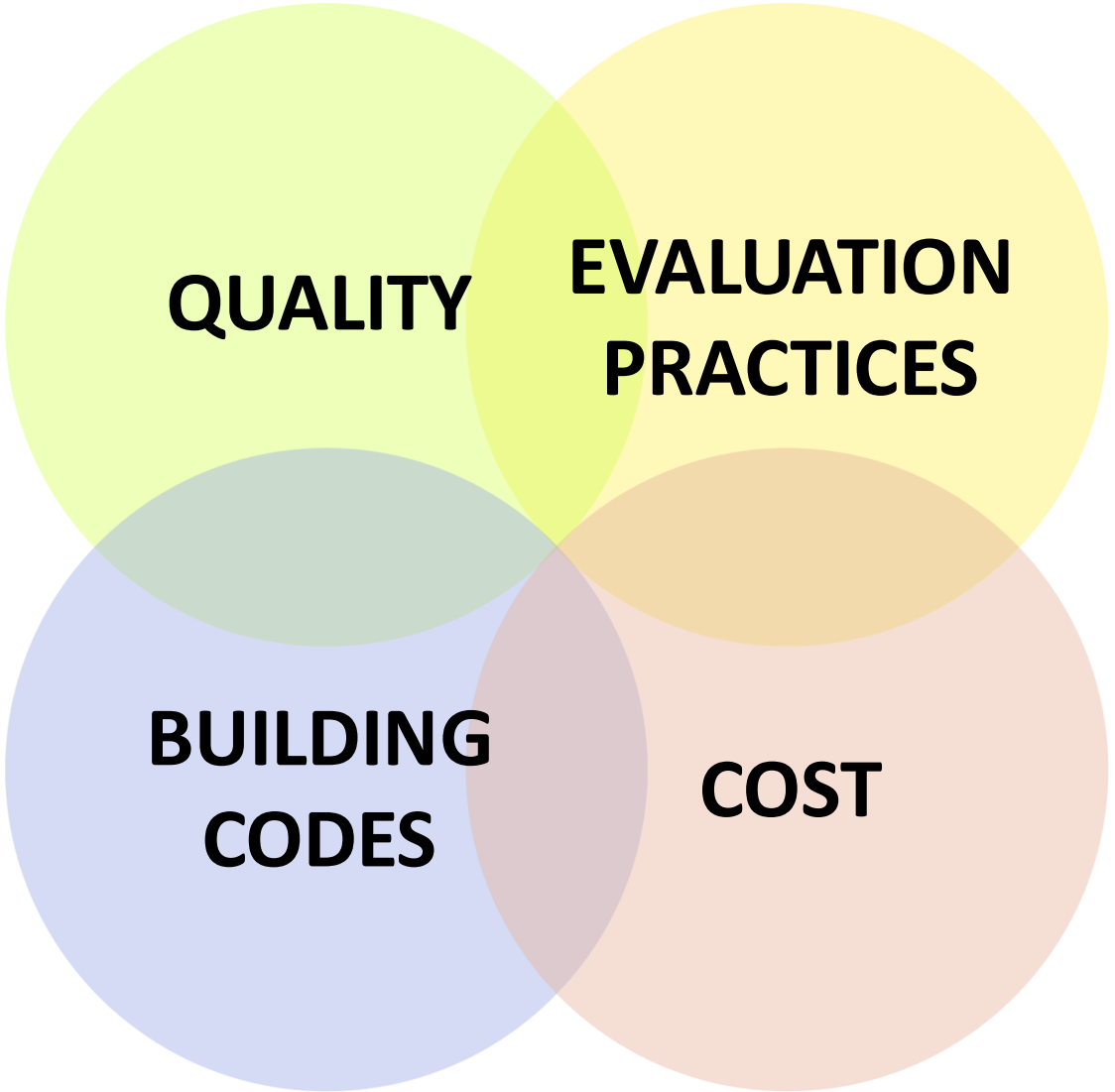
Construction

Special Inspection

Records Retention Policies

Maintenance

Joint Ownership Properties



Recertification for Occupancy

Structural Health Monitoring

Non-Destructive Evaluation of Foundations

Evacuation

Emergency Response

Investigation Overview: Potential Topics for CTS NCST Recommendations

Design

Code Enforcement

Construction

Special Inspection

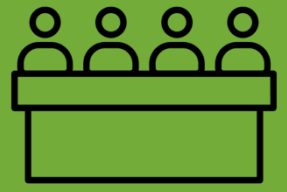
Records Retention Policies

Maintenance

Joint Ownership Properties

Interviews and Focus Groups

Organizational Outreach



Standards Committees

Recertification for Occupancy

Structural Health Monitoring

Non-Destructive Evaluation of Foundations

Evacuation

Emergency Response

2

Timeline of Site/Building History and Collapse

Source: NIST

2 Disclaimers

IMPORTANT: ALL DATA ARE PRELIMINARY

- These presentations describe preliminary data gathered to date as well as preliminary analyses of these data. Data and analyses are subject to change.
- Once all data are finalized and analyzed, they will inform a broader understanding of the likely technical cause or causes of the collapse – and NIST's findings and recommendations.
- These presentations do not constitute NIST findings or recommendations.
- All survey and interview data collection included a consent process that specifies the allowable uses of data and protections of respondents.
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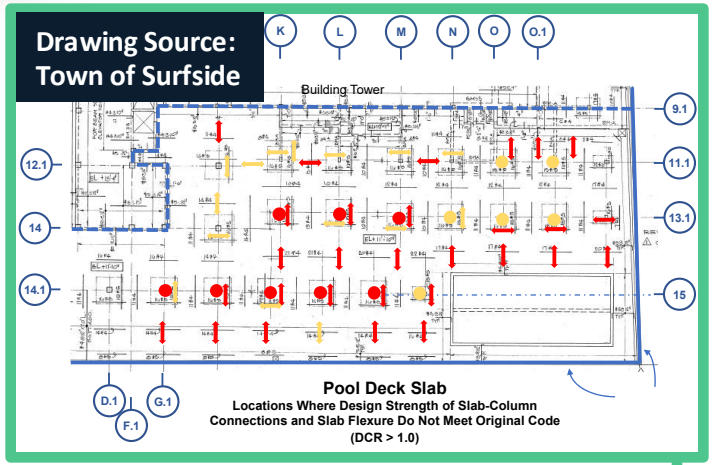
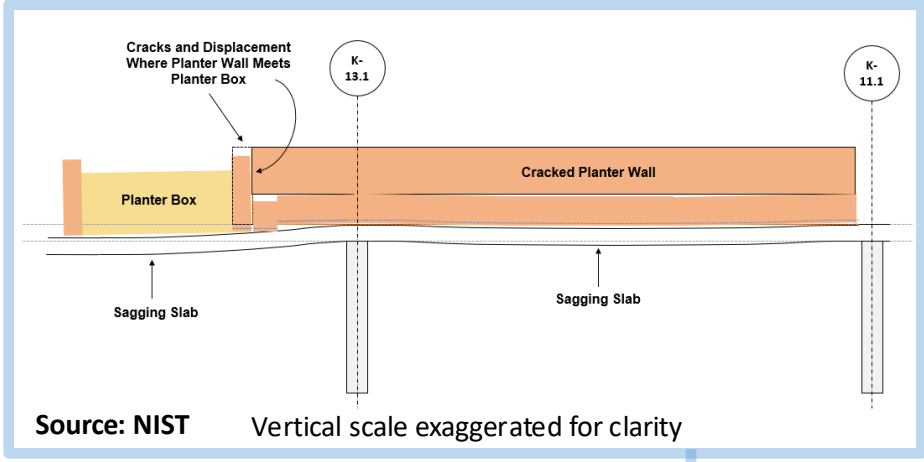
2 Timeline of the Site/Building History and Collapse





Source: NIST Vertical scale exaggerated for clarity

Source: 2021, A. Sarmiento

Site History 1900-1979

CTS Design & Construction 1979-1981

CTS Building History 1981-2021

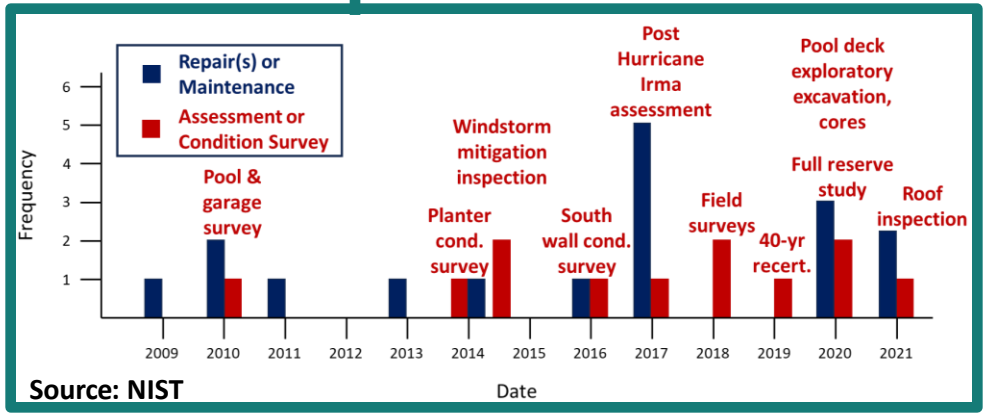
Champlain Towers South Collapse

Weeks/Days Prior to Collapse

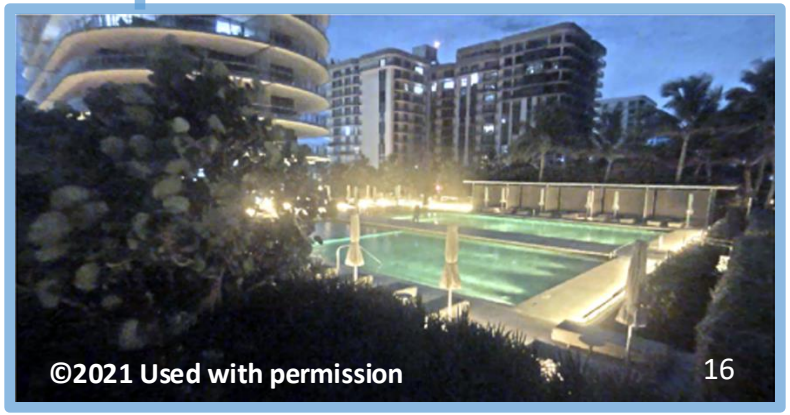
Hours/Minutes Prior to Collapse

Initiation & Progression

Source: USACE



Source: NIST



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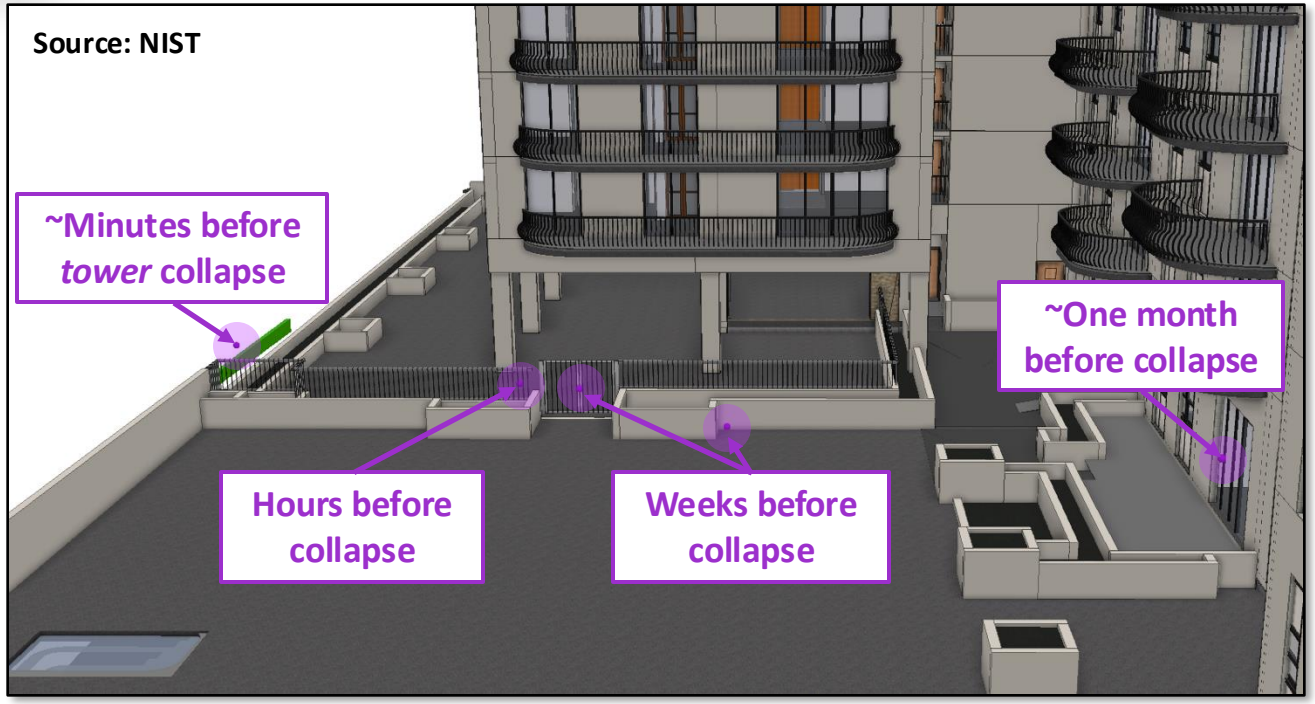
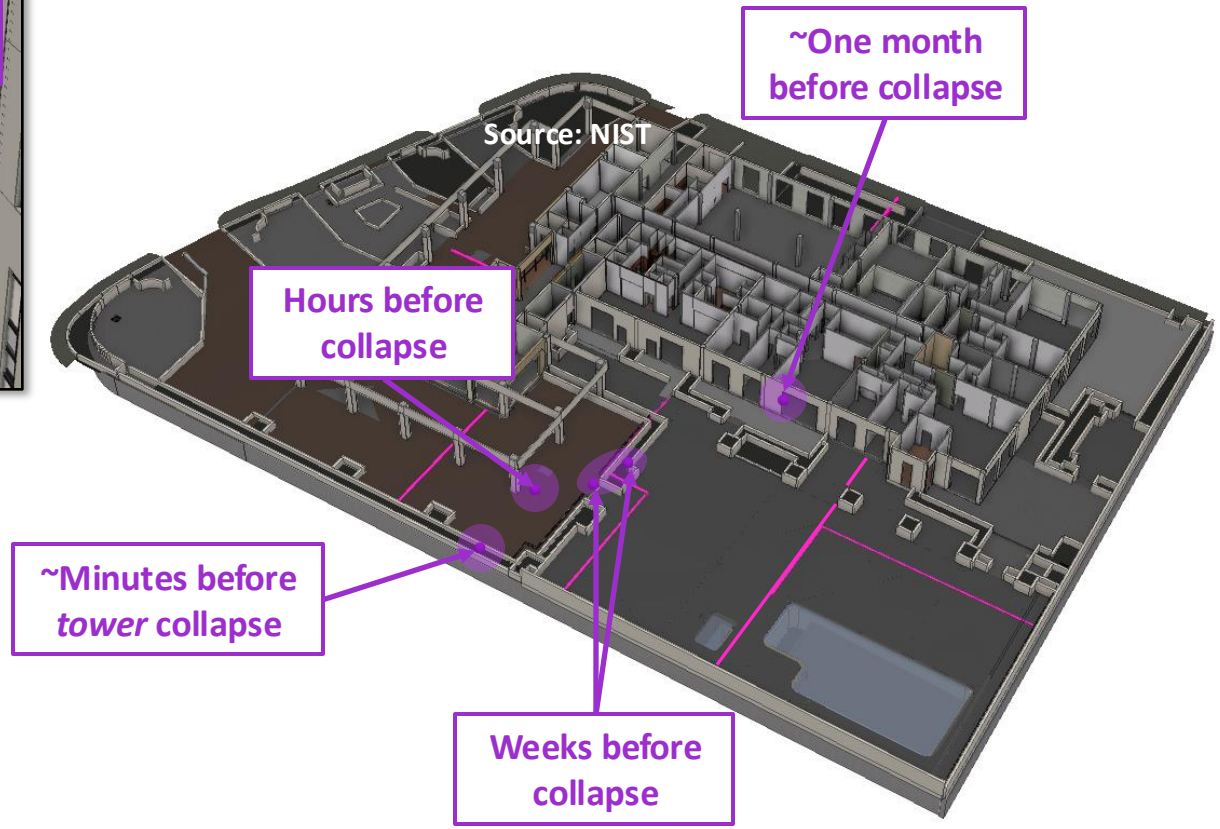
2 Timeline of Site/Building History and Collapse is Informed by Interviews, Audio-Visual Data, and Building Records





PRELIMINARY ANALYSIS RESULTS

2 Timeline of the Site/Building History and Collapse

Site History 1900-1979

CTS Design & Construction 1979-1981

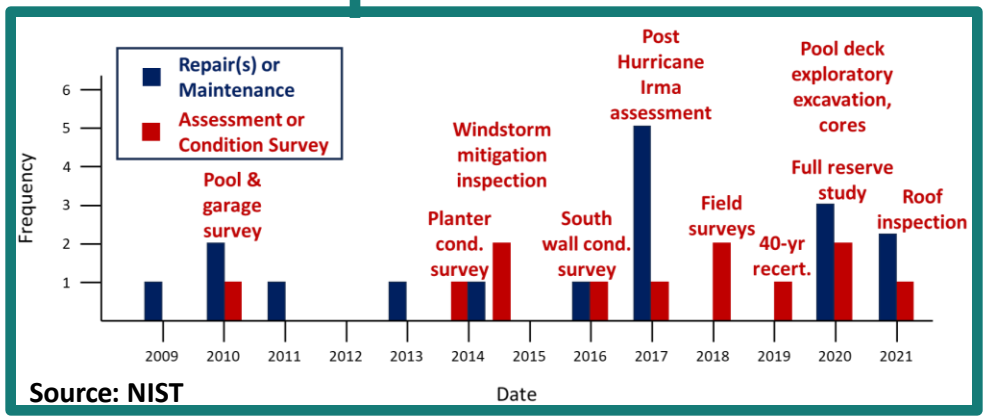
CTS Building History 1981-2021

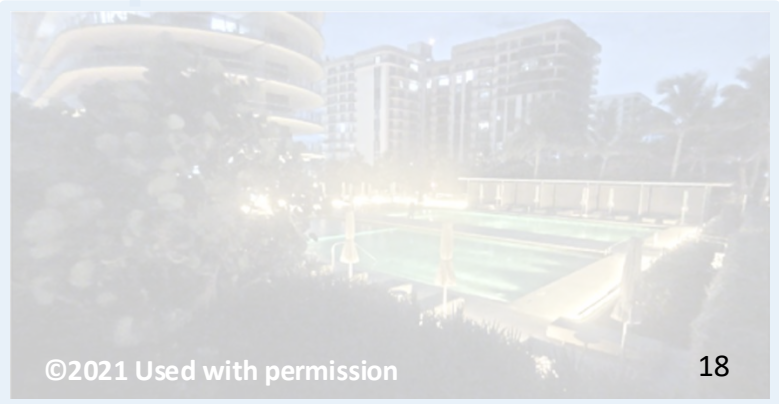
Champlain Towers South Collapse

Weeks/Days Prior to Collapse

Hours/Minutes Prior to Collapse

Initiation & Progression





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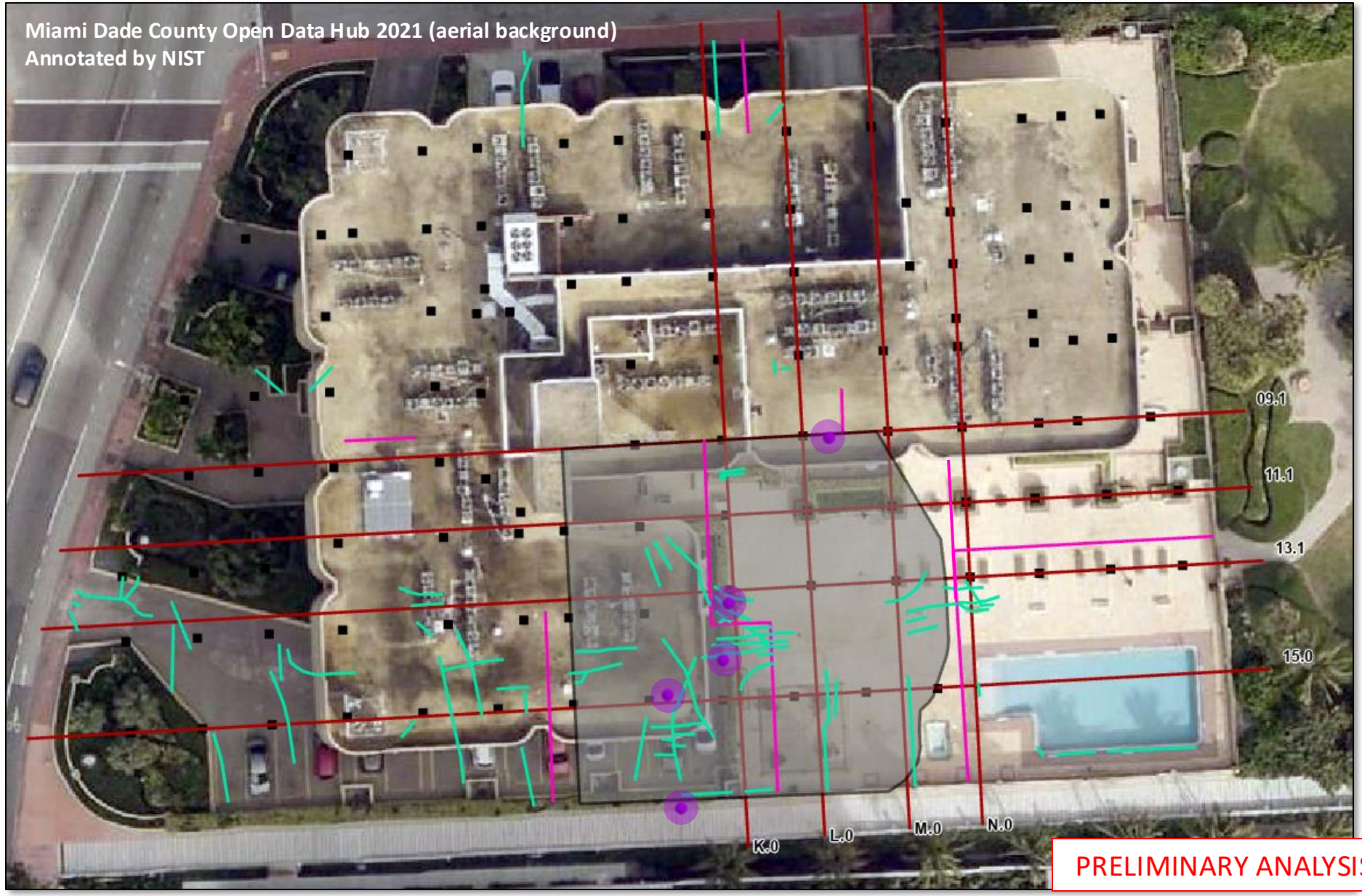

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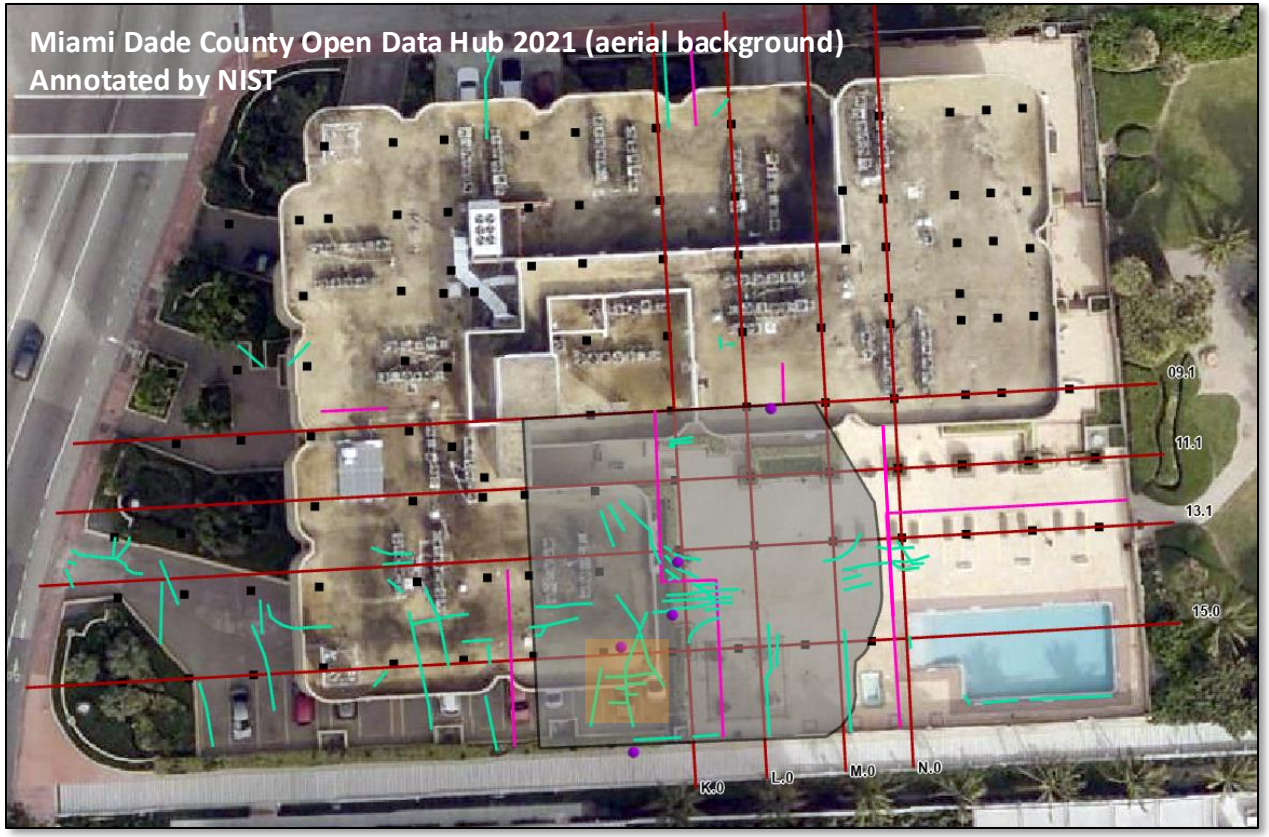

