

NCST Investigation of the Champlain Towers South Collapse

Cross-Project Panel Theme 1: Timeline and Evidence Collection

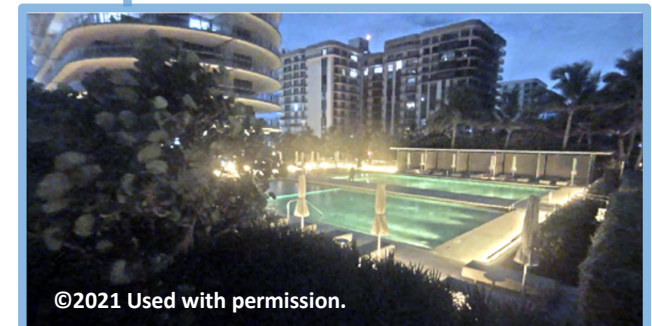
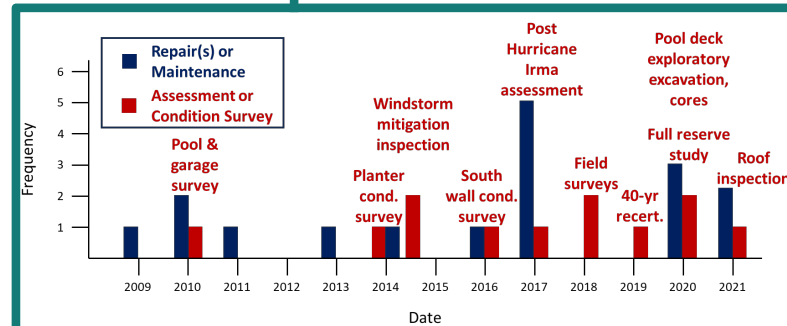
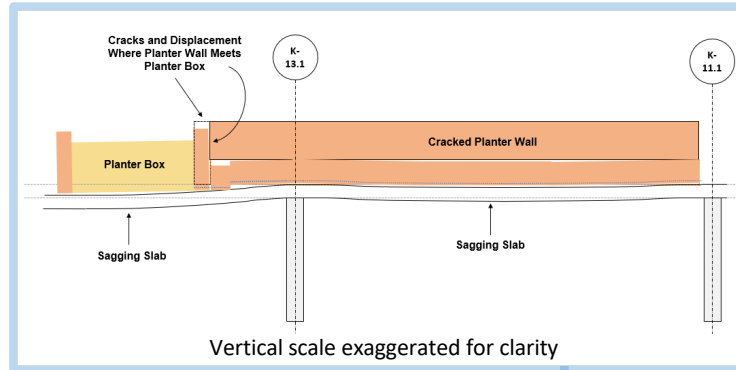
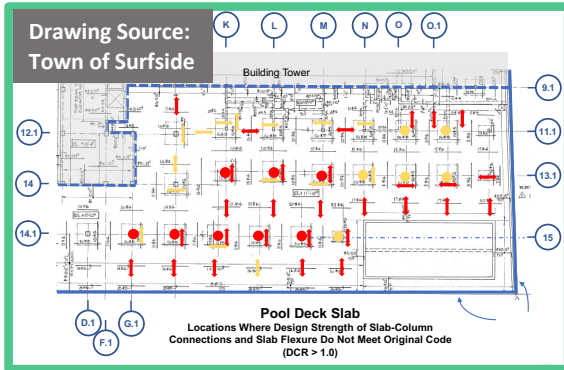
*Judith Mitrani-Reiser, N. Emel Ganapati,
David Goodwin, Christopher Segura,
Jonathan Weigand, Kamel Saidi, and Jack Moehle*



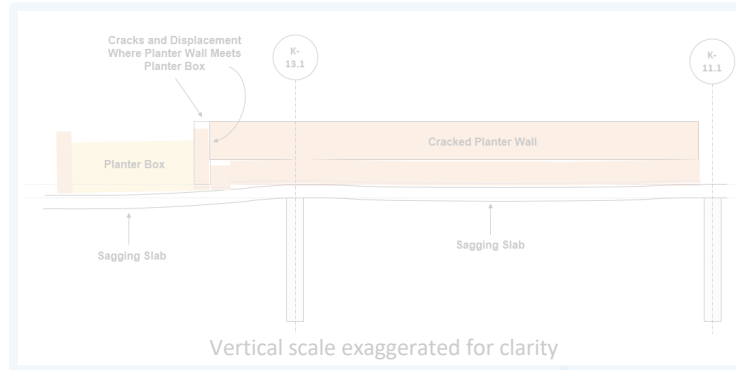
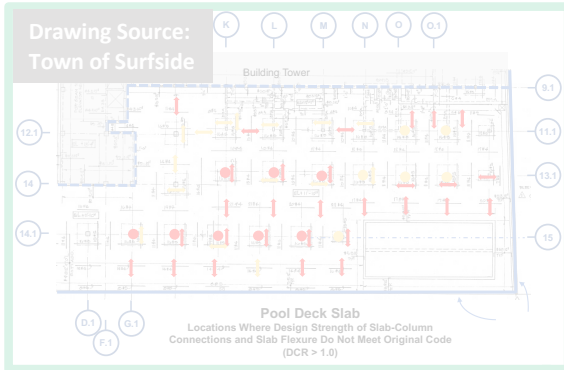
Timeline: Overview

Judith Mitrani-Reiser

CTS Investigation: Collapse Timeline



CTS Investigation: Collapse Timeline



Site History

1900-1979

CTS Design & Construction

1979-1981

CTS Building History

1981-2021

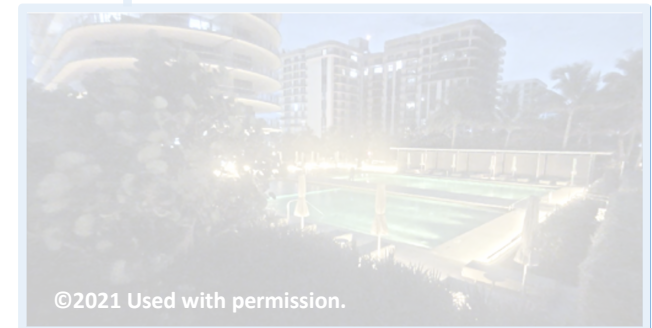
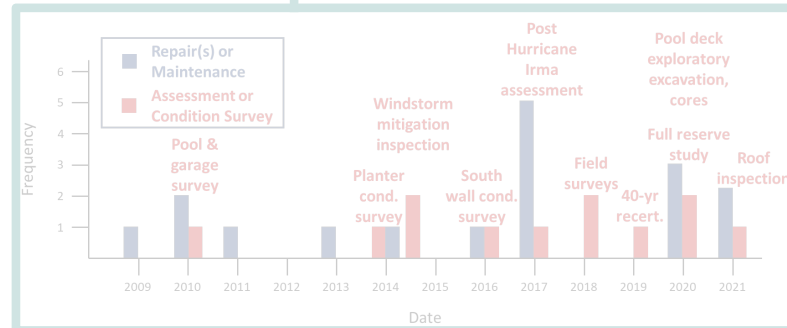
Champlain Towers South Collapse

Visual Evidence Presented in Slides Spans 4 min 14 s

Weeks/Days Prior to Collapse

Hours/Minutes Prior to Collapse

Initiation & Progression



CTS Investigation: Initiation and Progression Timeline

NIST



01:18:18

01:21:50

~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

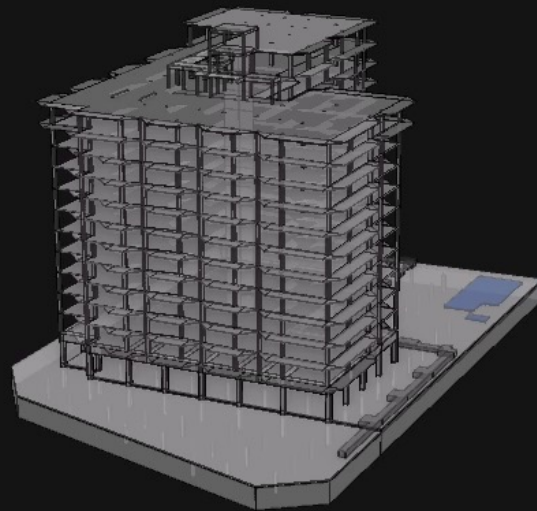
01:22:14

01:22:17



CTS Investigation: Collapse Initiation & Progression Footage

NIST



Source: NIST

CONTENT WARNING:

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

Theme 1 Panel will pause for 60 s.

Participants desiring to leave the meeting may do so now.

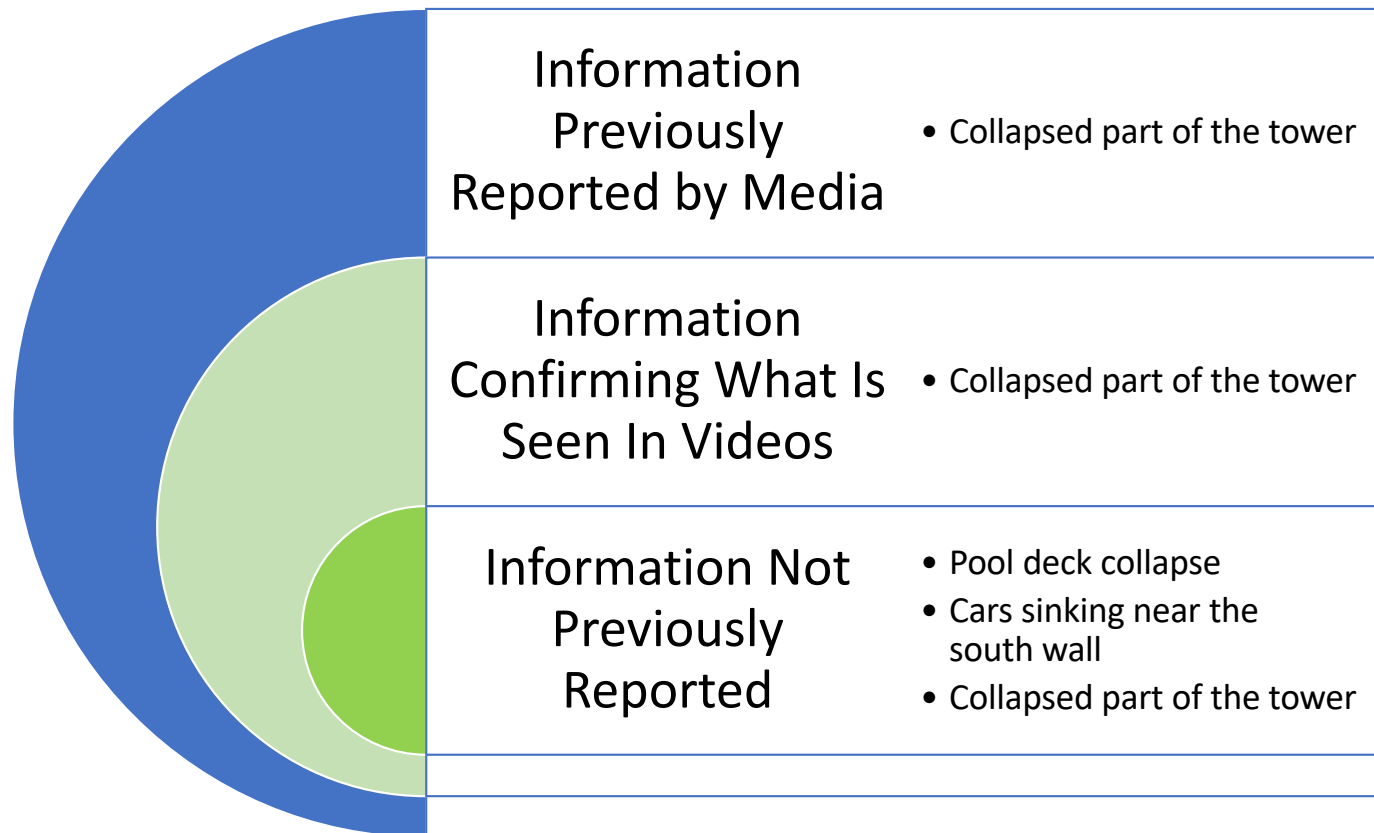
Theme 2 Panel will resume at 10:55 am ET.



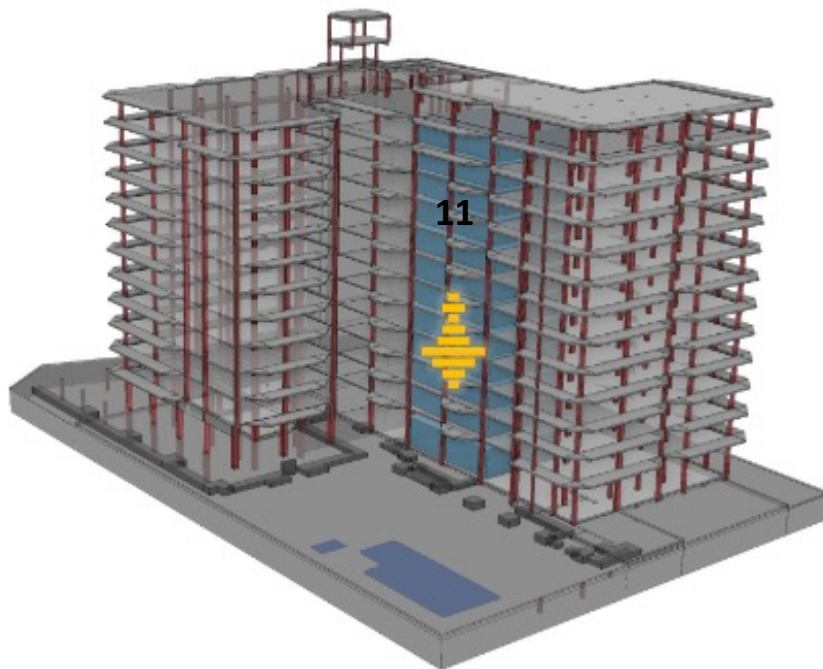
Timeline: Interviews

N. Emel Ganapati

CTS Investigation: Timeline from Interviews



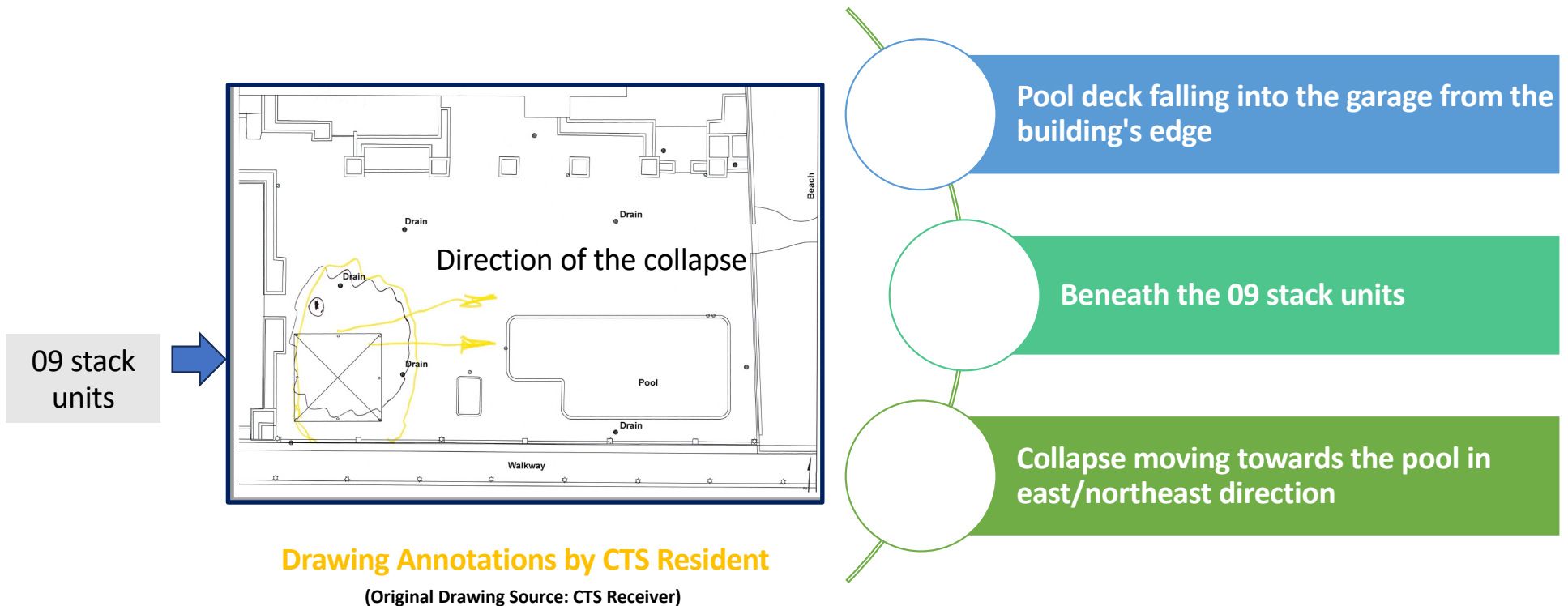
CTS Investigation: Timeline from Interviews



Source: NIST

- Noises in the 11 stack units from above the 1st floor before 1 am
- Like “knocking” or a “hammer” or “table” & “chairs” being moved above
- Noises getting “louder and louder” and “more intense” closer to the time of the pool deck collapse


CTS Investigation: Timeline from Interviews



CTS Investigation: Timeline from Interviews



Source: NIST


Direction of cars sinking

Car alarms "going off"

Cars sinking into the ground near the south wall from the East towards the West

Sinking does not "go all the way" to Collins Avenue

CTS Investigation: Timeline from Interviews



North Elevation View

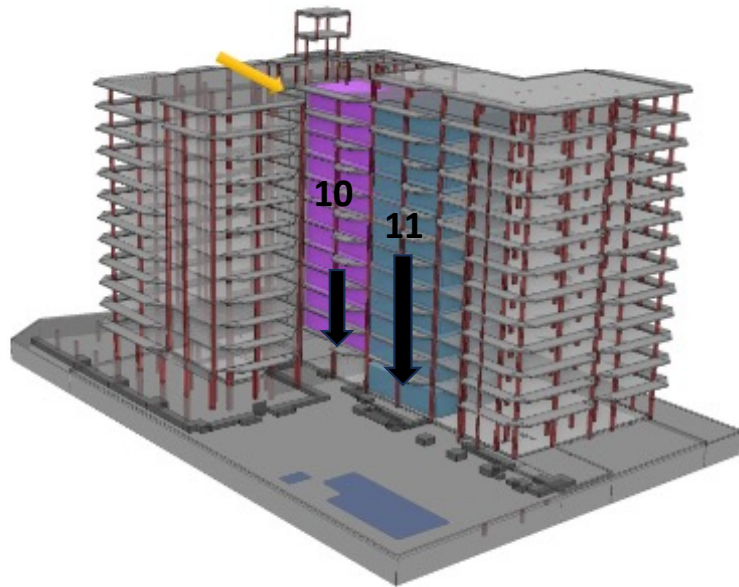
Drawing Annotations by CTS Resident

(Original Drawing Source: CTS Receiver)

- Horizontal cracks across the stucco façade
- Windows/sliding doors on the 1st floor exploding
- “A huge cloud of dust” blowing from the garage– getting “bigger and bigger” until nothing can be seen

CTS Investigation: Timeline from Interviews

From a small glass window on the landing of an emergency exit



Source: NIST

- The 11 stack units coming down “one by one” “like dominos”
- The 10 stack units start falling before the 11 stack units finished falling
- Almost felt like the units were “being dragged down”



Timeline: Parking Garage Ramp Video

David Goodwin

CTS Investigation: Initiation and Progression Timeline

NIST



01:18:18

01:21:50

~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

01:22:14

01:22:17

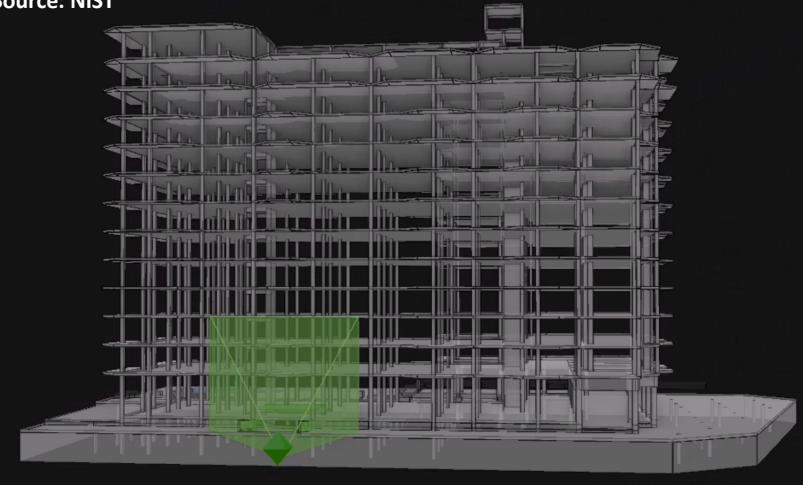


CTS Investigation: Initiation and Progression Timeline

NIST



Source: NIST



Elevation View of Camera Line of Sight

01:18:18

Visual Evidence Present



39

01:22:14

01:22:17

1:18:18 AM 6/24/2021

HEIGHT
6' 5"

RESTRICTED ACCESS
NO ENTRY WITHOUT AUTHORITY
BEACH TOWERS
305-534-2700

N ↙

Digitally adapted by NIST (Original Source: 2021, A. Sarmiento)

CTS Investigation: Parking Garage Ramp Footage + 3D Model **NIST**

Source for Model: NIST

1:18:18 AM 6/24/2021

CLEARANCE
6' 5"

CLEARANCE
6' 5"

M-8

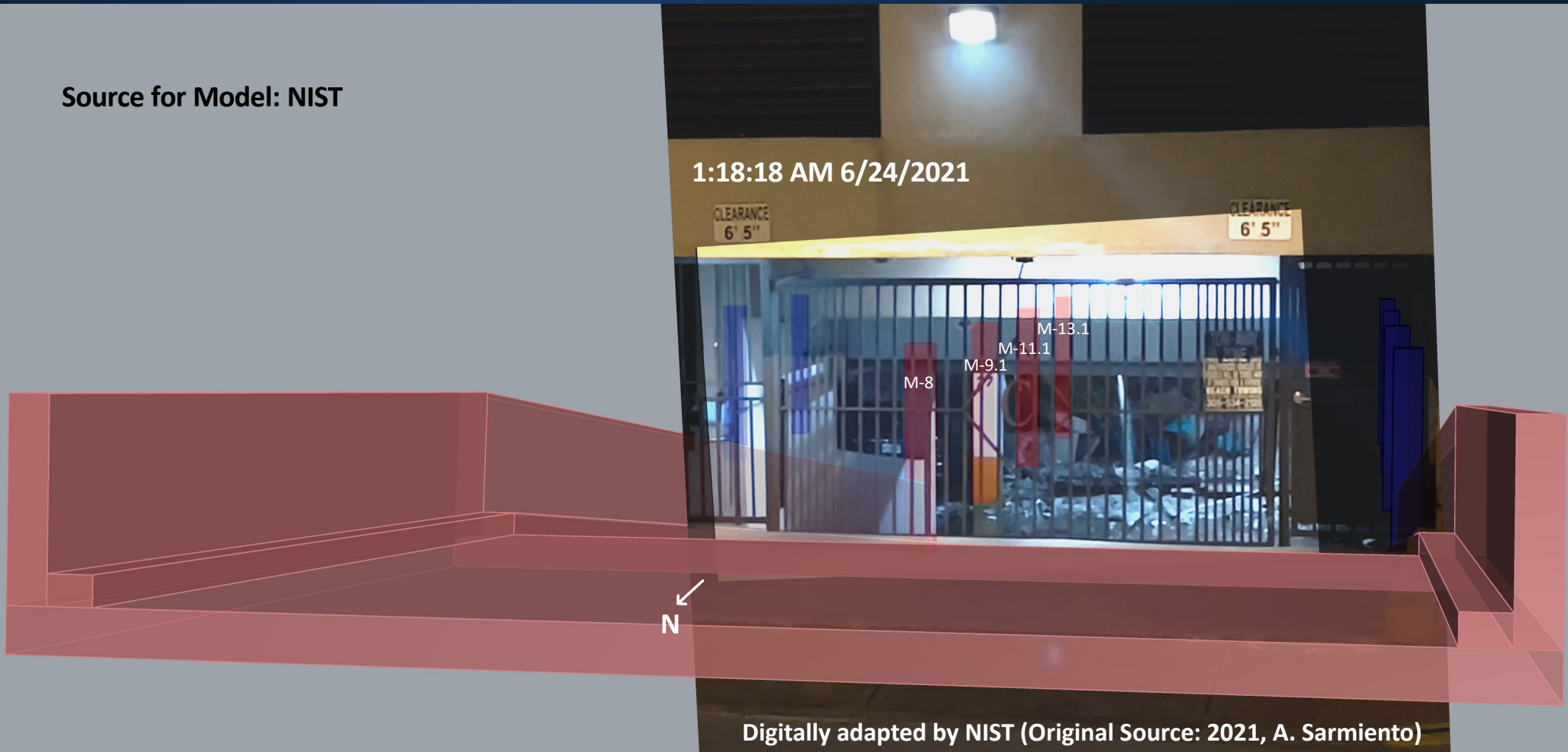
M-9.1

M-11.1

M-13.1

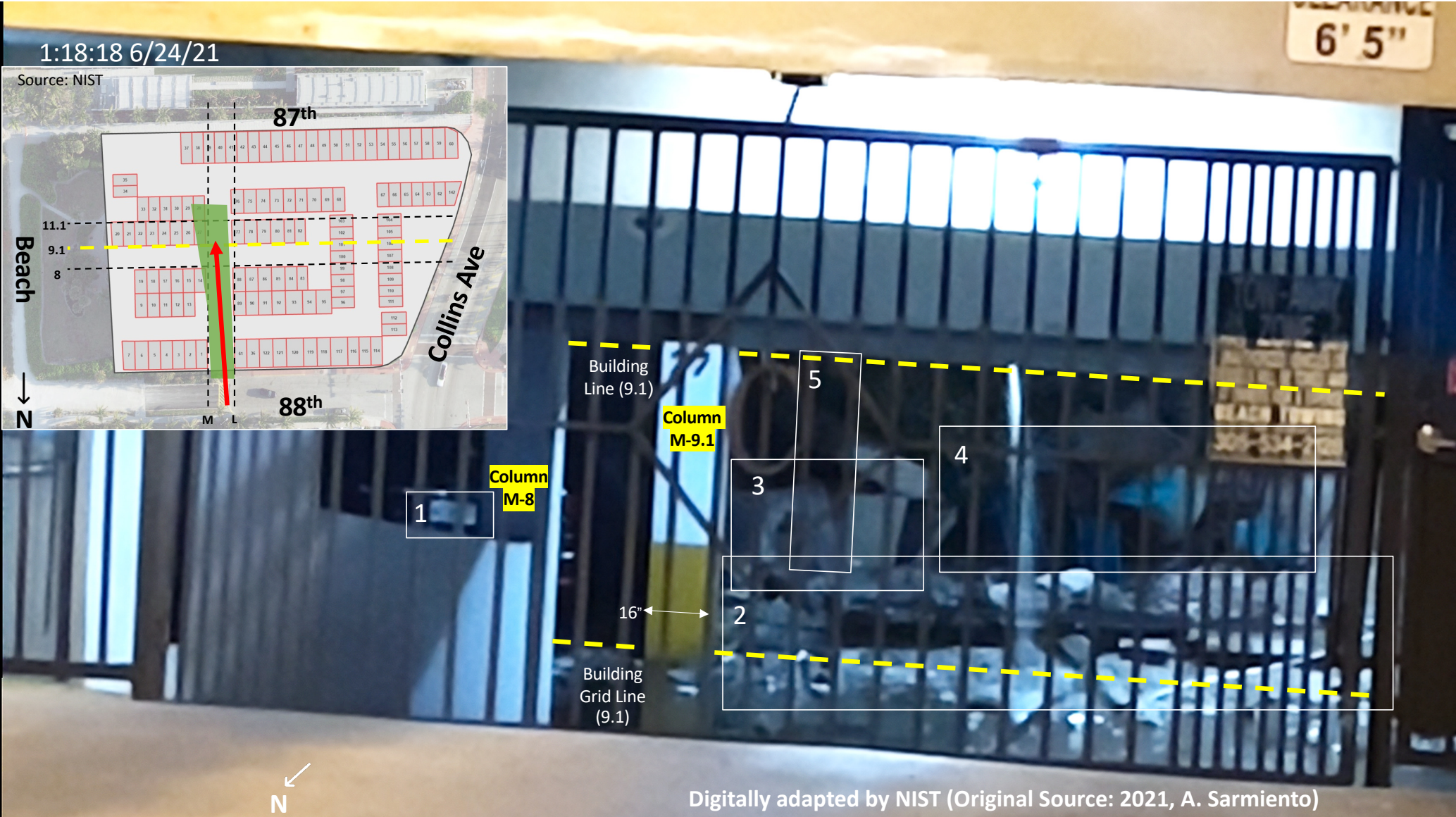
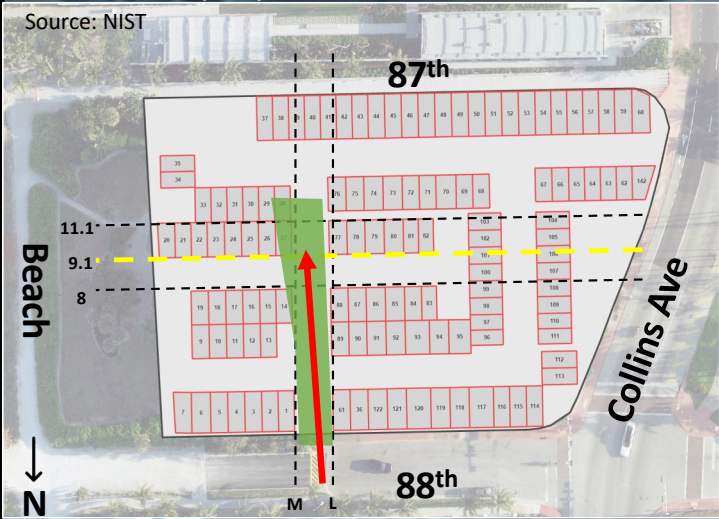
N

