

Video Analysis of NIST's Claim of a 5.4 s Collapse Time Over 18 Stories for WTC 7

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ABSTRACT

NIST, in its draft report for public comment, initially denied that WTC 7 collapsed at the acceleration of gravity with the claim that an overall collapse time of 5.4 seconds was 40 percent longer than a free-fall time of 3.9 seconds for the first 18 stories. After being confronted with analysis of the collapse clearly demonstrating that free-fall had occurred, NIST acknowledged this fact in its final report, yet still maintained that the overall collapse time was 5.4 seconds. NIST explained in the final report that this measurement was obtained by examining a single pixel of a video towards the center of the roofline. It is argued in this paper that NIST's chosen methodology for determining the point in time representing the onset of global collapse is not merely fallacious, but indicative of a willful and deliberate effort to deceive the public and obfuscate the implications of free-fall through scientific fraud.

INTRODUCTION

The National Institute of Standards and Technology (NIST) was tasked with investigating how and why World Trade Center Building 7 (WTC 7) collapsed completely at 5:20 p.m. on September 11, 2001. In its draft report, NIST denied that free-fall acceleration (the acceleration of gravity) of the building occurred during the collapse. NIST calculated the time it took WTC 7 to descend the first 18 stories from a video of the collapse by "Assuming that the descent speed [*sic*] was approximately constant" (an error; NIST clearly meant "acceleration" here and not "speed"). To make this measurement of *average* acceleration, NIST used *two* data points: "the position of the roofline prior to collapse and the last position the roofline could be observed before it was obstructed by a building in the foreground." By this means, NIST calculated that it took 5.4 seconds for the roofline of the building to fall 18 stories, while an object falling at gravitational acceleration would take 3.9 seconds to travel the same distance. NIST concluded in its draft report: "Thus, the actual time for the upper 18 stories to collapse, based on video evidence, was approximately 40 percent longer than the computed free fall time and was consistent with physical principles." By this means, NIST implicitly denied that free-fall acceleration had occurred.¹

The implied converse logic is that free-fall acceleration would *not* be consistent with physical principles. Dr. Shyam Sunder, prior to NIST's acknowledgement of free-fall, similarly tacitly acknowledged that free-fall would be inconsistent with the laws of physics within the hypothesis of a fire-induced collapse. He pointed out at a technical presentation, in response to a question from high school physics teacher David Chandler, that "free fall would be an object that has no structural components below it", and that a collapse occurring at 40 percent less than free fall acceleration "is not at all unusual because there *was* structural resistance that was provided in this particular case."²

However, NIST was forced to refine its analysis after David Chandler pointed out in comments on the draft report that the *average* acceleration of the building as it collapsed was a meaningless measurement, particularly since the assumption of constant acceleration was demonstrably *false*. Chandler observed that the relevant measurement to understand the forces at work was *instantaneous* acceleration. He performed his own video analysis of the collapse, measuring numerous data points and showing that acceleration indistinguishable from the acceleration of gravity had occurred, and that there had been a sudden onset of this free-fall acceleration.³

As a result, in its final report, NIST revised its conclusion and declared that there were three stages of collapse. In Stage 1, the first 1.75 seconds, "acceleration was less than that of gravity" as the building fell about 7 feet. In Stage 2, for 2.25 seconds, the building was in "free fall" as it fell another 105 feet. In Stage 3, for the next 1.4 seconds, after which the building was no longer visible in the video, "the acceleration decreased somewhat" as the building "encountered resistance".⁴ NIST acknowledged further that its calculated overall collapse time of "approximately 40 percent longer than that of free fall for the first 18 stories of descent" was "due primarily to Stage 1".⁵ NIST thus implicitly acknowledges that the building was not only at free-fall for 2.25 seconds, but also at *near* free-fall for at least another 1.4 seconds.

Hence, the fact that free-fall acceleration occurred is now uncontroversial. Nevertheless, NIST continued to defend its initial analysis in its final report, maintaining that the overall "collapse time" was "40 percent longer than that of free fall". Based upon this claim, NIST declared that its findings were "consistent with the results of global collapse analyses",⁶ which NIST had performed using computer models, and according to which the building also took 5.4 seconds to fall the first 18 stories.⁷ Notably, the original assertion that the rate of acceleration of the collapse was "consistent with physical principles" within the framework of a fire-induced progressive collapse hypothesis was removed from the final report.⁸

In its final report, NIST further explained how it arrived at a 5.4 s "collapse time", stating that "It was difficult to detect the exact instant that the north wall began to collapse", and so for its analysis, a start time had been chosen based on a single pixel of the video. The onset of global collapse was determined to be the frame in which this single pixel brightened, and thus changed from representing the roofline to representing the sky. The pixel chosen was "close to the center of the north face roofline".⁹