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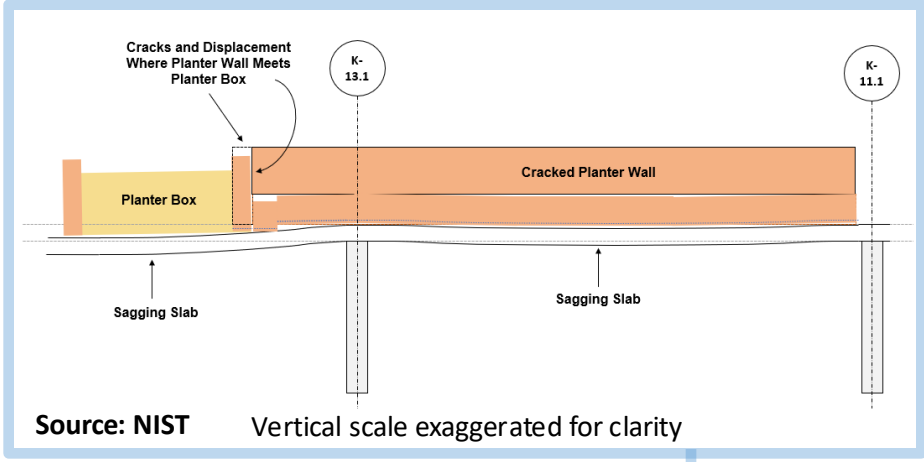


Source: NIST Vertical scale exaggerated for clarity

Source: 2021, A. Sarmiento

Site History 1900-1979

CTS Design & Construction 1979-1981

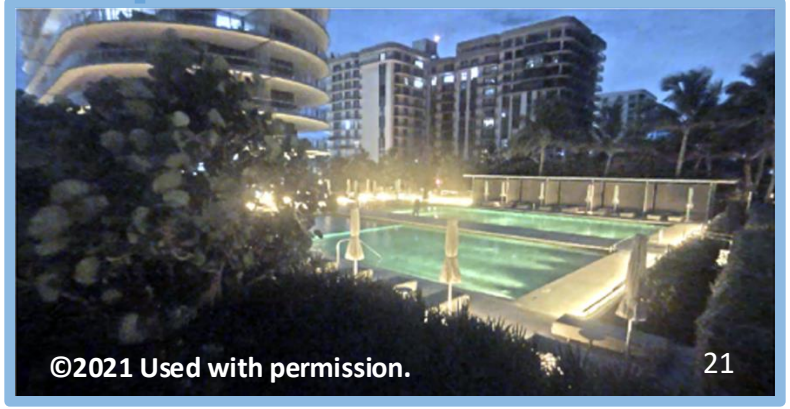
CTS Building History 1981-2021

Champlain Towers South Collapse

- **Weeks/Days Prior to Collapse**
- **Hours/Minutes Prior to Collapse**
- **Initiation & Progression**

Source: USACE

Source: NIST



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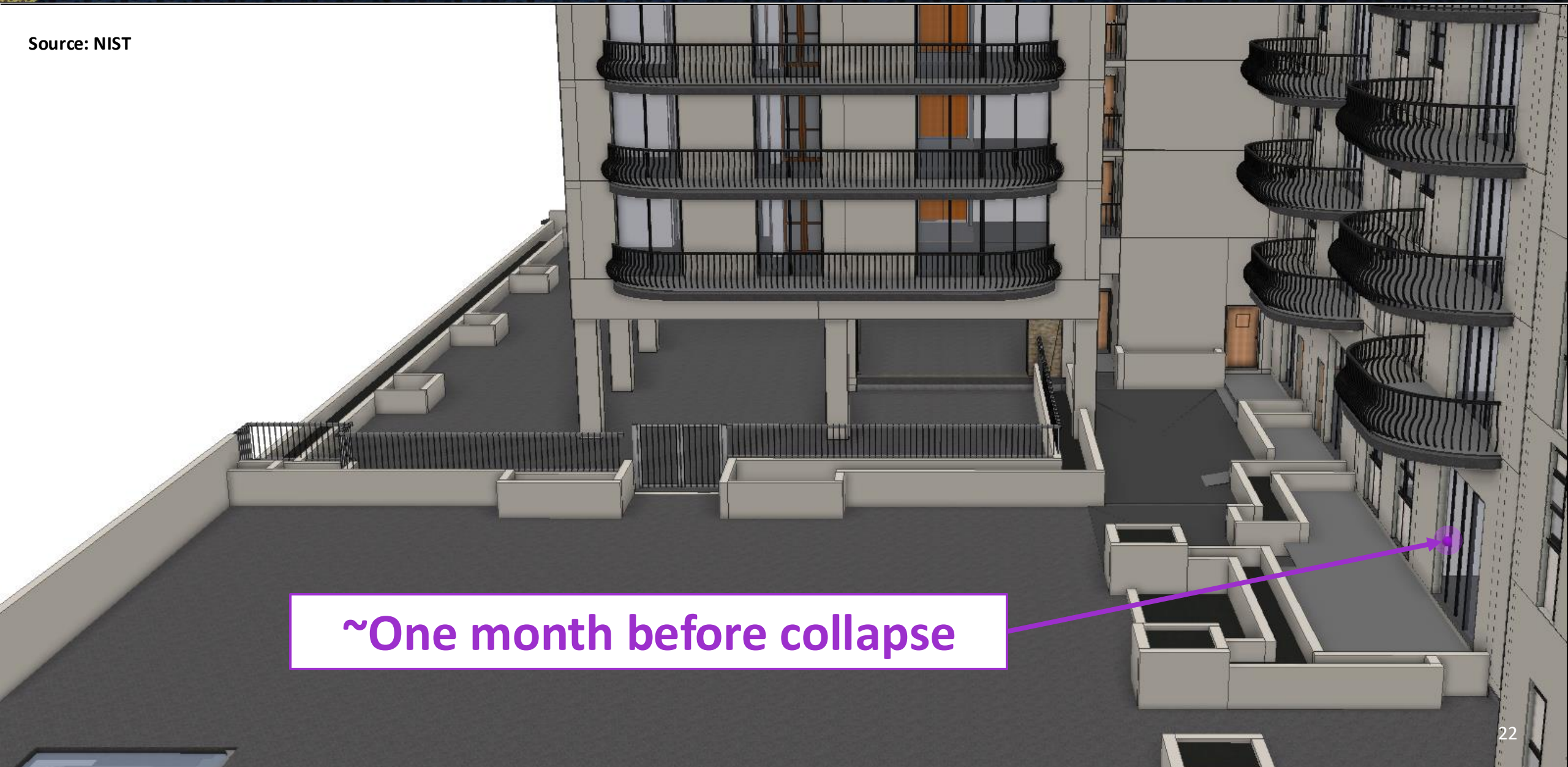

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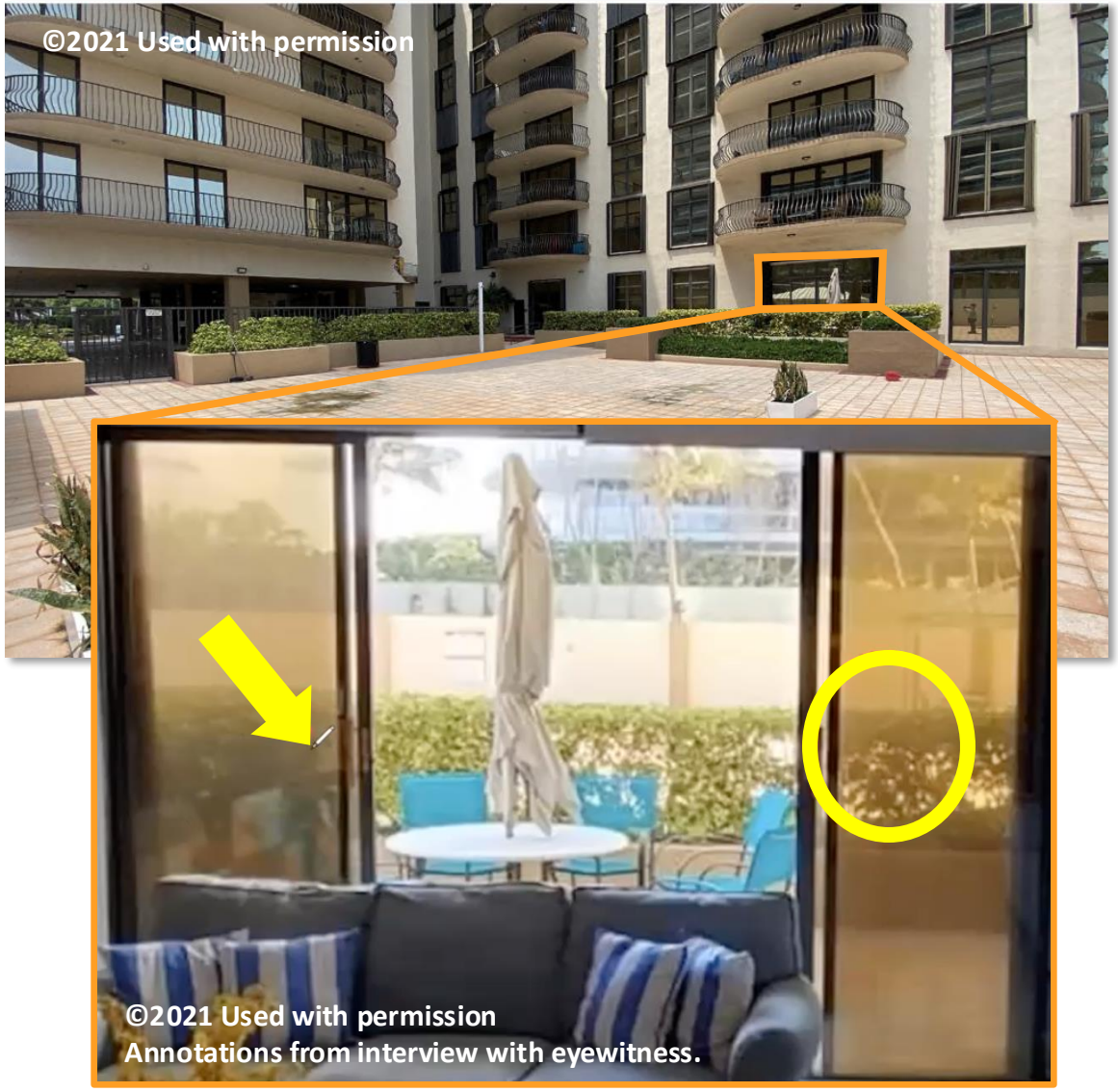

PRELIMINARY ANALYSIS RESULTS

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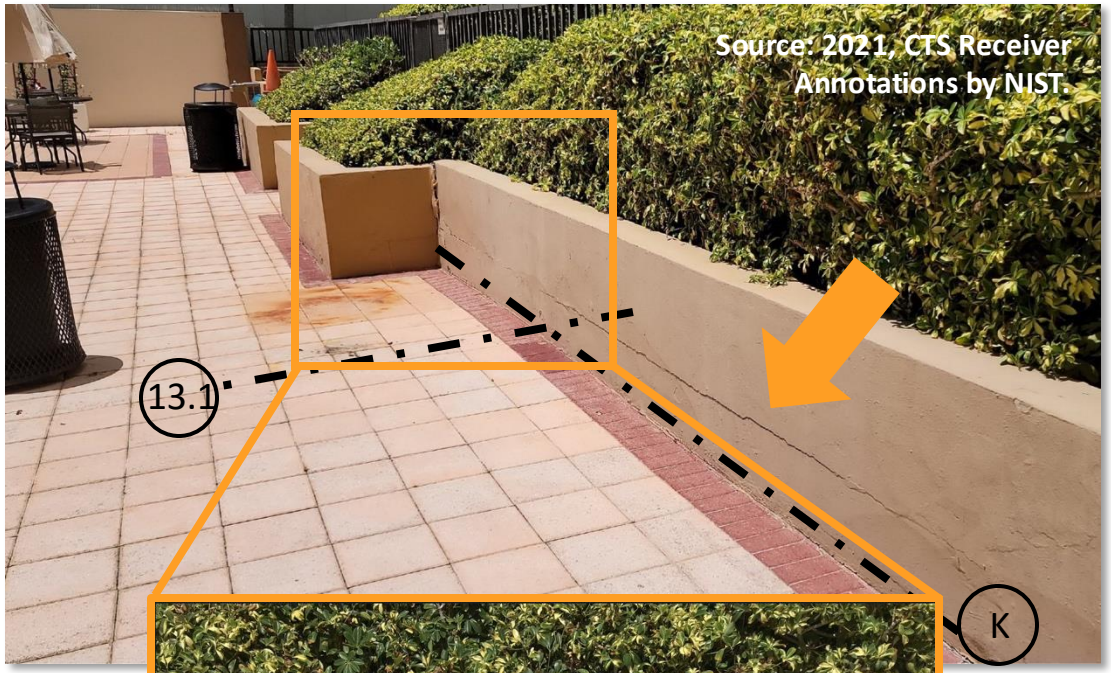

Source: 2021, CTS Receiver Annotations by NIST.

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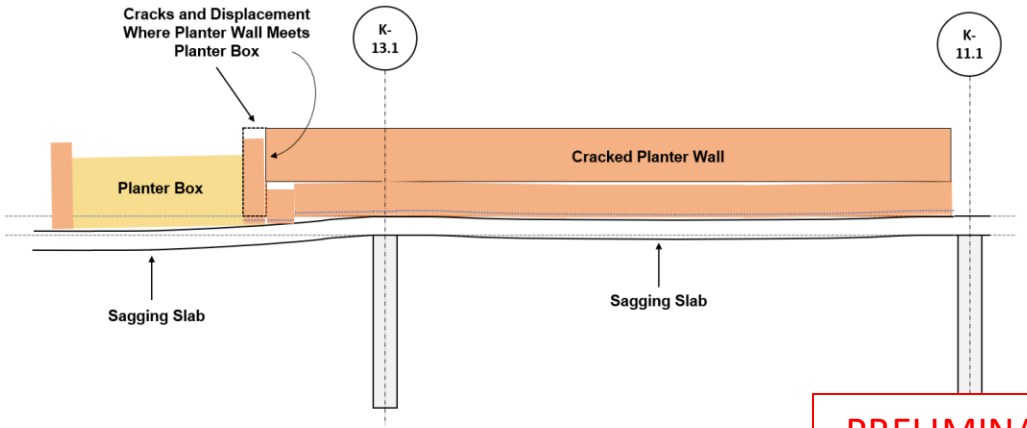

Source: NIST (vertical scale exaggerated for clarity)

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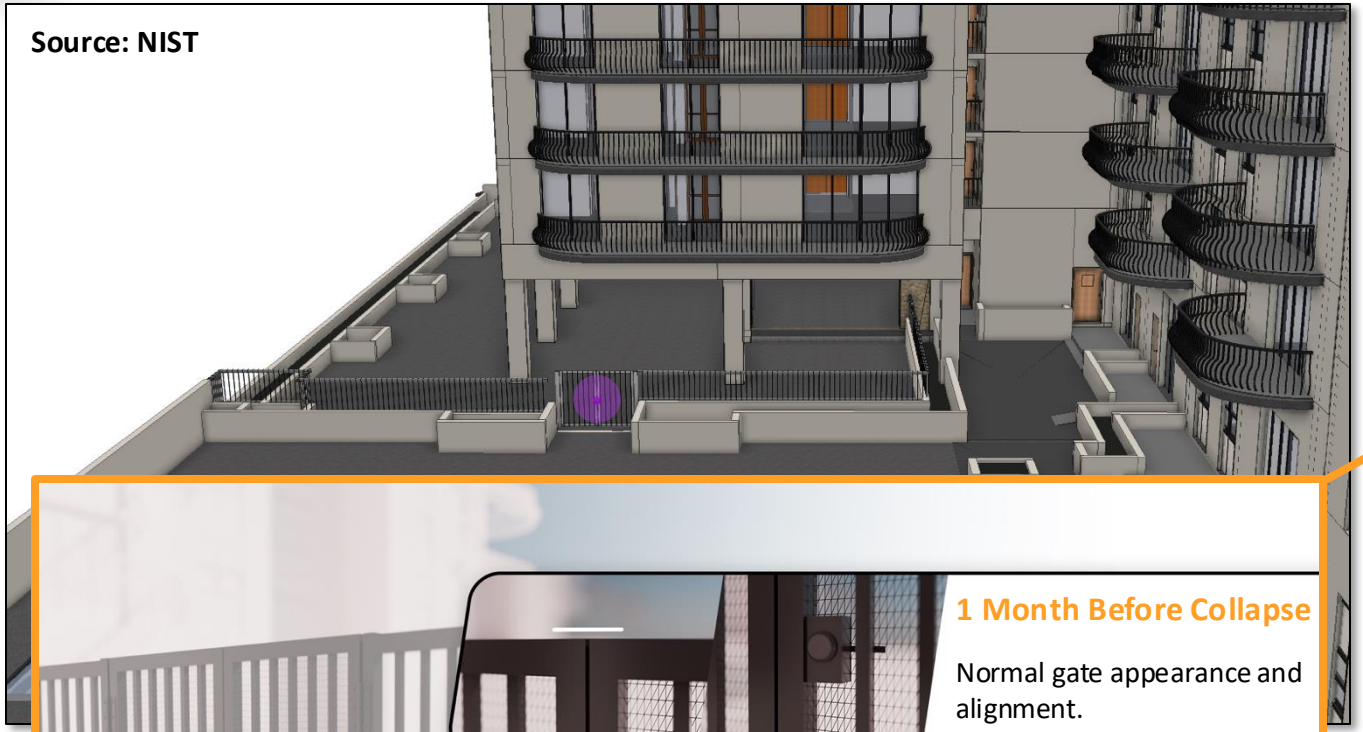

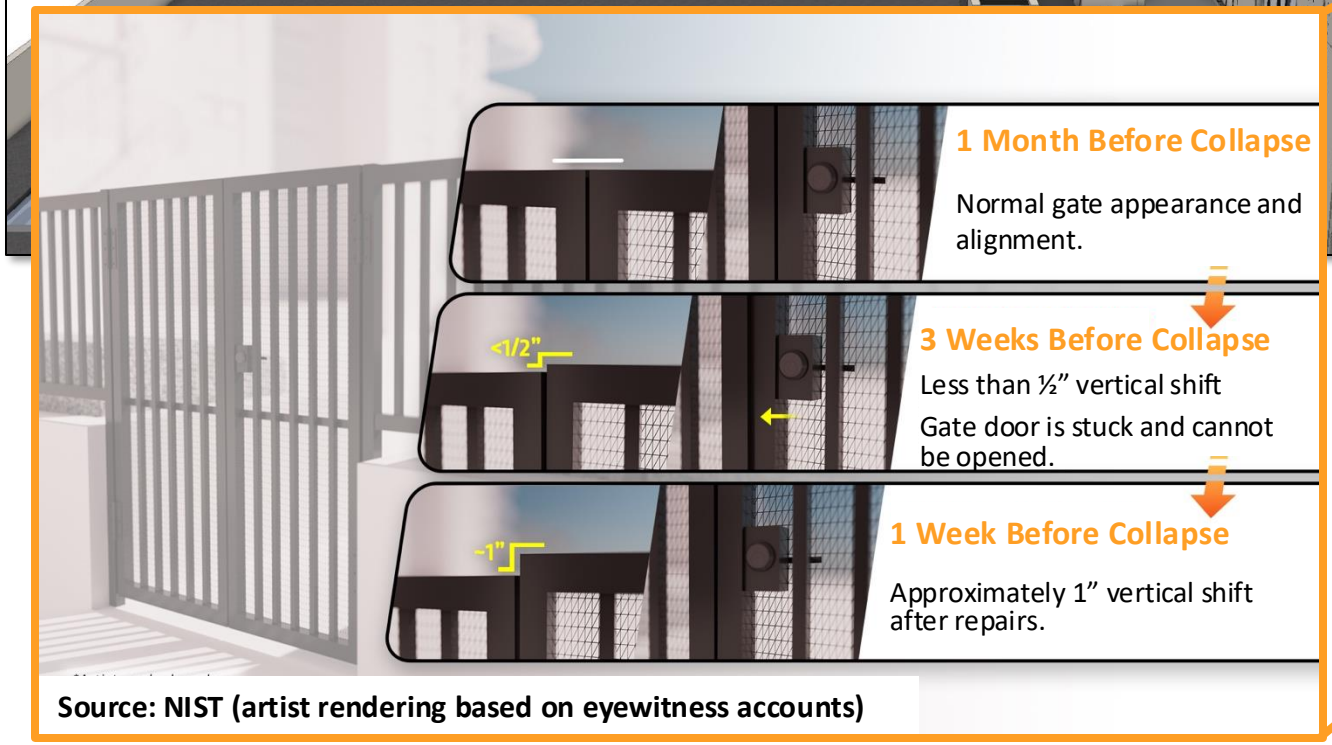

Source: NIST (artist rendering based on eyewitness accounts)

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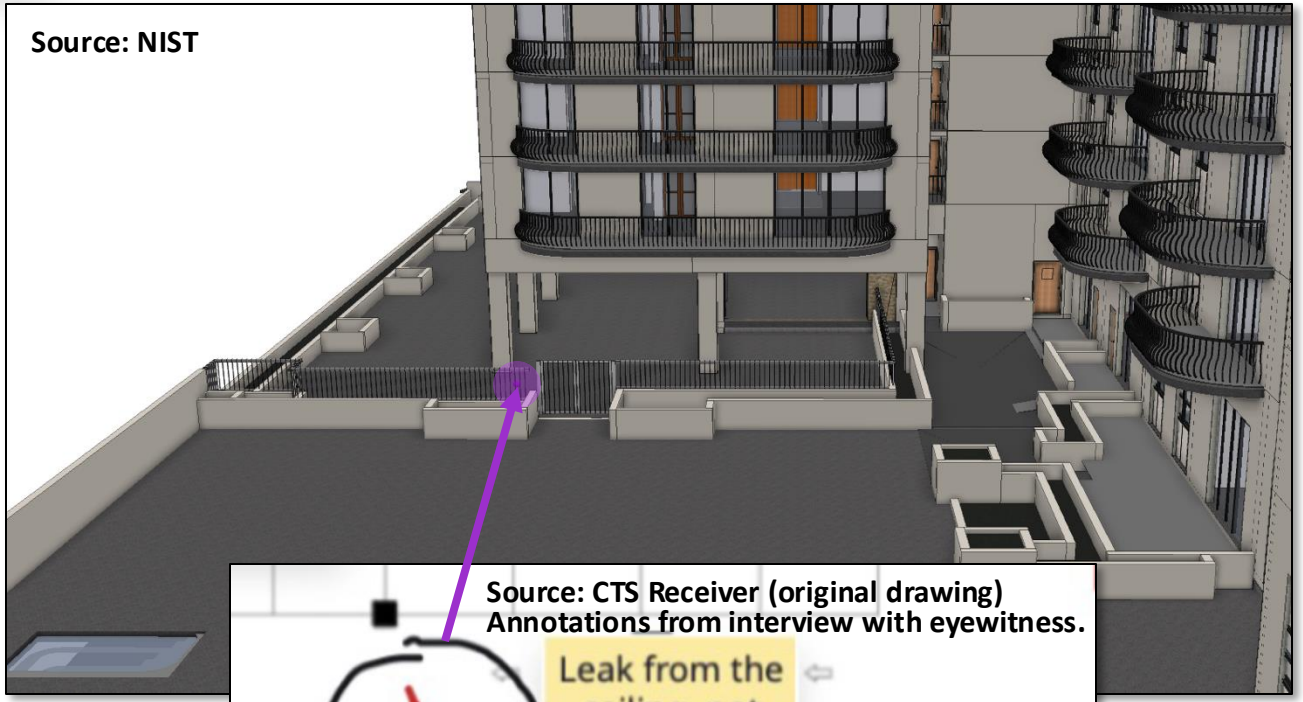

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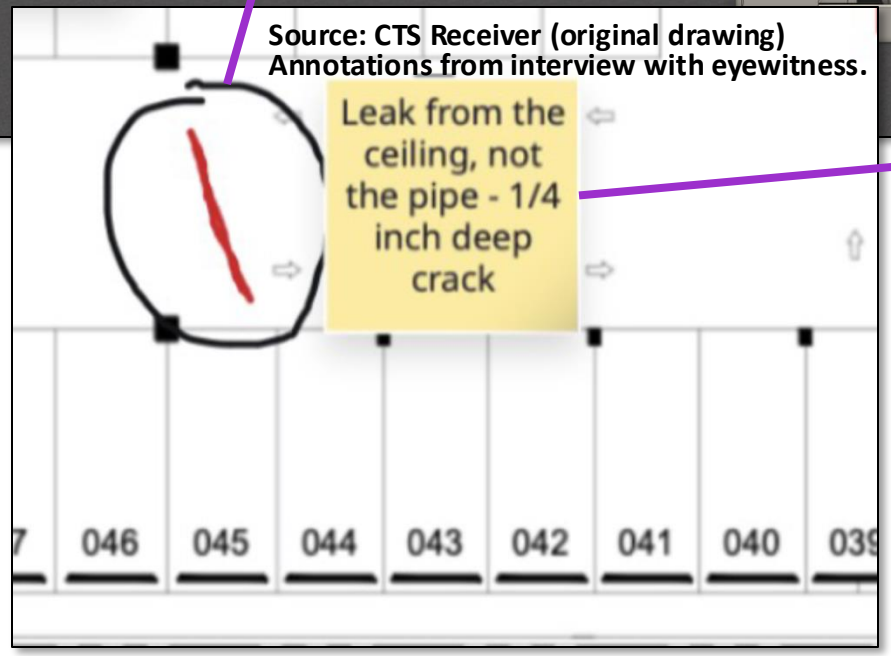


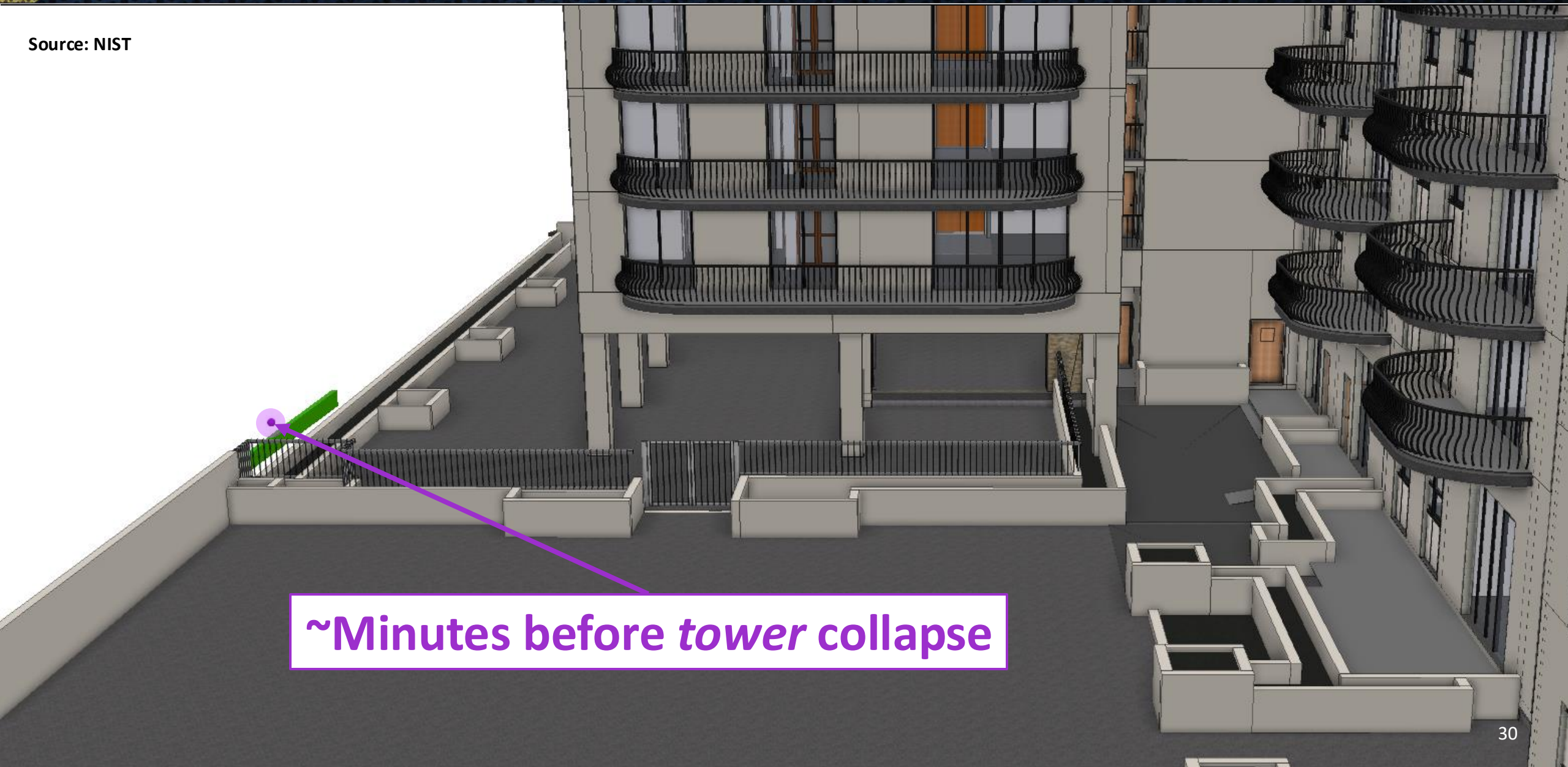
Source: CTS Receiver (original drawing)
Annotations from interview with eyewitness.