Digitally adapted by NIST (Original Source: 2021, A. Sarmiento)



1:18:18 6/24/21

Source: NIST



Digitally adapted by NIST (Original Source: 2021, A. Sarmiento)

Picture taken down
parking garage ramp
in May 2021



Source: © 2021 Building Staff



CTS Investigation: Parking Garage Ramp Footage

NIST

Key Point: North portion of pool deck slab collapsed into the basement (parking garage) prior to the global collapse of the eastern part of the tower





Timeline: Beach Access Walkway Video

Christopher Segura

CTS Investigation: Initiation and Progression Timeline

NIST



01:18:18

01:21:50

~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

01:22:14

01:22:17



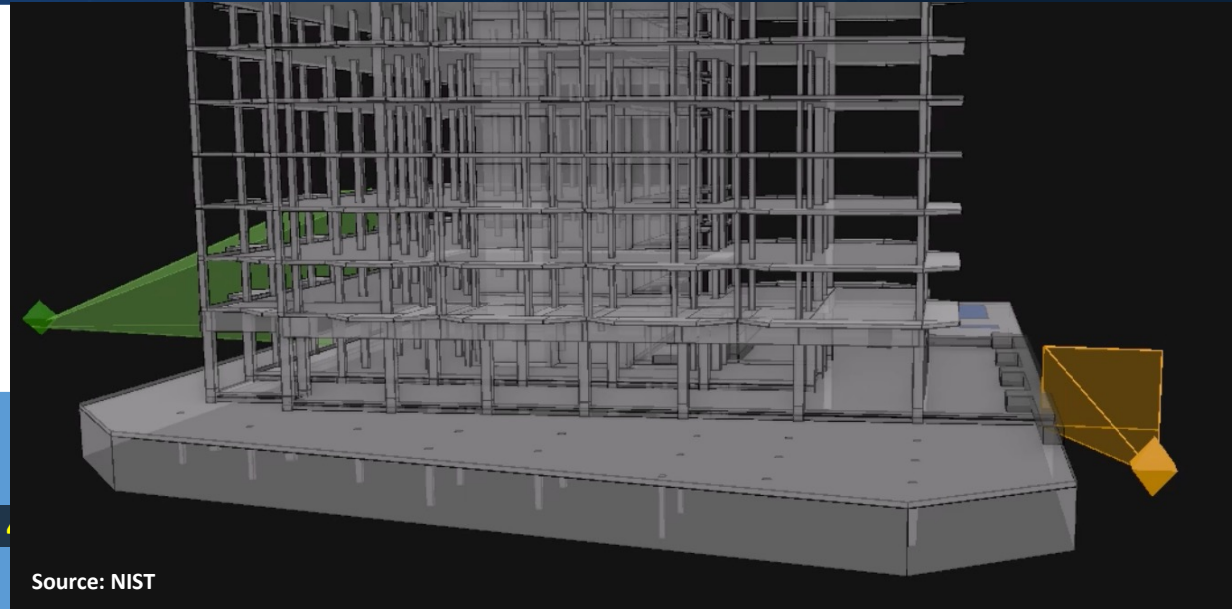
CTS Investigation: Initiation and Progression Timeline

NIST

Bird's Eye View of Camera Line of Sight



des Spans





Beach Access Walkway
camera activated by
motion



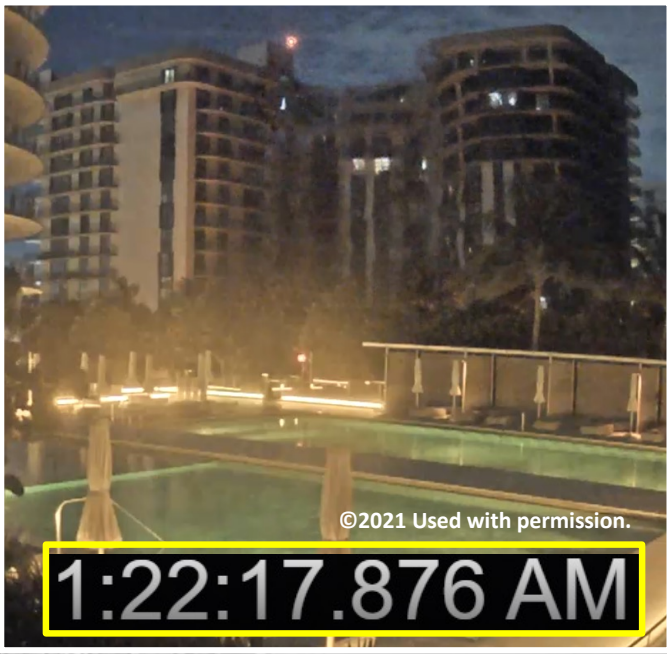
N.W. East View 1:21:39.128 AM 6/24/2021

©2021 Used with permission.



Beach Access Walkway camera activated by motion

South Face camera activated by motion



1:22:17.876 AM

1:21:00 1:21:50 1:22:00 1:22:50 1:23:00 1:23:50 1:24:00 1:24:50 1:25:00 1:25:50 1:26:00 1:26:50 1:27:00

N.W. East View 1:21:39.128 AM 6/24/2021

©2021 Used with permission.



Dust and debris appear and move westward, beginning to engulf the frame of the Beach Access Walkway camera footage

Beach Access Walkway camera activated by motion

South Face camera activated by motion



N.W. East View 1:22:24.262 AM 6/24/2021

Observation 1: Beach Access Walkway video captures moments just before, during, and after the tower collapses



Dust and debris appear and move westward, beginning to engulf the frame of the Beach Access Walkway camera footage

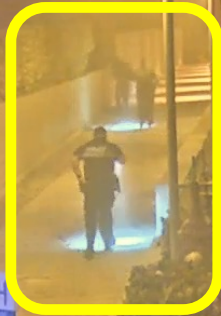
Beach Access Walkway camera activated by motion

South Face camera activated by motion



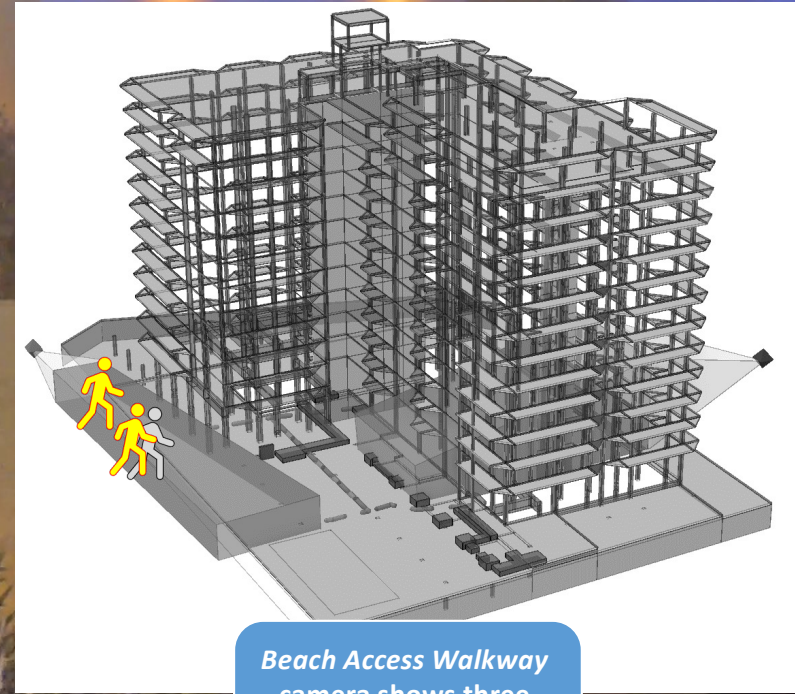
N.W. East View **1:22:24.262 AM** 6/24/2021

©2021 Used with permission.



1 civilian

2 police officers,
wearing body
cameras

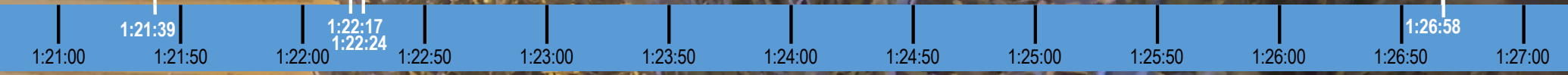


Beach Access Walkway
camera shows three
individuals on walkway,
observing damage.

Dust and debris appear
and move westward,
beginning to engulf the
frame of the *Beach Access*
Walkway camera footage

Beach Access Walkway
camera activated by
motion

South Face camera
activated by motion



N.W. East View **1:26:57.962 AM** 6/24/2021

2021-06-24 01:27:06 -0400
AXON BODY 3 X6030815T



Tall privacy wall to hedges
> 25 ft.

Dust and debris appear and move westward, beginning to engulf the frame of the *Beach Access Walkway* camera footage

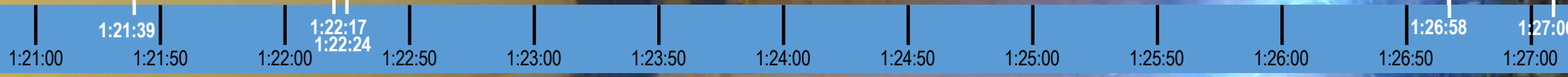
Beach Access Walkway camera activated by motion

South Face camera activated by motion



Beach Access Walkway camera shows three individuals on walkway, observing damage.

Body camera shows two individuals, observing damage.



Source: 2021, Surfside Police Dept.

CTS Investigation: Comparison to Beach Access Walkway Footage

NIST



Source: 2021, CTS Receiver

CTS Investigation: Comparison to Beach Access Walkway Footage

Observation 2: Portion of hedges and the metal fence are not visible in *Beach Access Walkway* footage because they had already collapsed with pool deck



CTS Investigation: Beach Access Walkway Footage

Observation 1: The Beach Access Walkway video captures moments just before, during, and after the tower collapses

Observation 2: Hedges and the metal fence are not visible in video because they had already collapsed with pool deck

Key Point: South portion of pool deck slab collapsed into the basement (parking garage) prior to the global collapse of the eastern part of the tower





Timeline: Upper Story Corridor Video

Jonathan Weigand

CTS Investigation: Initiation and Progression Timeline

NLST



01:18:18

01:21:50

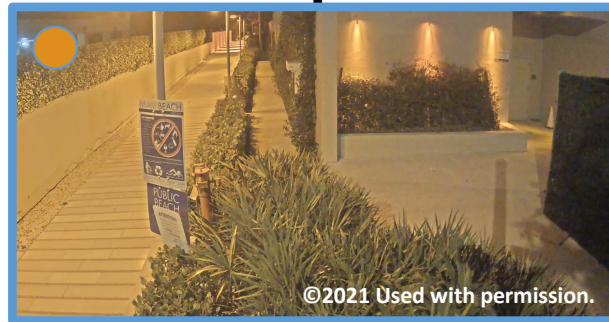
~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

01:22:14

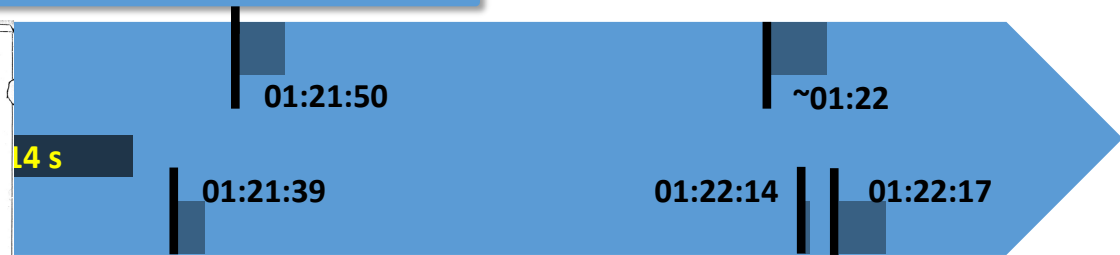
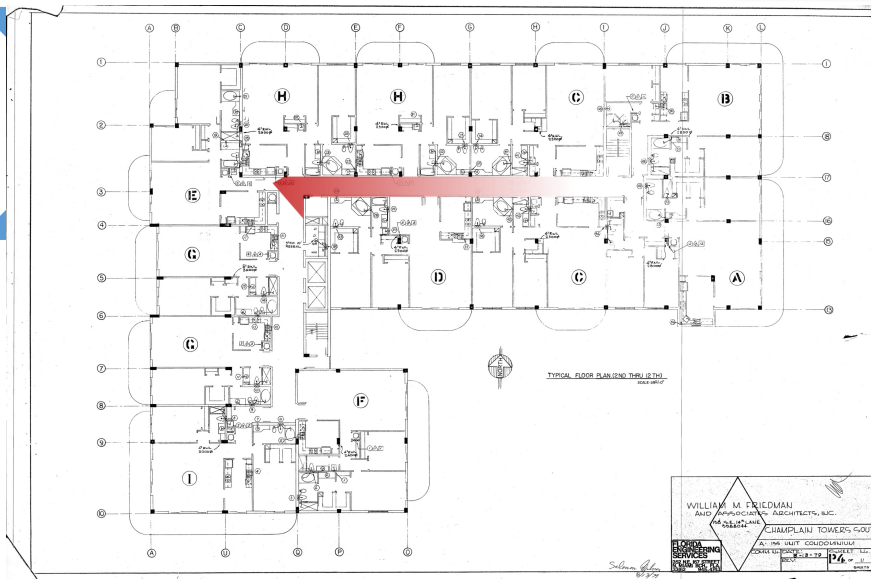
01:22:17



CTS Investigation: Initiation and Progression Timeline



Drawing Source: Town of Surfside



CTS Investigation: Initiation and Progression Timeline

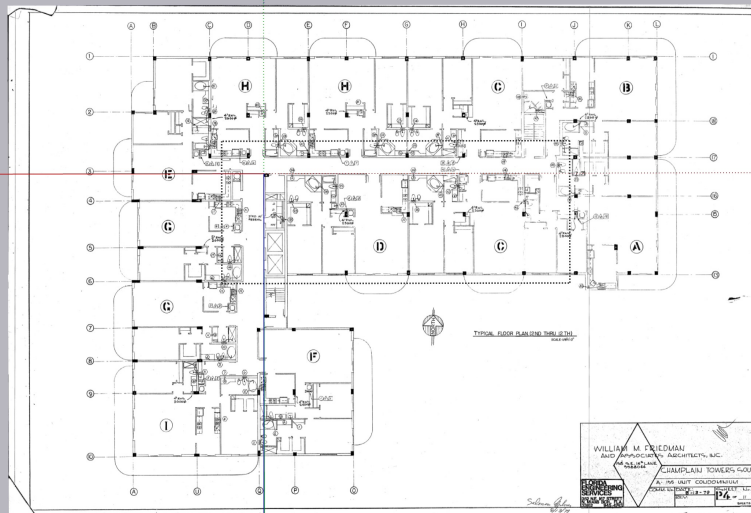
NIST



©2021 Used with permission.

Drawing Source: Town of Surfside

Video Source: NIST



01:21:50

~01:22

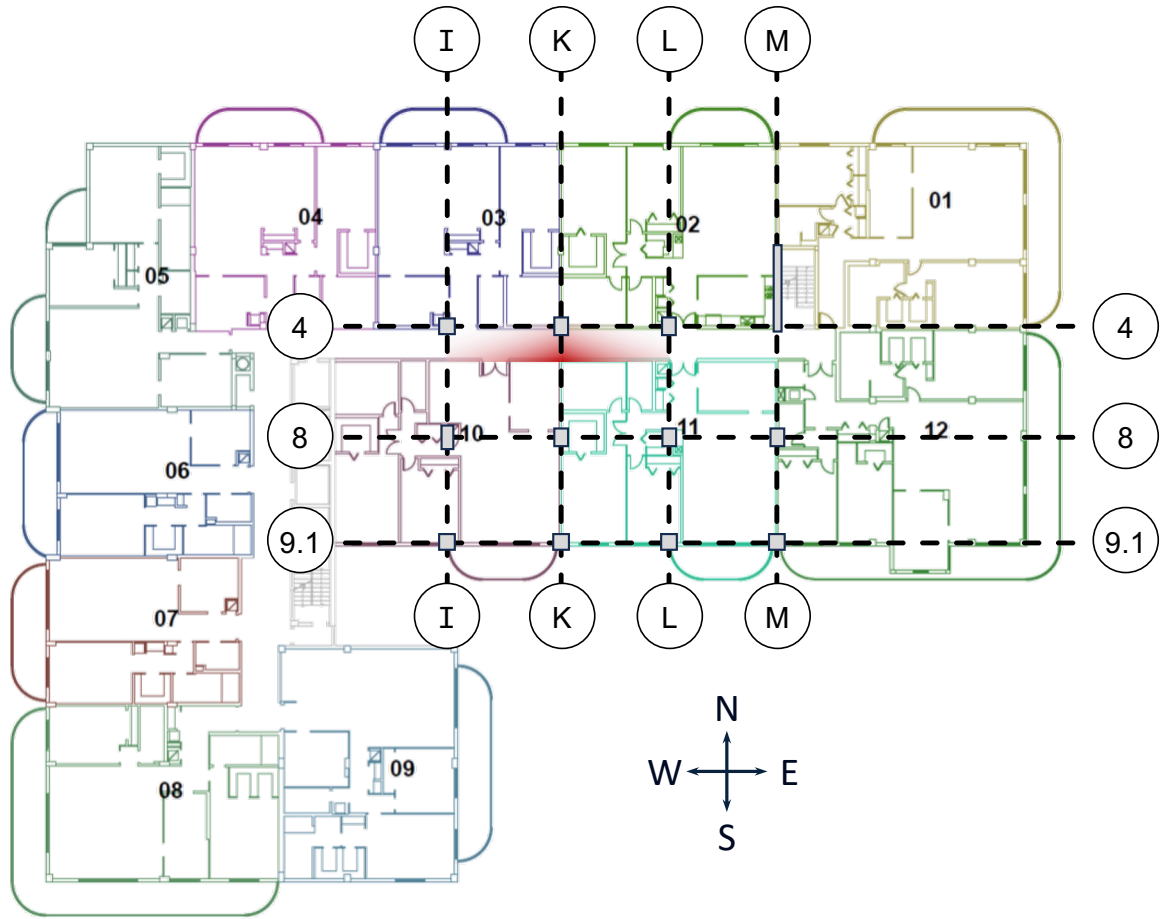
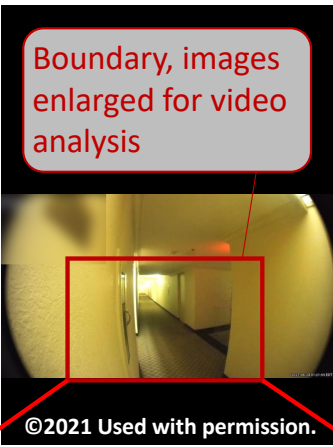
01:21:39

01:22:14

01:22:17



Camera activated by motion



Source: NIST



Camera activated by motion

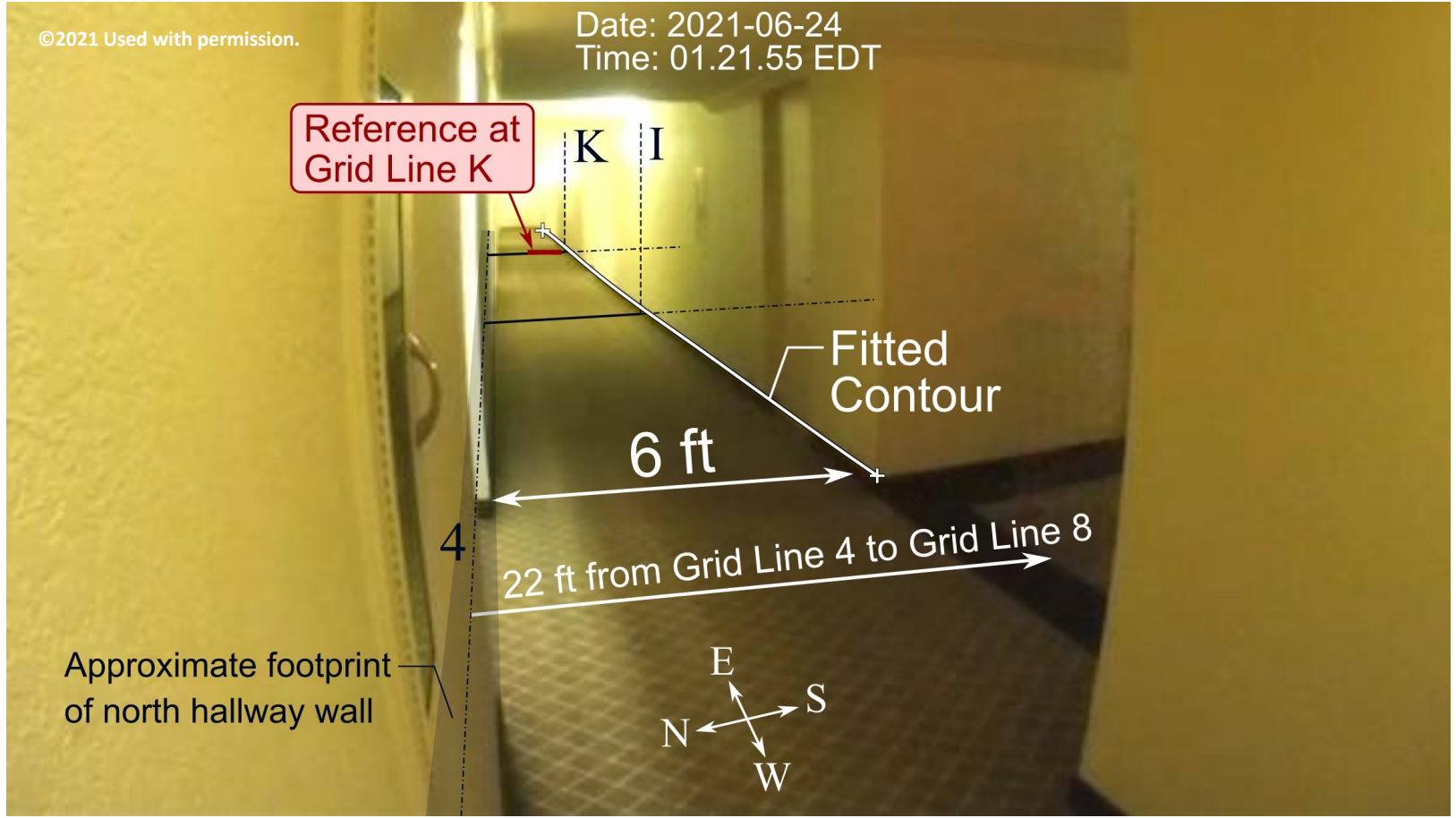
Initial frame extracted for comparative analysis