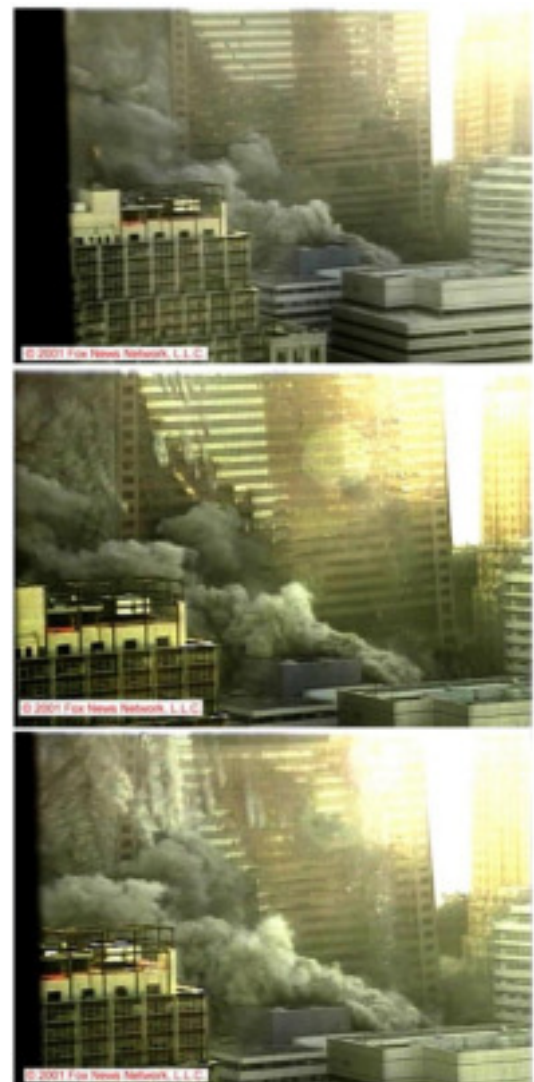


Figure 1

However, this is problematic because any movement of the center roofline at this stage could indicate lateral displacement of the north façade southward due to it being pulled inward as a result of the collapse of the core. Lateral displacement *away* from the point of view of the camera could be *perceived* as "downward" displacement, but not actually representative of the beginning of downward movement, and thus not an accurate means by which to determine the onset of global collapse. It seems highly unlikely that the analysts at NIST would not have considered this and been aware of this ambiguity. Moreover, it was explicitly brought to their attention. In public comments on the NIST presentation "WTC 7 Technical Approach and Status Summary" on December 12, 2006, Retired FDNY Battalion Chief Arthur Scheuerman stated that the collapsing core was "pulling in the entire exterior façade." He reiterated, "As the core failed, the perimeter walls were pulled inward, with the greatest deflection at the top floors."¹⁰ A video of the collapse taken from a different angle very clearly shows significant pull-in of the north face as global collapse is underway. Stills from this video were included in the NIST report (**Figure 1**).¹¹

NIST points out that the building oscillated laterally prior to global collapse, with "a relatively small motion toward the west, followed by a larger movement toward the east."¹² It defined the beginning of "global collapse" as the point in time that "initial movement of the north face occurred at the roofline", which movement NIST described as "initial descent". It characterized visible displacement of the roofline as "downward" motion.¹³ Yet it also observed that while there was "Substantial movement of the building's upper edge", there remained "little movement of the northeast and northwest corners".¹⁴ NIST's own findings, therefore, strongly suggest the observed movement of the center roofline was the result of the north face being pulled inward, which *prima facie* invalidates the methodology it used for determining the point in time representing the onset of global collapse, and thus also its conclusions regarding the collapse time.

The claim of a 5.4 second collapse time is significant not only because it was the basis for NIST's initial denial of free-fall, but also because even after acknowledging free-fall, it continued to serve as the basis for NIST's declaration that the collapse was consistent with the results of its computer model, and it implies a gradual rather than sudden onset of free-fall. For these reasons, NIST's claim warrants further examination. Two initial questions must be asked: 1) Can NIST's claim of displacement of the roofline at the time it claims represents the onset of global collapse be verified? 2) If so, does this displacement indicate *downward* movement representing the onset of global collapse?

OBSERVATIONS

The same video NIST used for its analysis¹⁵ was obtained from the release of NIST Cumulus videos obtained by the International Center for 9/11 Studies through a Freedom of Information Act (FOIA) request.¹⁶ Observations were made using commercially available video editing software.¹⁷ The frame rate of the video is NTSC standard, 29.97 frames per second.