Miami Dade County Open Data Hub 2021 (aerial background)
Annotated by NIST

PRELIMINARY ANALYSIS RESULTS

Timeline of Site/Building History and Collapse is Informed by Interviews, Audio-Visual Data, and Building Records

Source: NIST



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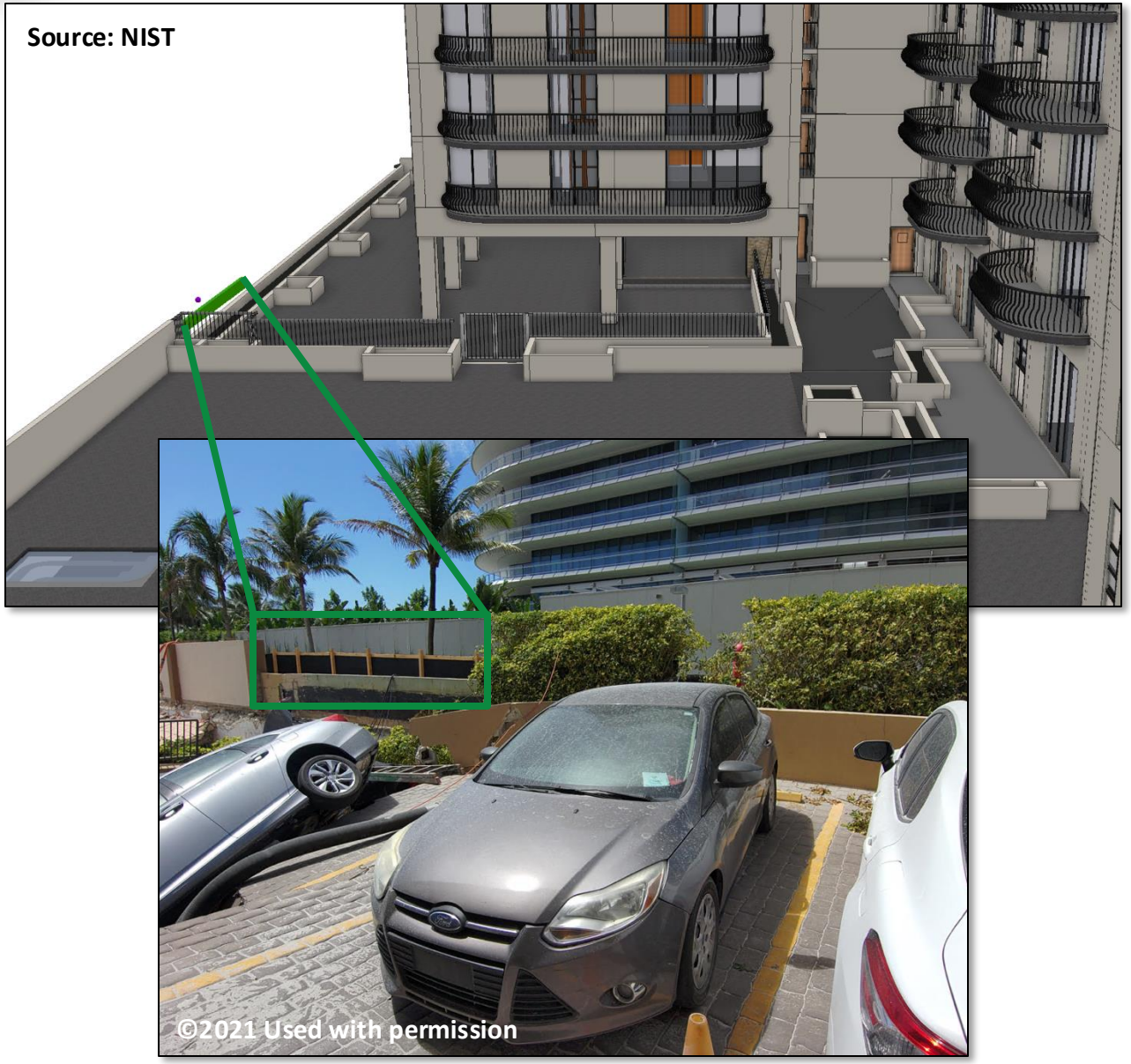

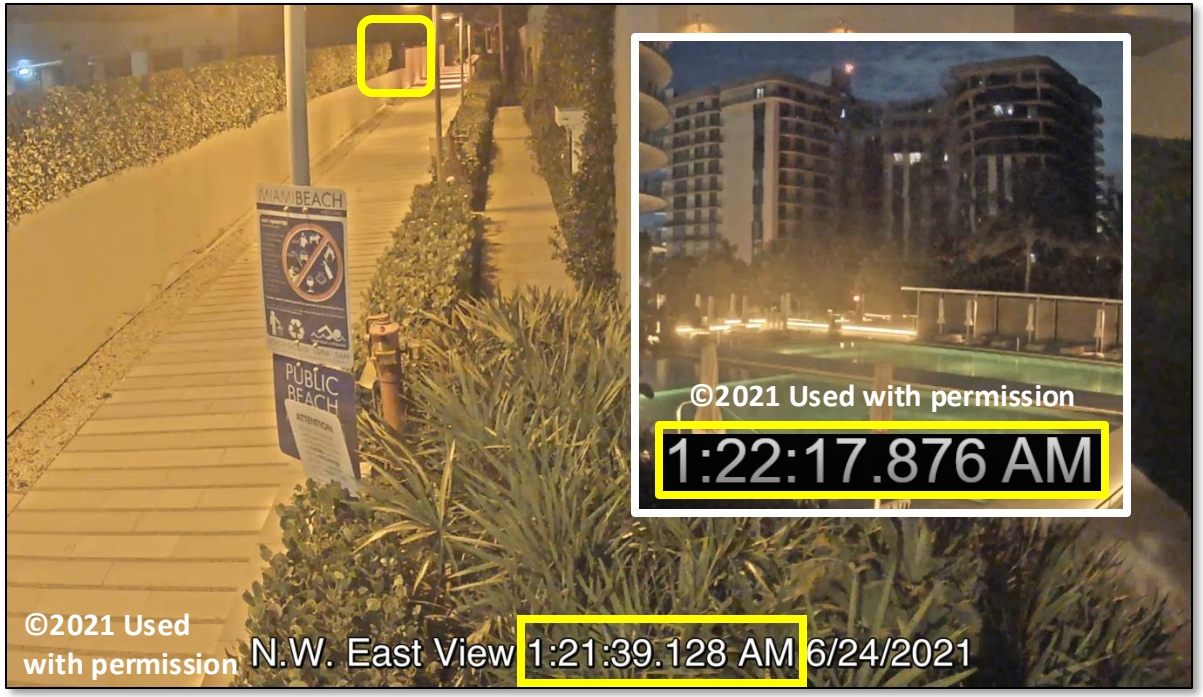

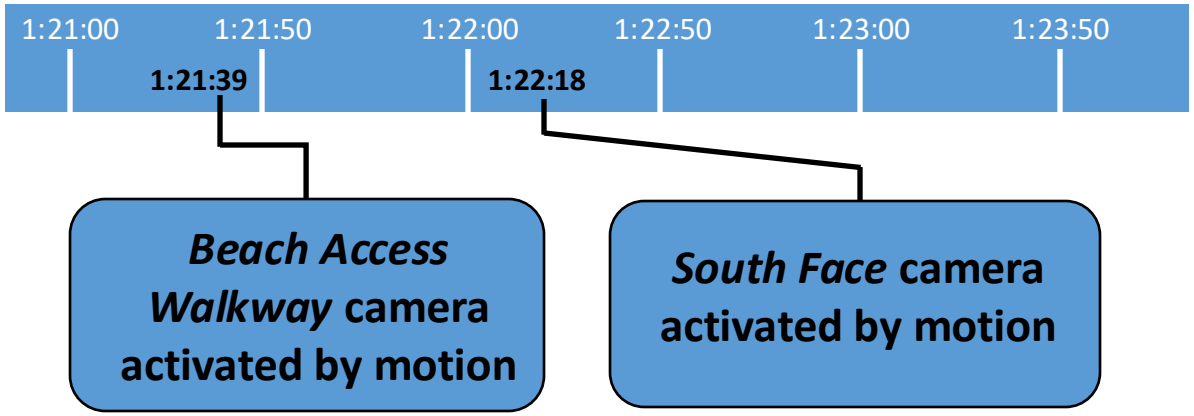

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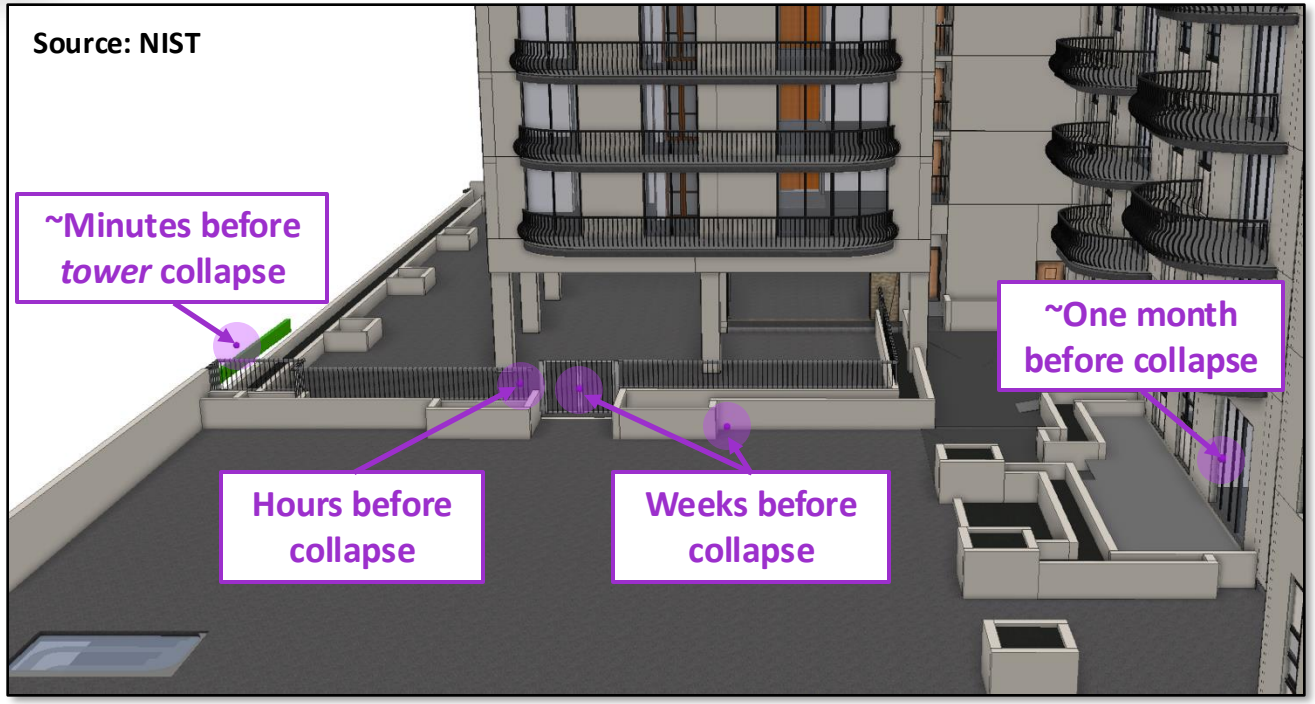

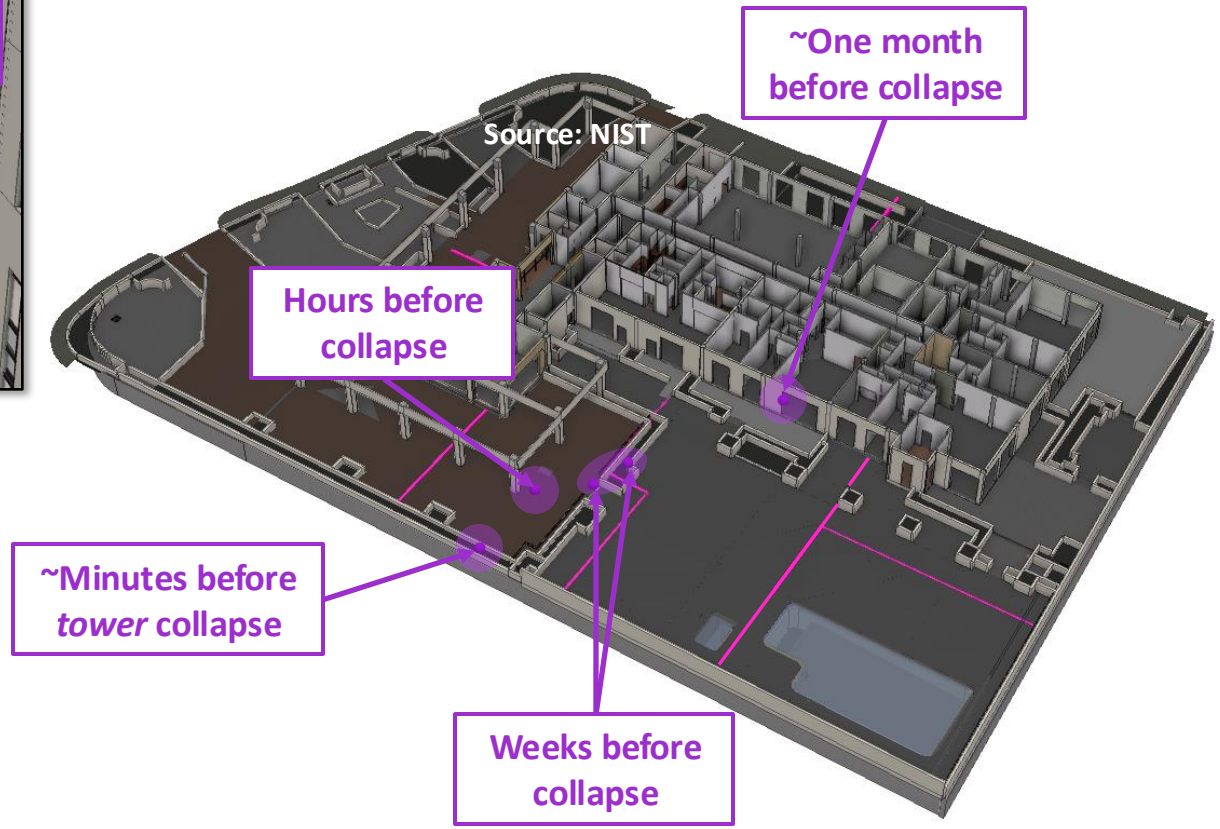

PRELIMINARY ANALYSIS RESULTS

CONTENT WARNING:

The following slides contain
images, video footage, and other
content that some may find disturbing.

Participants desiring to skip this section,
please proceed to Section 4 of the talk or step away
from the live presentation for approximately ten minutes.

3 Failure Initiation and Progression Updates

South Face Camera, Night of the Partial Collapse

3 Summary from June 2025 Update

1. Collapse Sequence

- The pool deck collapsed more than four minutes before the general collapse of the tower.
- In the tower collapse, Grid Line 9.1 started to drop a second, or a bit more, before 1:22:17 am.
  - The columns on Grid Line K and/or L dropped first.
  - The initial column failures were low in the building.
- There were severe structural movements in the interior of the tower before the precipitous drop of the tower at Grid Line 9.1.

2. Failure Initiation

- The investigation rigorously examines about two dozen possible initiating events for the failure.

Examples lower likelihood initiating events include:

- Karst formation (sinkholes).
- Pile failure.
- Separation of the Level 1 slab from the south basement wall.

Examples of higher likelihood initiating events include:

- Failure of a typical slab-column connection in the pool deck.
  - Design understrength, deviations in construction from requirements, loads added to the pool deck, and material degradation led to critically low margins of safety at the time of failure.
- Shortening of a lower-level column in the tower.
- Local crushing of a slab-beam-column joint at Level 1 on Grid Line 9.1.
  - Design understrength and construction deviations reduced the strength of the structural elements in these latter two initiating events. We continue to assess the impacts of material degradation.

3. Failure Progression

- The vulnerability of the structure where the pool deck met the tower allowed the collapse of the pool deck to progress into the tower.
- The poor resistance to progressive collapse allowed the collapse to spread through the east wing of the tower.

PRELIMINARY ANALYSIS RESULTS

3 Summary from June 2025 Update

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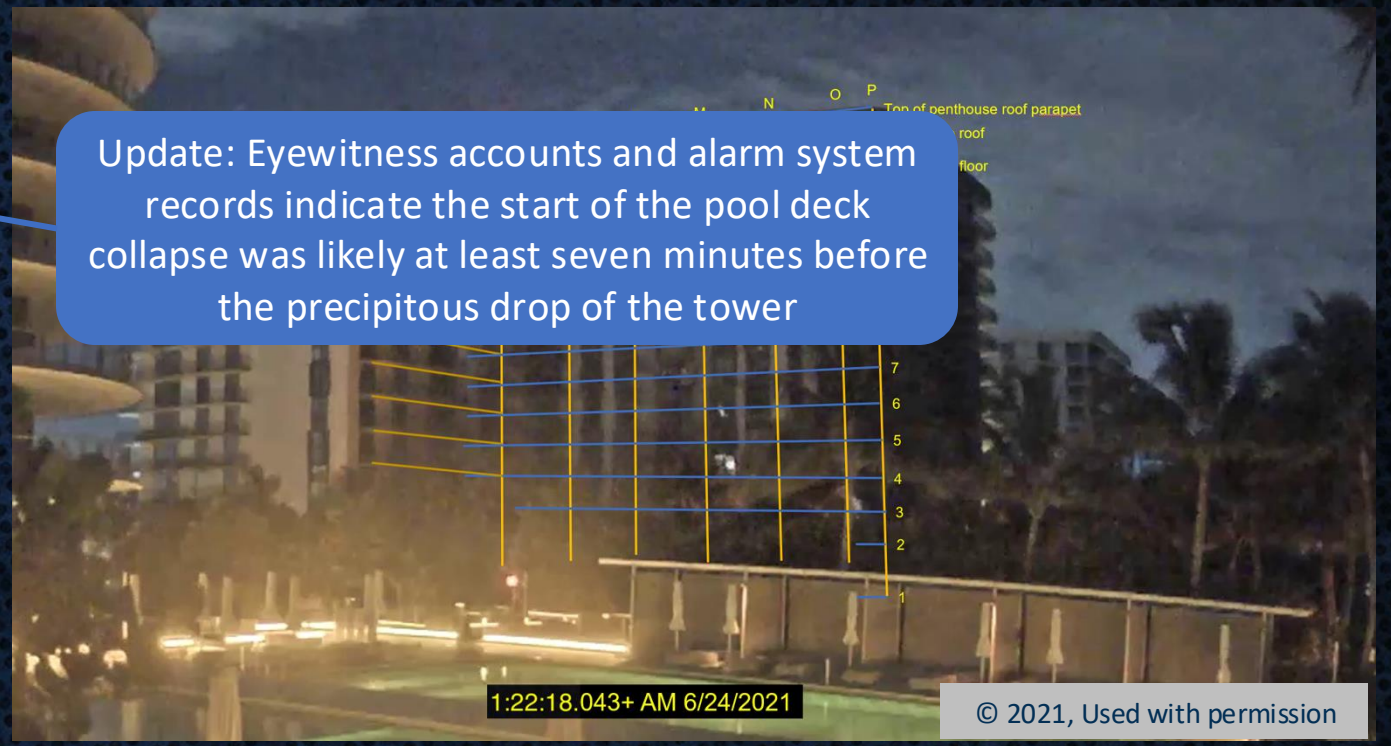


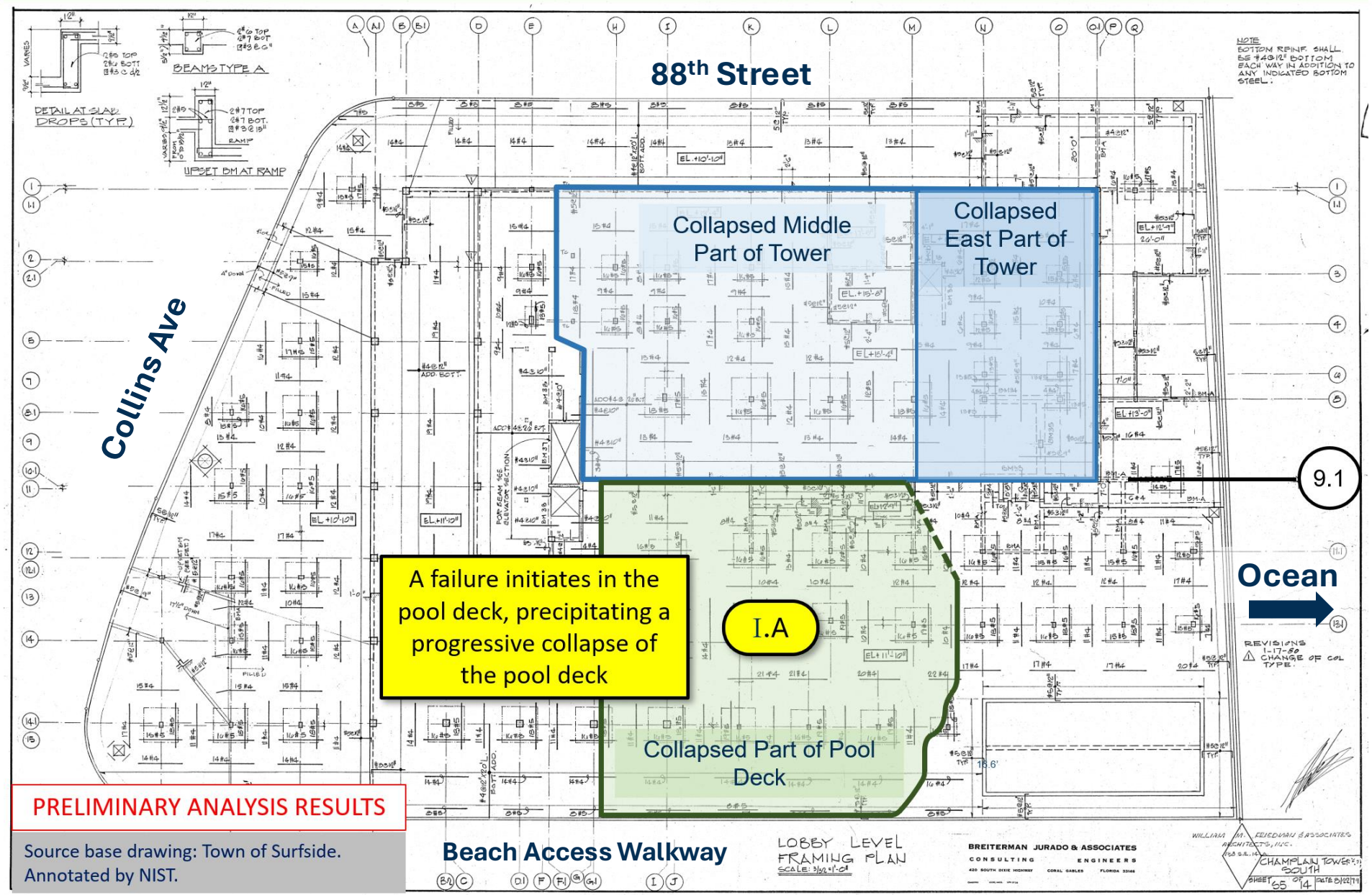
PRELIMINARY ANALYSIS RESULTS

Where Did the Failure Initiate?