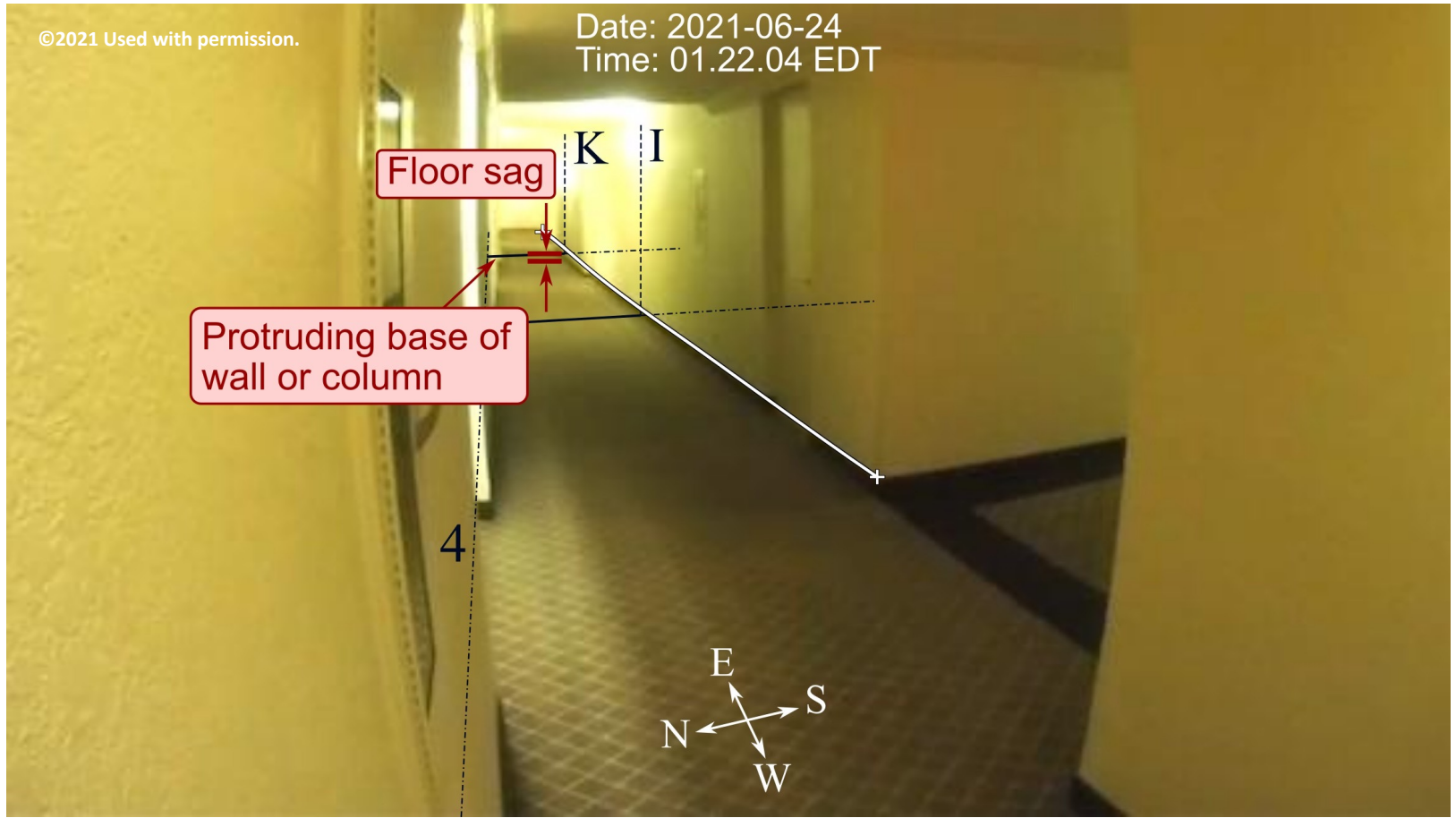
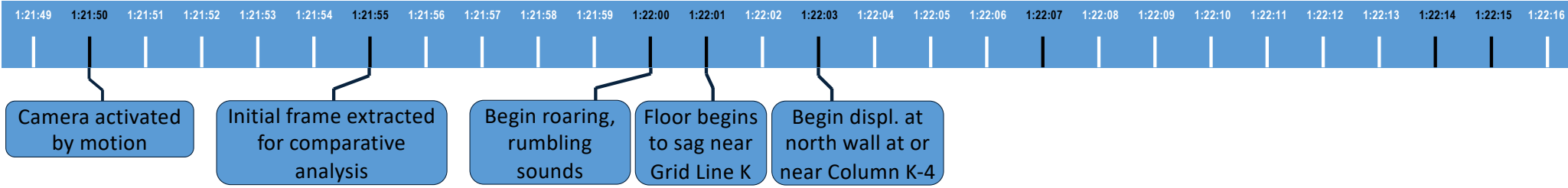


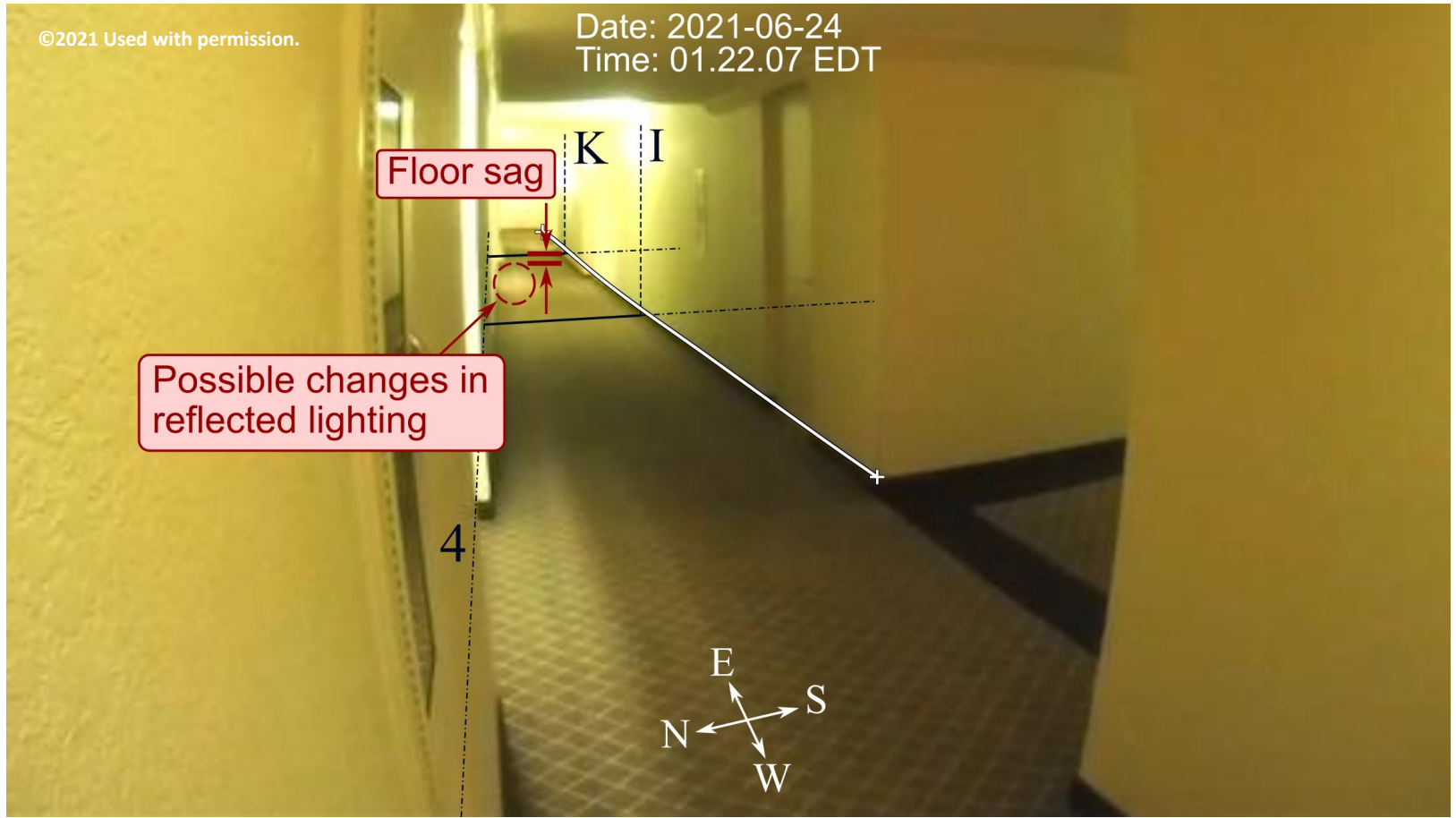
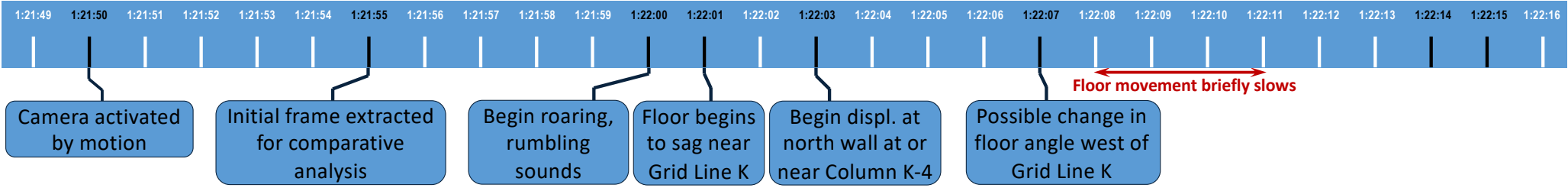


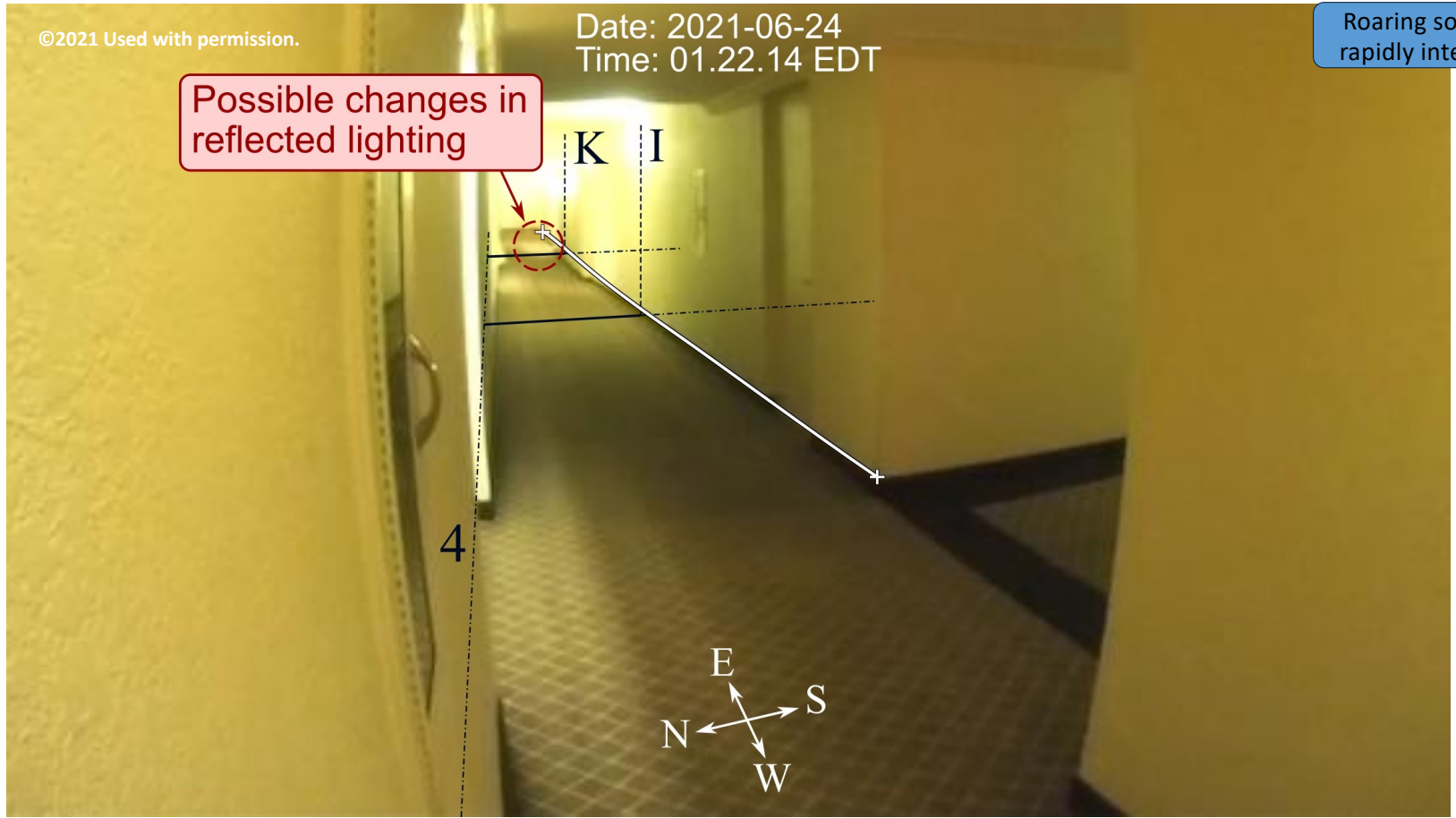
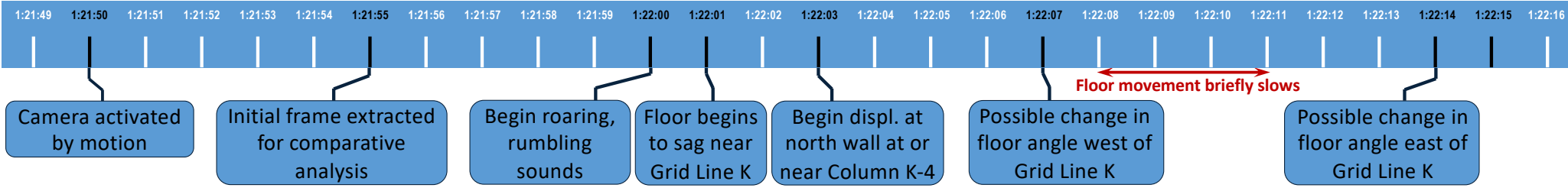
Camera activated by motion

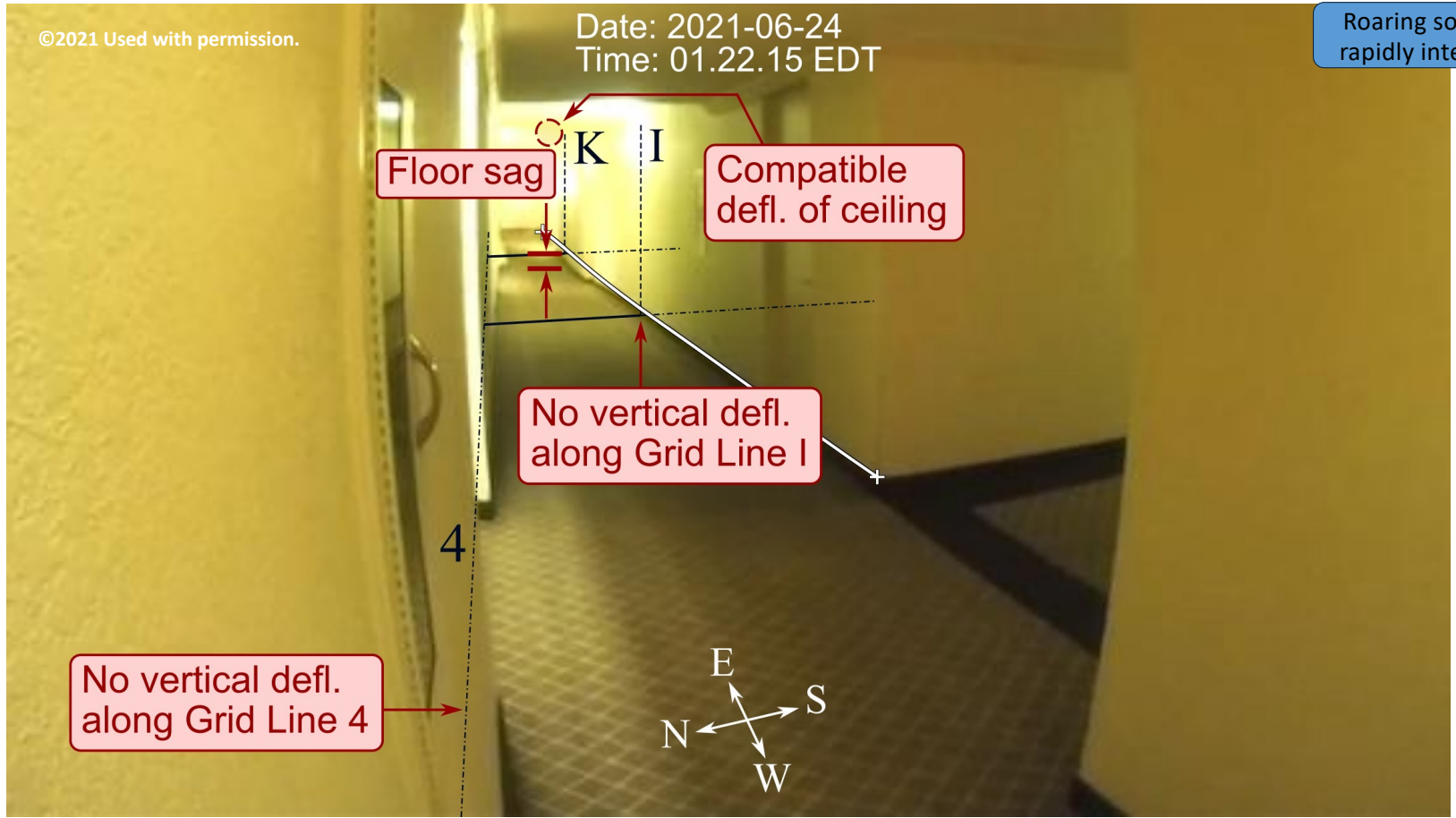
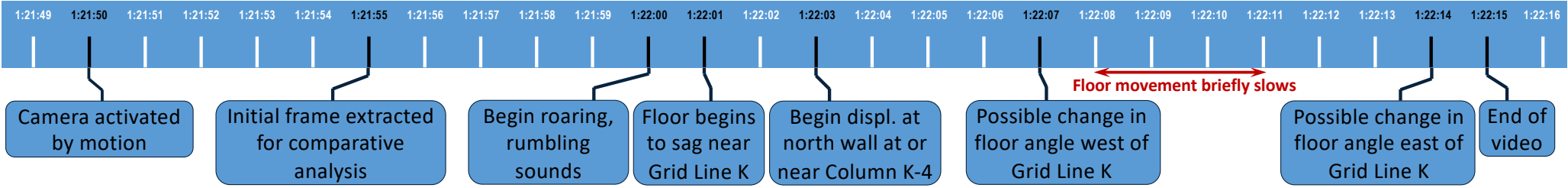
Initial frame extracted for comparative analysis











CTS Investigation: Upper Story Corridor Footage

NIST

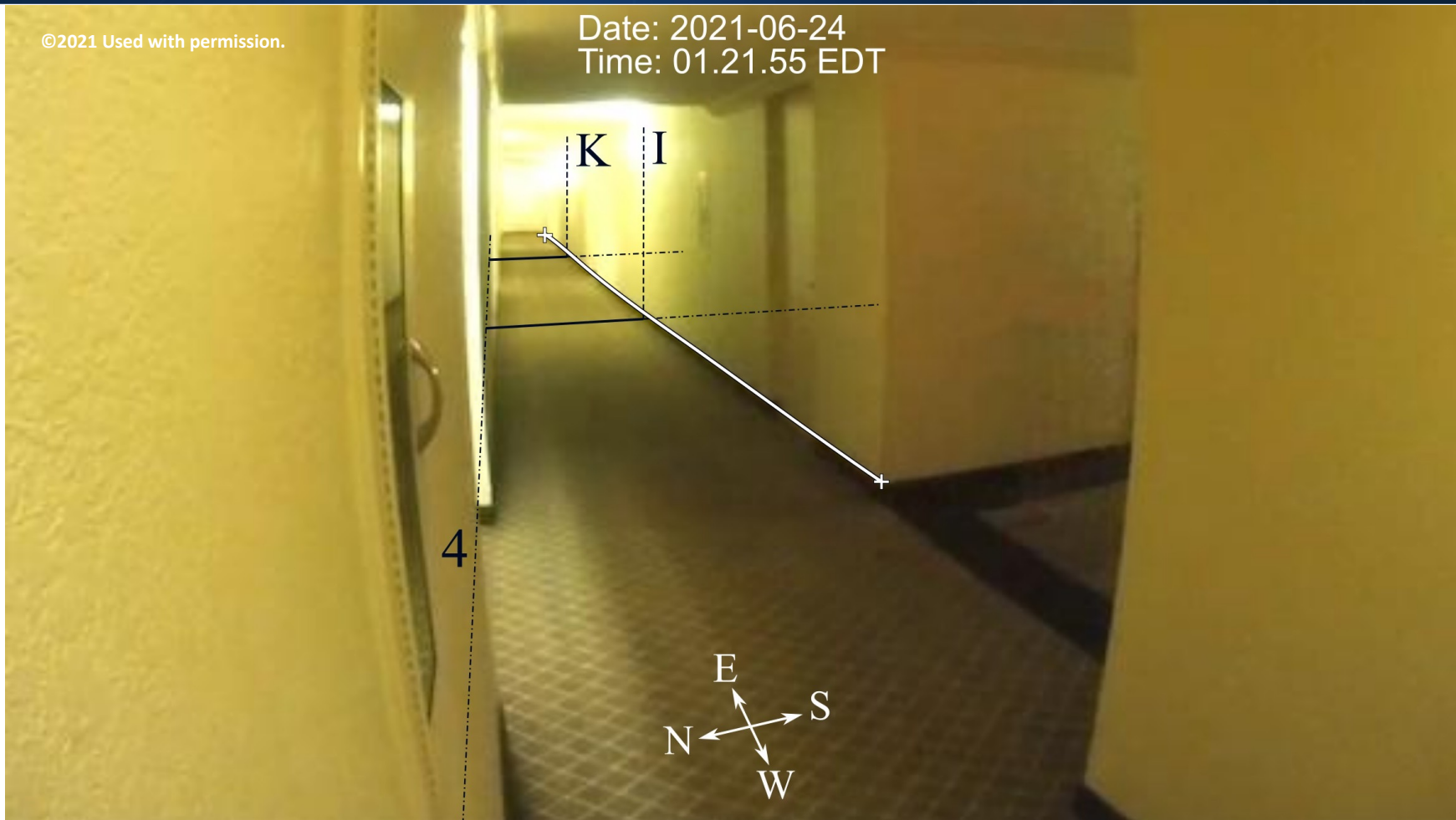
Key Point: Prior to the tower collapse, severe deflections occurred in an upper story corridor of the CTS building near Grid Location K-4. These deflections were concentrated on the south side of the corridor near Grid Line K.



CTS Investigation: Upper Story Corridor Footage

©2021 Used with permission.

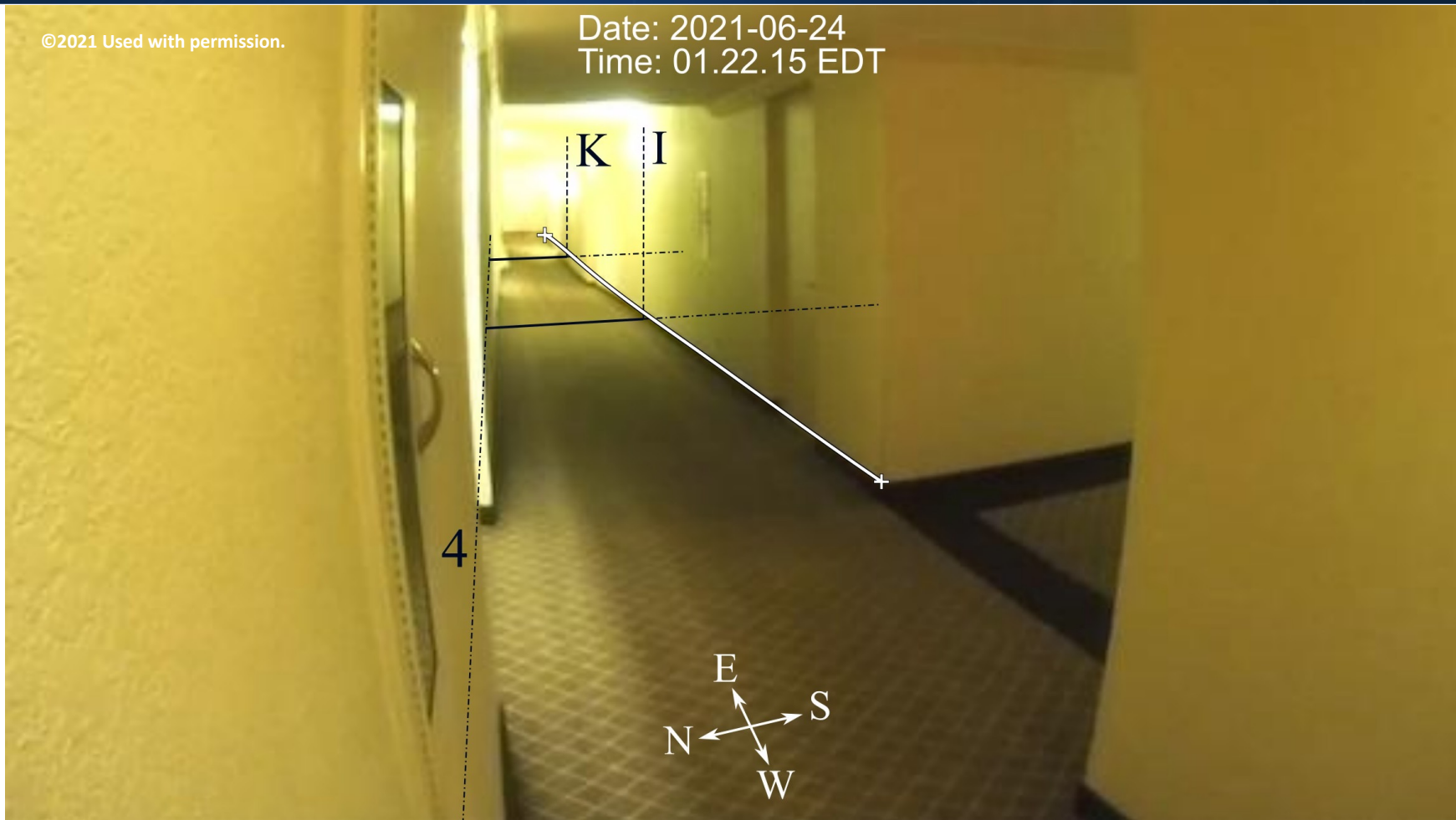
Date: 2021-06-24
Time: 01.21.55 EDT



CTS Investigation: Upper Story Corridor Footage

©2021 Used with permission.