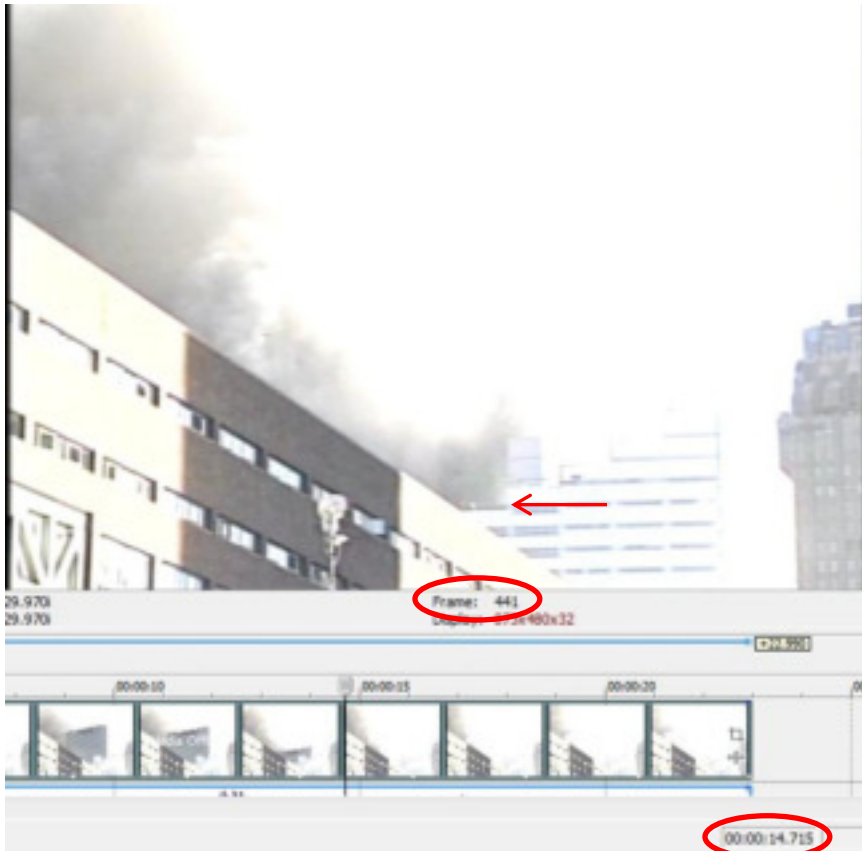


Figure 2 - The last frame WTC 7 is visible in the video was first determined. At frame 441, 14.715 s into this copy of the video, the roofline is still just visible.

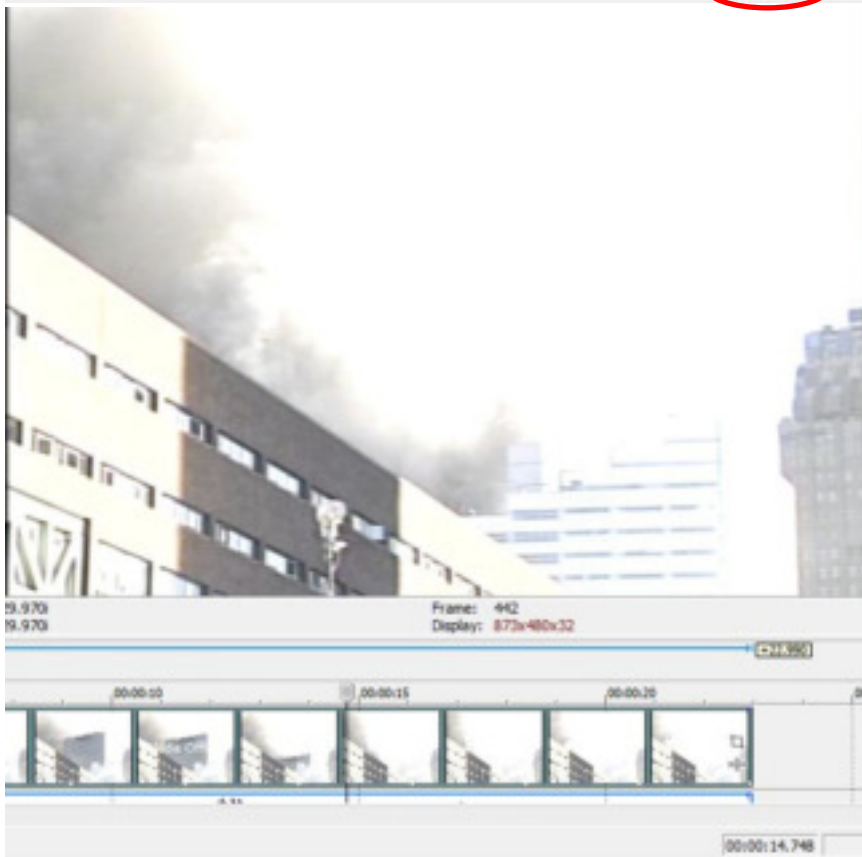


Figure 3 – The roofline is no longer visible in frame 442 at 14.748 s. NIST states it used the last frame the roofline is visible (i.e., frame 441). However, frame 442 was chosen as representing NIST's "5.4 s" into global collapse to err on the side of conservatism (that is to say, giving NIST the benefit of the doubt on its start time by one frame).