- Scenario I: In the Pool Deck
- Scenario II: In the Tower

Source: 2021, A. Sarmiento

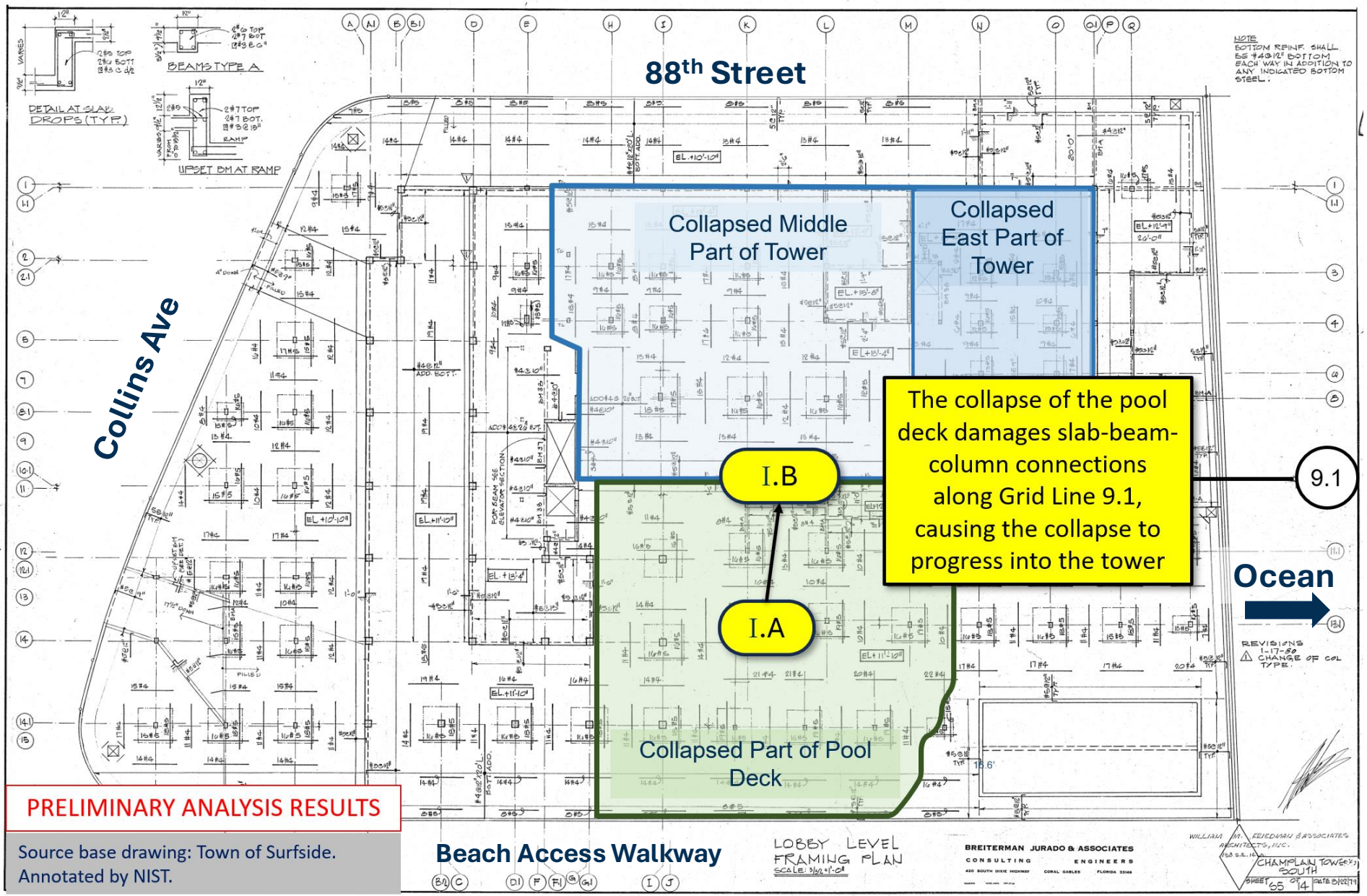
3 Scenario I: Failure Initiation in the Pool Deck



PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

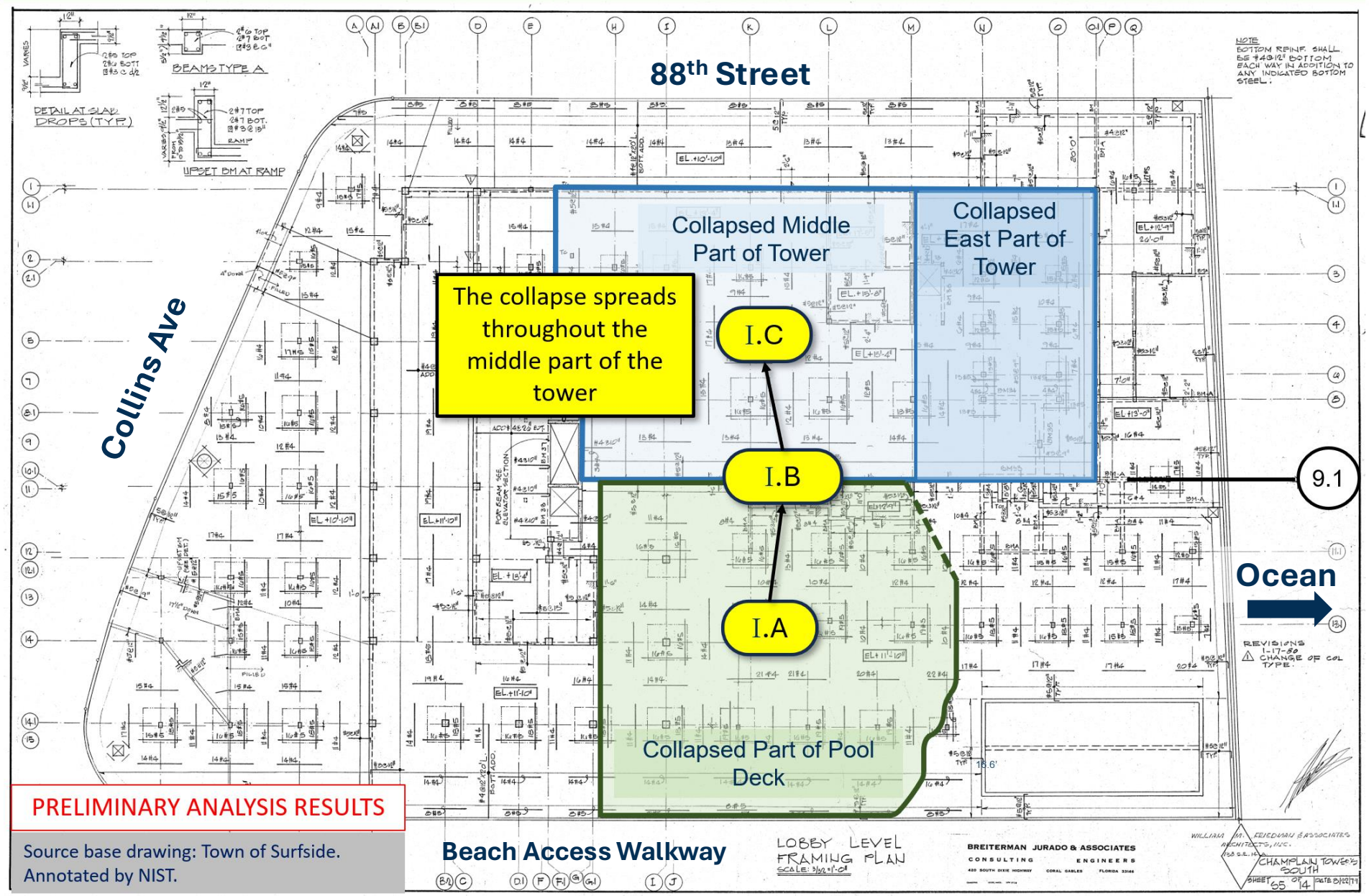
3 Scenario I: Failure Initiation in the Pool Deck



PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

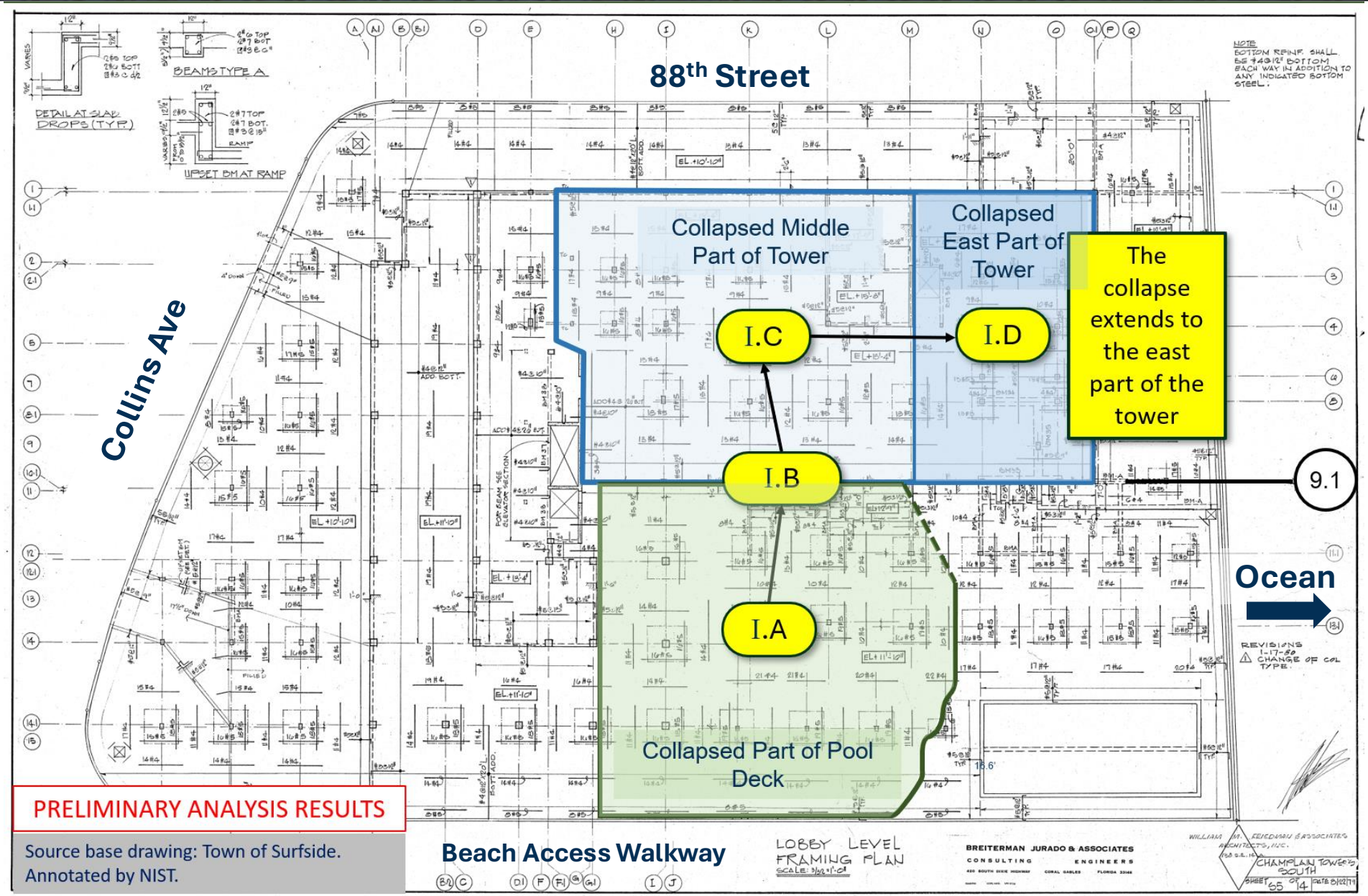
3 Scenario I: Failure Initiation in the Pool Deck



PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

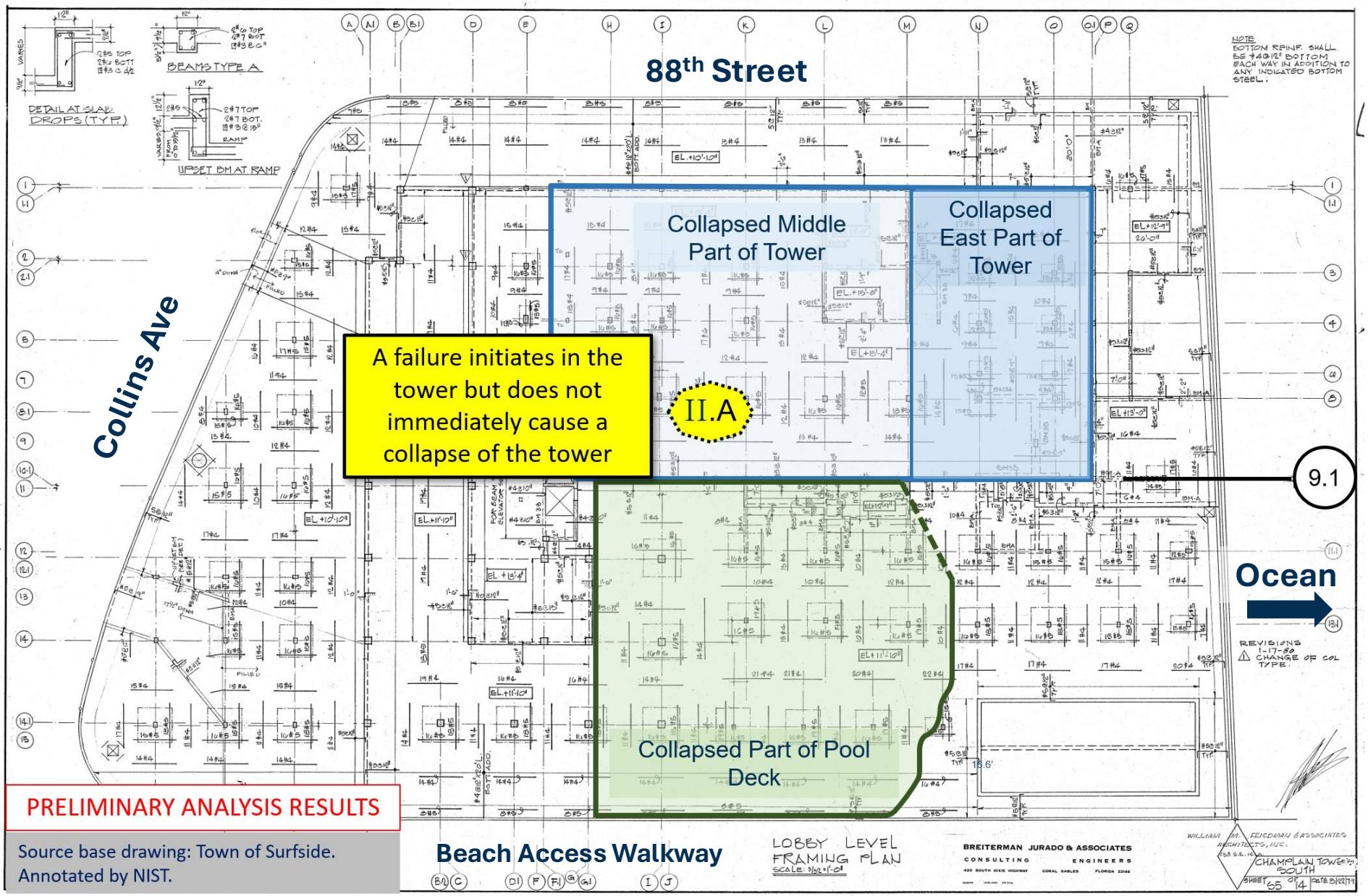
3 Scenario I: Failure Initiation in the Pool Deck



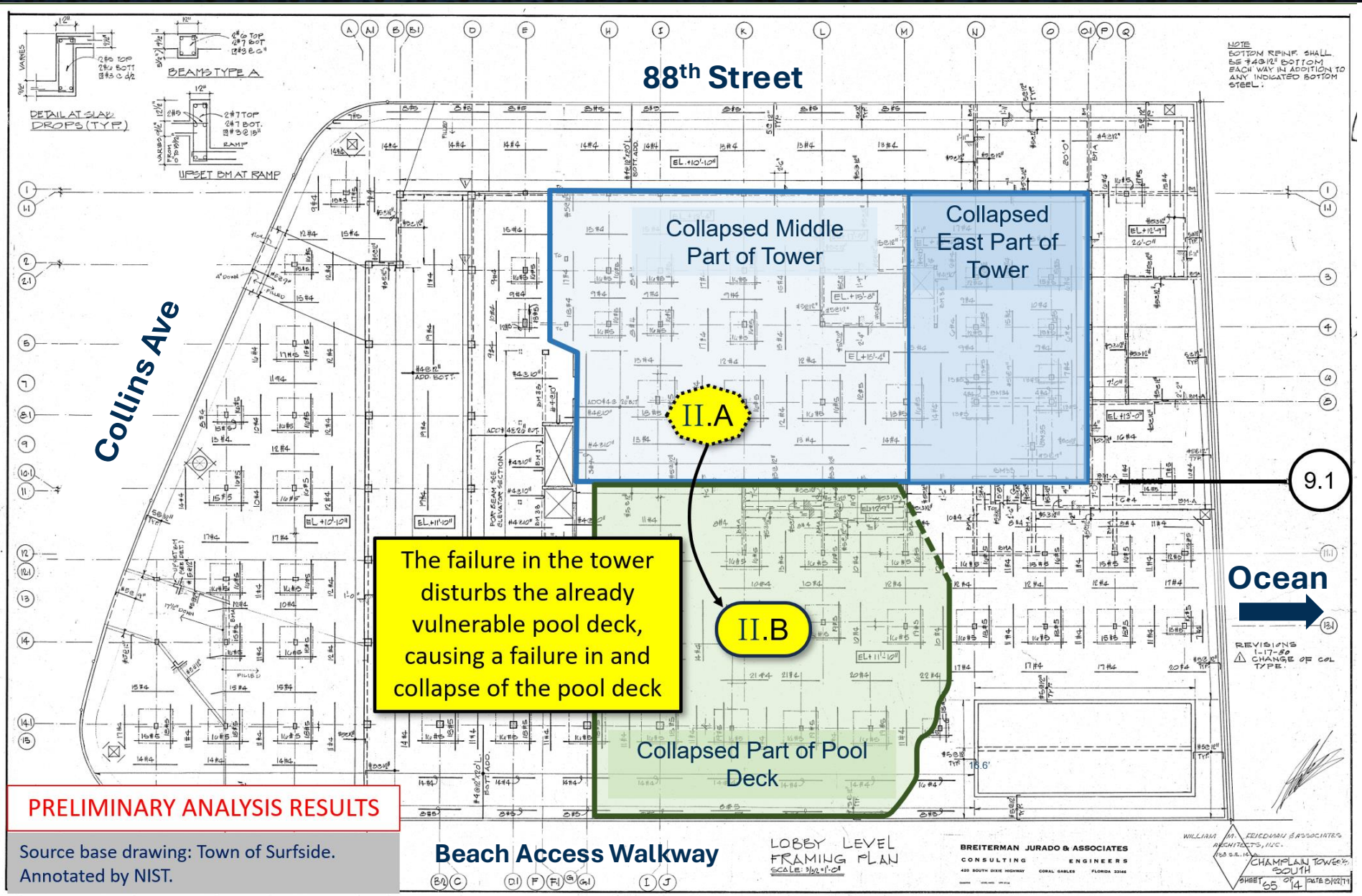
PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

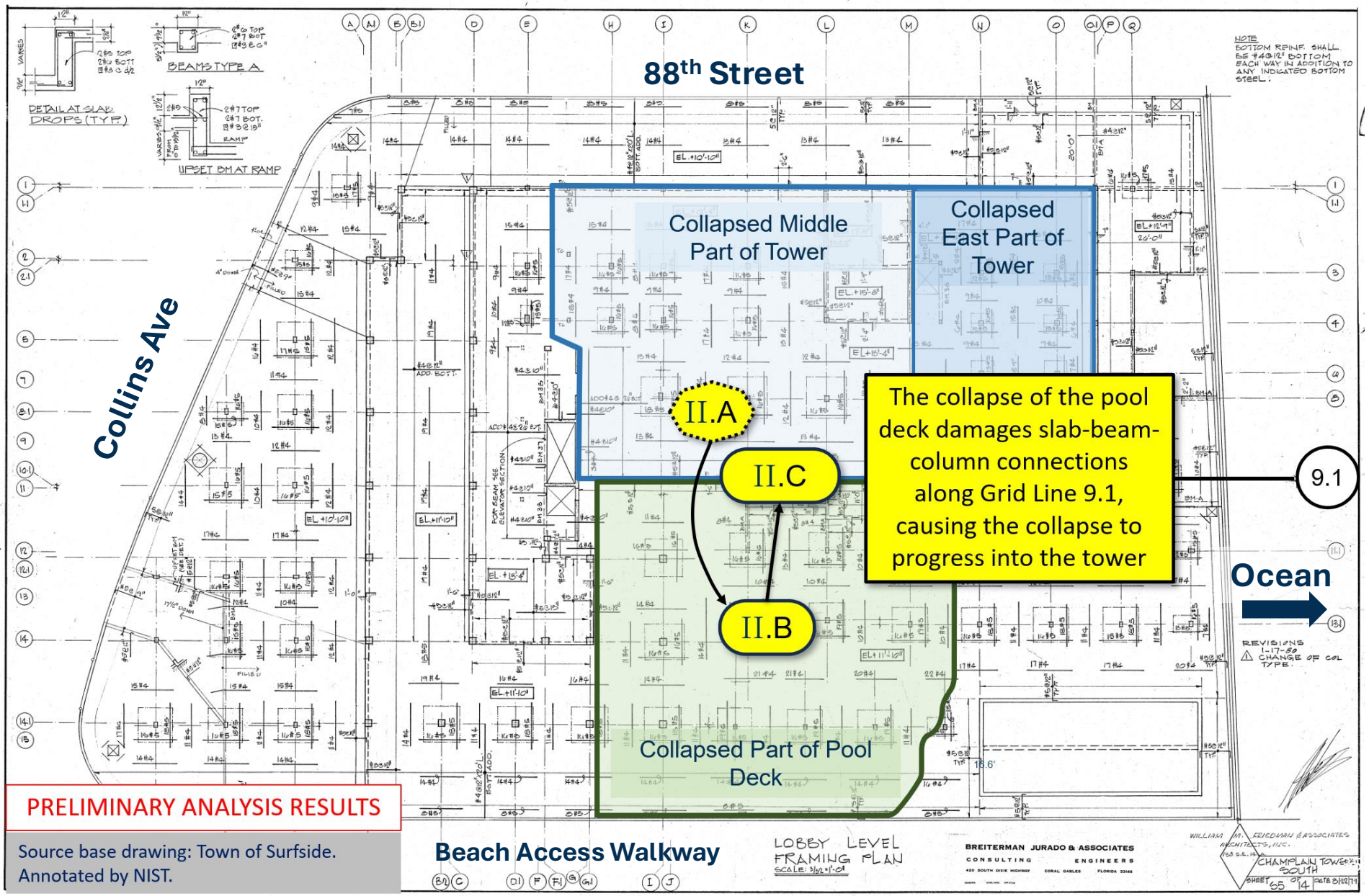
3 Scenario II: Failure Initiation in the Tower



3 Scenario II: Failure Initiation in the Tower



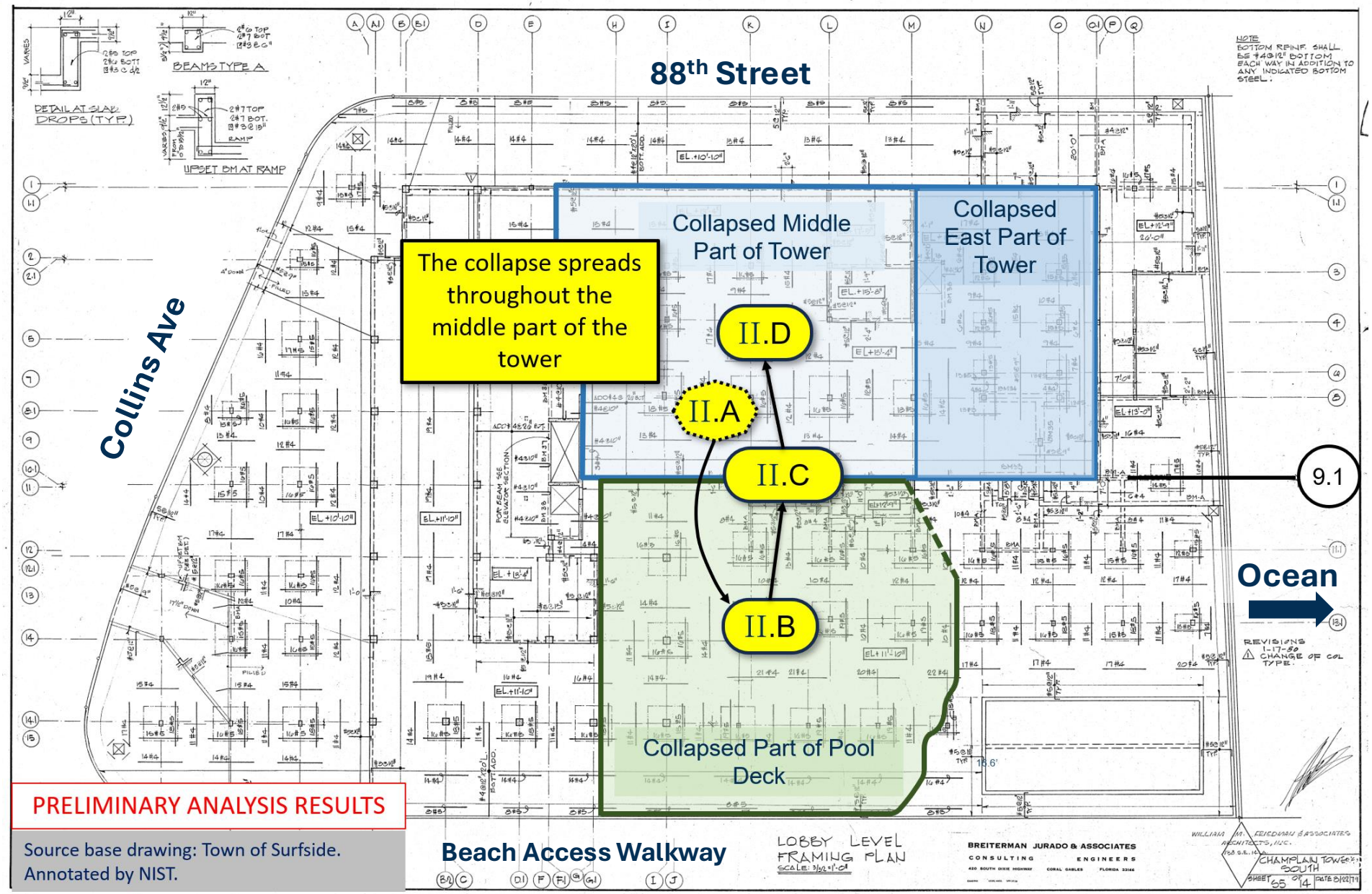
Scenario II: Failure Initiation in the Tower



PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

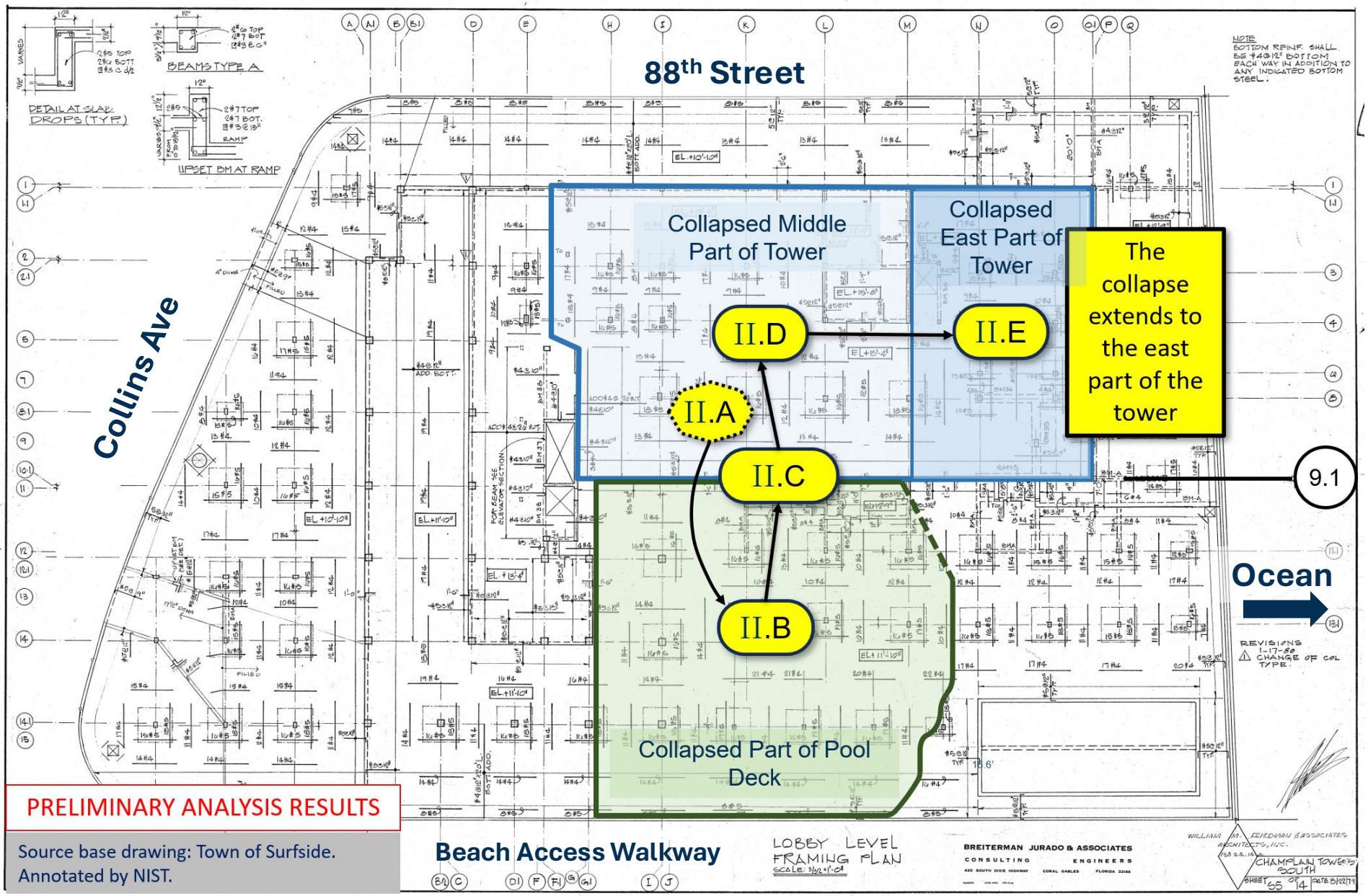
3 Scenario II: Failure Initiation in the Tower



PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

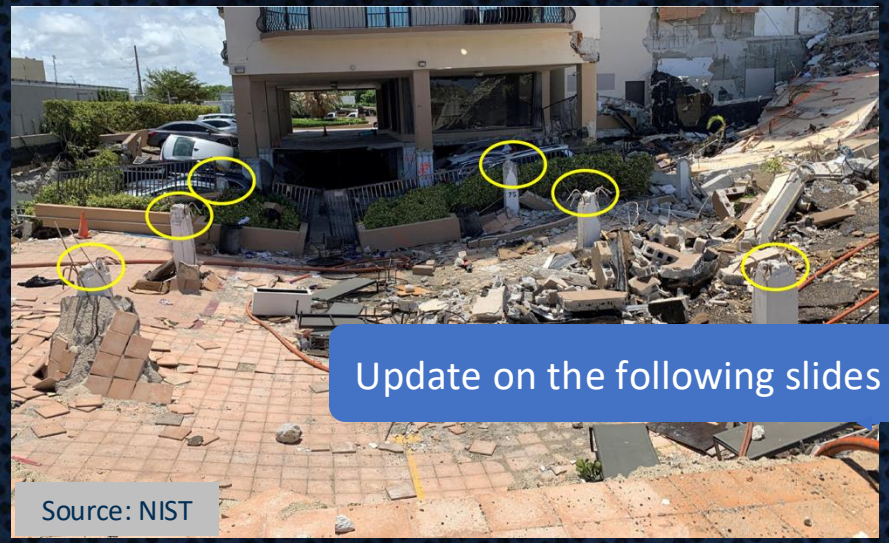
Scenario II: Failure Initiation in the Tower

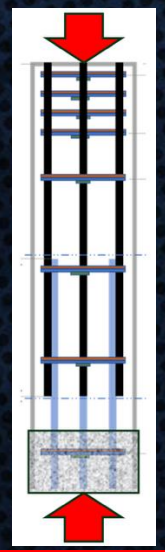


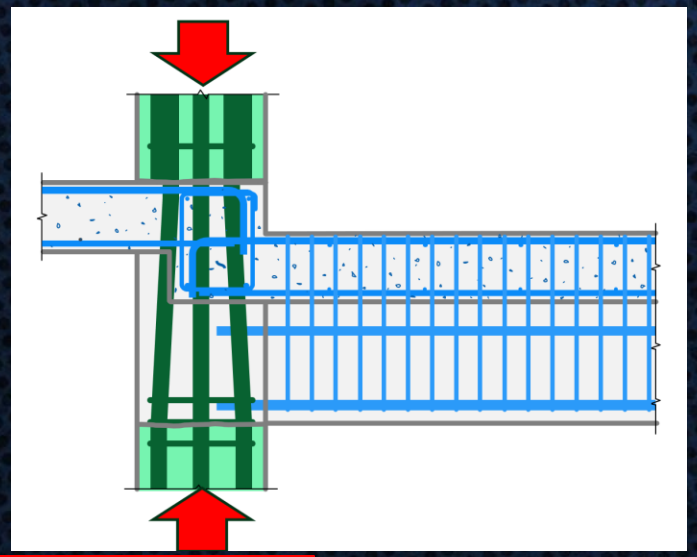
PRELIMINARY ANALYSIS RESULTS

Source base drawing: Town of Surfside.
Annotated by NIST.

3 Failure Initiation







2. Failure Initiation

- The investigation rigorously examines about two dozen possible initiating events for the failure.

Examples of lower likelihood initiating events include:

- Karst formation (sinkholes).
- Pile failure.
- Separation of the Level 1 slab from the south basement wall.

Examples of higher likelihood initiating events include:

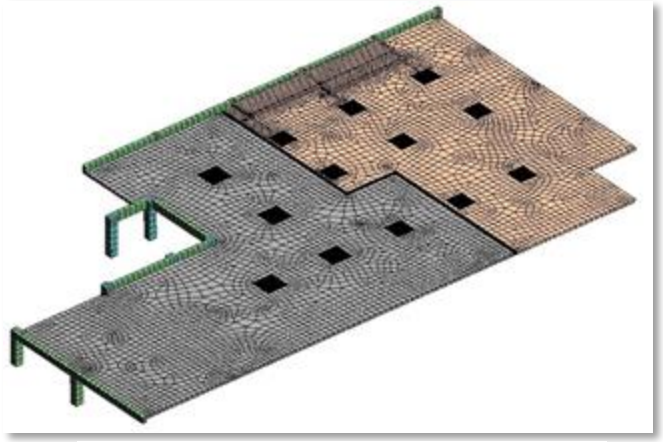
- Failure of a typical slab-column connection in the pool deck.
  - Design understrength, deviations in construction from requirements, loads added to the pool deck, and material degradation led to critically low margins of safety at the time of failure.
- Shortening of a lower-level column in the tower.
- Local crushing of a slab-beam-column joint at Level 1 on Grid Line 9.1.
  - Design understrength and construction deviations reduced the strength of the structural elements in these latter two initiating events. We continue to assess the impacts of material degradation.

PRELIMINARY ANALYSIS RESULTS

3 Pool Deck Slab-Column Connections Critically Low Margins of Safety at Time of Failure

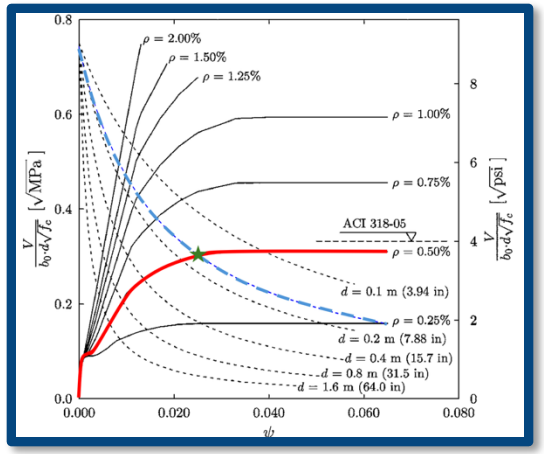
Laboratory slab-column connection tests

Source: NIST



Finite element modeling

Source: NIST using ATENA software



Critical Shear Crack Theory

Source: ACI

Design Understrength (largest, pervasive)

Misplaced Slab Reinforcement (pervasive)

Heavier, More Extensive Planters (near north side of pool deck)

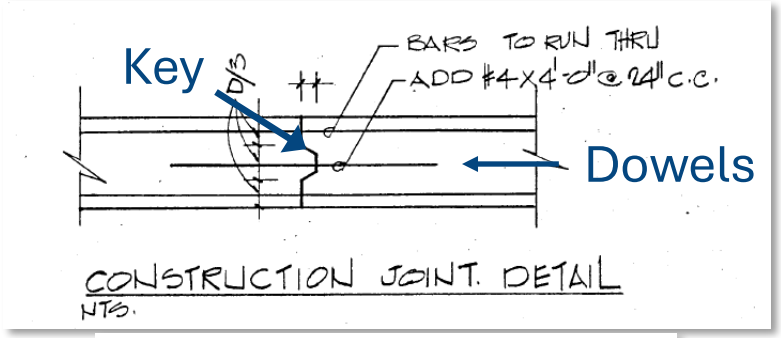
Added Fill and Paving (variable)

Corrosion of Slab Reinforcement (variable)

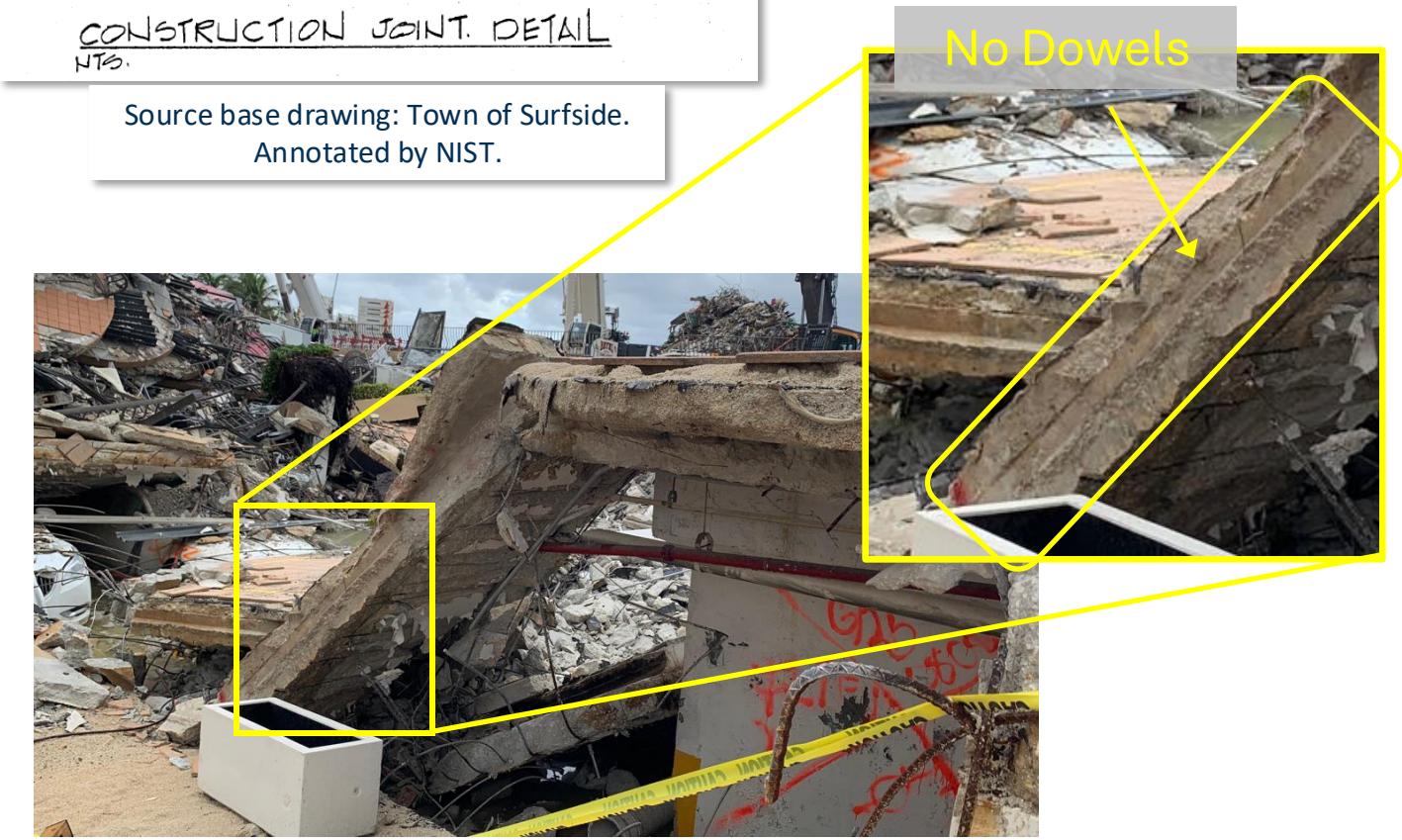
- Together, caused the bulk of the critically low margins of safety
- Existed from the time construction was complete – 40 years before the partial collapse

PRELIMINARY ANALYSIS RESULTS

3 Pool Deck Slab-Column Connections
Construction Joints in Slab



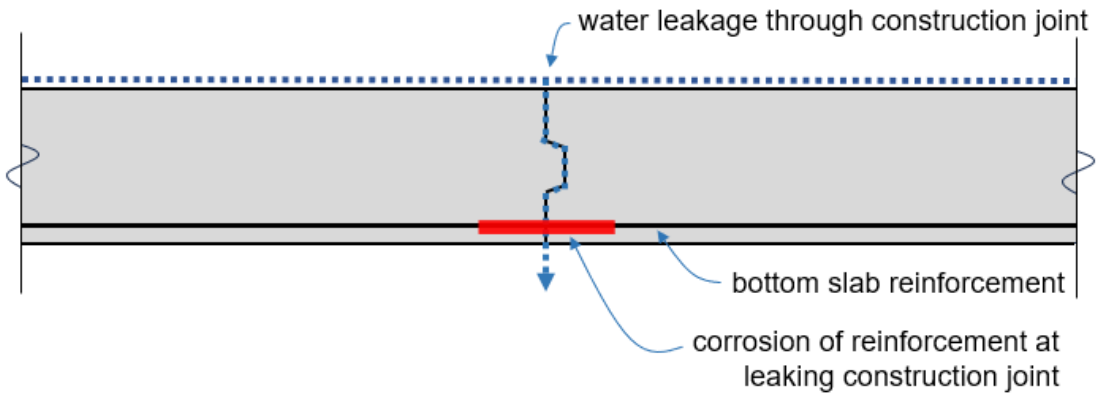
Source base drawing: Town of Surfside.
Annotated by NIST.



Source: NIST

PRELIMINARY ANALYSIS RESULTS

3 Pool Deck Slab-Column Connections
Construction Joints in Slab



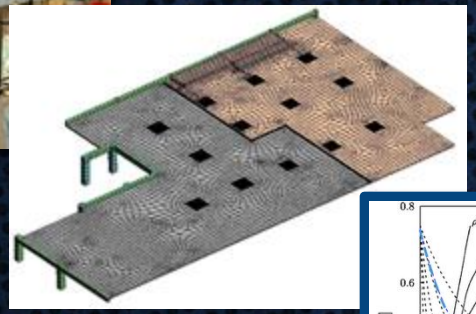
PRELIMINARY ANALYSIS RESULTS

Source all images: NIST

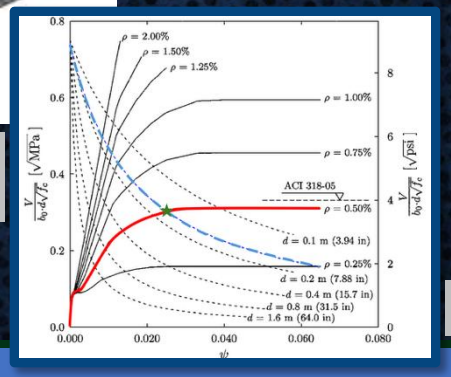
3 Pool Deck Slab-Column Connections

Computational Simulation and Structural Laboratory Tests

Source: NIST

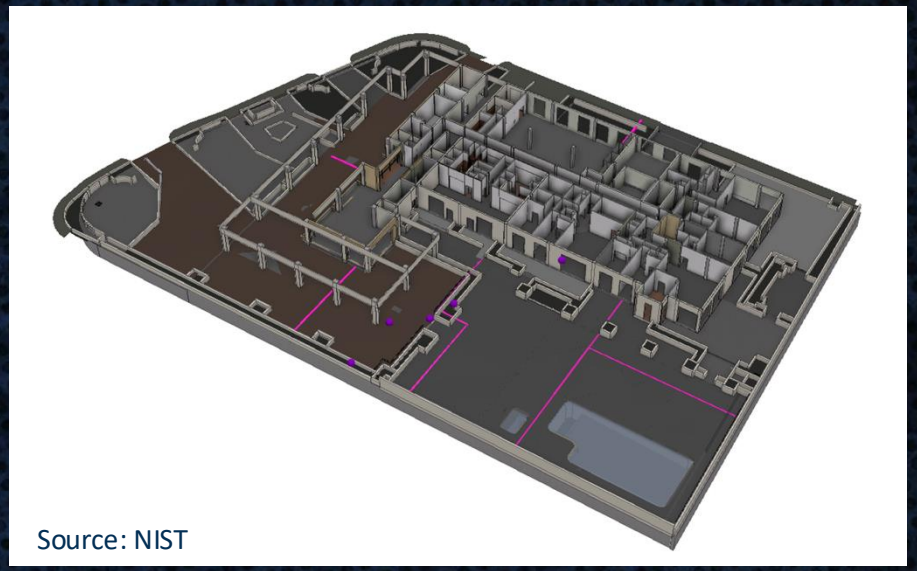


Source: NIST using ATENA software



Source: ACI

Collapse Evidence



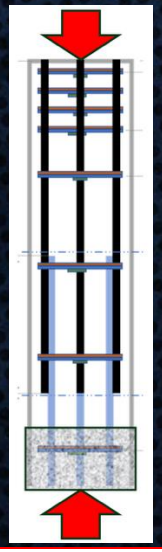
Source: NIST

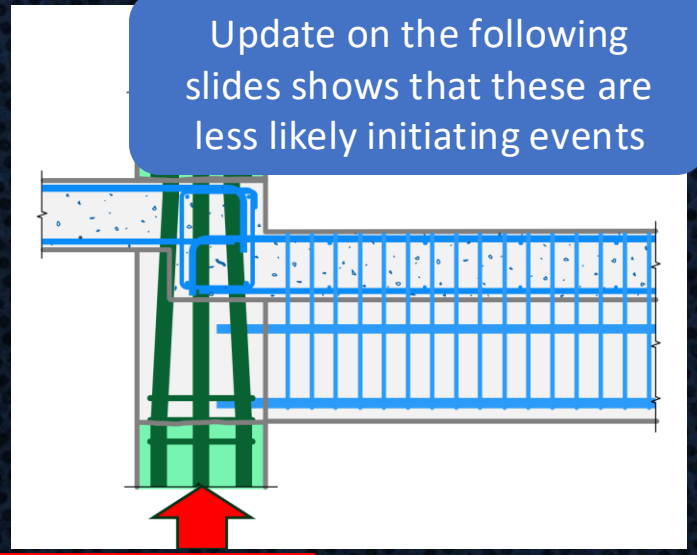
Recent work indicates that it is MORE LIKELY that the failure started in a pool deck slab-column connection than we considered in June

PRELIMINARY ANALYSIS RESULTS

3 Failure Initiation


Source: NIST





Update on the following slides shows that these are less likely initiating events

2. Failure Initiation

- The investigation rigorously examines about two dozen possible initiating events for the failure.

Examples of lower likelihood initiating events include:

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- Separation of the Level 1 slab from the south basement wall.

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- Failure of a typical slab-column connection in the pool deck.
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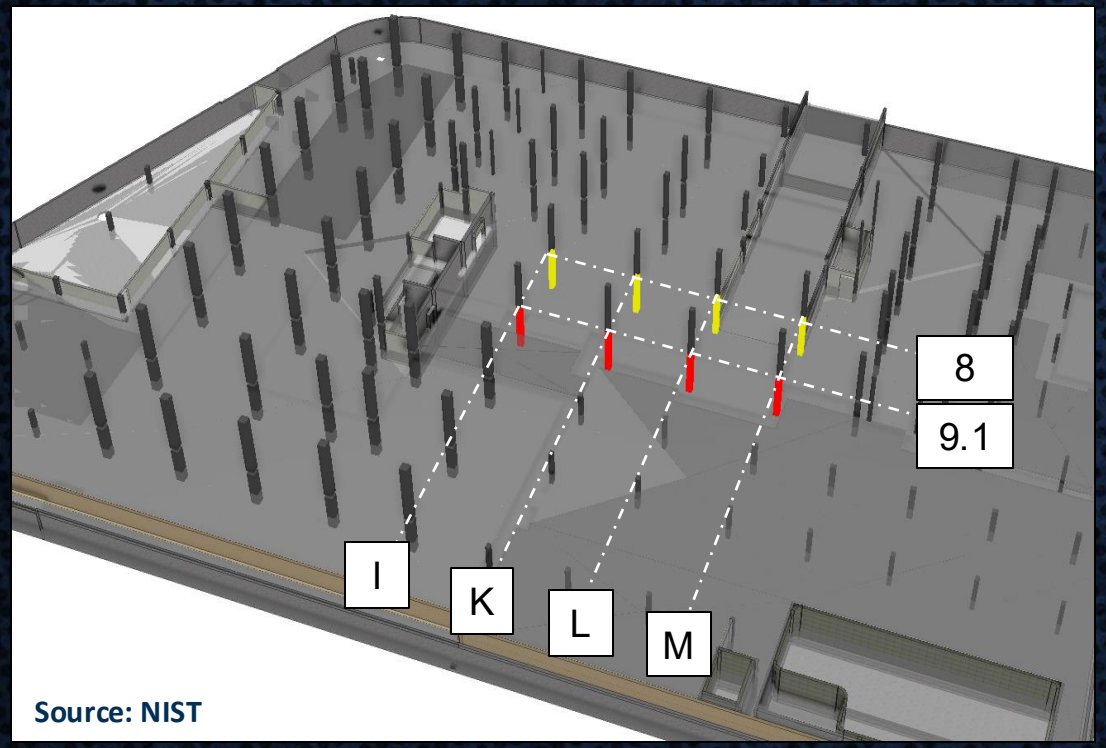
- Shortening of a lower-level column in the tower.
- Local crushing of a slab-beam-column joint at Level 1 on Grid Line 9.1.
  - Design understrength and construction deviations reduced the strength of the structural elements in these latter two initiating events. We continue to assess the impacts of material degradation.