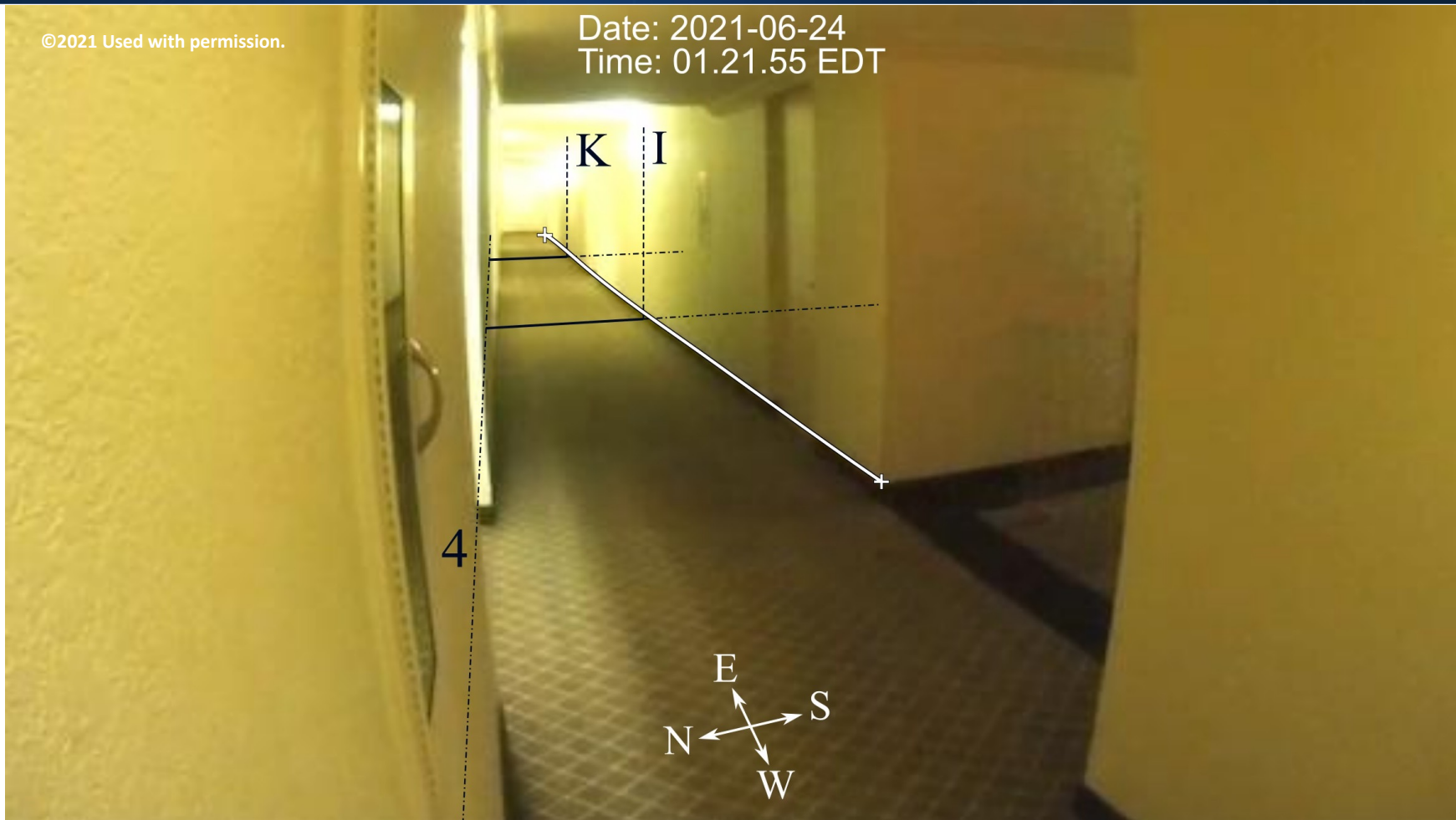
Date: 2021-06-24
Time: 01.22.15 EDT



CTS Investigation: Upper Story Corridor Footage

©2021 Used with permission.

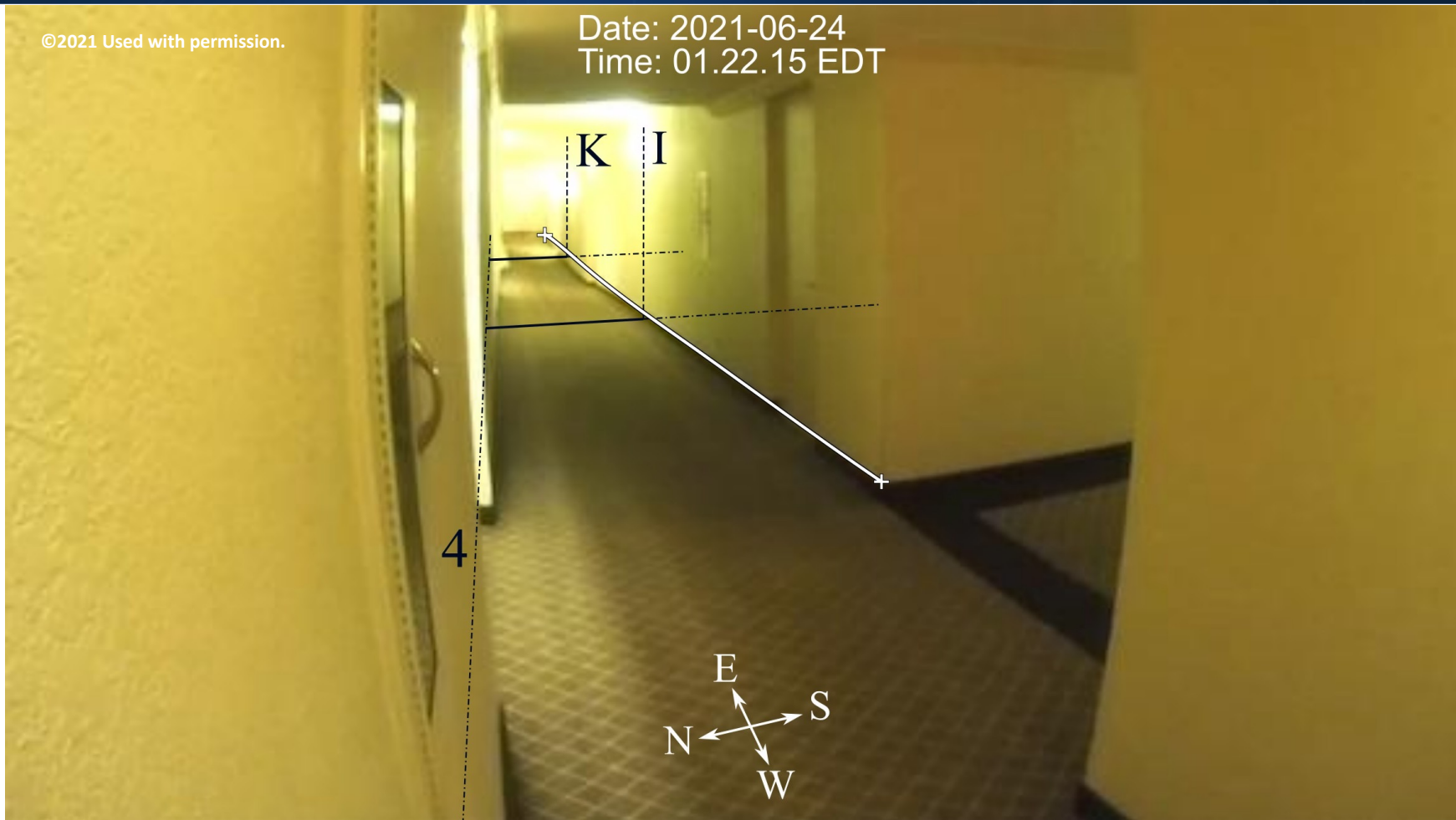
Date: 2021-06-24
Time: 01.21.55 EDT



CTS Investigation: Upper Story Corridor Footage

©2021 Used with permission.

Date: 2021-06-24
Time: 01.22.15 EDT





Timeline: 11 Stack Unit Video

Kamel Saidi

CTS Investigation: Initiation and Progression Timeline

NLST



01:18:18

01:21:50

~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

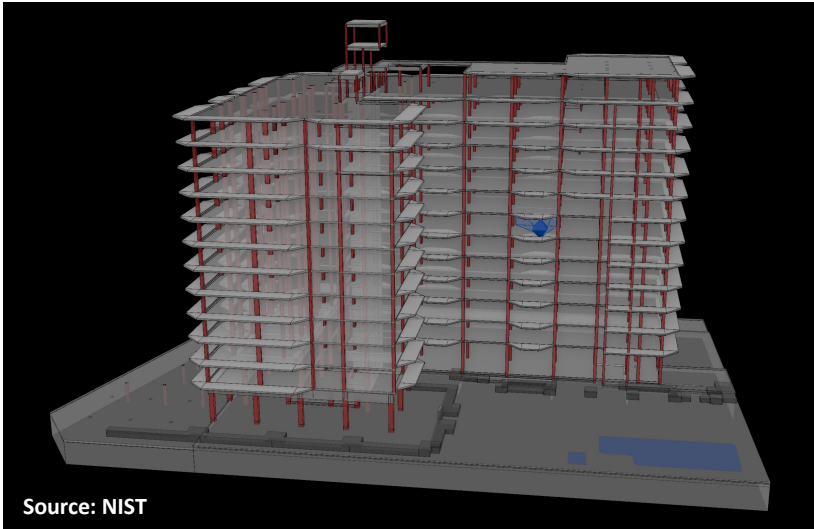
01:22:14

01:22:17



CTS Investigation: Initiation and Progression Timeline

NIST



Material falling from above

Bar counter

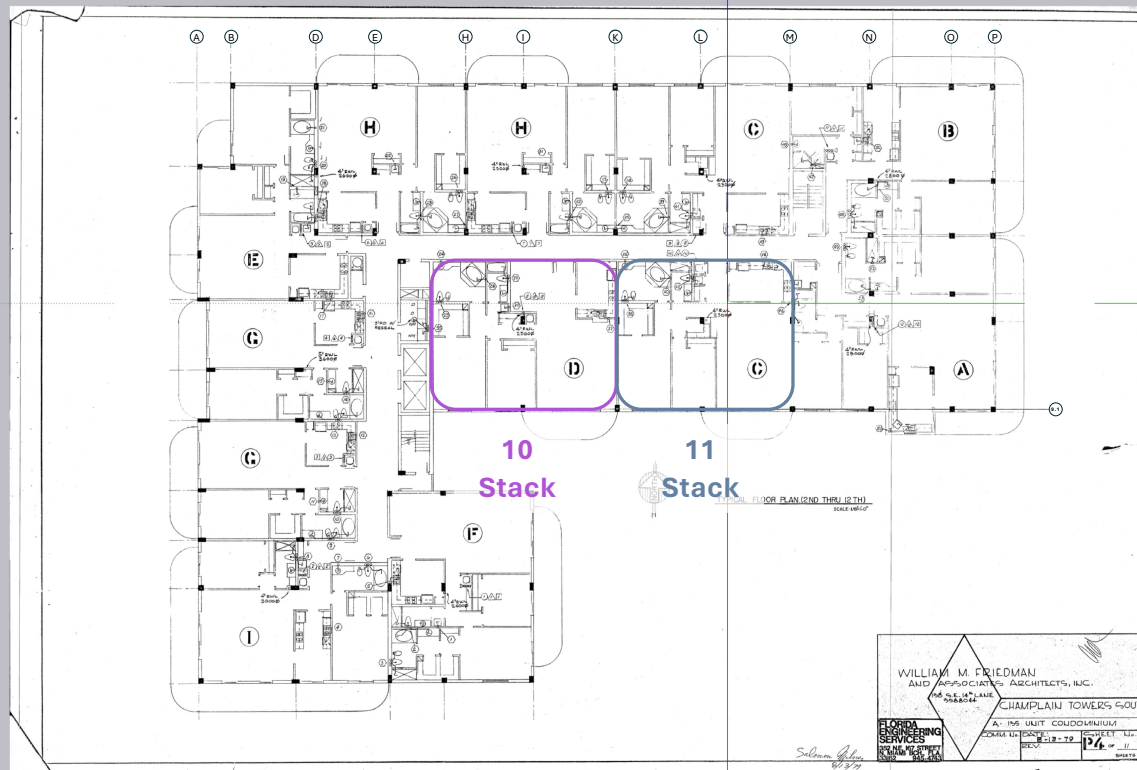


~01:22

4

01:22:17

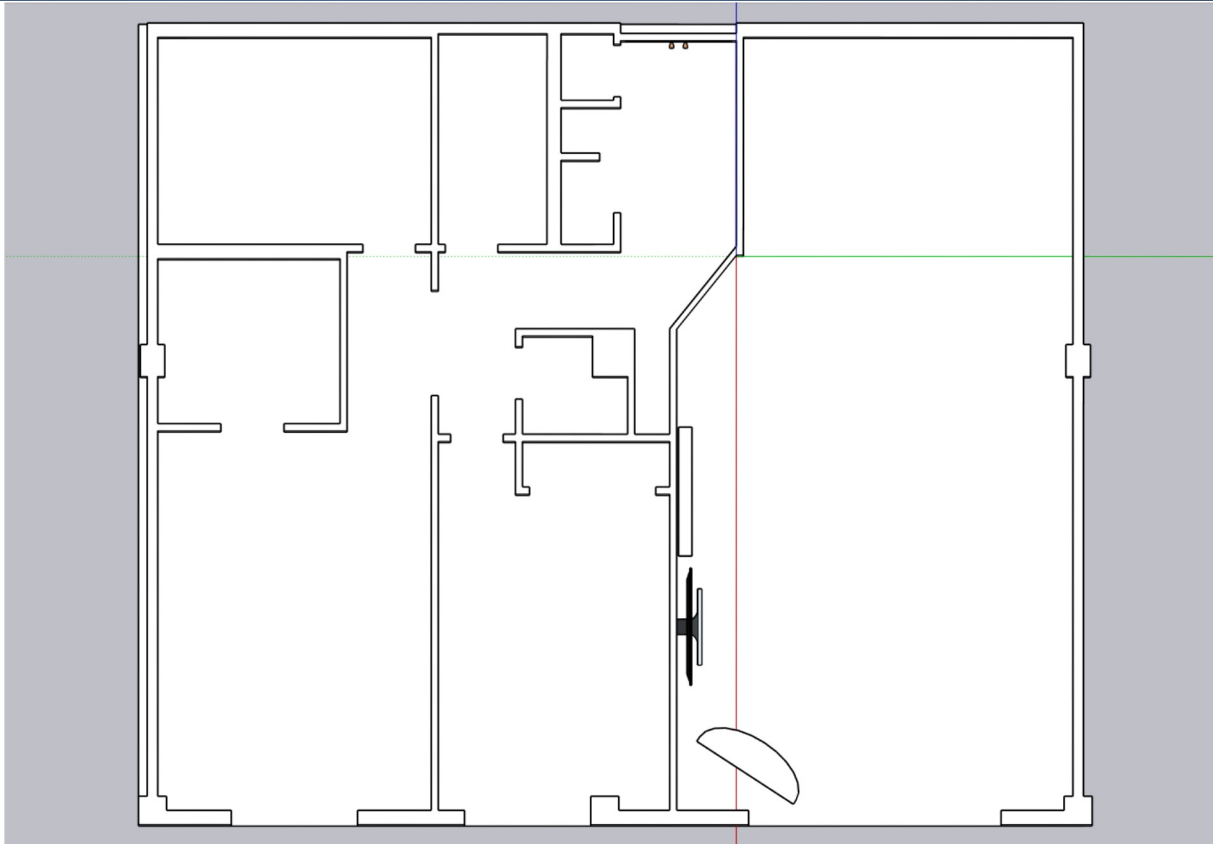
CTS Investigation: 11 Stack Unit Footage



Location of the 11 Stack Unit in CTS

CTS Investigation: 11 Stack Unit Footage

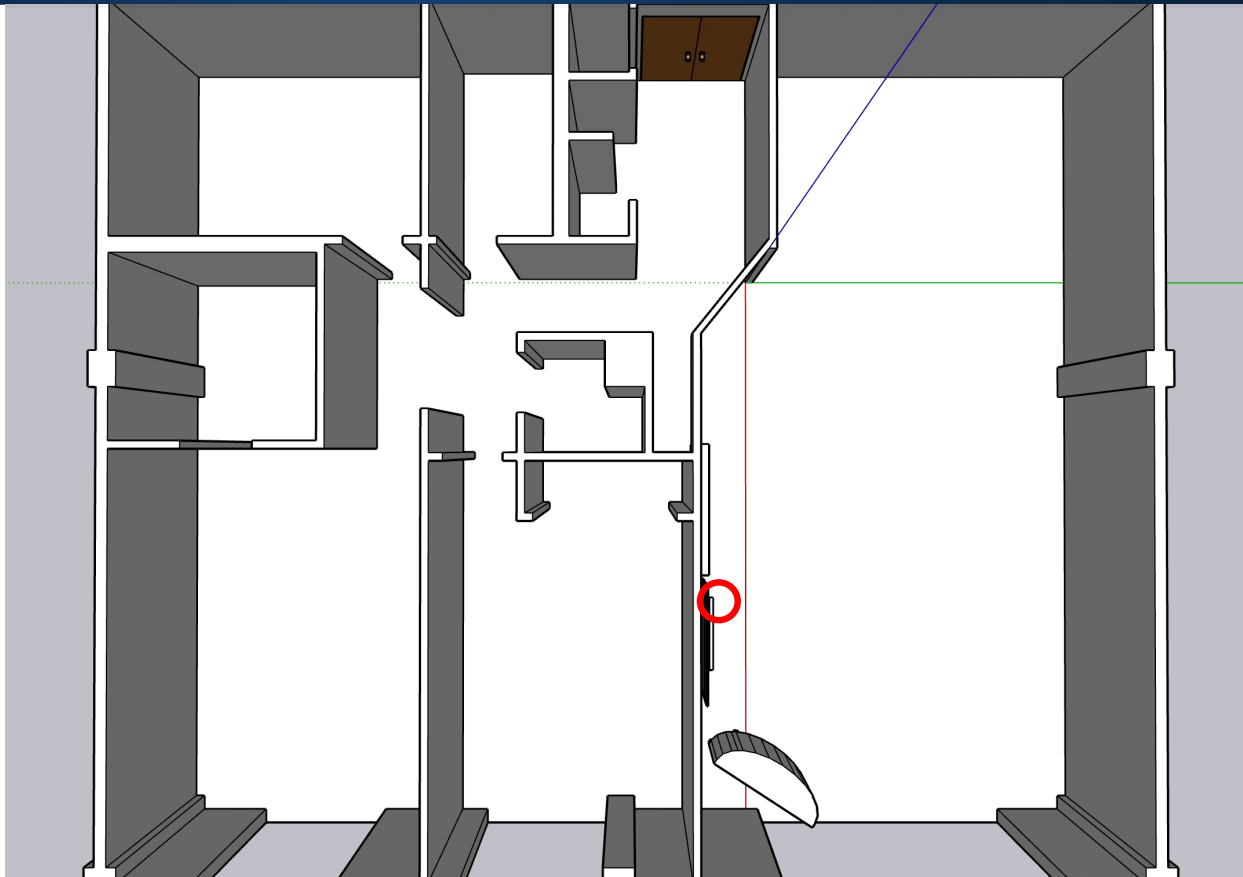
NIST



Closeup plan view of the 11 Stack Unit

CTS Investigation: 11 Stack Unit Footage

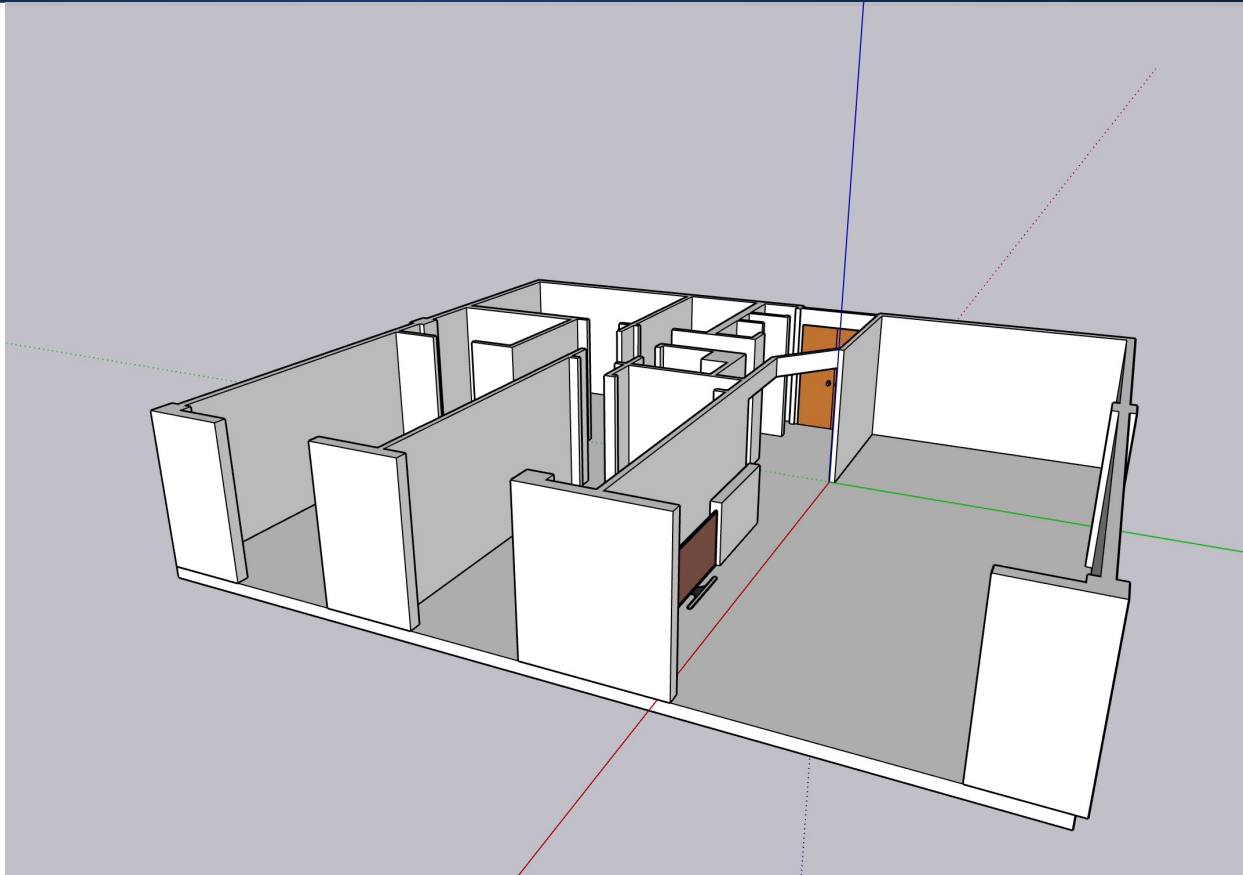
NIST



3D model of the 11 Stack Unit

CTS Investigation: 11 Stack Unit Footage

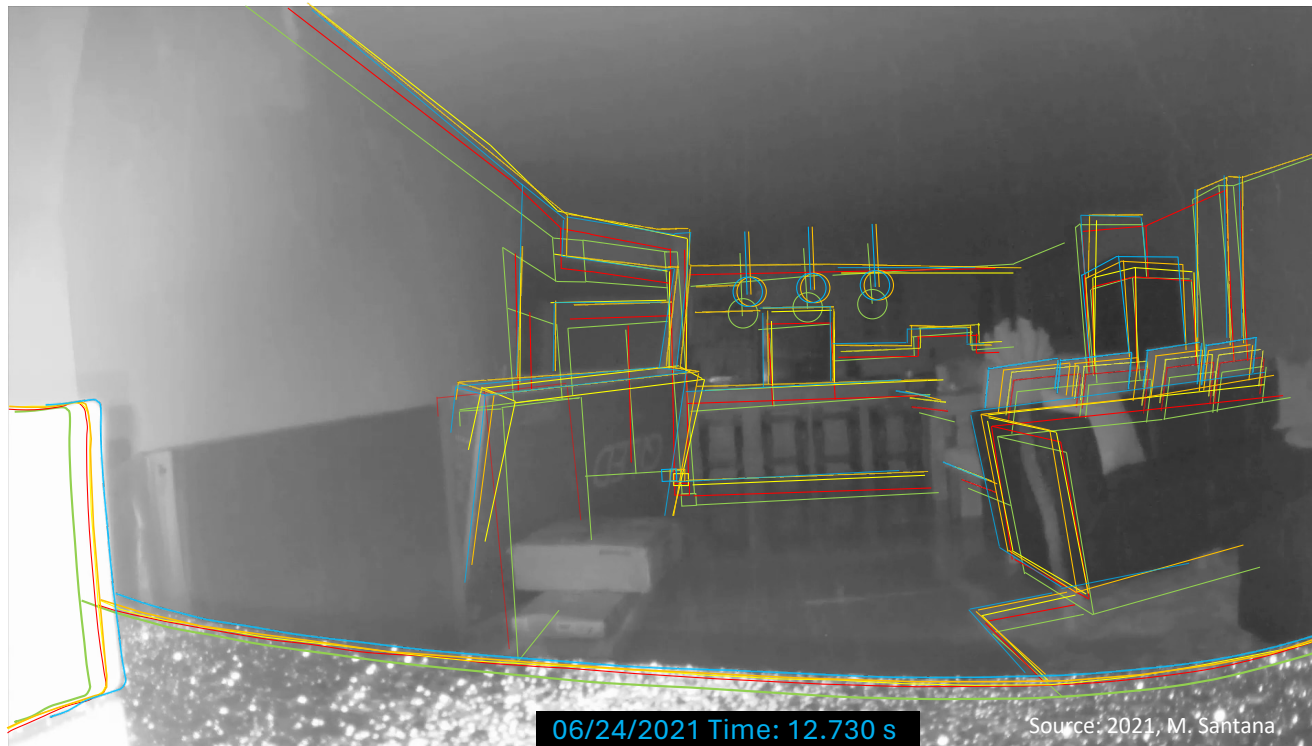
NIST



Estimating the position and orientation of the security camera in the 11 Stack Unit