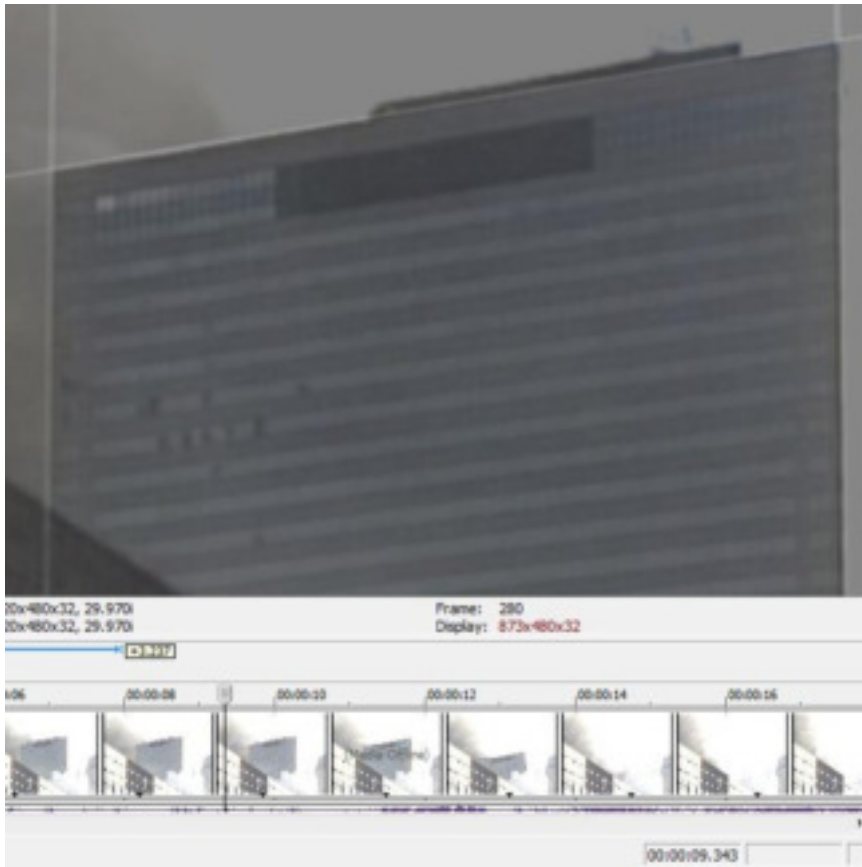


Figure 4 - According to NIST, the onset of global collapse began 5.4 s prior to the last frame in which the building is visible. Thus, the nearest frame to NIST's starting time is frame 280 at 9.343 s. This is NIST "0.0 s". The building was magnified in the frame, maintaining aspect ratio. Straight lines were fixed to approximate the position of the walls and roofline to establish a baseline. Scrubbing the video (dragging the timeline cursor forward and backward) reveals slight movement of the roofline (not readily apparent in captured stills).

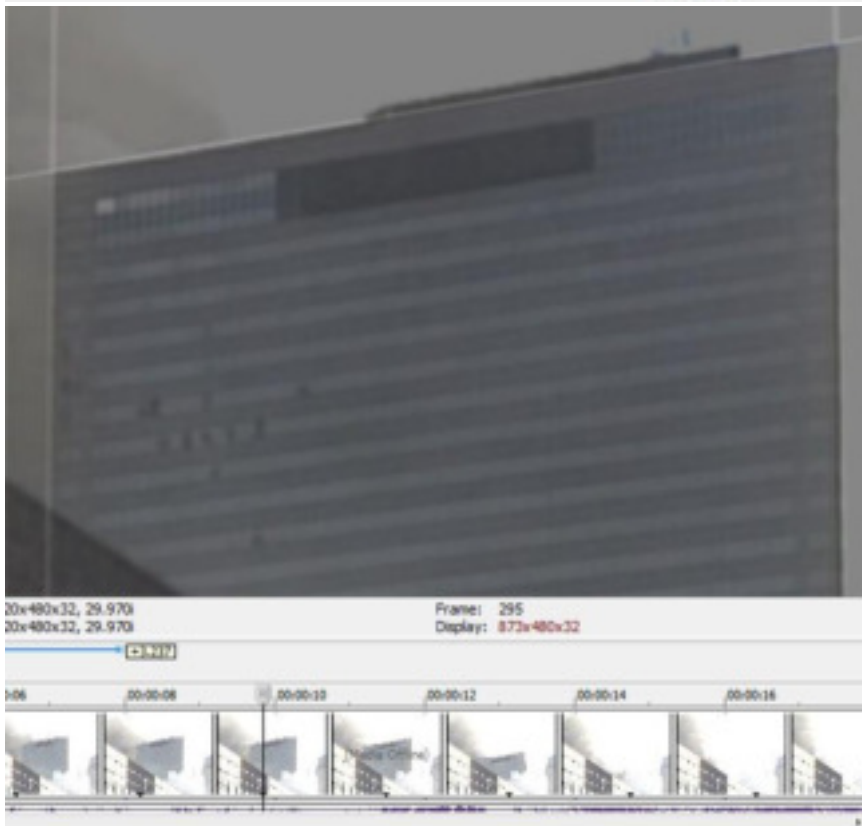


Figure 5 - At frame 295 ("0.5 s" at 9.843 s), continued movement of the roofline towards the center is noticeable by scrubbing, but there remains no vertical displacement at either corner.