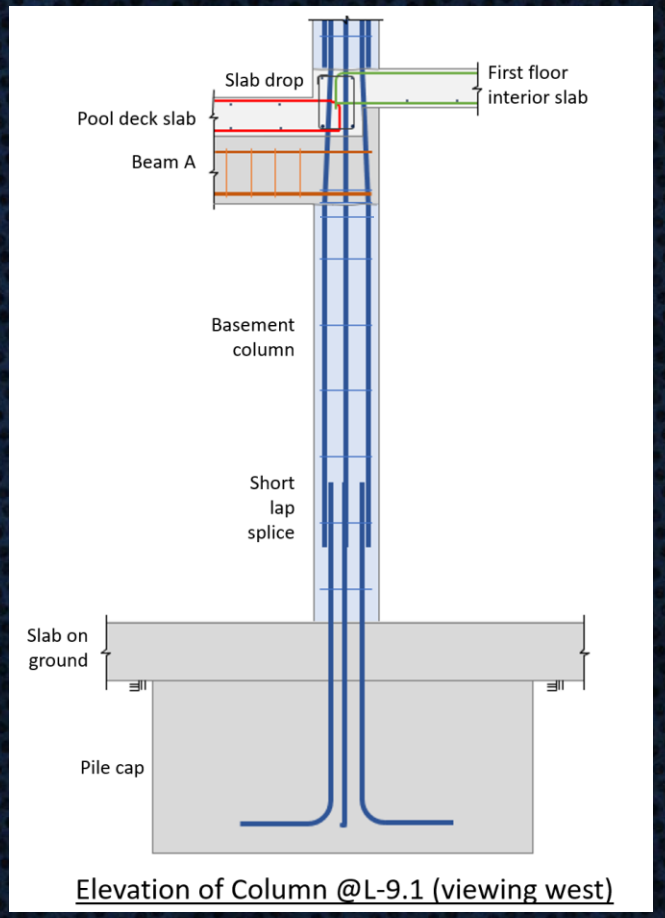
PRELIMINARY ANALYSIS RESULTS

3 Tower Basement Columns

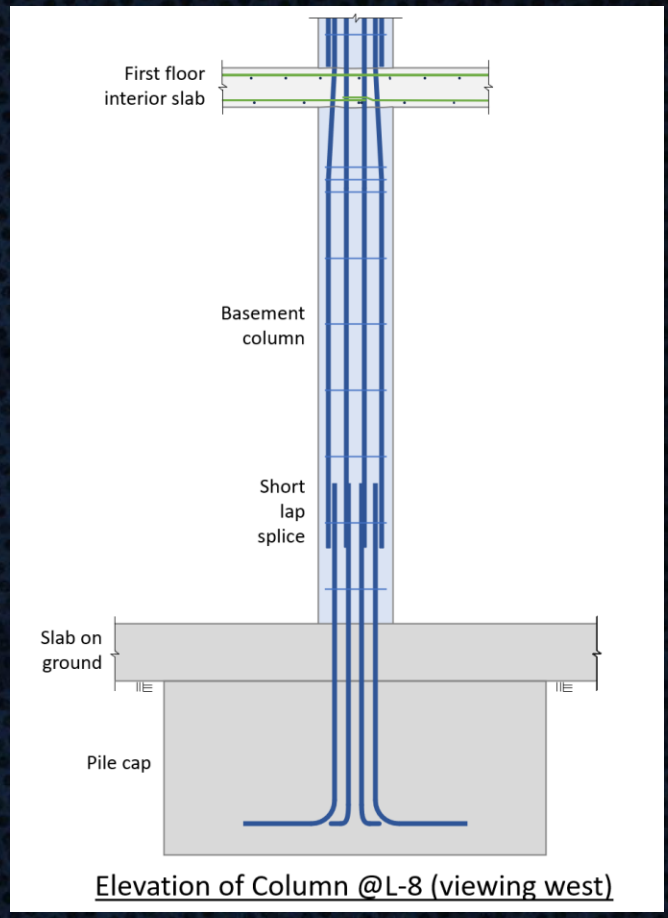
Columns I-8, K-8, L-8 and M-8 in yellow
Columns I-9.1, K-9.1, L-9.1 and M-9.1 in red



Source: NIST



Elevation of Column @L-9.1 (viewing west)



Elevation of Column @L-8 (viewing west)

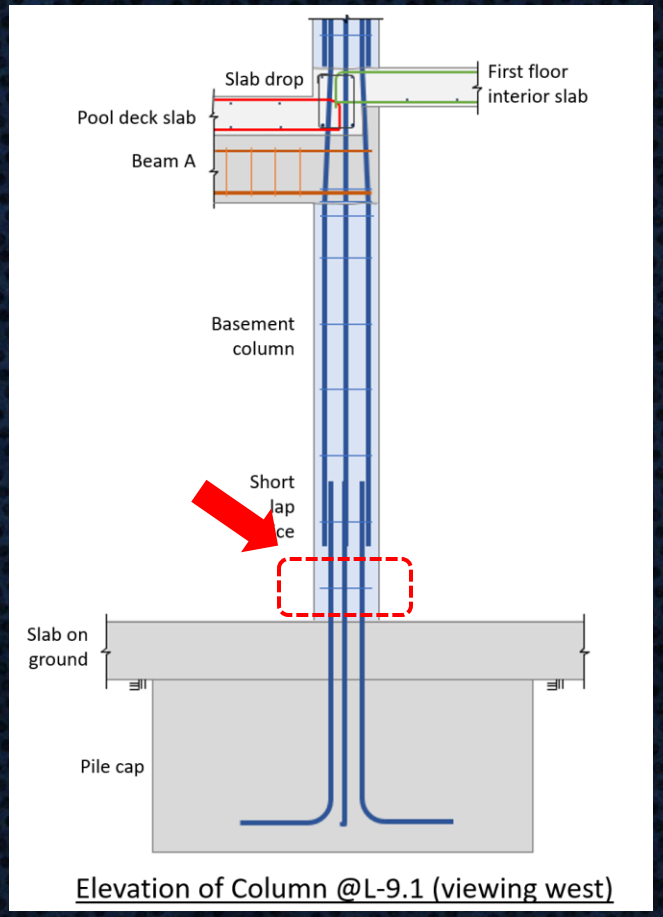
Reinforcement details shown are representative of details found in some specimens of the physical evidence.

PRELIMINARY ANALYSIS RESULTS

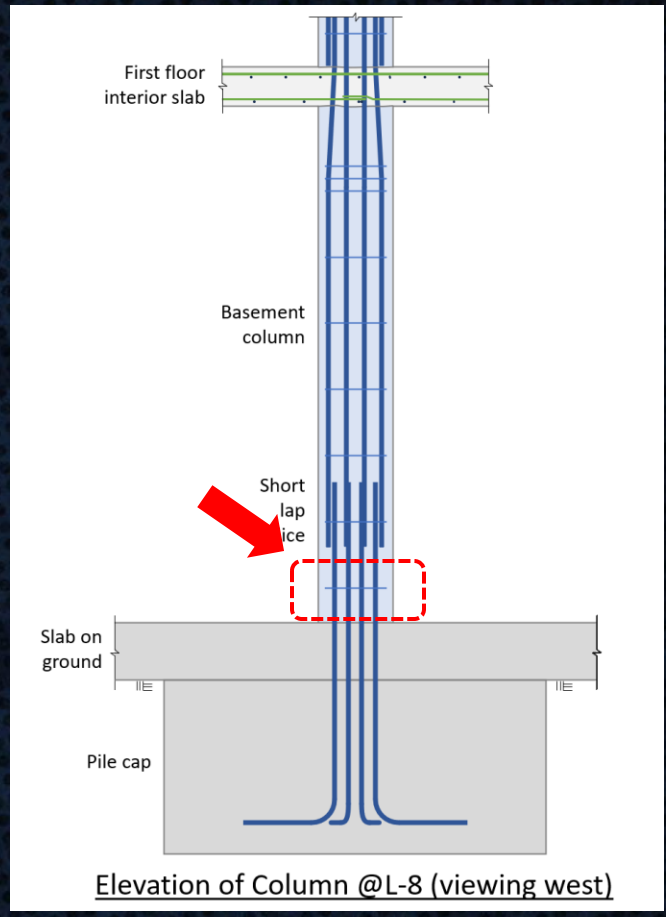
3 Tower Basement Columns

Recent work indicates failure initiation by crushing of deteriorated concrete at the base of a tower column is *less likely* than we considered in June

Material and petrographic analyses show no evidence of deterioration of the concrete at the bases of basement columns that resulted in significant loss of strength of that concrete



Elevation of Column @L-9.1 (viewing west)



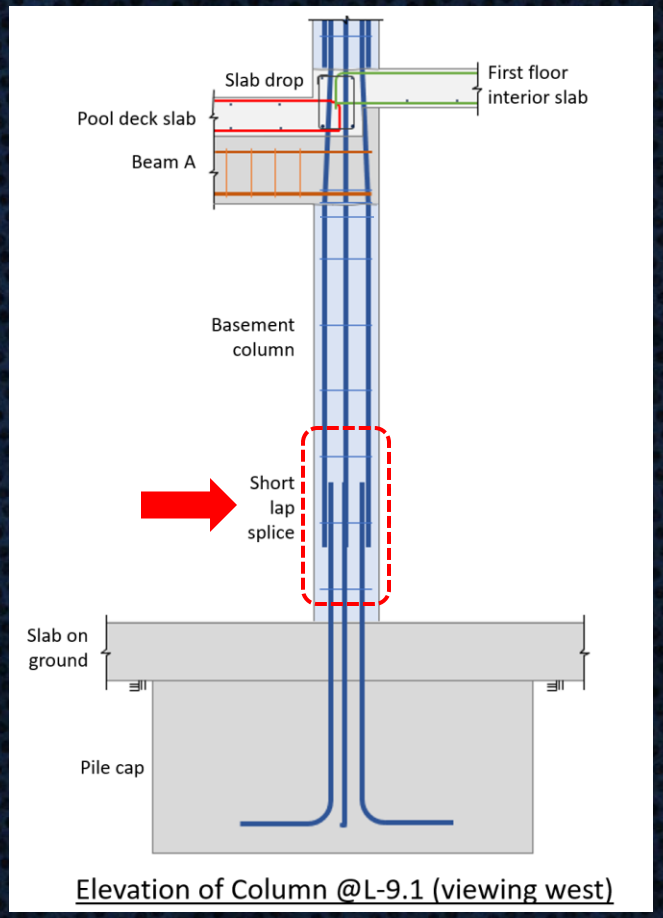
Elevation of Column @L-8 (viewing west)

PRELIMINARY ANALYSIS RESULTS

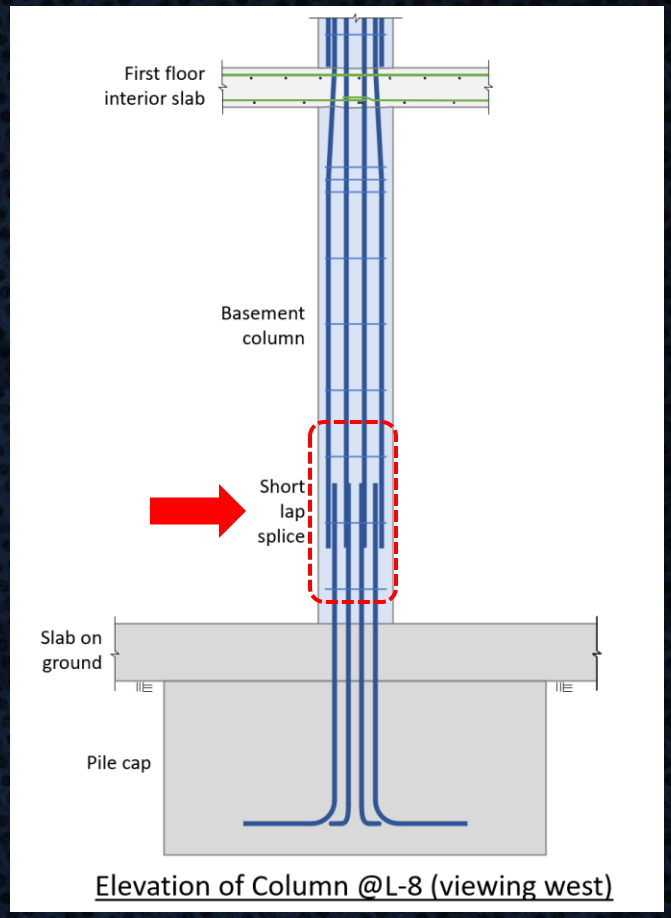
3 Tower Basement Columns

Recent work indicates failure initiation caused by a short lap splice in a tower basement column is *less likely* than we considered in June

- Structural laboratory tests of basement column replicas showed that short lap splices diminish the basement columns' strength and deformation capacity somewhat, but, absent other contributing factors, not to a level that would have failed a column under the conditions present at the time of the partial collapse
- Columns with short lap splices failed in a brittle and explosive manner in the laboratory, with immediate loss of column capacity. This failure mode is inconsistent with the scenario that the columns shortened but were able to bear sufficient load to not cause the tower to collapse



Elevation of Column @L-9.1 (viewing west)



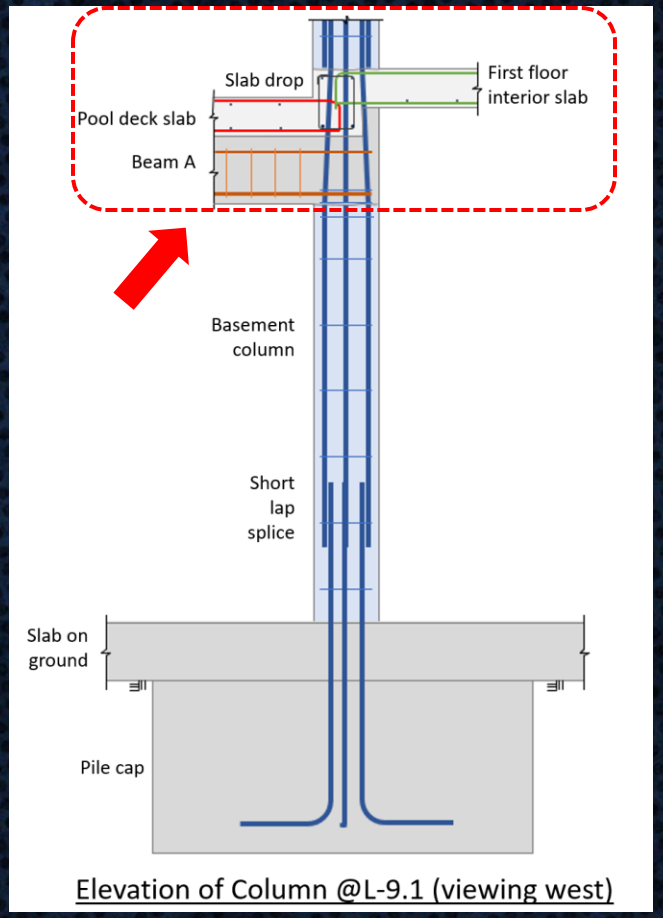
Elevation of Column @L-8 (viewing west)

PRELIMINARY ANALYSIS RESULTS

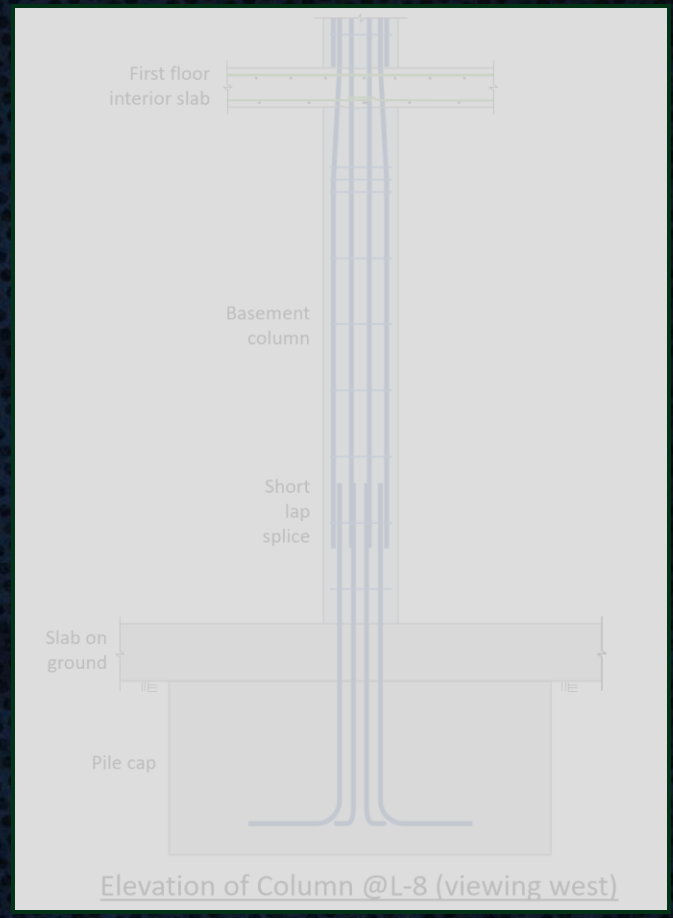
3 Tower Basement Columns

Recent work indicates failure initiation by crushing of a first-level slab-beam-column joint on Grid Line 9.1 is *less likely* than we considered in June

- During structural laboratory tests, CTS replicas (with the pool deck slab and Beam A constructed as they were prior to the failure of the pool deck) sustained column axial loads greater than the loads estimated to be present at the time of failure



Elevation of Column @L-9.1 (viewing west)



Elevation of Column @L-8 (viewing west)

PRELIMINARY ANALYSIS RESULTS

3 Tower Basement Columns

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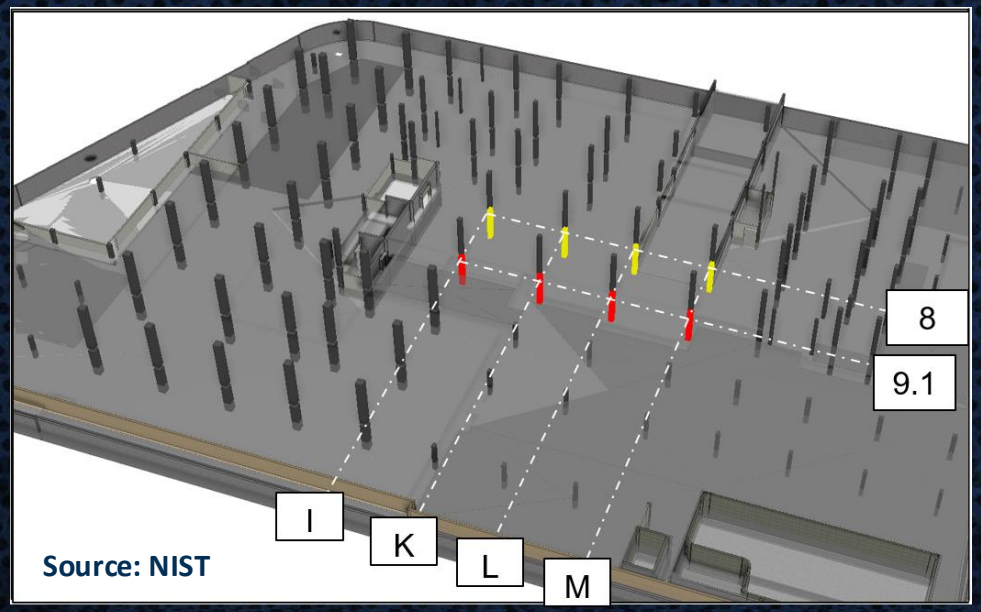
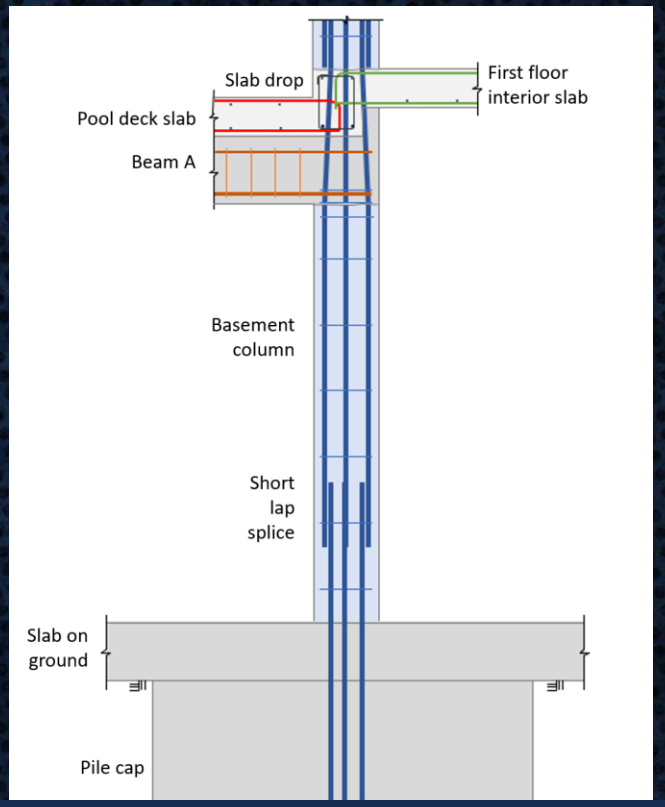
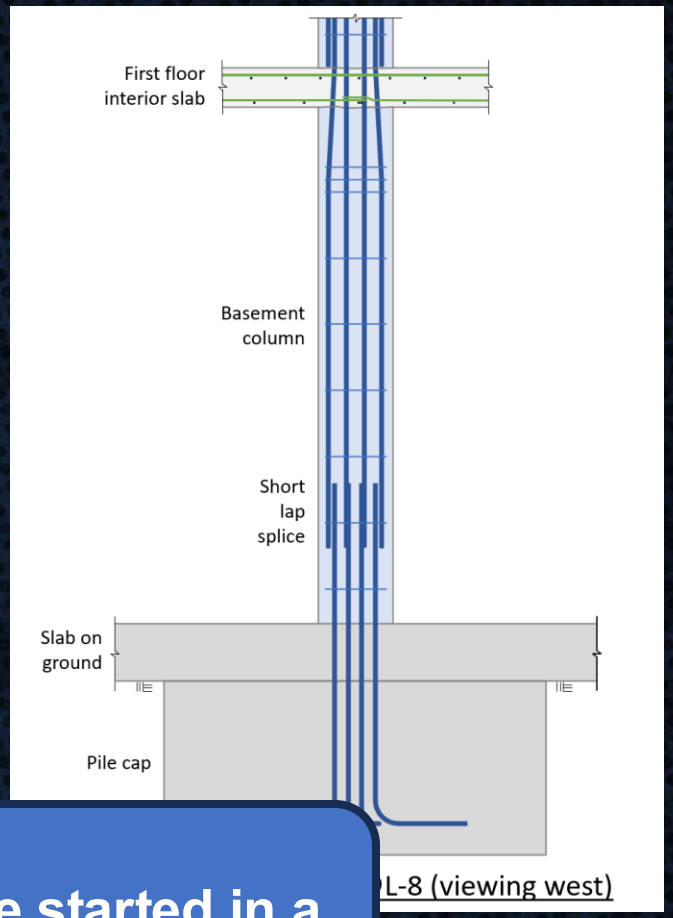




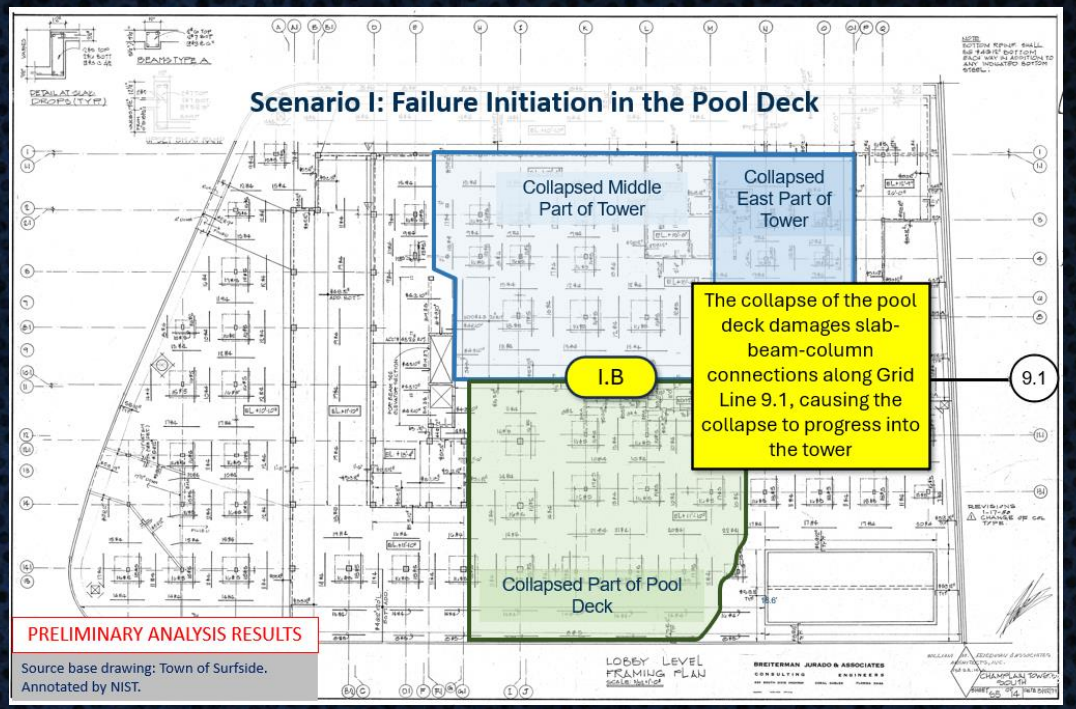


Recent work indicates it is LESS LIKELY that the failure started in a tower basement column than we considered in June

s found in

PRELIMINARY ANALYSIS RESULTS

3 Failure Progression from Pool Deck into Tower

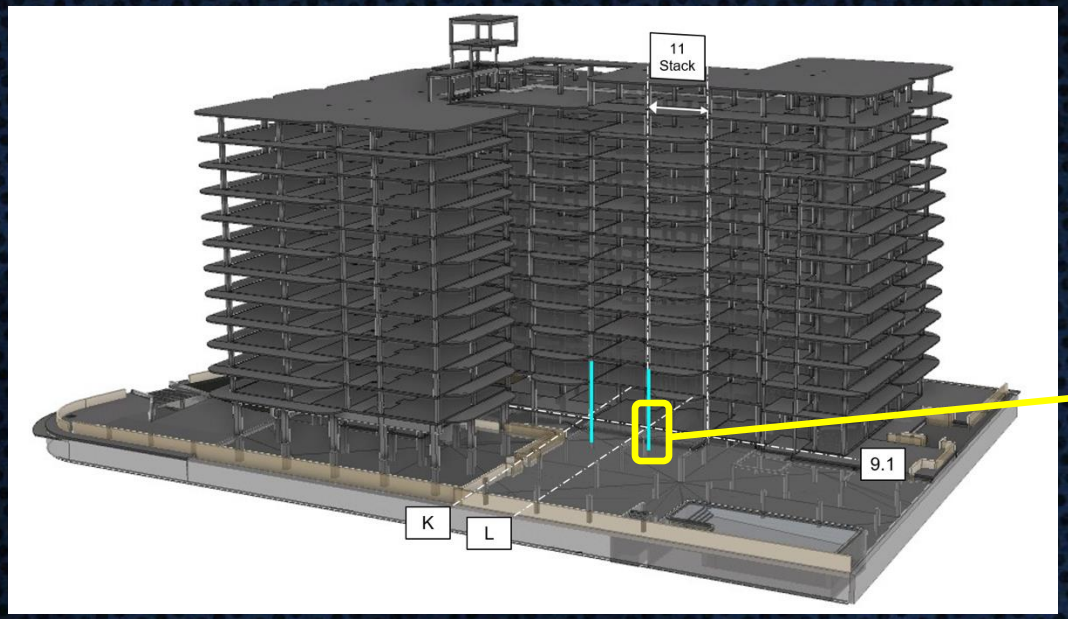


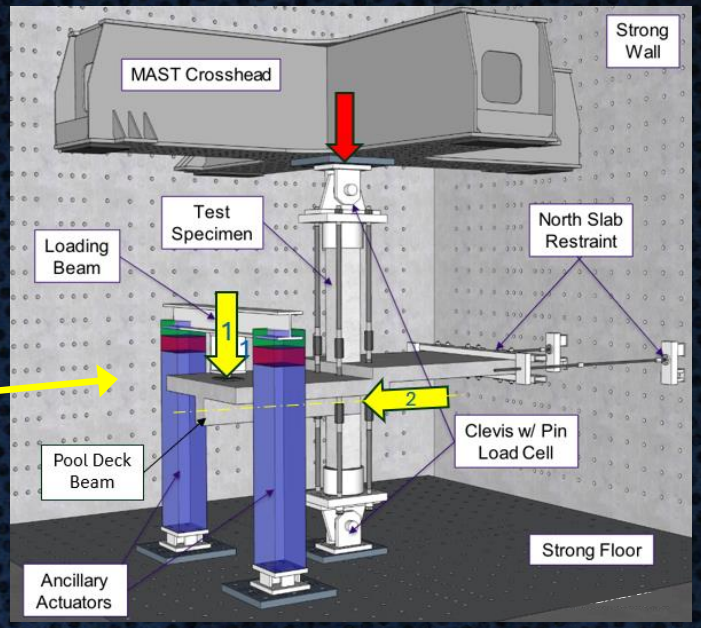
3. Failure Progression

- The vulnerability of the structure where the pool deck met the tower allowed the collapse of the pool deck to progress into the tower.
- The poor resistance to progressive collapse allowed the collapse to spread through the east wing of the tower.