CTS Investigation: 11 Stack Unit Footage

NIST



Tracking movement of objects in the 11 Stack Unit video

CTS Investigation: 11 Stack Unit Footage

NIST

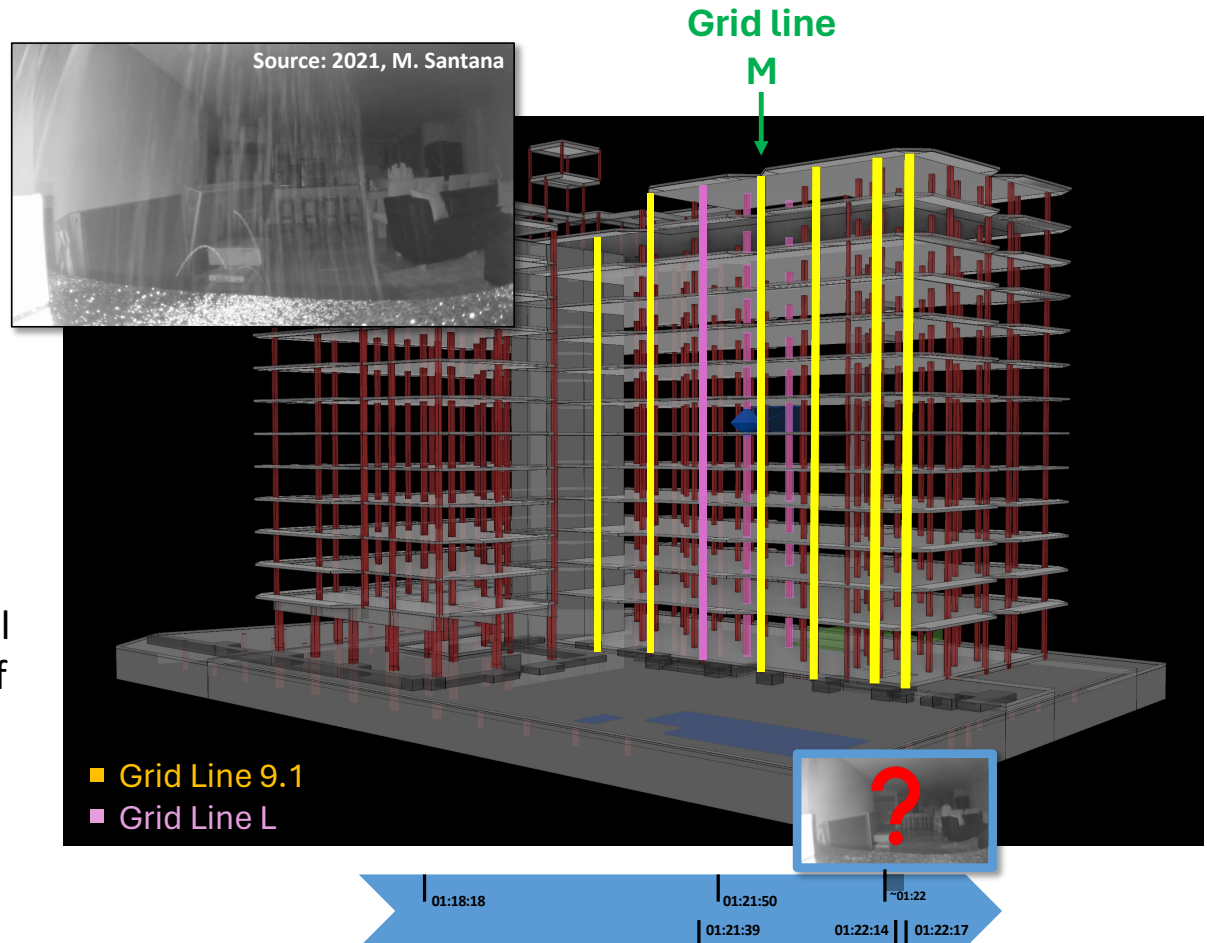


Tracking movement of objects in the 11 Stack Unit video

CTS Investigation: 11 Stack Unit Footage

Key Points:

- Material seen falling in front of the camera may indicate distress from the floor above or the upper parts of the unit's walls
- Movements observed in the room are consistent with movements of Grid line 9.1
- Distortions in the kitchen partition wall may indicate greater vertical motion of Grid Line L relative to M
- No accurate timestamp yet





Timeline: South Face Video

Kamel Saidi and Jack Moehle

CTS Investigation: Initiation and Progression Timeline

NIST



01:18:18

01:21:50

~01:22

Visual Evidence Presented in Slides Spans 4 min 14 s

01:21:39

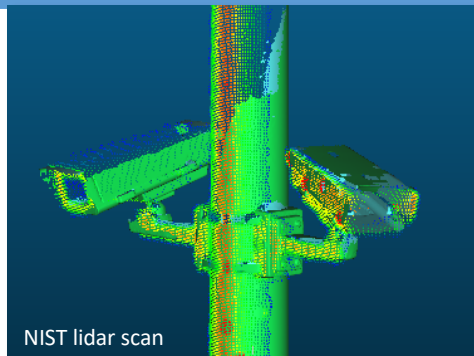
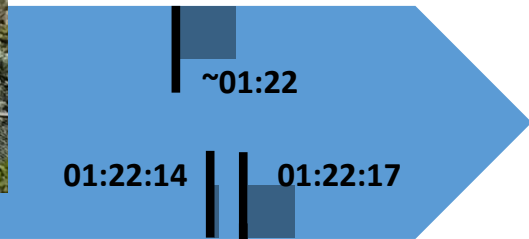
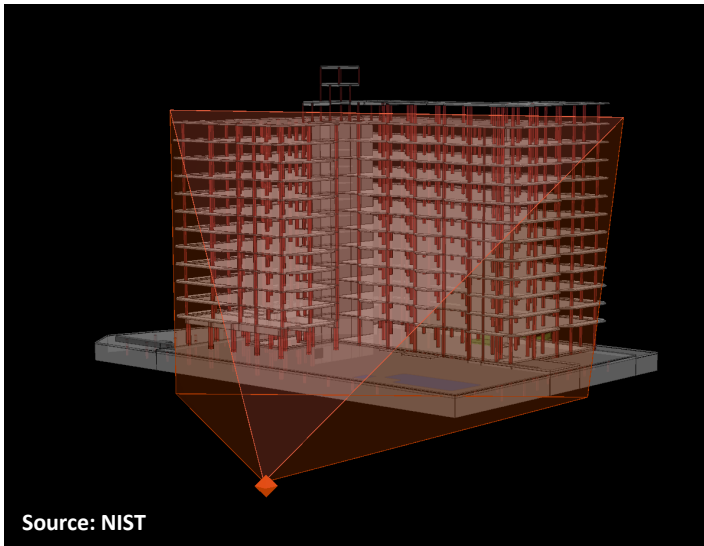
01:22:14

01:22:17



CTS Investigation: South Face Footage

NIST



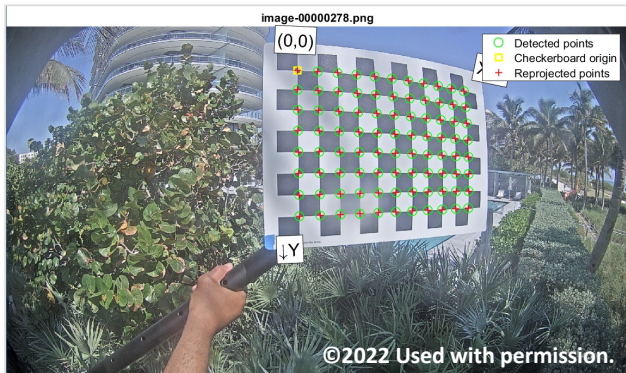
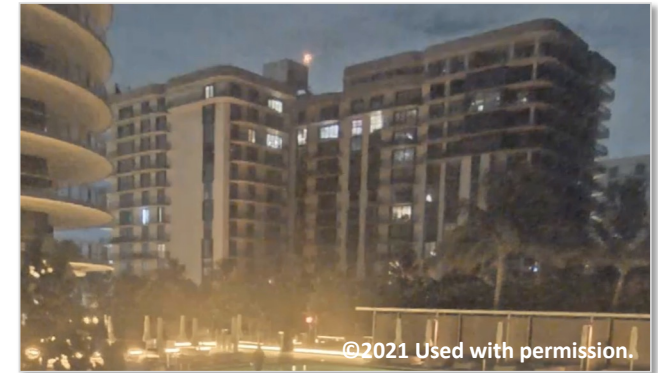
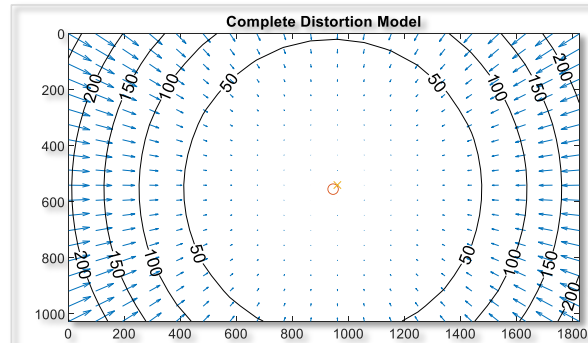
CTS Investigation: South Face Camera Footage

NIST

Original

Distortion Model

Rectified

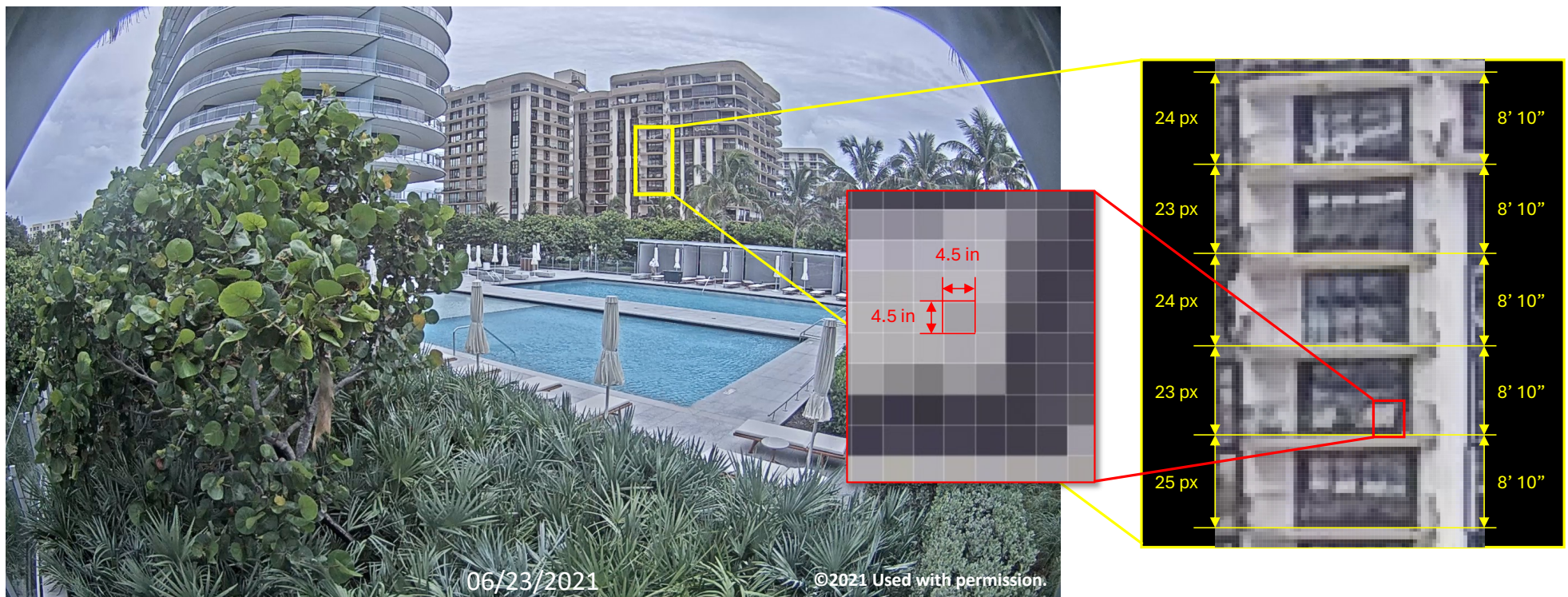


Pixel error = [0.1323, 0.1151]
Focal Length = (1005.37, 1004.12) +/- [0.6022, 0.5964]
Principal Point = (944.194, 554.208) +/- [0.2691, 0.218]
Skew = 0 +/- 0
Radial coefficients = (-0.3685, 0.1387, 0) +/- [0.0004529, 0.0005593, 0]
Tangential coefficients = (0, 0) +/- [0, 0]



CTS Investigation: South Face Camera Footage

- On the façade of CTS, 1 image pixel \cong 4.5 in (or 0.113 m)



CTS Investigation: South Face Camera Footage



1:22:17.609 AM to 1:22:18.309 AM
6/24/2021

Measuring Motion



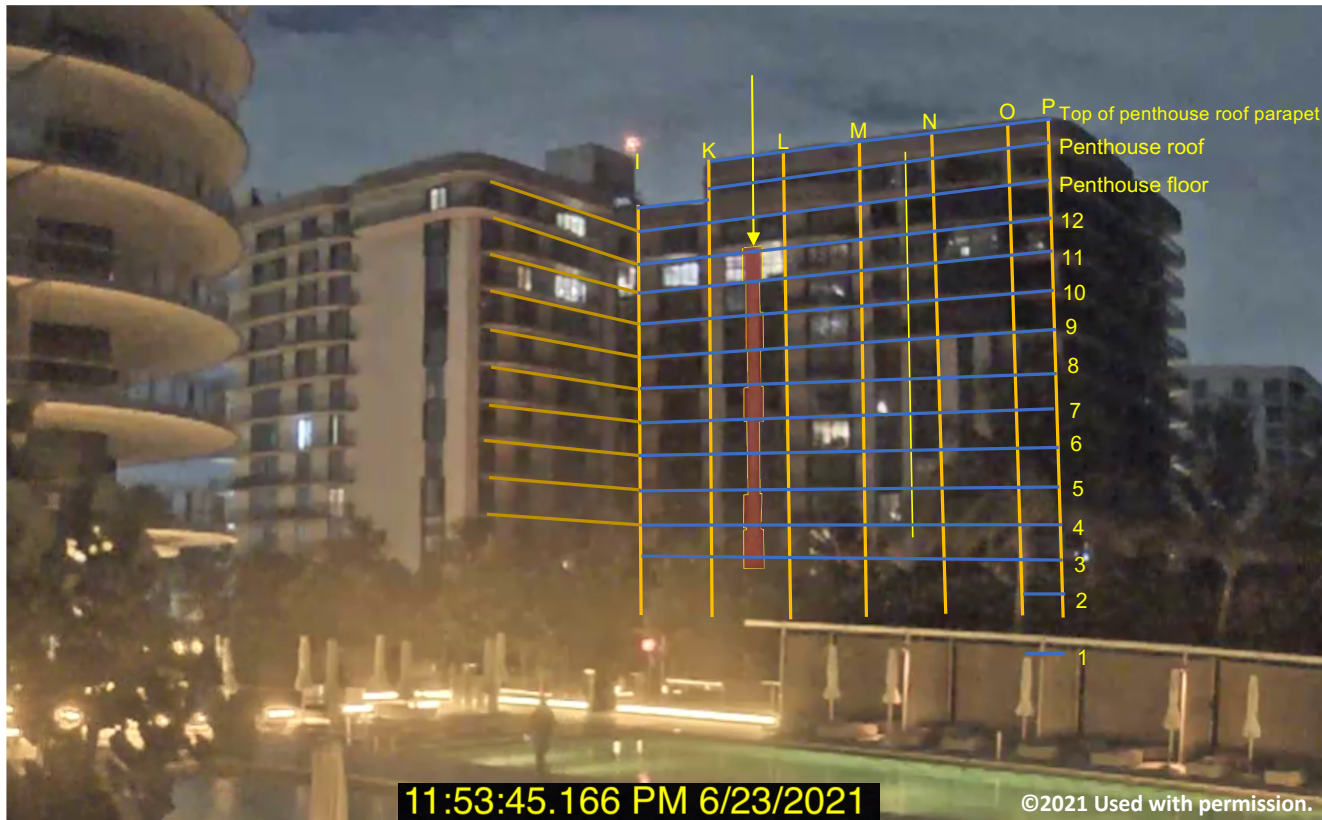
CTS Investigation: South Face Camera Footage

NIST



Understanding Unique Features

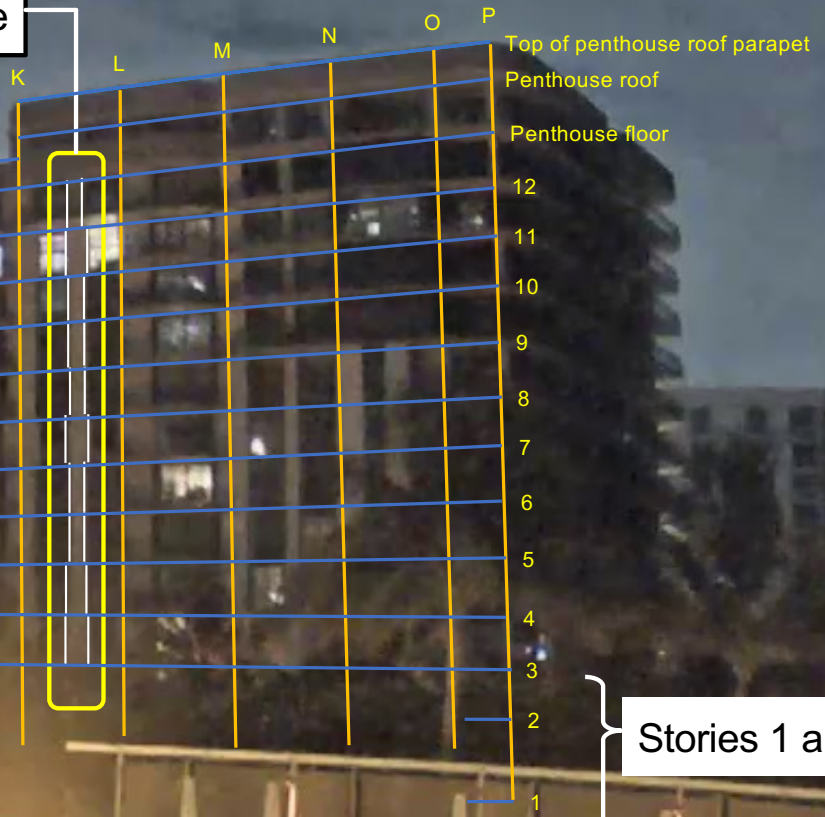
CTS Investigation: South Face Camera Footage



Understanding Unique Features

- The unique outline as seen approximately 1.5 hours before the collapse.
- The outline extends from the 3rd to the 11th floor.
- The outline is between Grid Lines K and L.

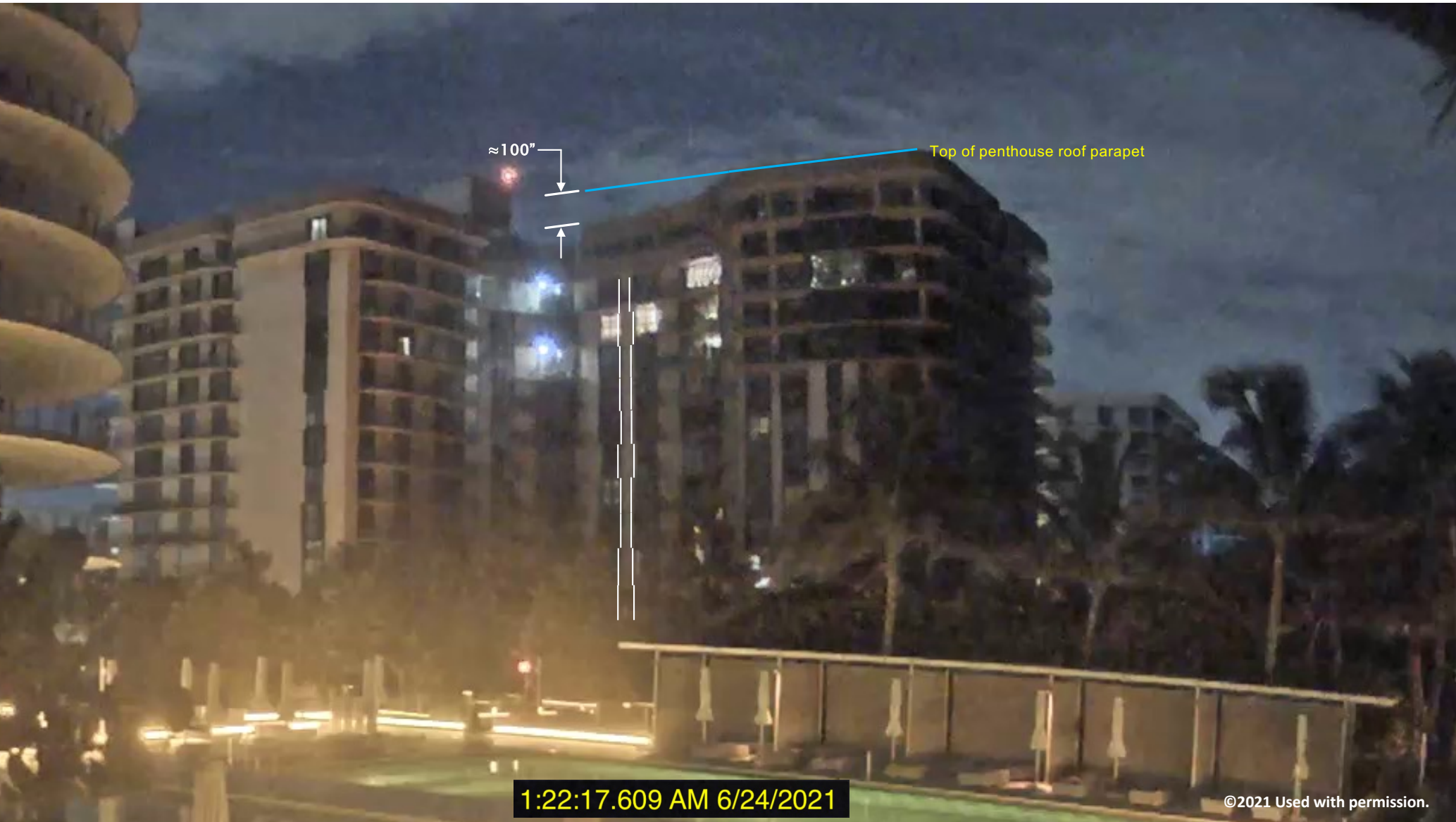
Unique façade shape



Stories 1 and 2 blocked from view

11:53:45.166 PM 6/23/2021

©2021 Used with permission.



≈ 100"

Top of penthouse roof parapet

1:22:17.609 AM 6/24/2021

©2021 Used with permission.



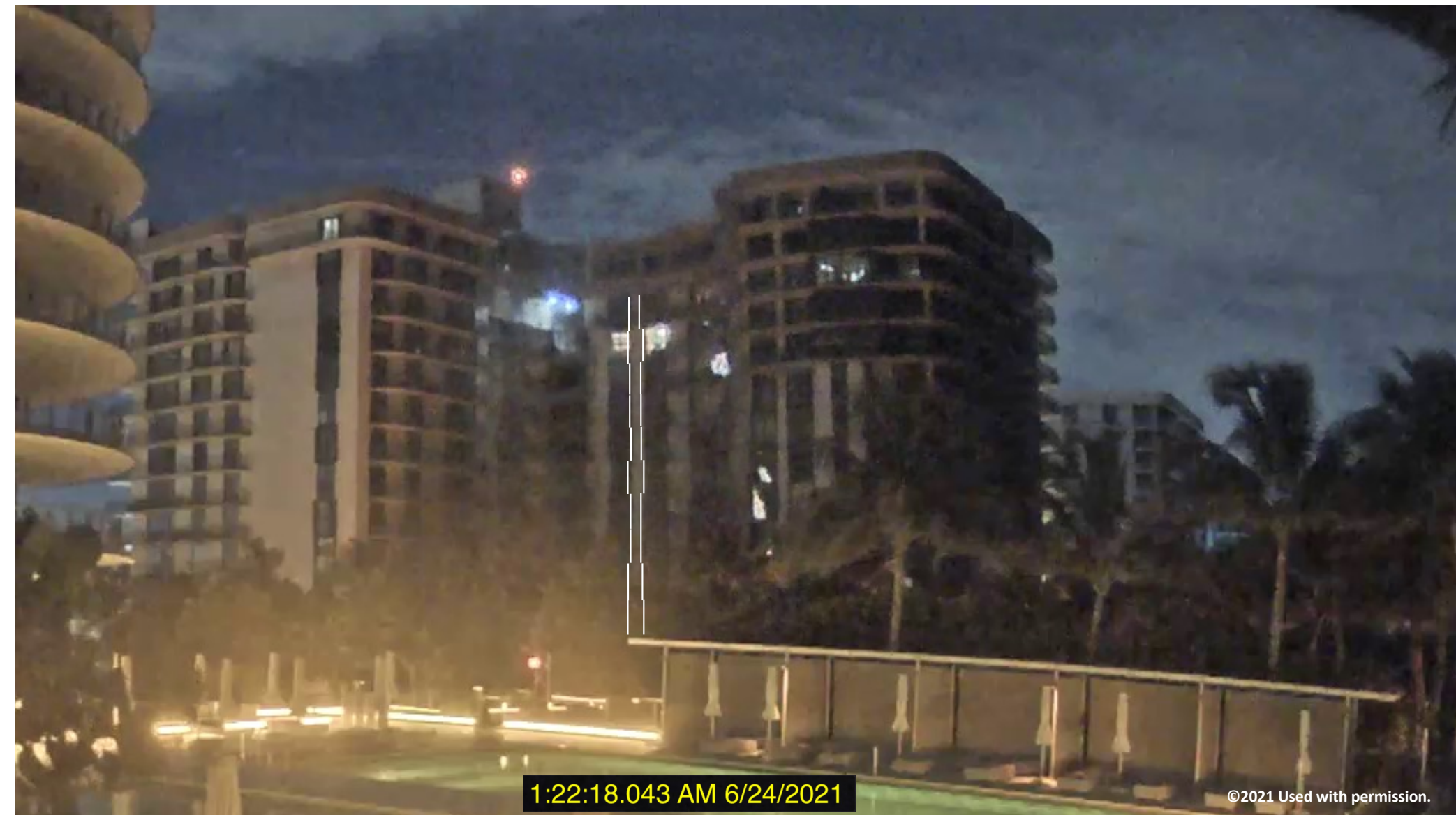
1:22:17.743 AM 6/24/2021

©2021 Used with permission.