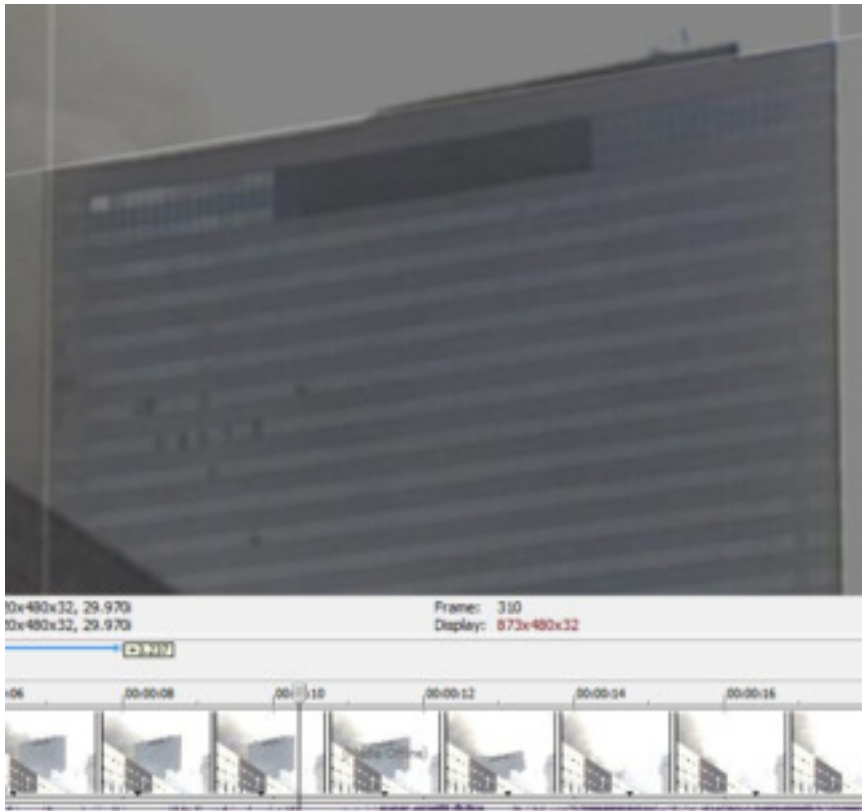


Figure 6 - At frame 310 ("1.0 s" at 10.344 s), the displacement of the center of the roofline has become quite apparent even in still frame. The northwest corner (right) shows no displacement. The northeast corner (left) is showing lateral, but not vertical, displacement. The perception is eastward movement, but presuming the width of the north face has not increased, this must be illusory and the displacement is actually northward. This conclusion is supported by visual evidence of northward leaning of the northeast corner during collapse (see **Figure 1**).

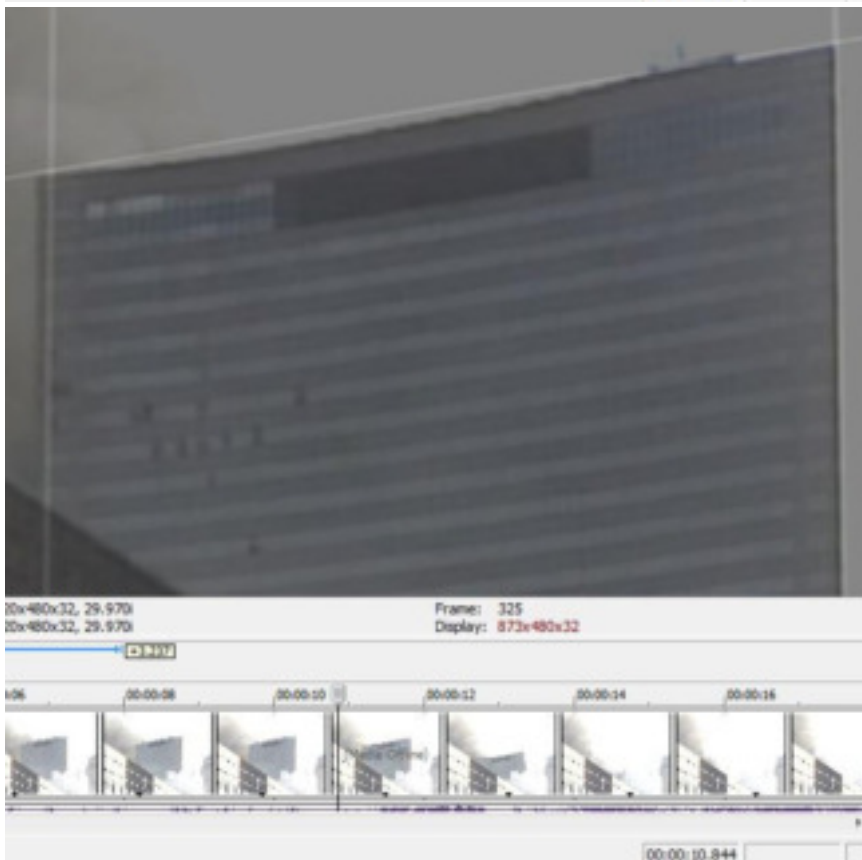


Figure 7 - At frame 325 ("1.5 s" at 10.844 s), the displacement towards the center of the roofline is dramatic. There remains no apparent displacement of the northwest corner at this magnification (see also Figure 21). Lateral displacement of the northeast corner has increased, but still no unambiguous vertical displacement is apparent.