Updates on the following slides

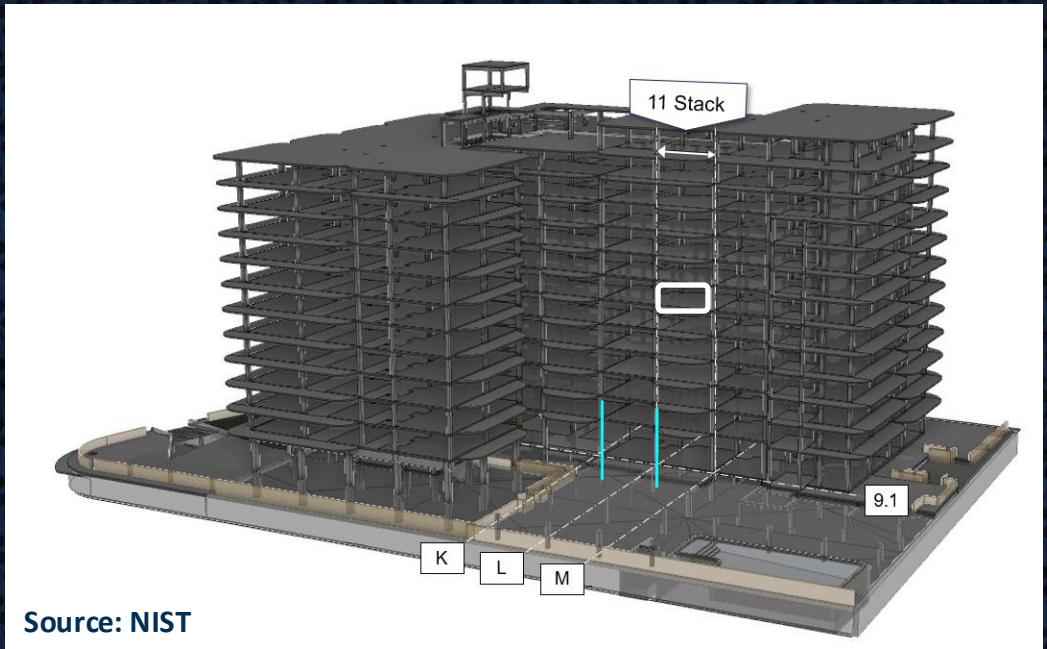
PRELIMINARY ANALYSIS RESULTS



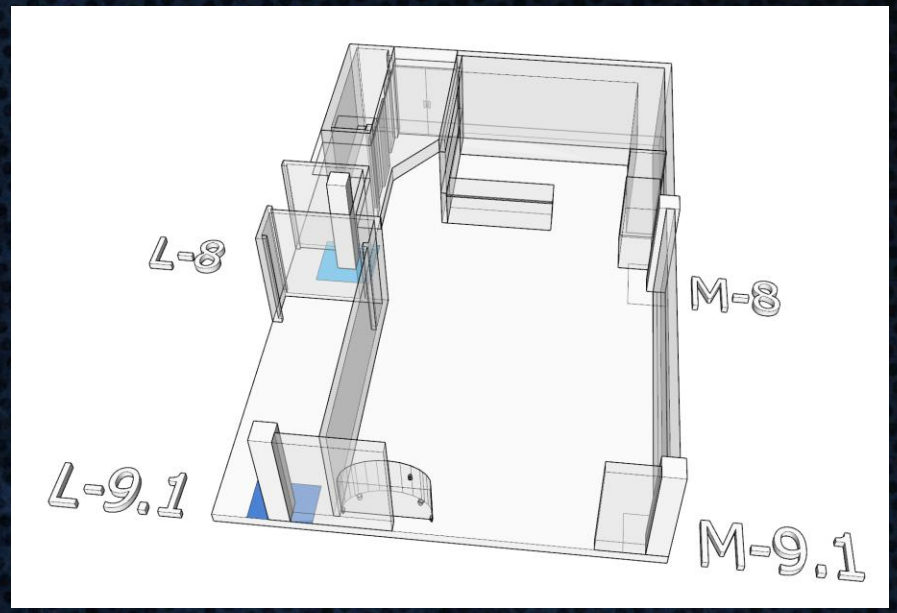


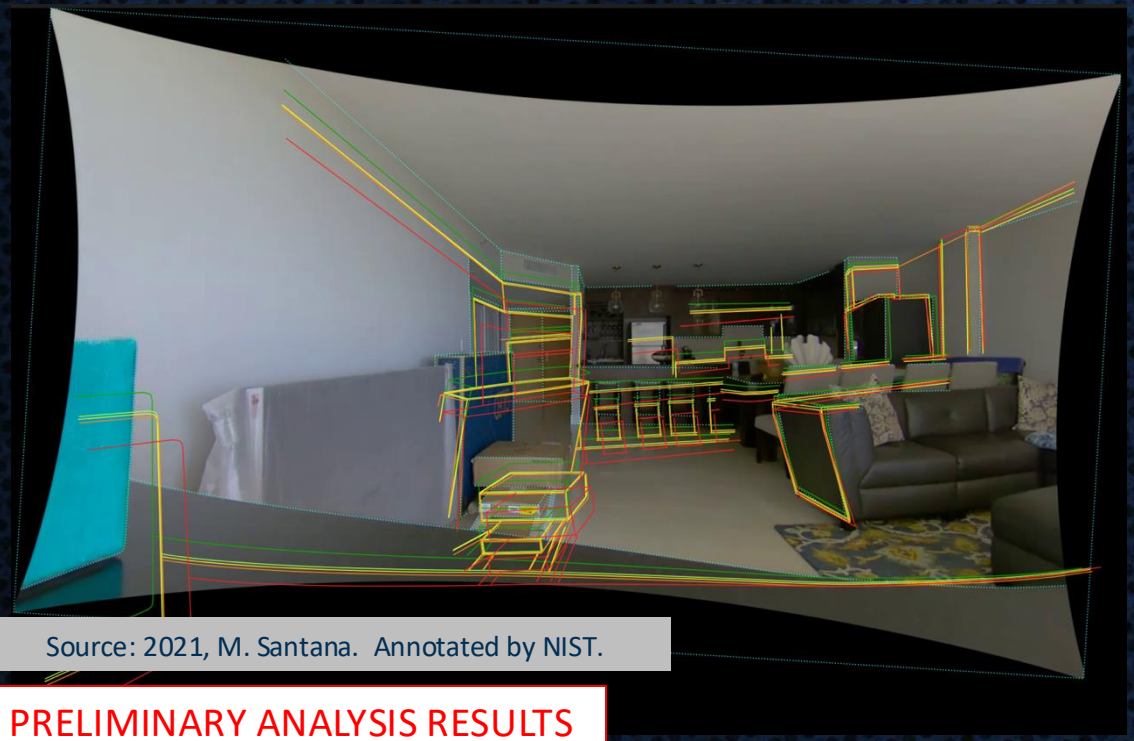
Source all images: NIST

PRELIMINARY ANALYSIS RESULTS

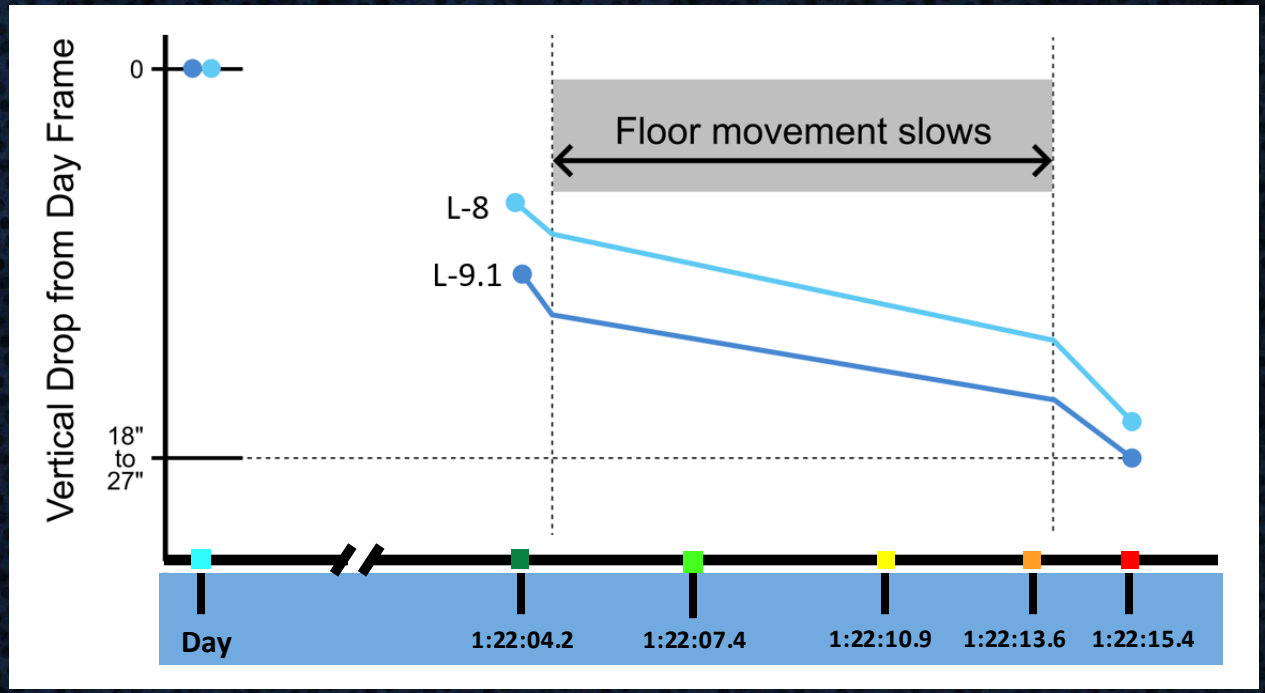


Source: NIST

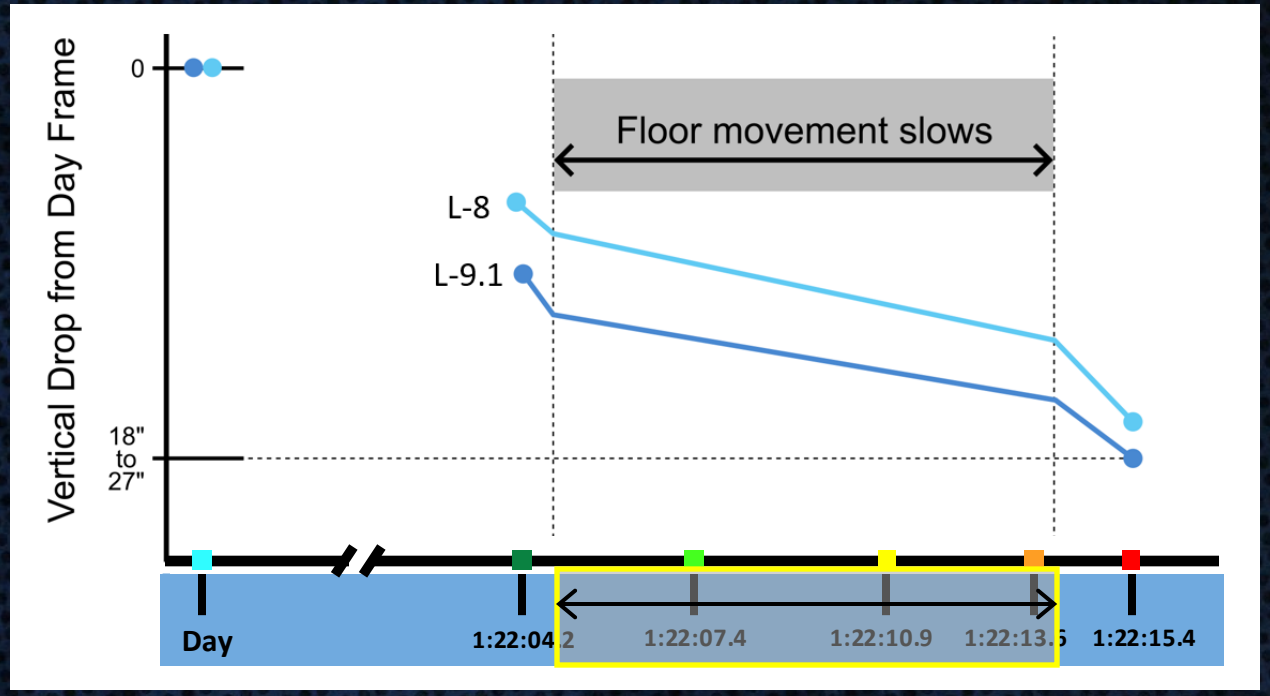




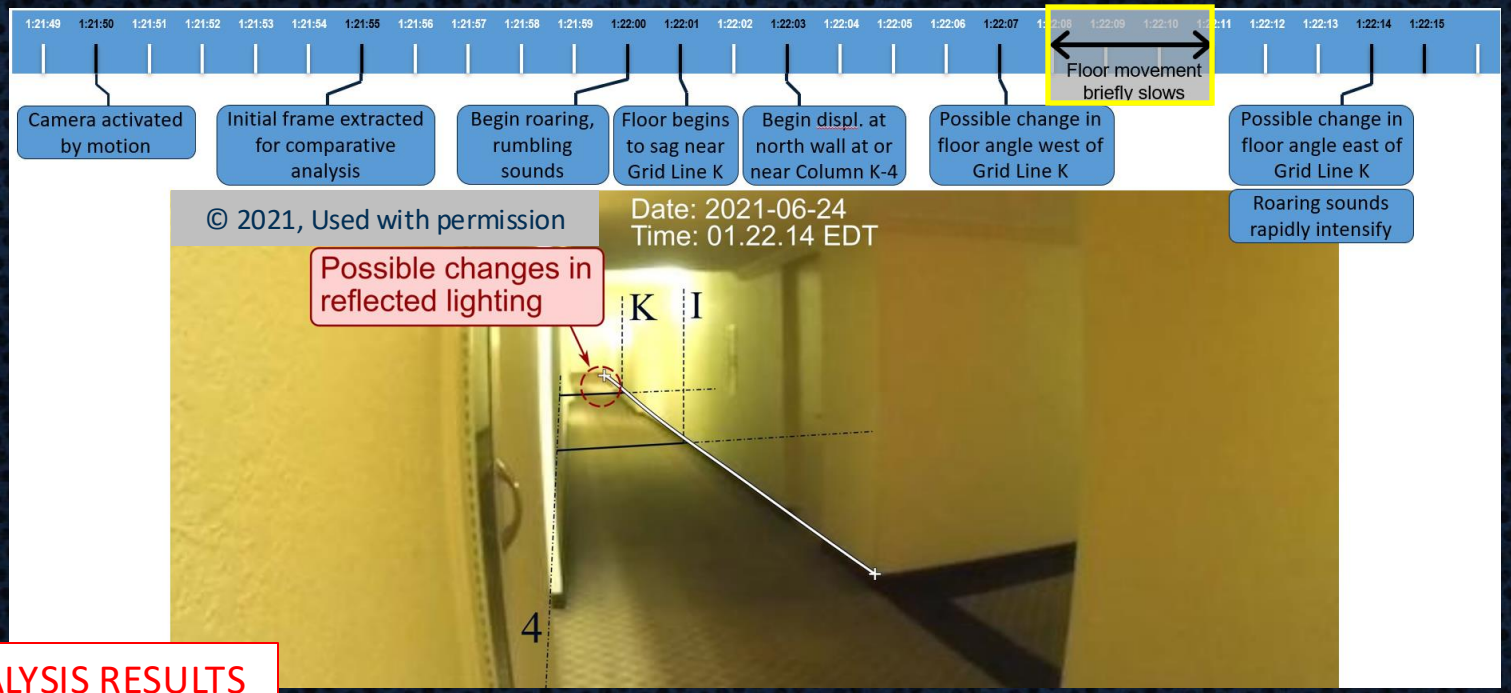
Source: 2021, M. Santana. Annotated by NIST.



PRELIMINARY ANALYSIS RESULTS



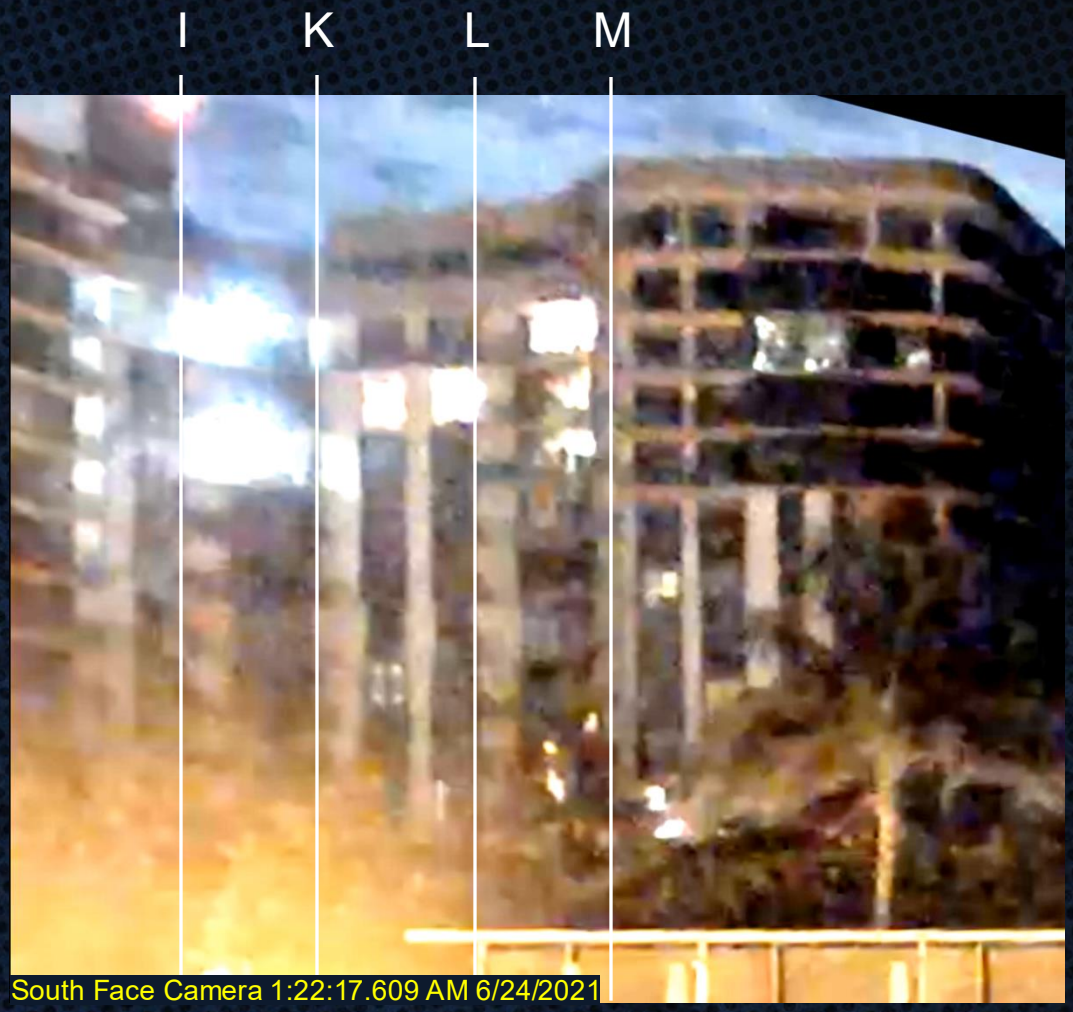
11 Stack Unit Footage



Upper Story Corridor Footage

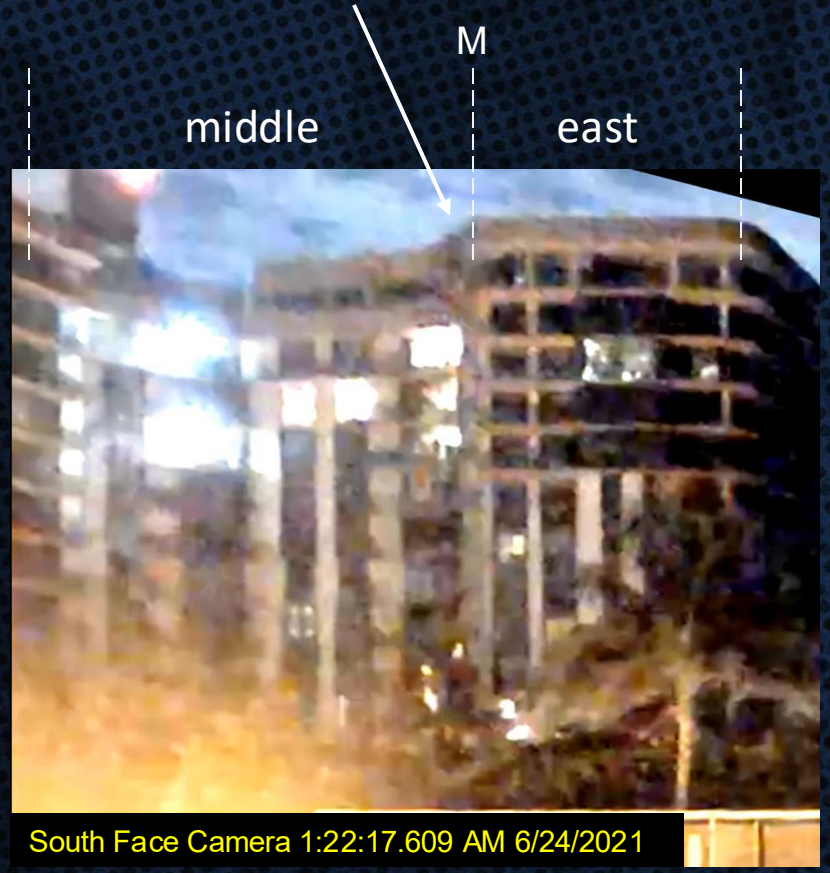
PRELIMINARY ANALYSIS RESULTS

3 Perspective Corrected and Enhanced South Face Video

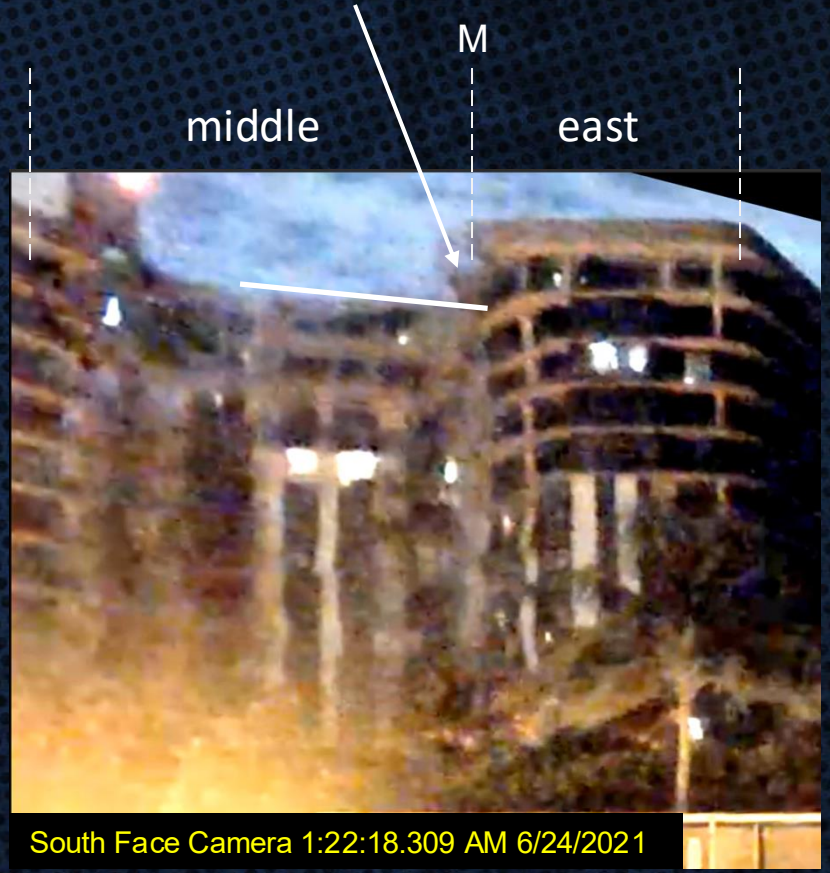


PRELIMINARY ANALYSIS RESULTS

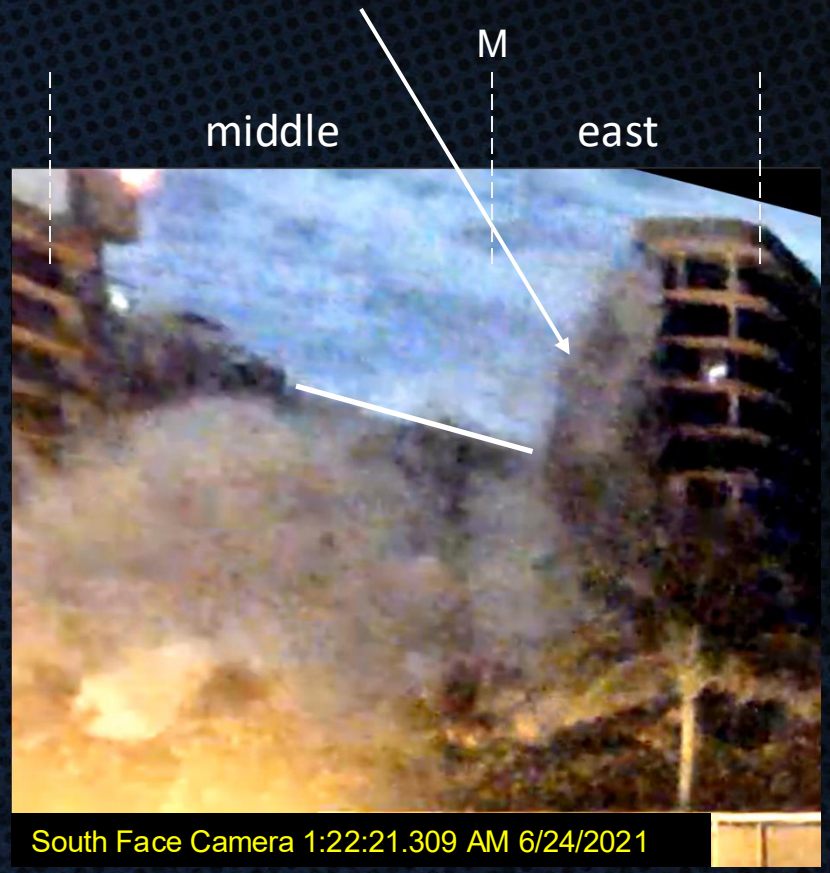
Collapsing middle part of tower is still connected to the east part at Grid Line M, which has not yet dropped