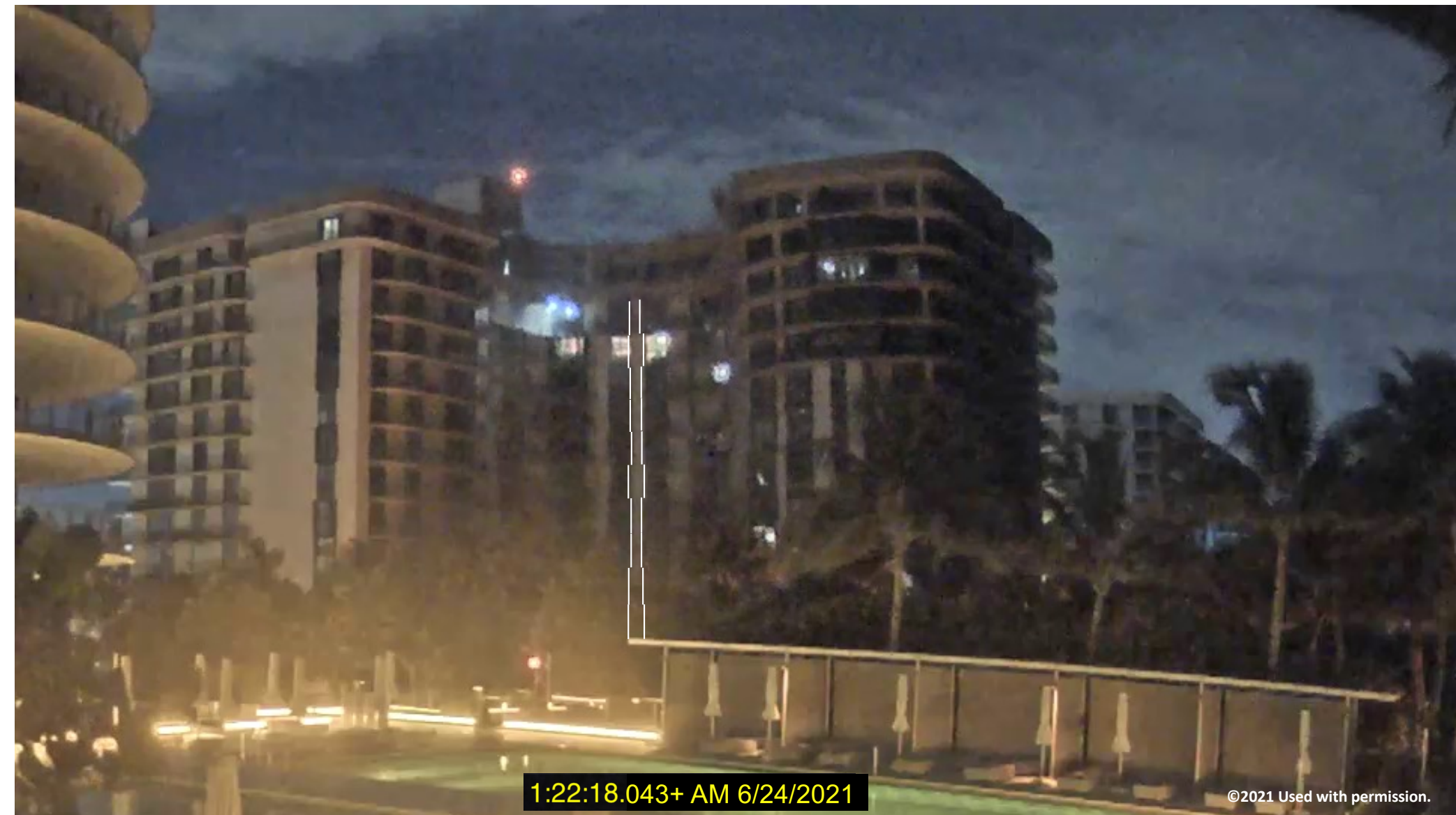
1:22:17.876 AM 6/24/2021

©2021 Used with permission.



1:22:18.043 AM 6/24/2021

©2021 Used with permission.



1:22:18.043+ AM 6/24/2021

©2021 Used with permission.

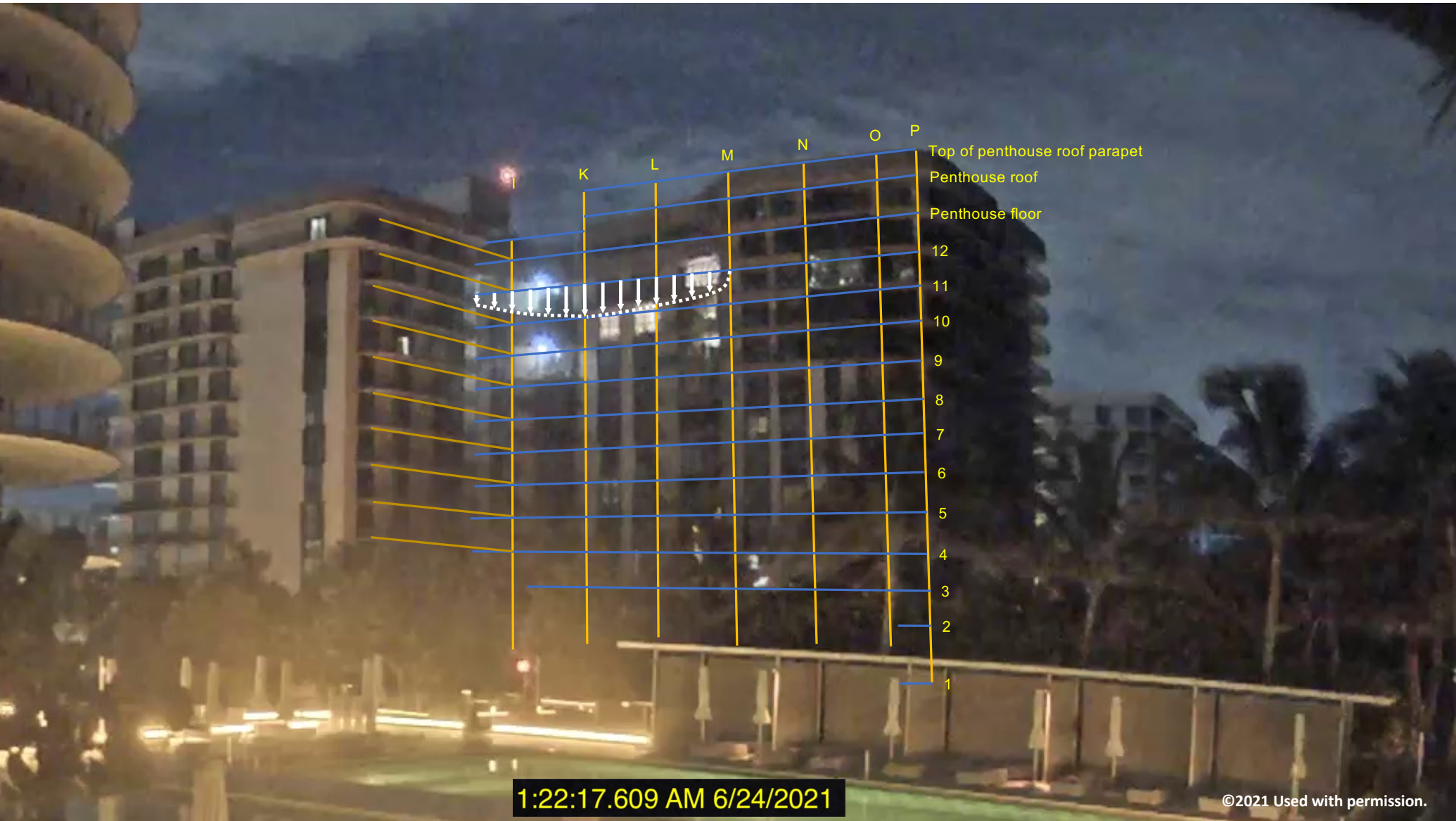


Key Points:

1. The unique façade shape moves uniformly downward, indicating that the failures that triggered the eastern part of the tower drop must have occurred below the 3rd floor.

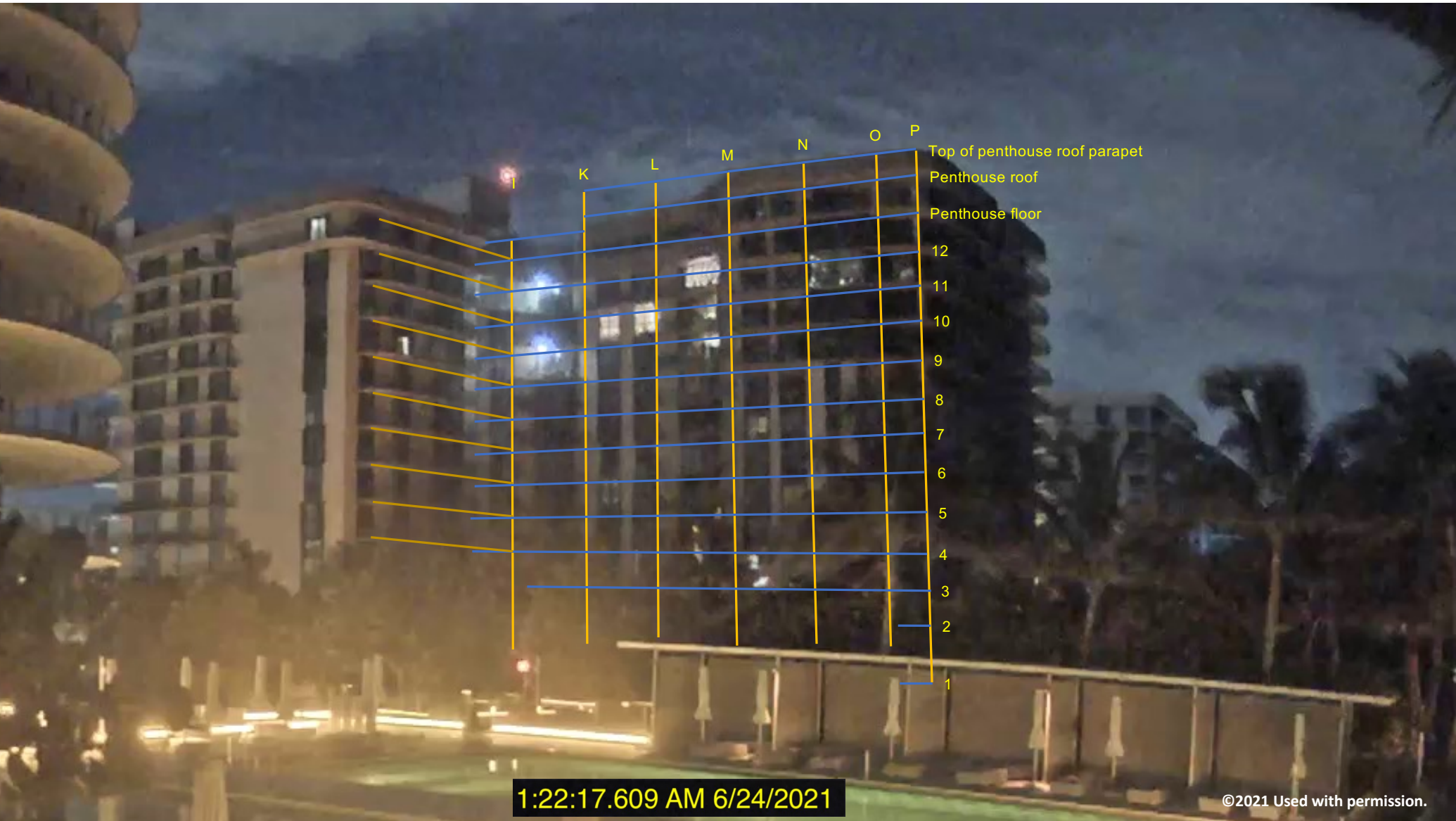
1:22:18.176 AM 6/24/2021

©2021 Used with permission.



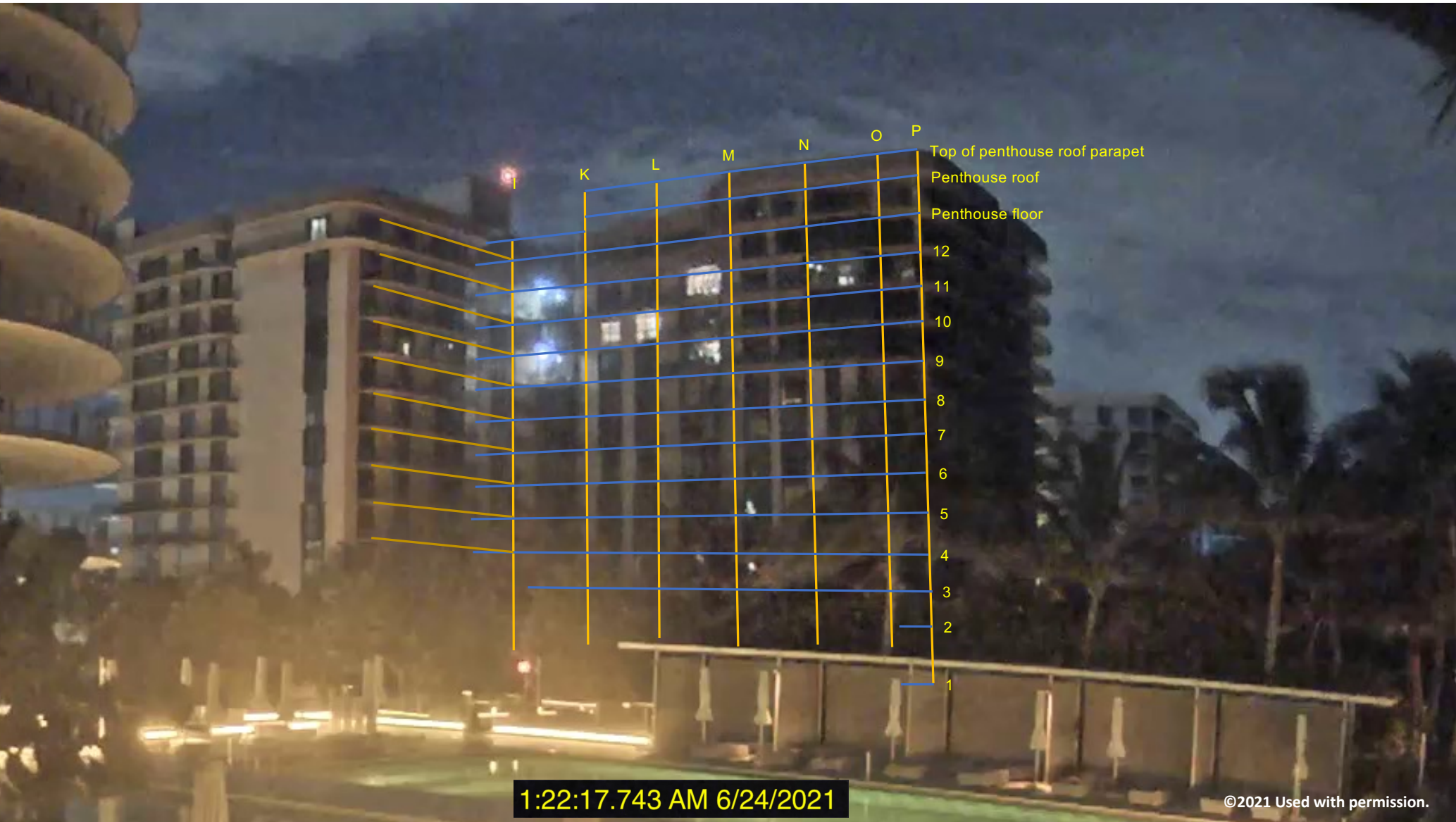
1:22:17.609 AM 6/24/2021

©2021 Used with permission.



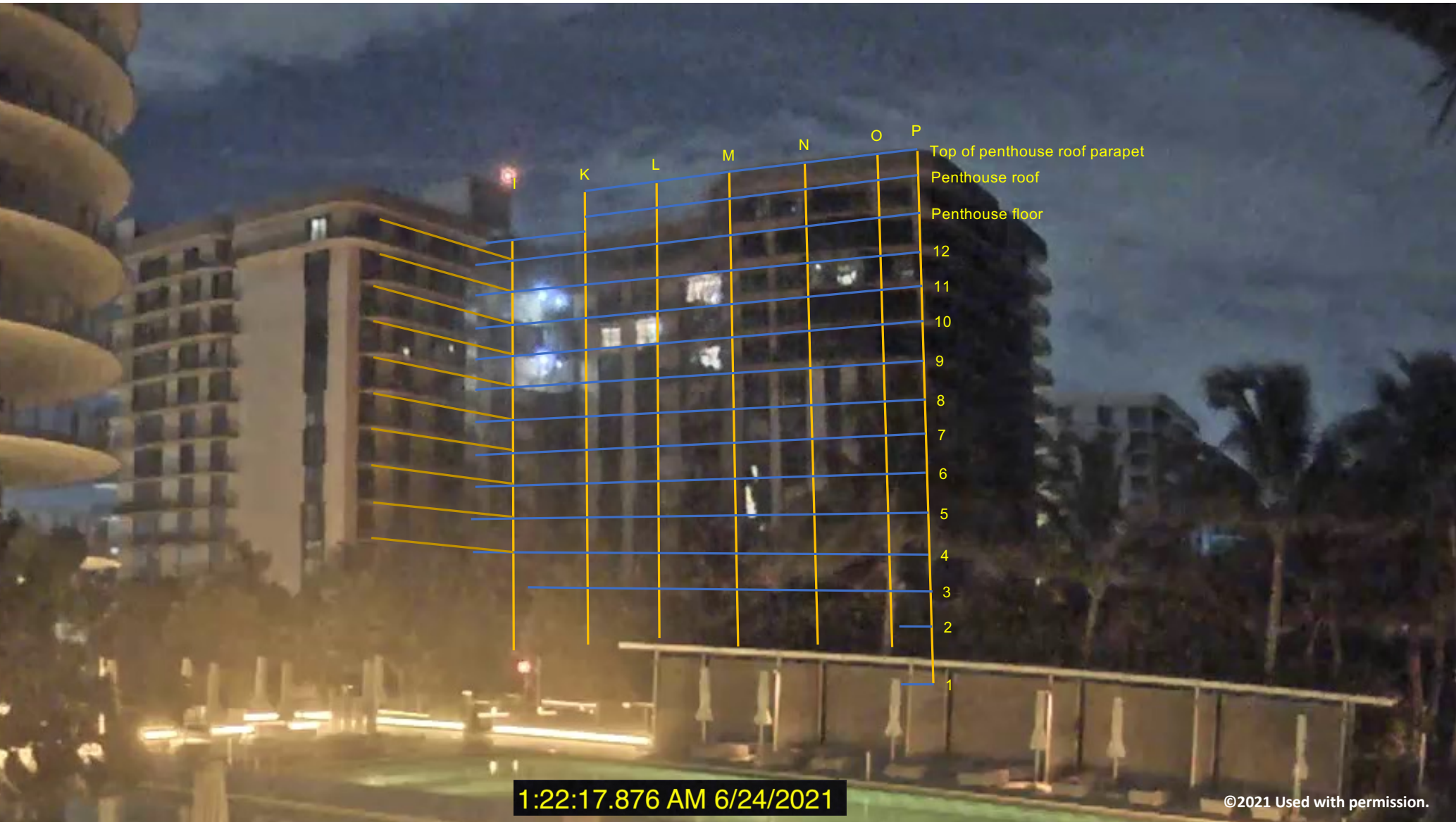
1:22:17.609 AM 6/24/2021

©2021 Used with permission.



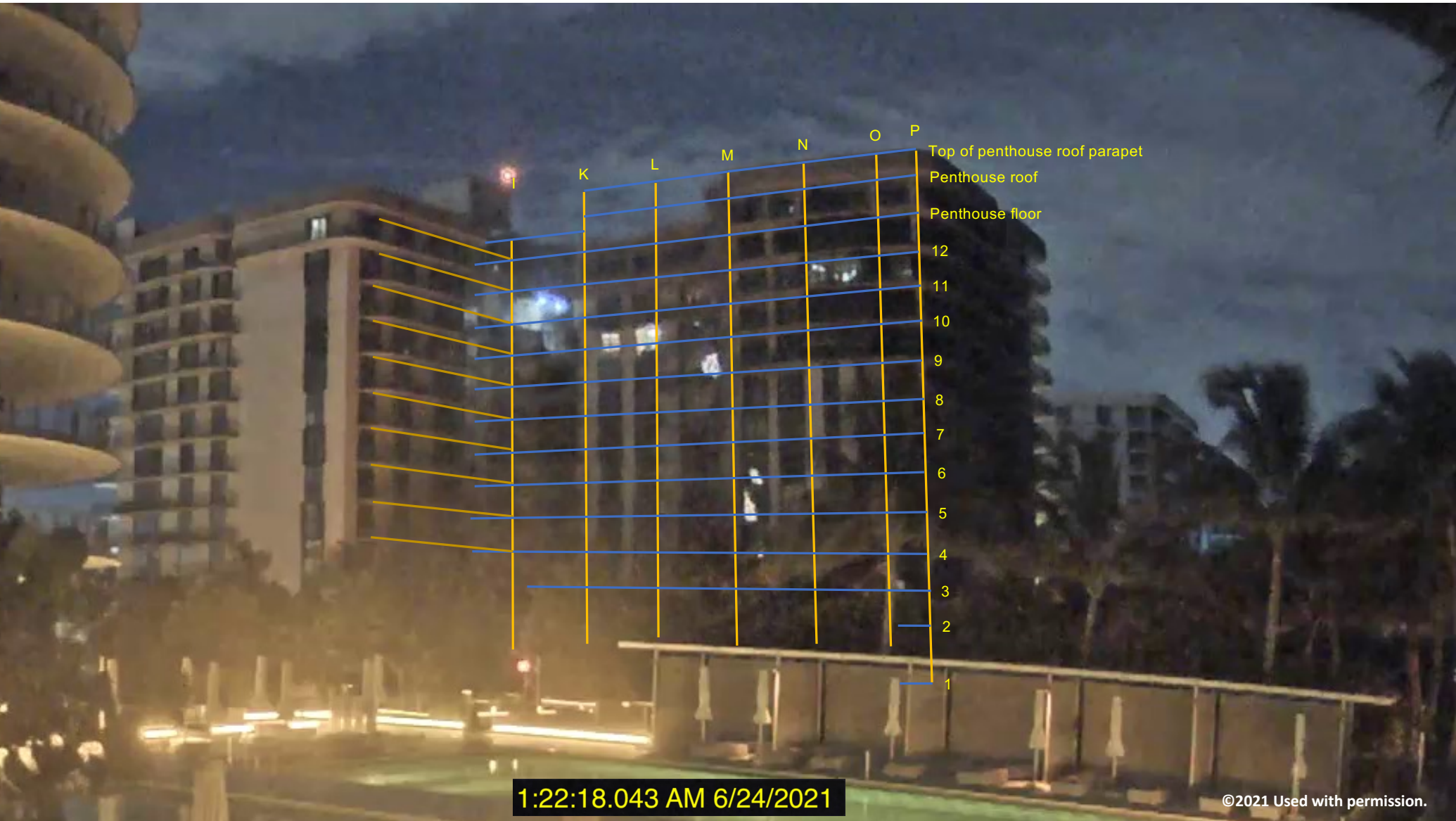
1:22:17.743 AM 6/24/2021

©2021 Used with permission.



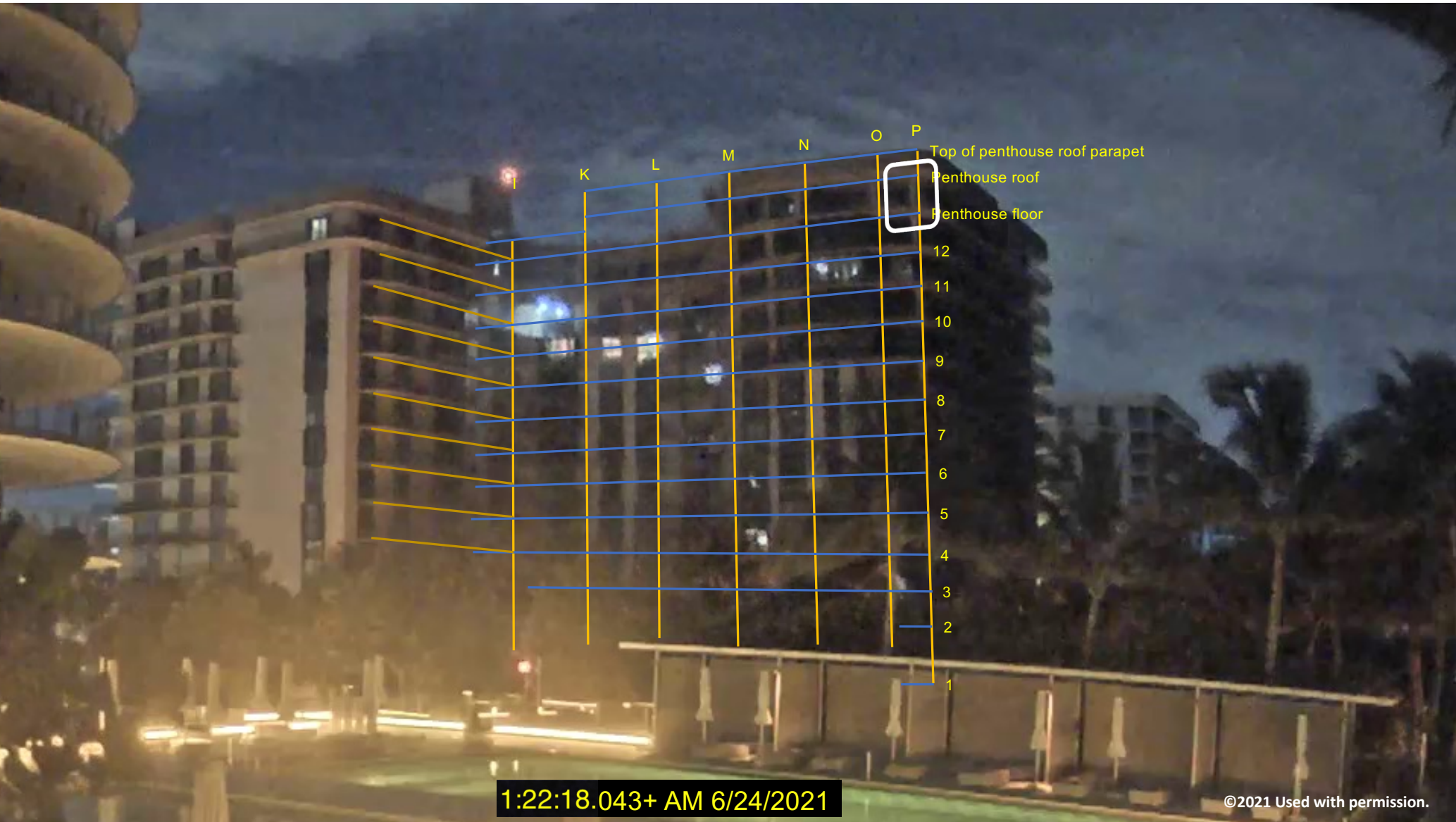
1:22:17.876 AM 6/24/2021

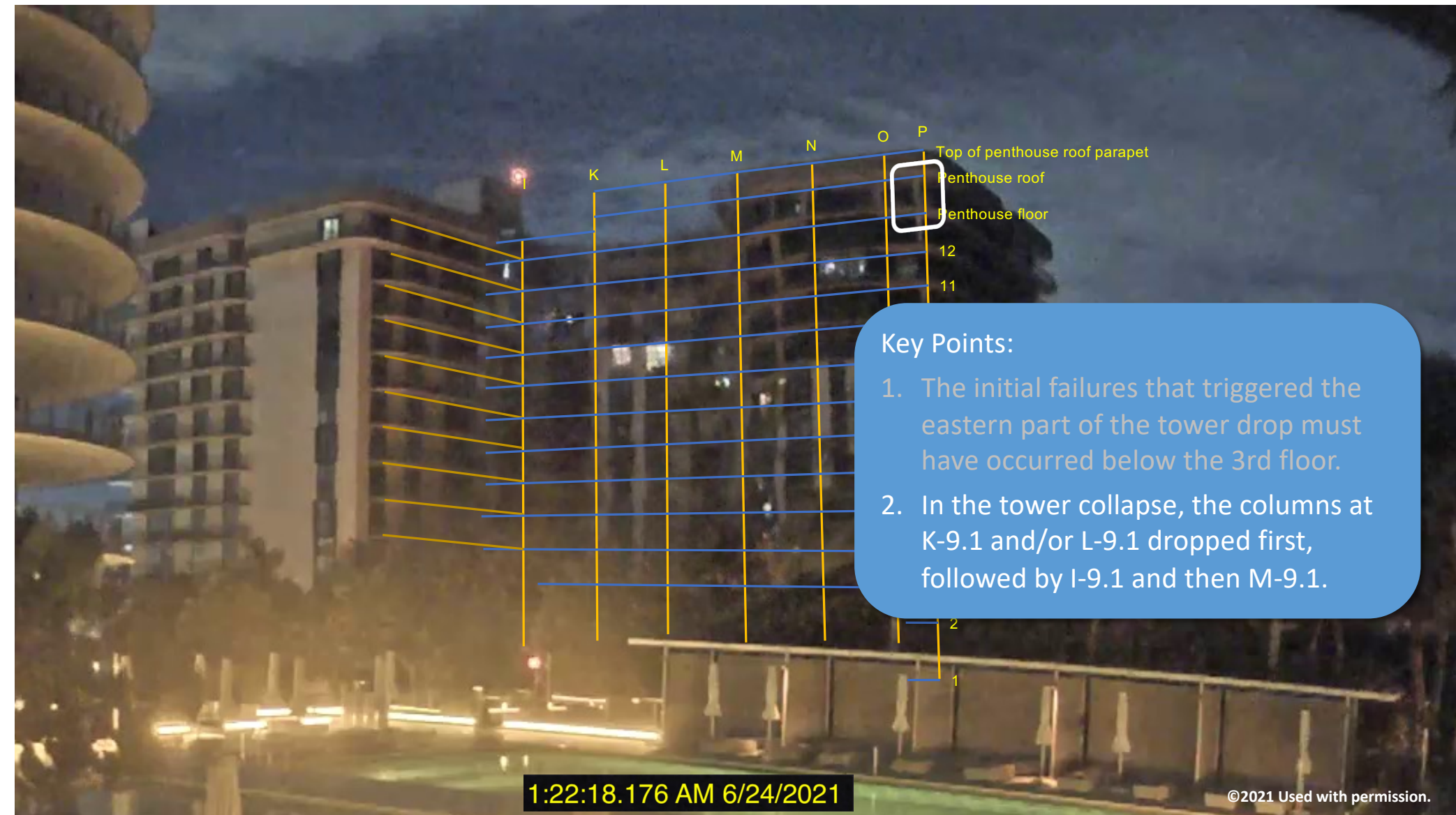
©2021 Used with permission.