Figure 8 - At frame 340 ("2.0 s" at 11.345), significant vertical displacement is apparent along the entire north face, including both northwest and northeast corners. Global collapse is underway.

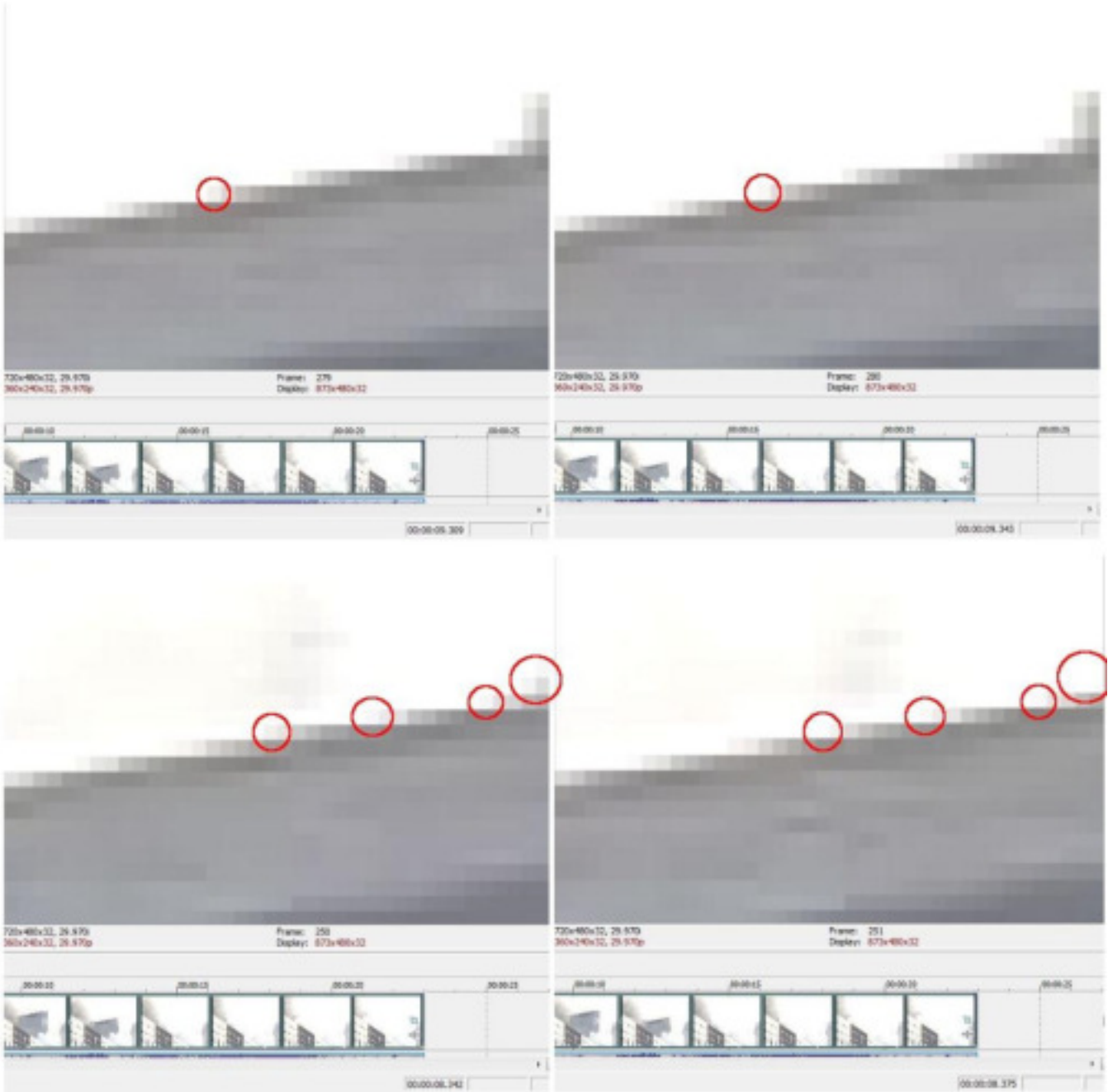


Figure 9 - Magnification was increased towards the center of the roofline to examine for single pixels that brighten, to the extent that the pixel could be said to represent sky rather than the roofline. A pixel that has brightened between frames 279 (9.309 s, top left) and 280 (9.343 s, NIST "0.0 s", top right) is circled. However, NIST's starting time for global collapse seems arbitrary, inasmuch as movement is noticeable by scrubbing the video significantly *prior* to frame 280. Between frames 250 (8.342 s, bottom left) and 251 (8.375 s, NIST "-0.97 s", bottom right), chosen arbitrarily to illustrate the point, numerous pixels are observed to brighten significantly, so as to be indistinguishable from the sky.