The middle part of tower has separated from the east part in this frame



The collapse progresses into the east part of tower in this frame



PRELIMINARY ANALYSIS RESULTS

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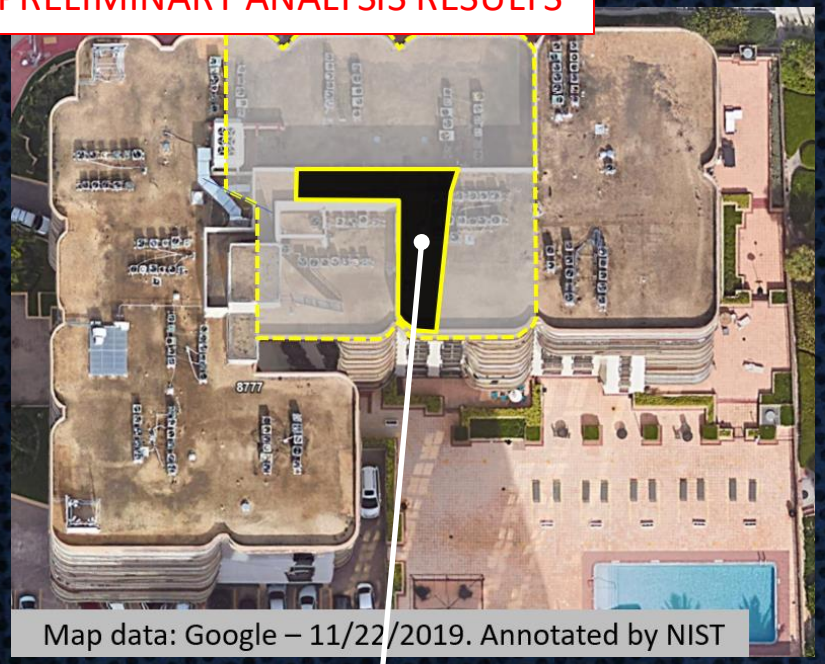
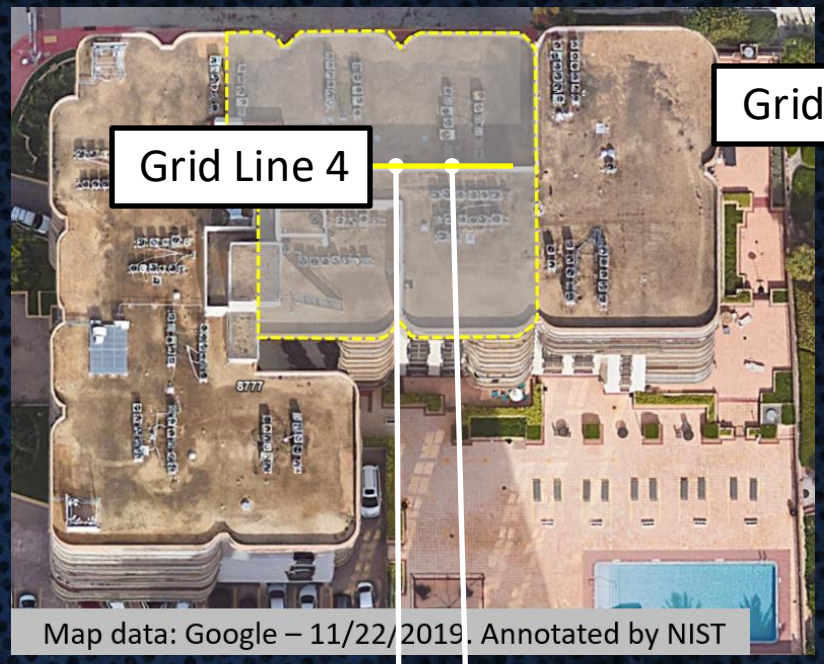
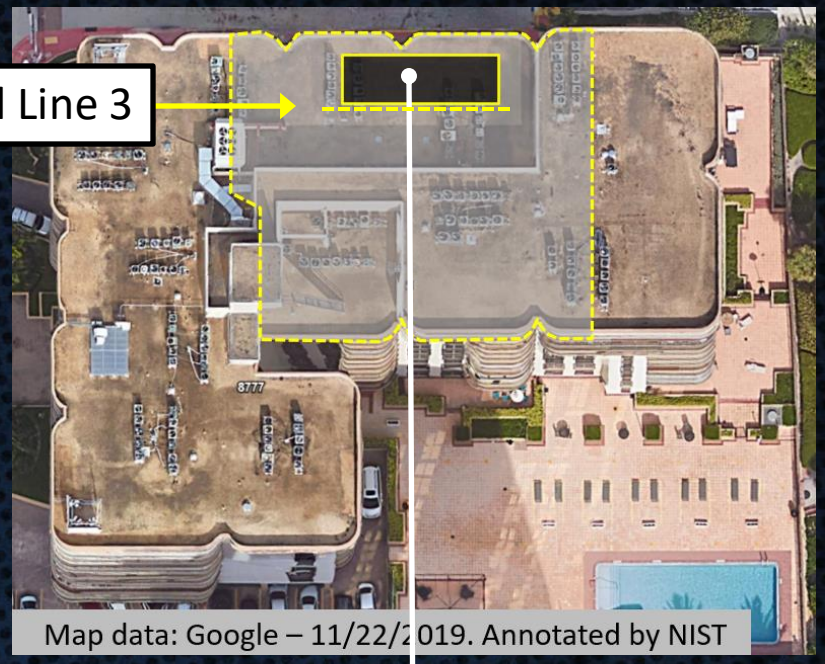
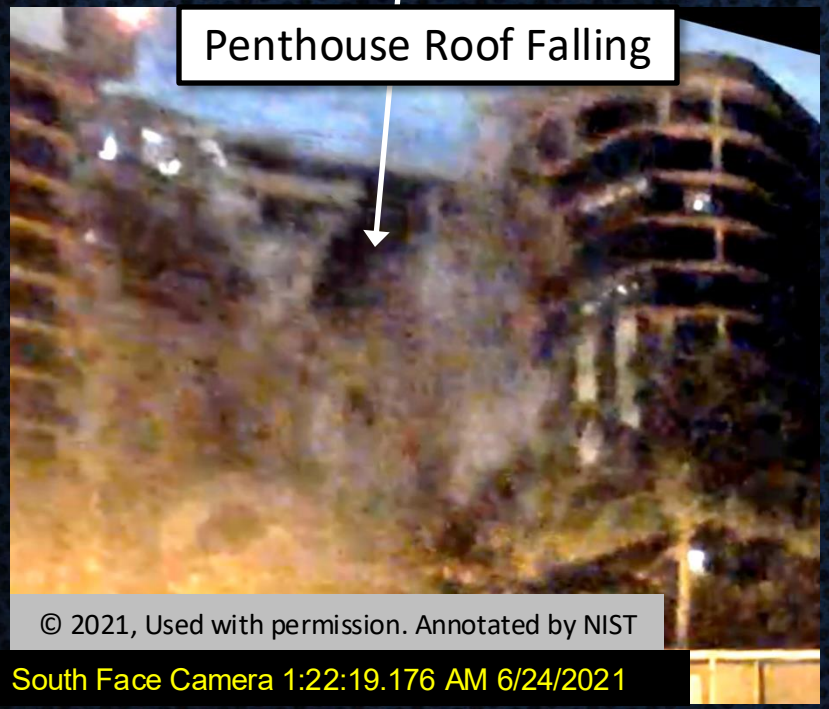
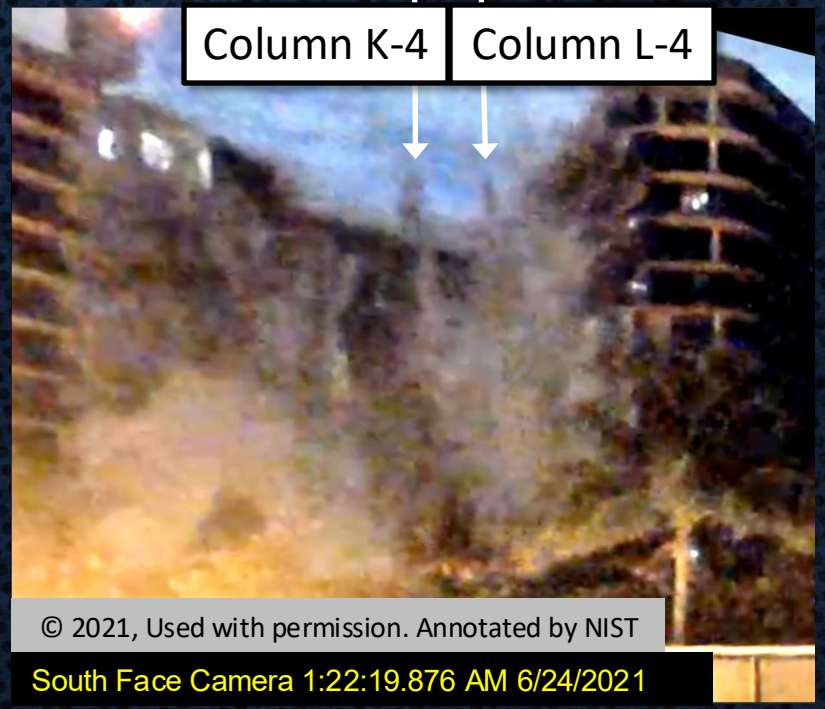
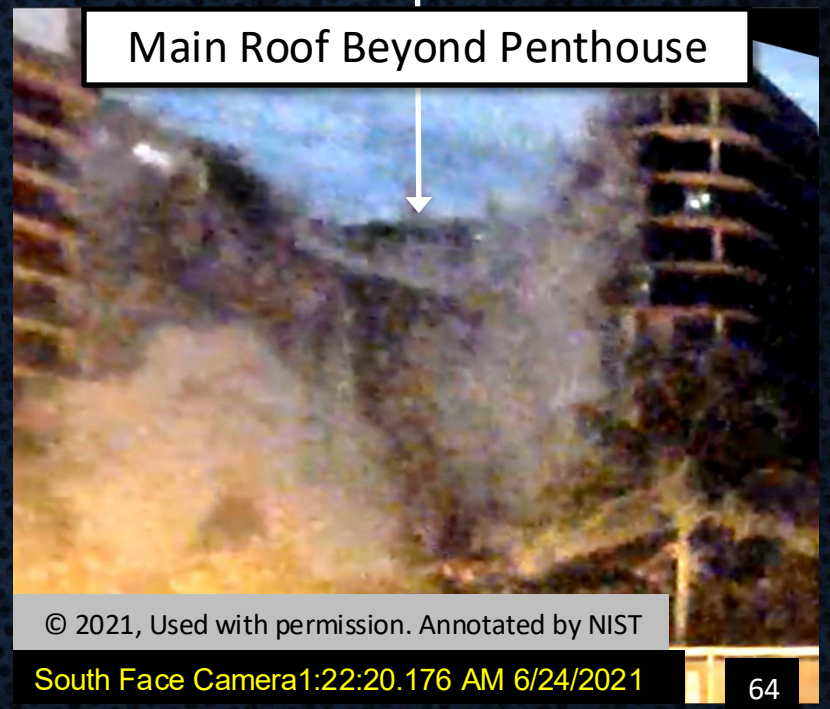






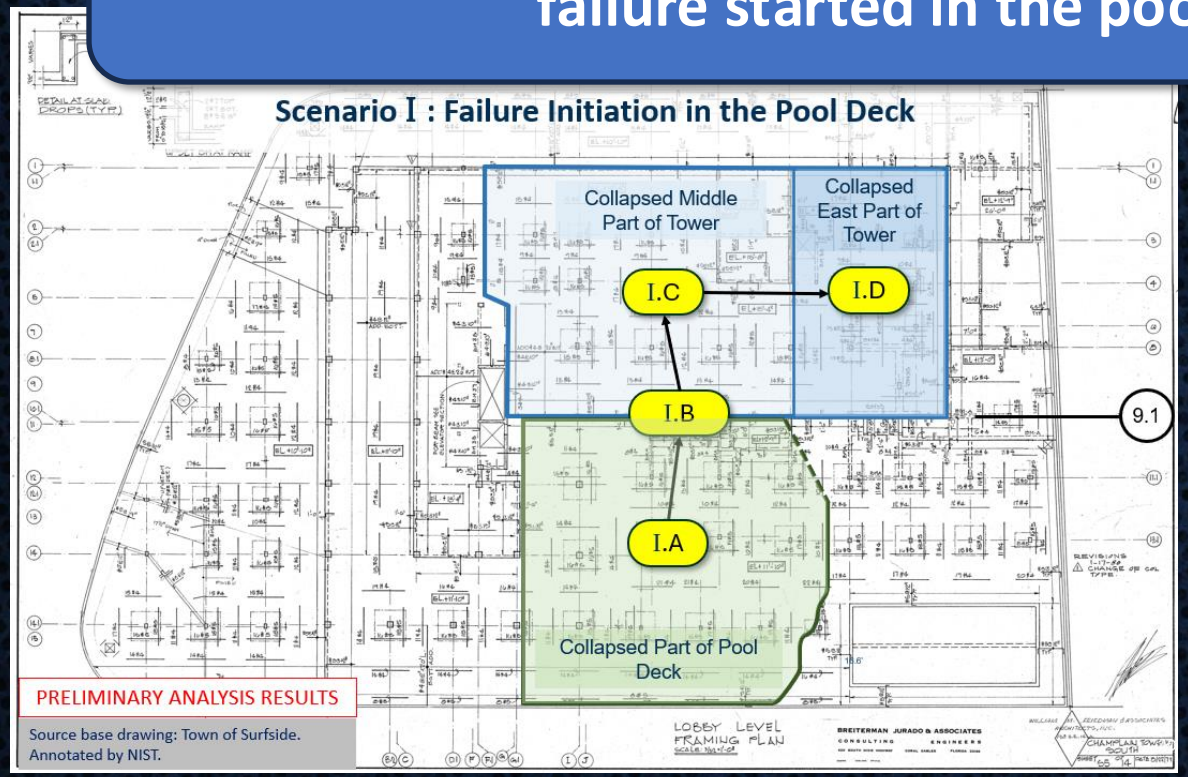


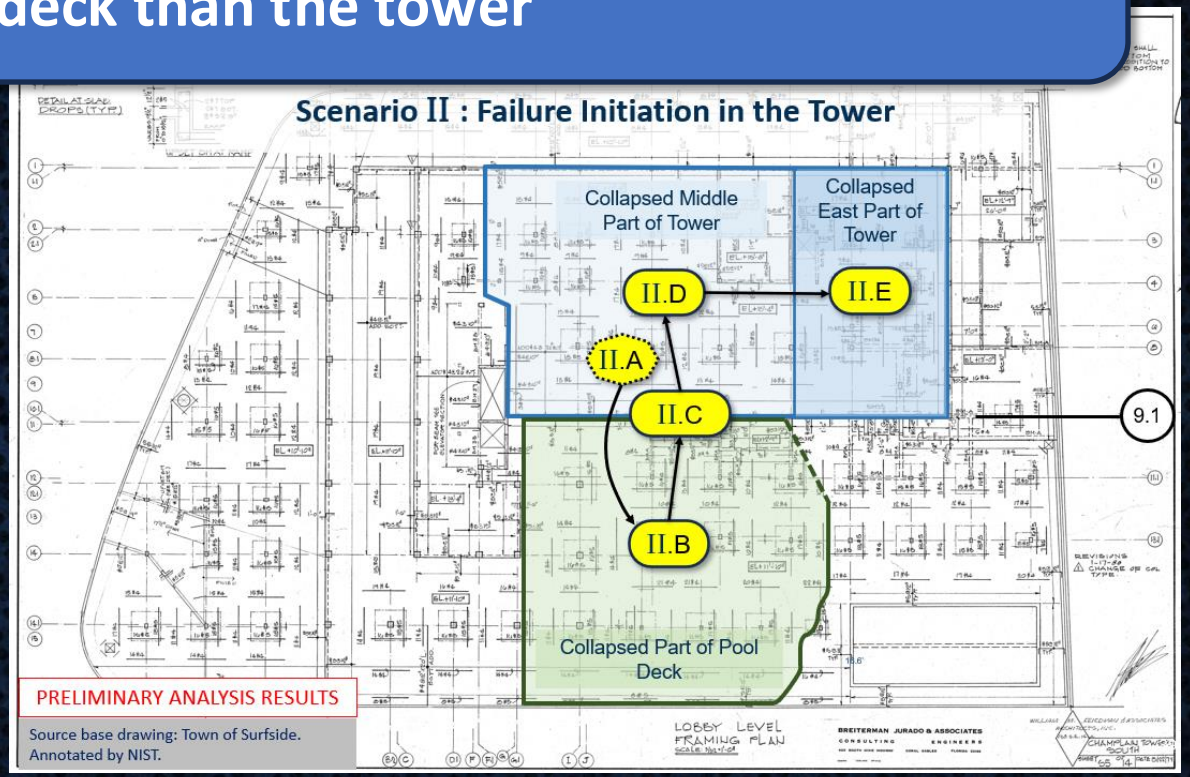




Champlain Towers South Investigation

Recent work indicates that it is MORE LIKELY that the failure started in the pool deck than the tower





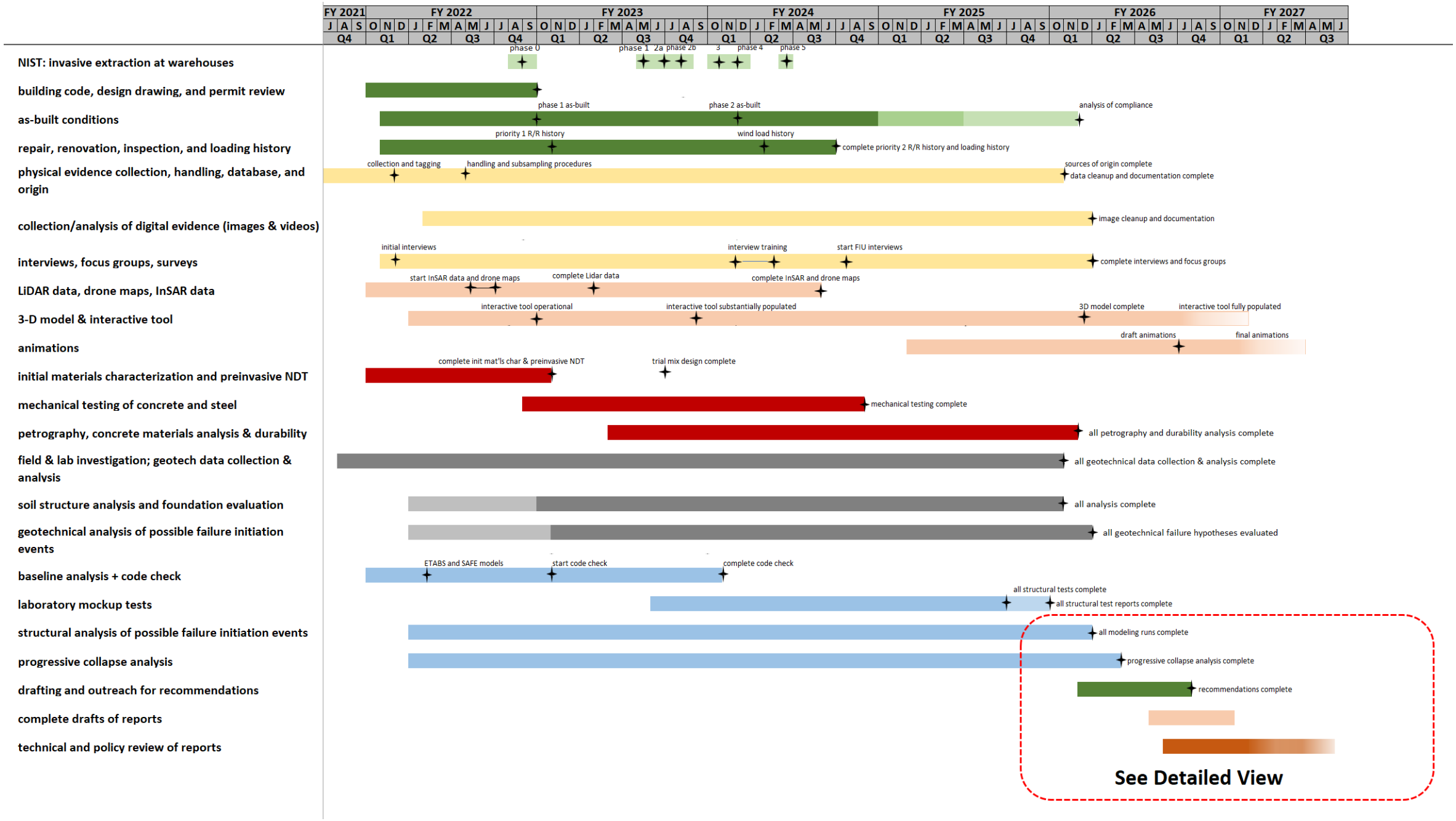
Computer vision techniques allow us to track the progression of the partial collapse through the tower

PRELIMINARY ANALYSIS RESULTS

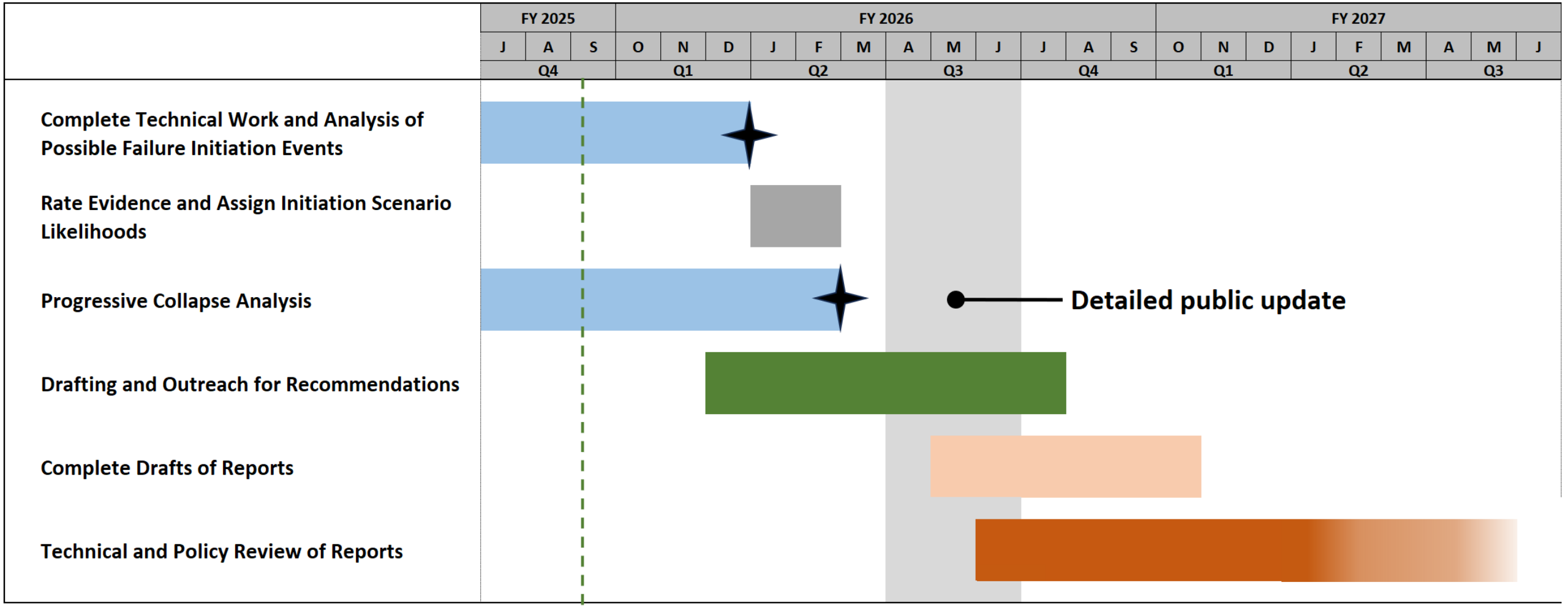
4 Investigation Schedule

Source: NIST

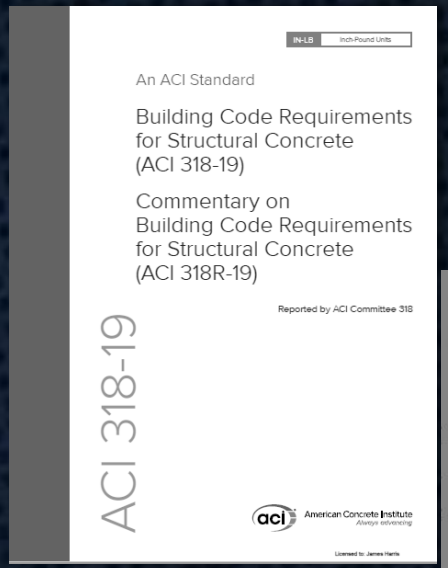
Champlain Towers South Investigation Schedule



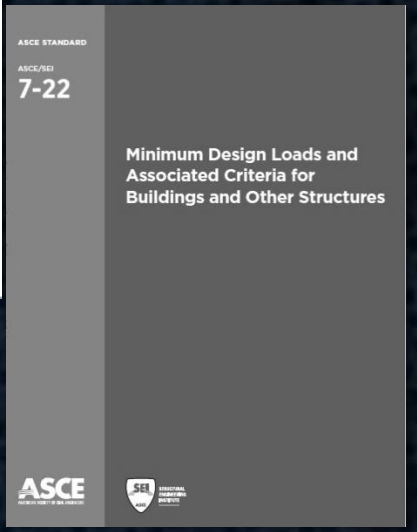
4 Investigation Schedule Detail



5 Next Steps and Conclusion



Source: ACI



Source: ASCE

5 Next Steps and Conclusion

Bringing Technical Work to a Close

- The investigation has employed a rigorous, systematic approach to analysis of the plausible failure scenarios and causes.
- Using a fully integrated, interdisciplinary team, we are near the end of analysis of failure scenarios and expect to complete the technical work of this analysis by the end of CY 2025.

Preliminary Findings

- **It is *more likely* that the collapse initiated in the pool deck than the tower.**
- At the time of the failure, the pool deck's slab-column connections had critically low margins of safety. The bulk of the critically low margins of safety was caused by design understrength and misplaced slab reinforcement.
- The structure had low resistance to progressive collapse, allowing the collapse of the pool deck to spread into and throughout the middle and east parts of the tower.

Report and Recommendations

- We are engaging with key stakeholder groups and will continue to do so to disseminate preliminary analysis results and to gather information that will inform technical and policy recommendations.
- Report drafting has begun but will accelerate following completion of technical work for possible failure initiating events at the end of CY 2025.
- We will provide a detailed public update on our investigative findings in the spring/early summer 2026 and expect to complete drafts of all reports ready for technical and policy review several months after our public update.

PRELIMINARY ANALYSIS RESULTS

NCST Investigation of the Champlain Towers South Collapse

Investigation Overview & Update

Source: NIST

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NIST's Investigation of the Champlain Towers South Partial Collapse

NIST CTS Information

https://www.nist.gov/champlain

Public Meeting Videos

https://www.nist.gov/disaster-failure-studies/champlain-towers-south-collapse-ncst-investigation/public-meeting-videos

NIST DFS Portal

https://www.nist.gov/disaster-failure-studies/data-submission-portal