1:22:18.043 AM 6/24/2021

©2021 Used with permission.



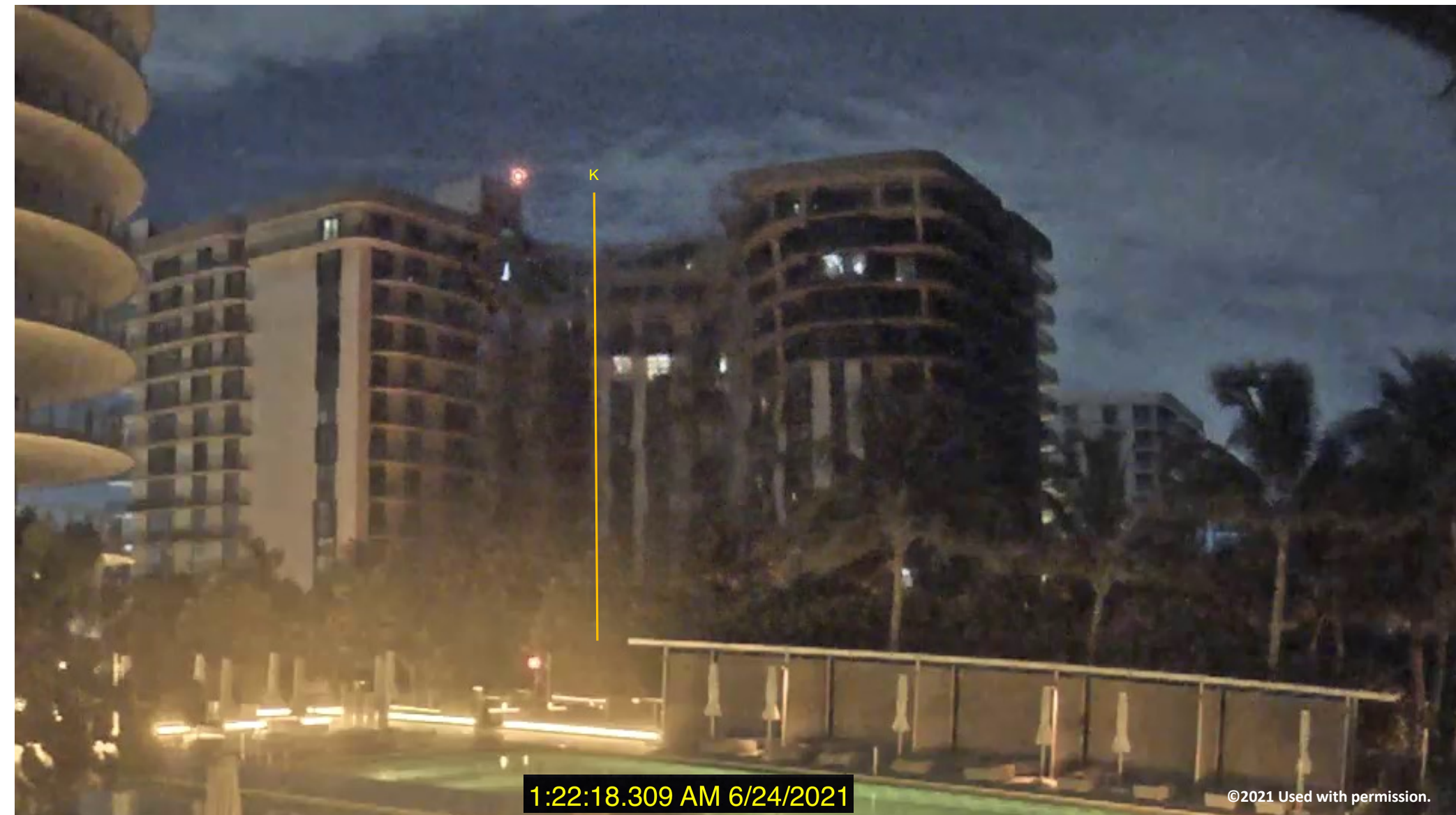


Key Points:

- 1. The initial failures that triggered the eastern part of the tower drop must have occurred below the 3rd floor.
- 2. In the tower collapse, the columns at K-9.1 and/or L-9.1 dropped first, followed by I-9.1 and then M-9.1.

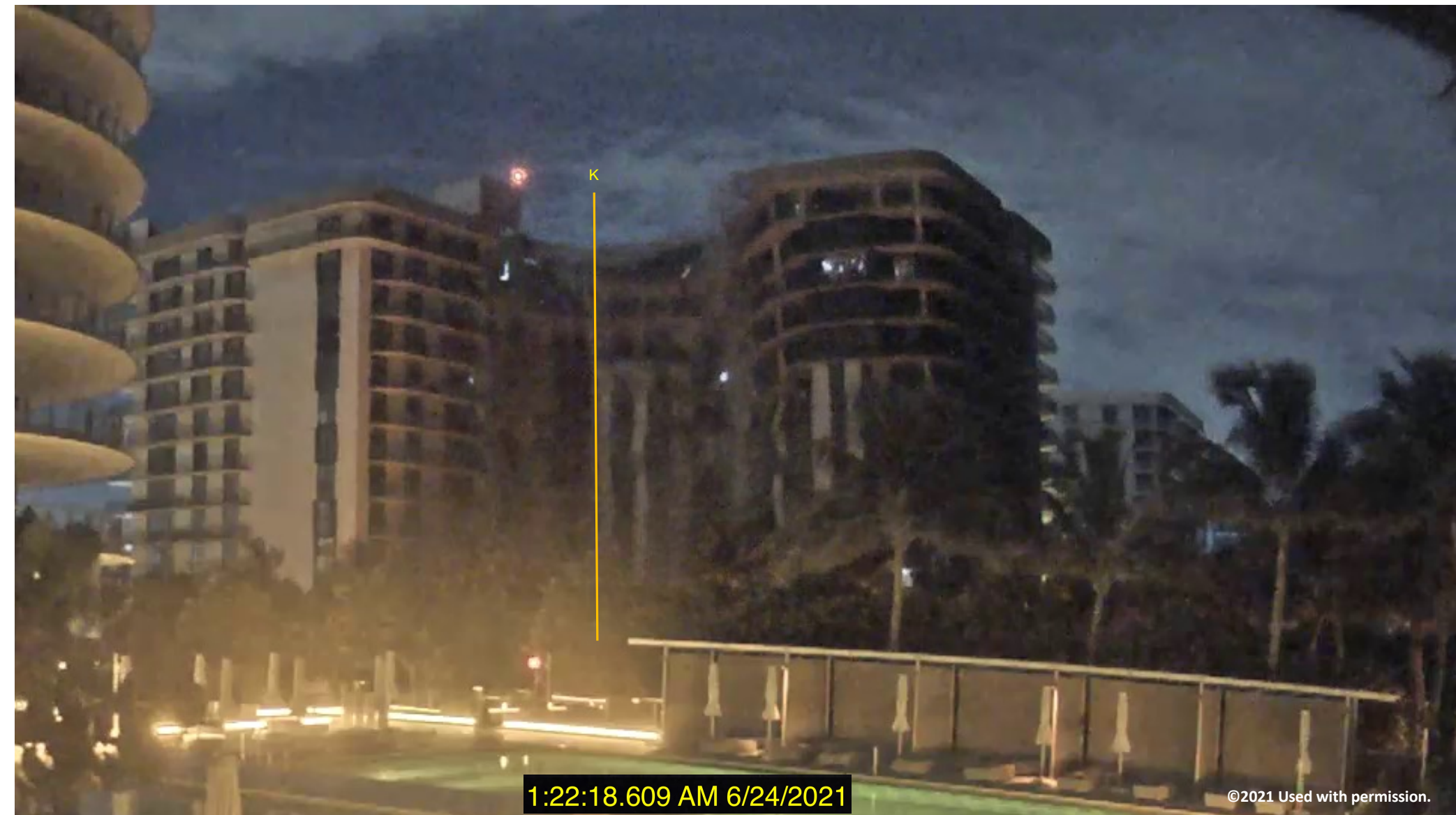
1:22:18.176 AM 6/24/2021

©2021 Used with permission.



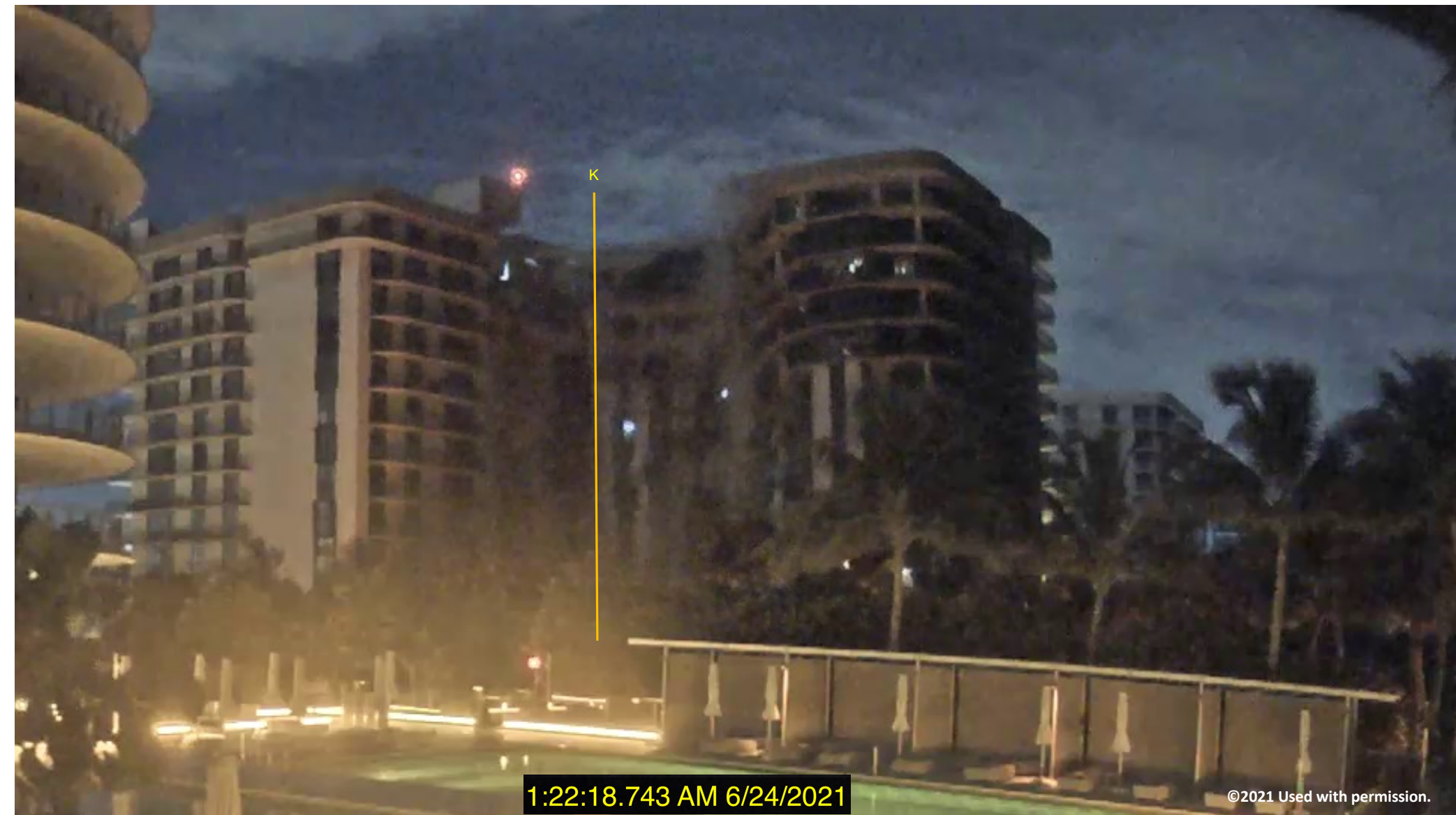
1:22:18.309 AM 6/24/2021

©2021 Used with permission.



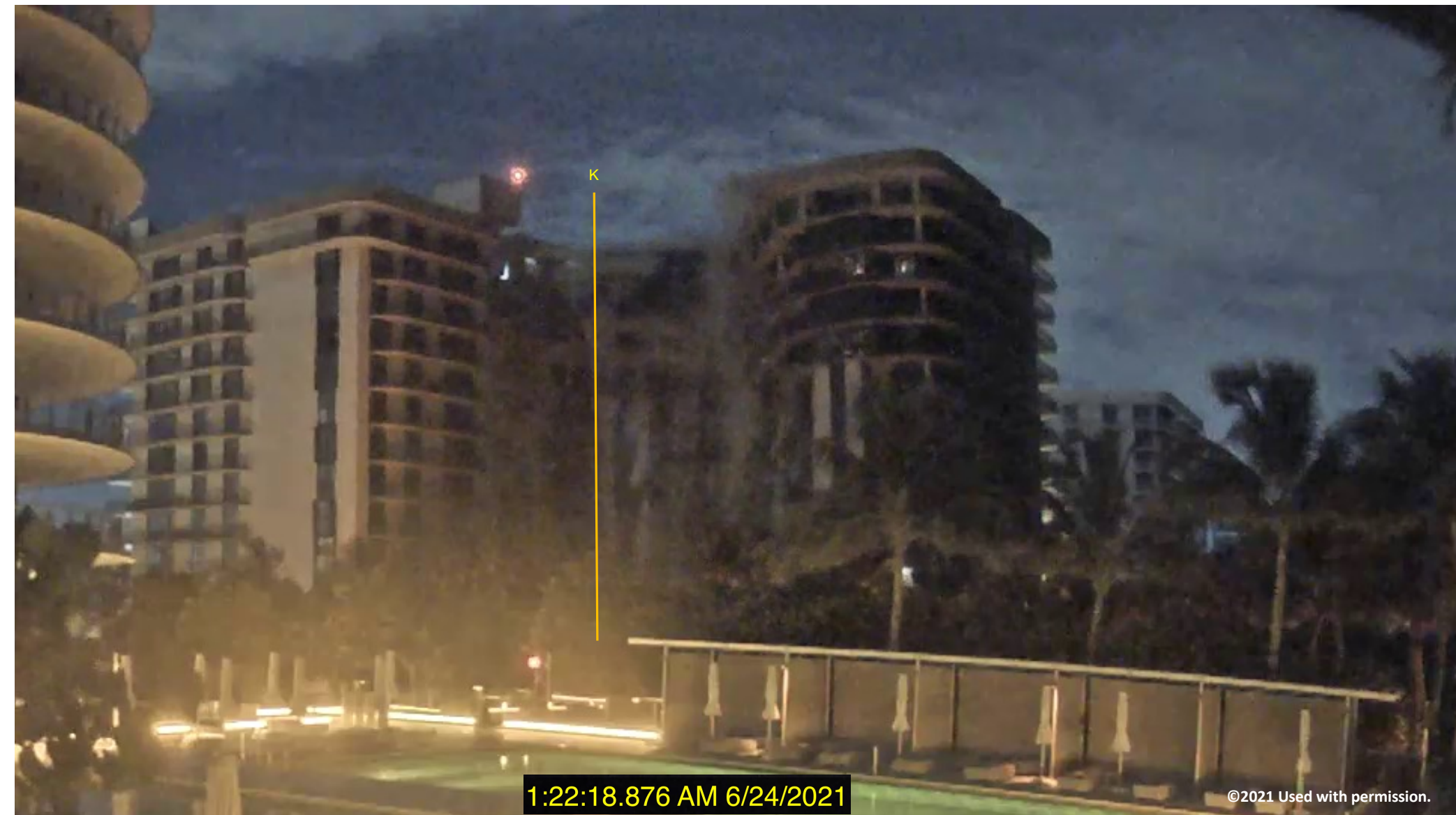
1:22:18.609 AM 6/24/2021

©2021 Used with permission.



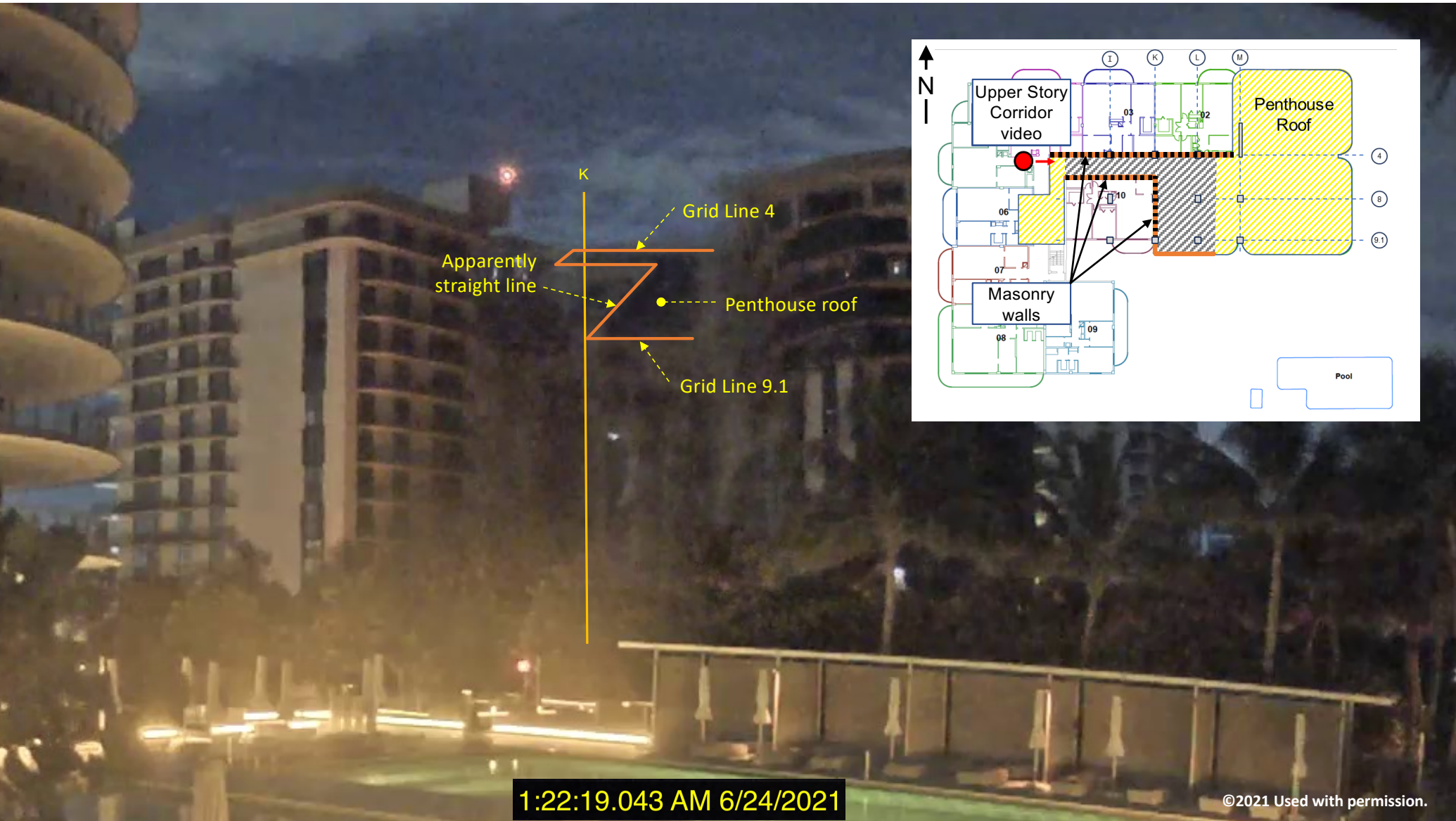
1:22:18.743 AM 6/24/2021

©2021 Used with permission.



1:22:18.876 AM 6/24/2021

©2021 Used with permission.



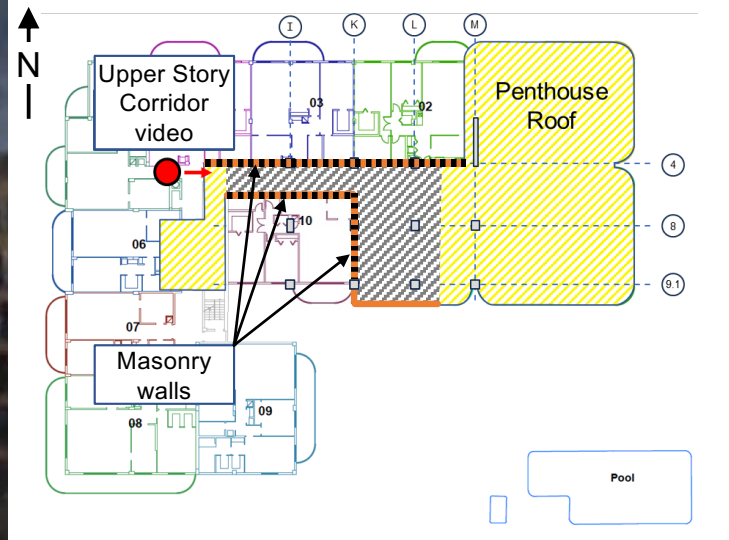
K

Grid Line 4

Apparently straight line

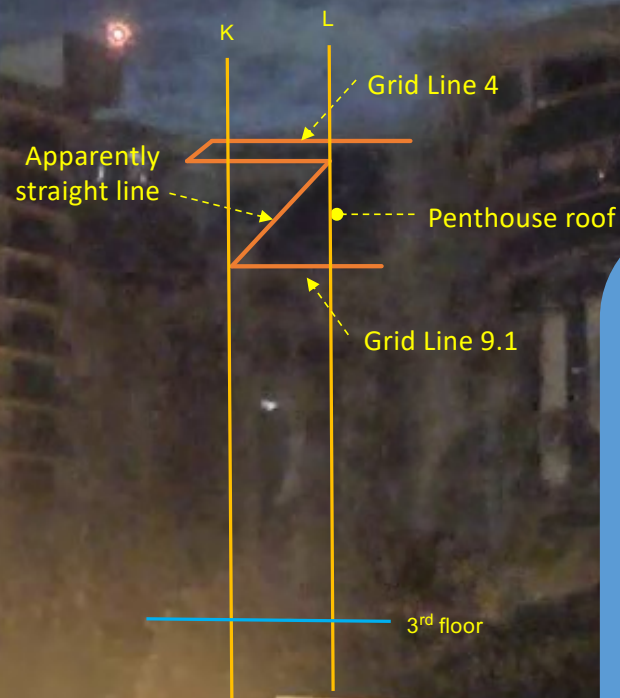
Penthouse roof

Grid Line 9.1



1:22:19.043 AM 6/24/2021

©2021 Used with permission.



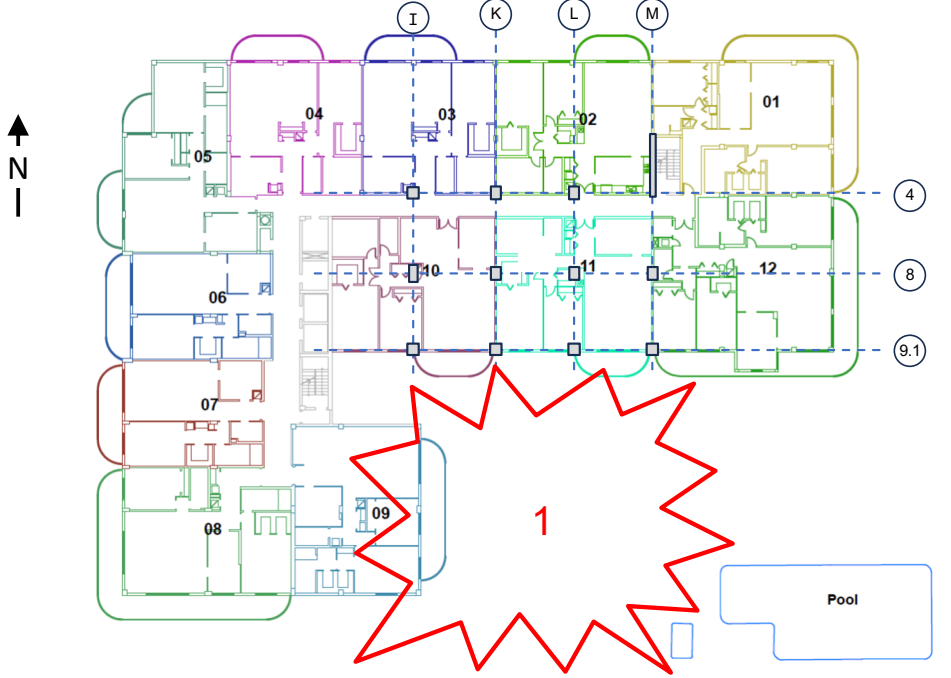
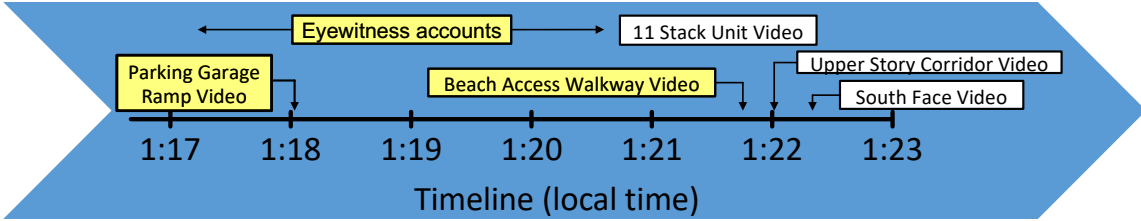
Key Points:

1. The initial failures that triggered the eastern part of the tower drop must have occurred below the 3rd floor.
2. In the tower collapse, the columns at K-9.1 and/or L-9.1 dropped first, followed by I-9.1 and then M-9.1.
3. As the columns on Grid Line 9.1 dropped, the collapse advanced northward.