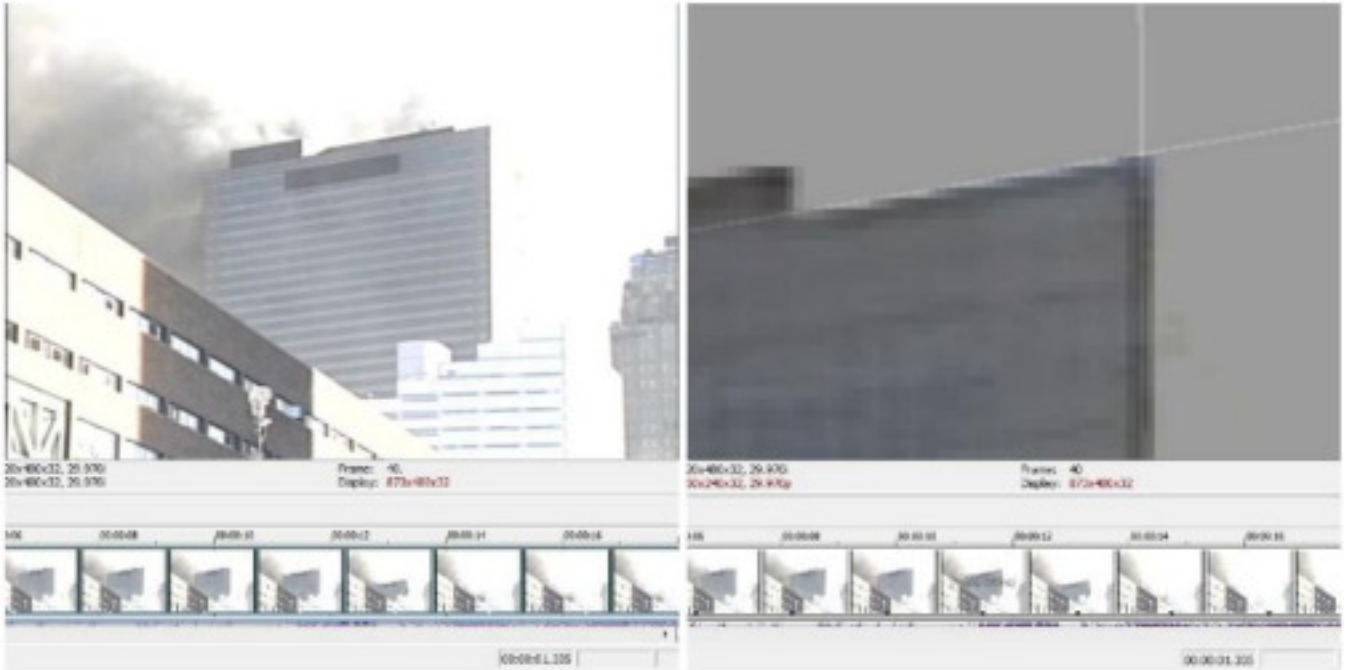


Figure 10 – Further observations were also made of the northwest corner, which was seen to oscillate side-to-side when scrubbing. Magnification was increased so that individual pixels are distinguishable. At frame 40 (1.335 s, NIST "-8.01 s"), the east penthouse has not yet begun to collapse, and a baseline for the northwest corner is established from which to determine subsequent displacement.