1:22:19.043 AM 6/24/2021

©2021 Used with permission.

CTS Investigation: Assembling the Pieces



Digitally Adapted by NIST
(Original Drawing Source: CTS Receiver)

Parking Garage Ramp Video



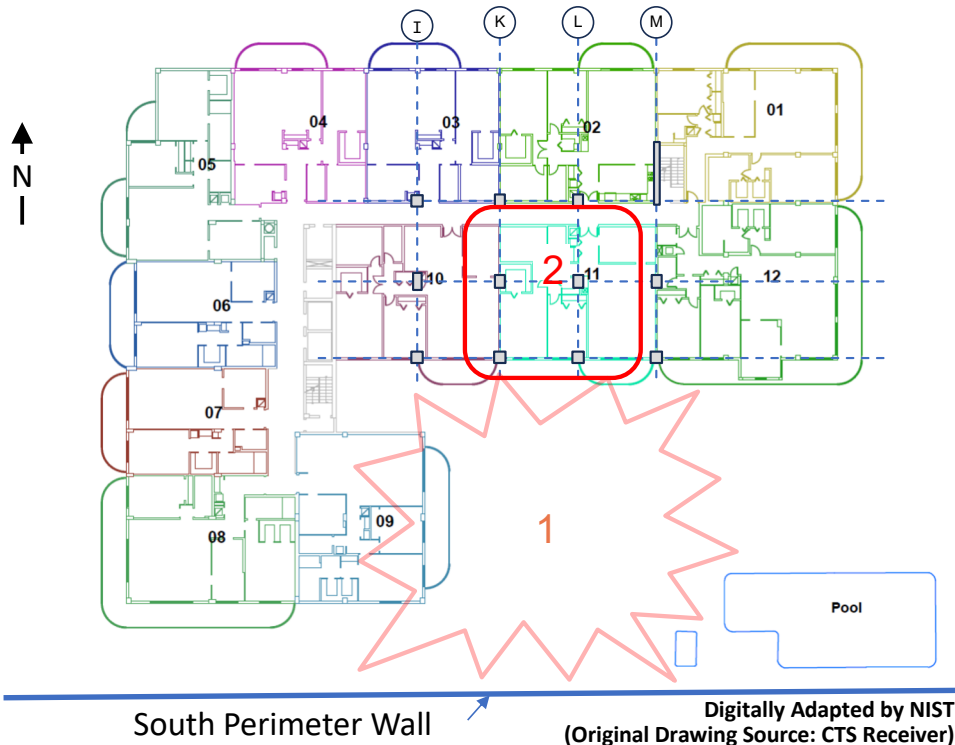
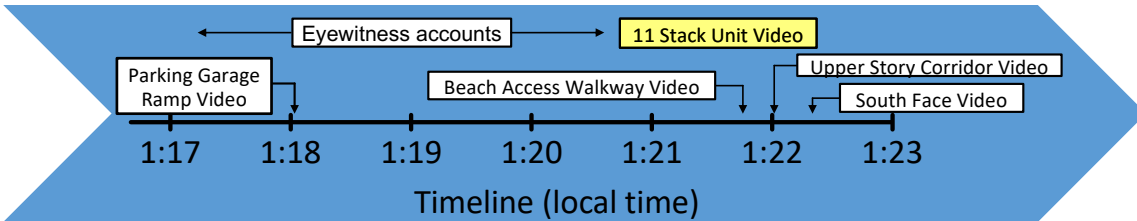
Beach Access Walkway Video
+
Police Body Camera Video



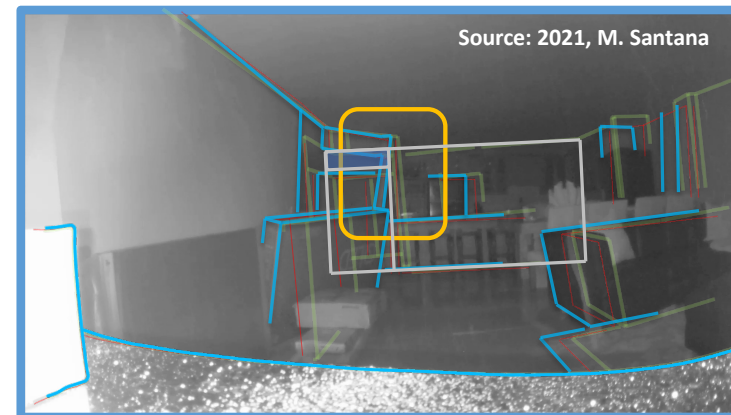
Eyewitness accounts



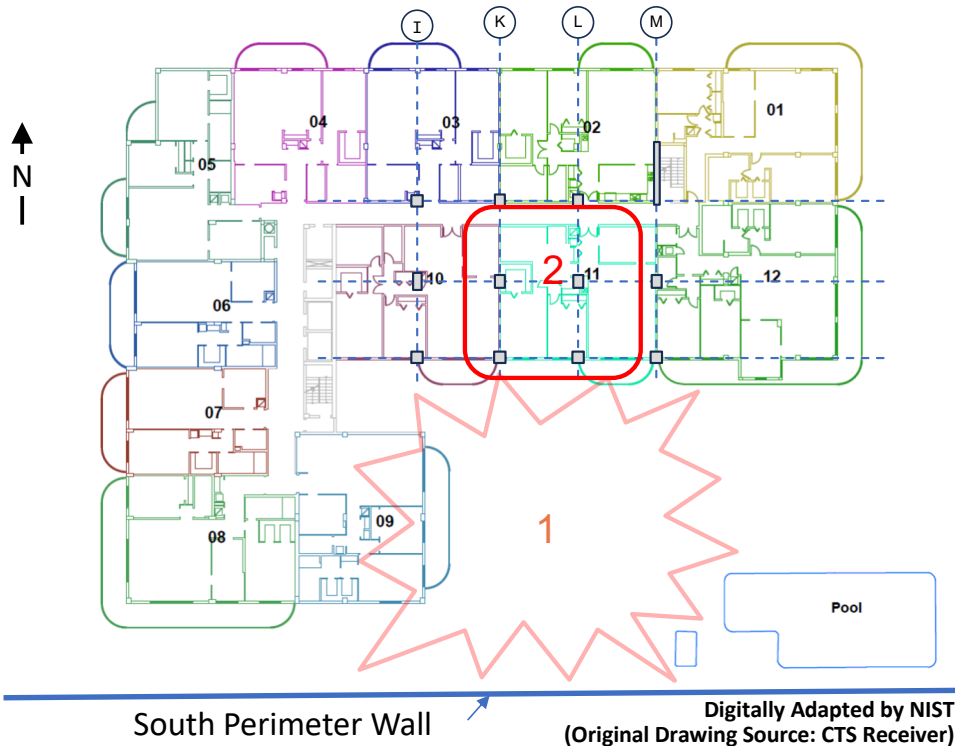
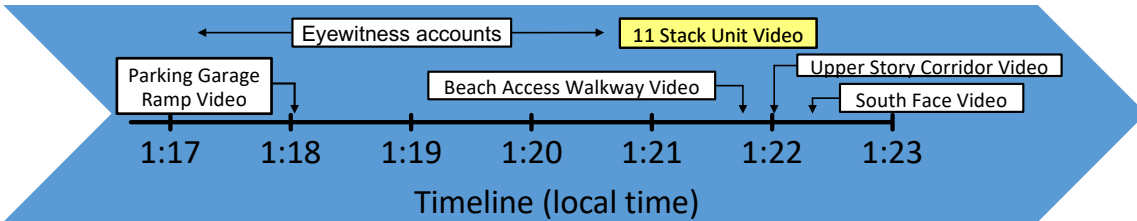
CTS Investigation: Assembling the Pieces



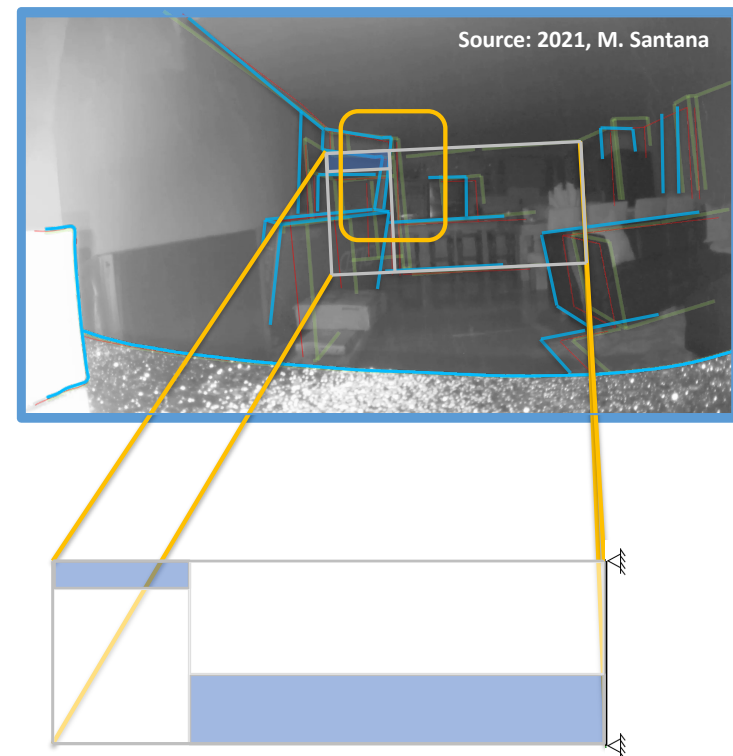
11 Stack Unit Video



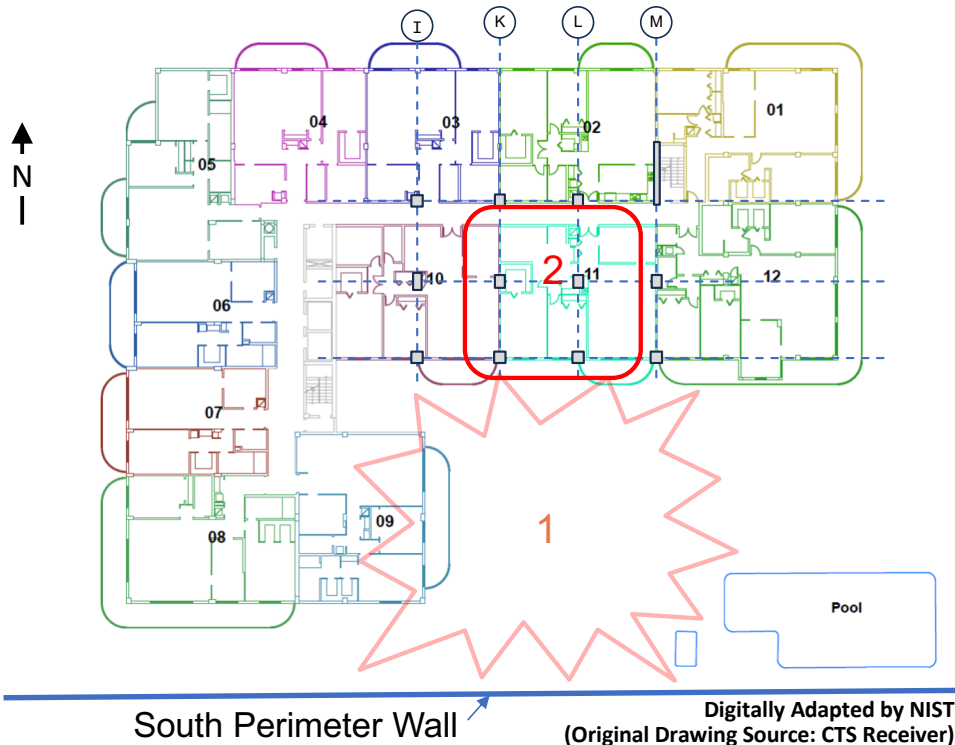
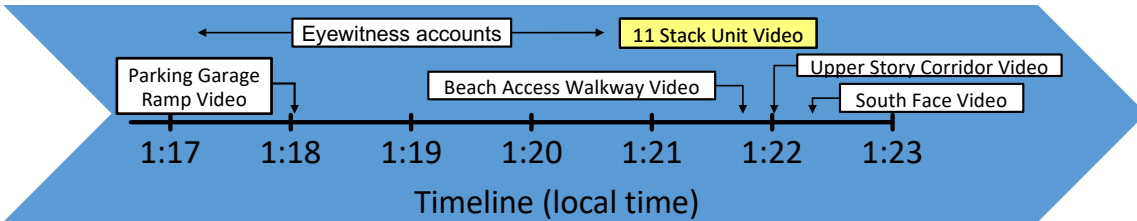
CTS Investigation: Assembling the Pieces



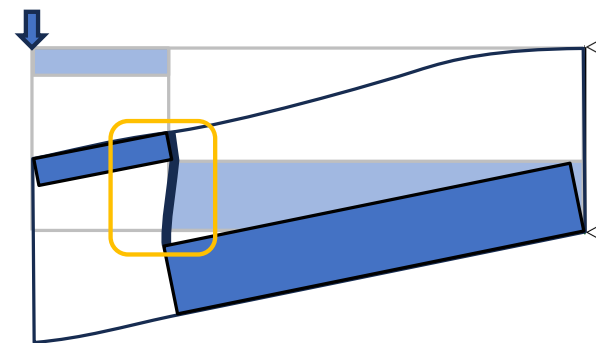
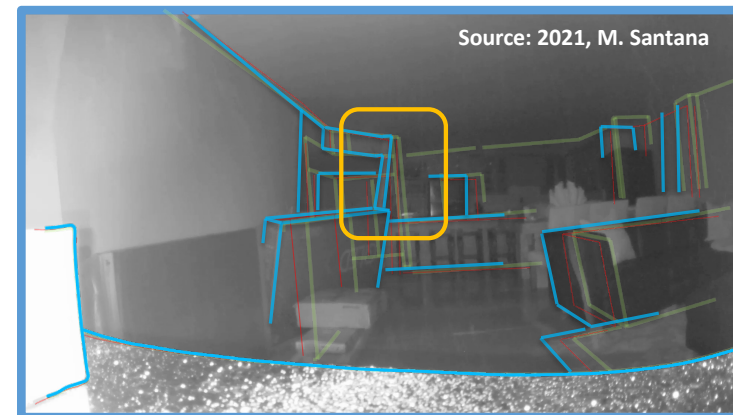
11 Stack Unit Video



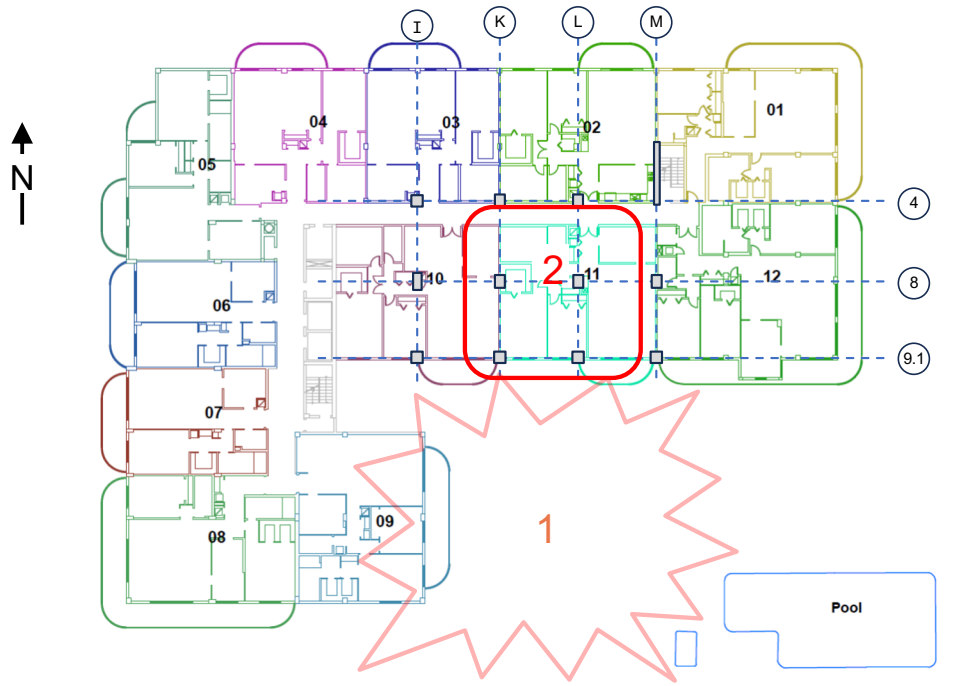
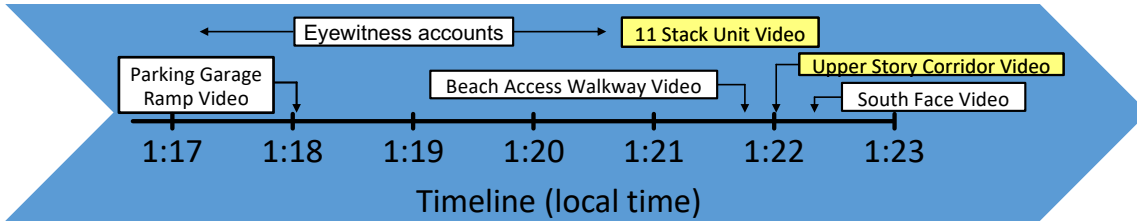
CTS Investigation: Assembling the Pieces



11 Stack Unit Video



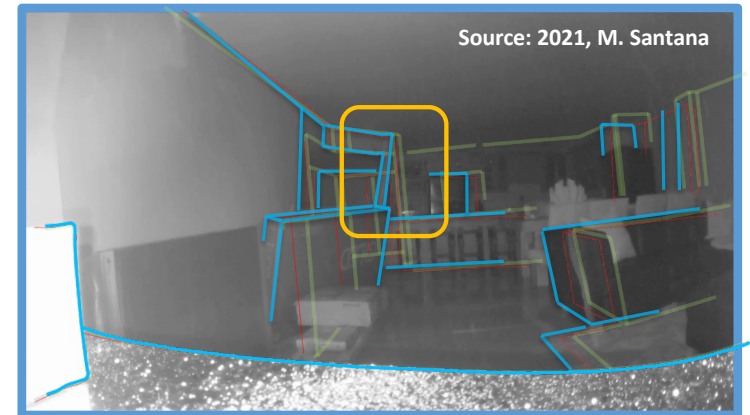
CTS Investigation: Assembling the Pieces



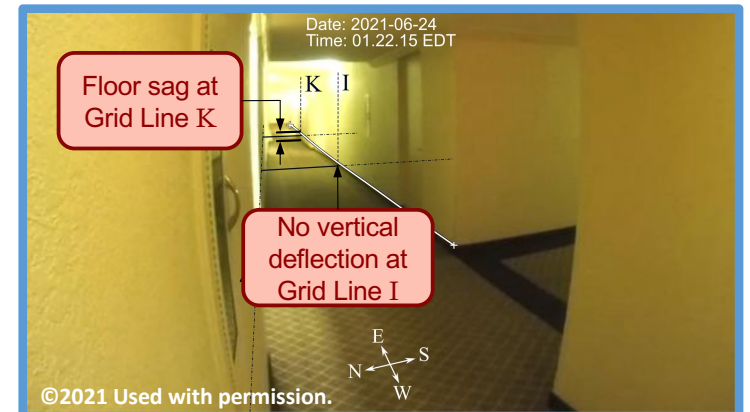
South Perimeter Wall

Digitally Adapted by NIST
(Original Drawing Source: CTS Receiver)

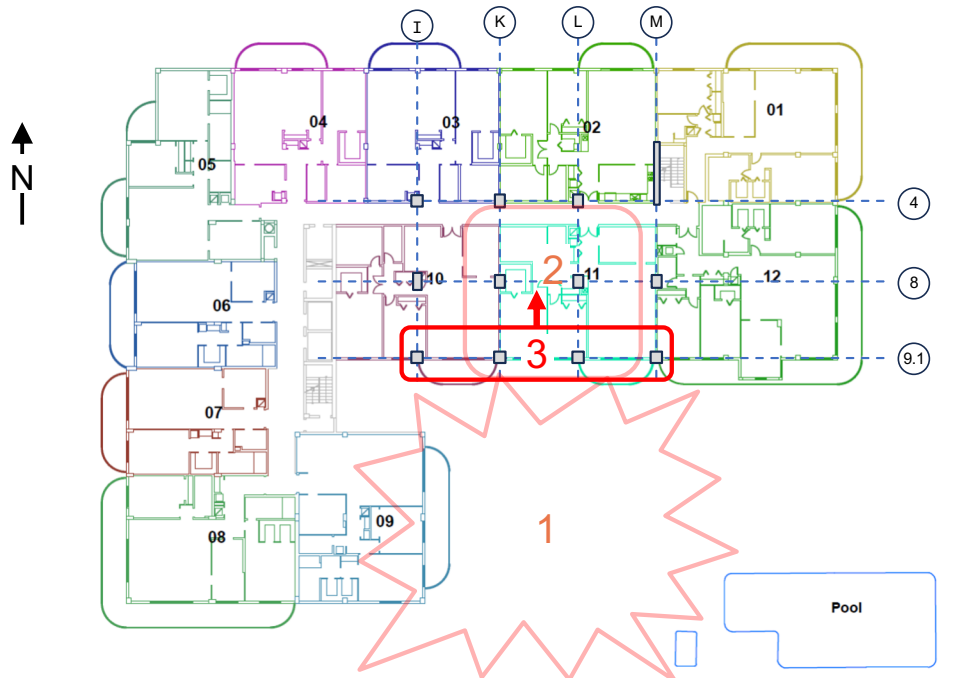
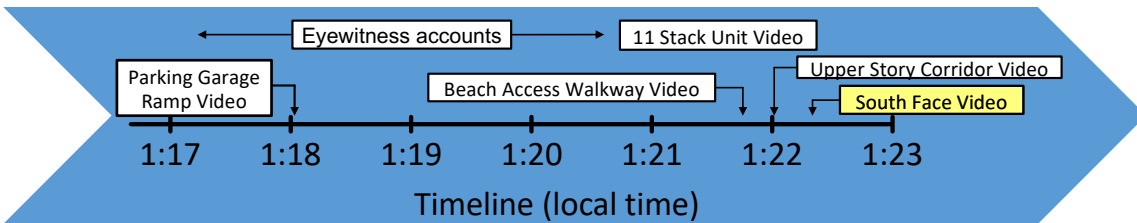
11 Stack Unit Video



Upper Story Corridor Video



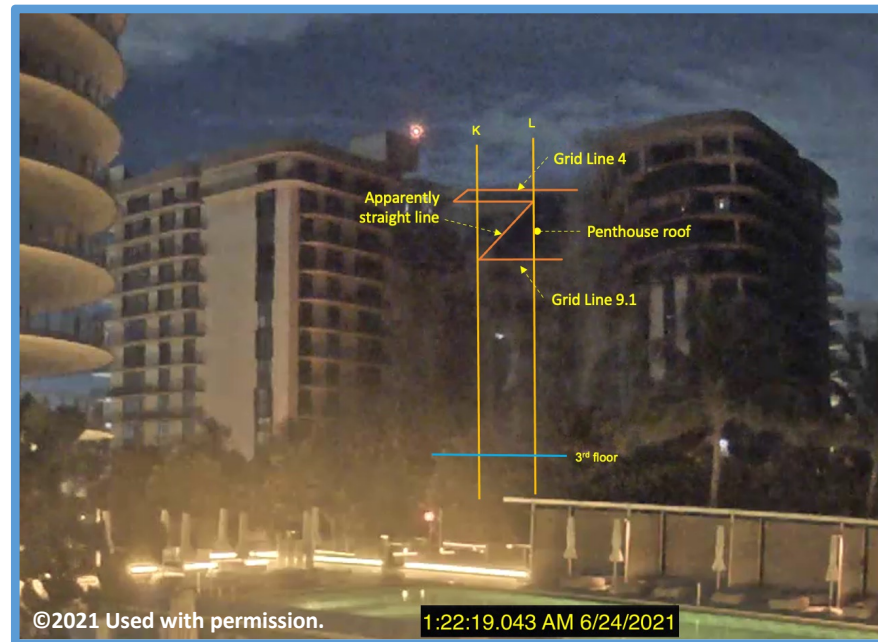
CTS Investigation: Assembling the Pieces



South Perimeter Wall

Digitally Adapted by NIST
(Original Drawing Source: CTS Receiver)

South Face Video

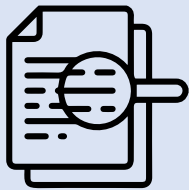


©2021 Used with permission.

1:22:19.043 AM 6/24/2021

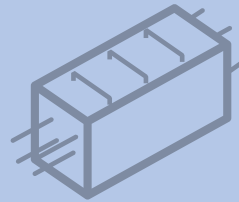
Questions?

Theme 1: *Timeline and Evidence Collection*



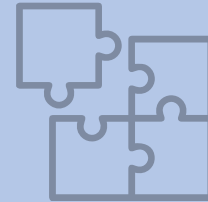
*Judith Mitrani-Reiser,
N. Emel Ganapati, David Goodwin,
Christopher Segura,
Jonathan Weigand, Kam Saidi,
Jack Moehle*

Theme 2: *Analysis and Testing Updates*



*Fahim Sadek, James Harris,
Christopher Segura,
Kenneth Hover, Jack Moehle,
Sissy Nikolaou,*

Theme 3: *Analysis of Failure Hypotheses*



*Glenn Bell, Fahim Sadek,
Georgette Hlepas,
Scott Jones, James Harris,
Youssef Hashash*