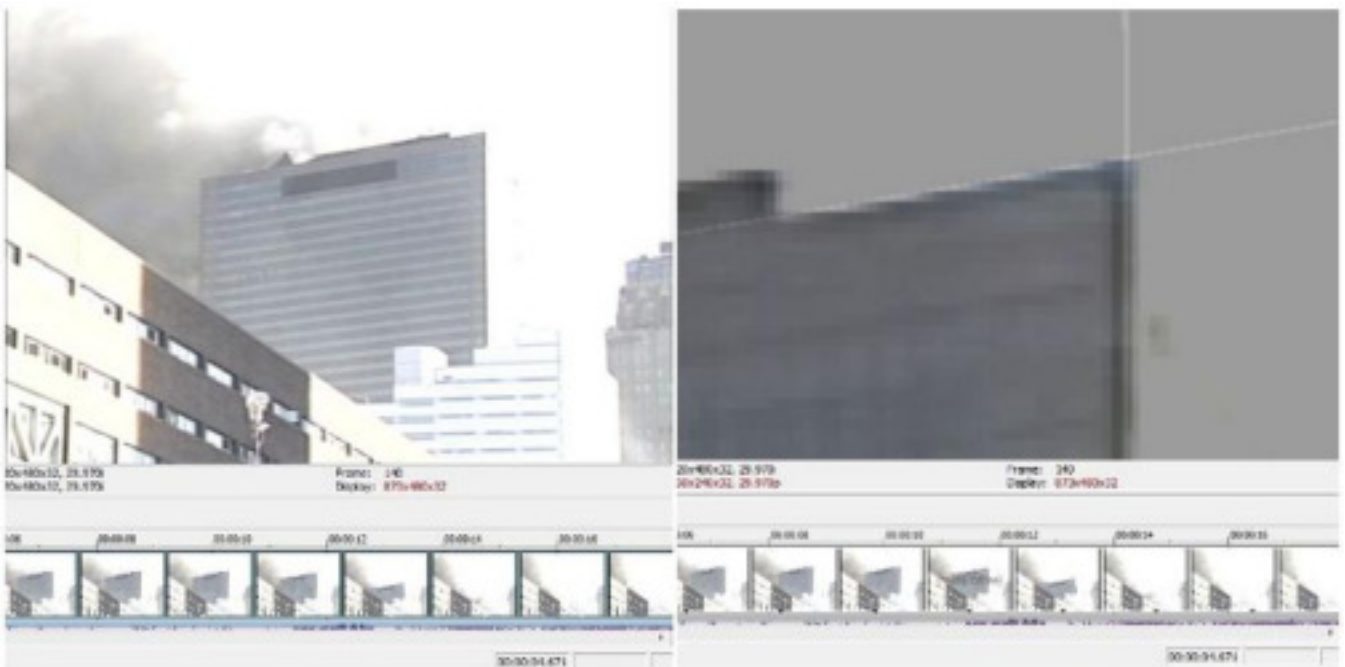


Figure 11 - At frame 140 (4.671 s, NIST "-4.67 s"), collapse of the penthouse is underway. The northwest corner is showing eastward (towards the left) lateral displacement.

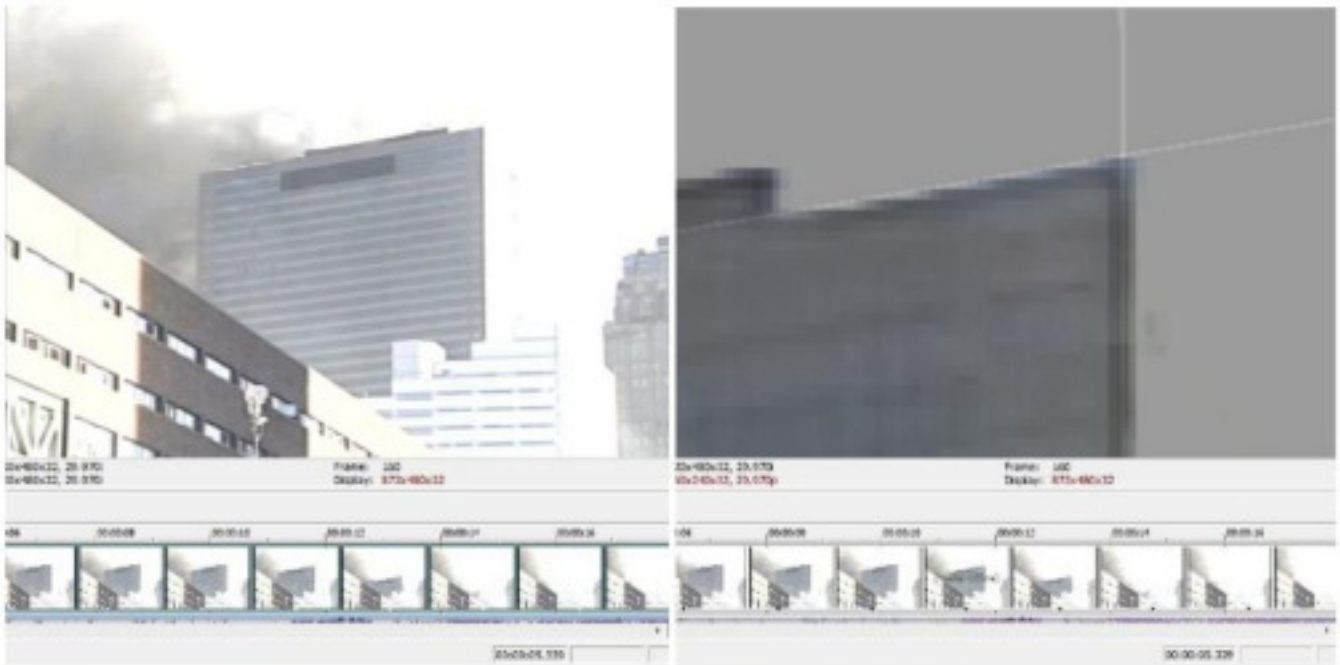


Figure 12 – At frame 160 (5.339 s, NIST "-4.00 s"), the east penthouse has disappeared. The northwest corner has oscillated back to its baseline position.

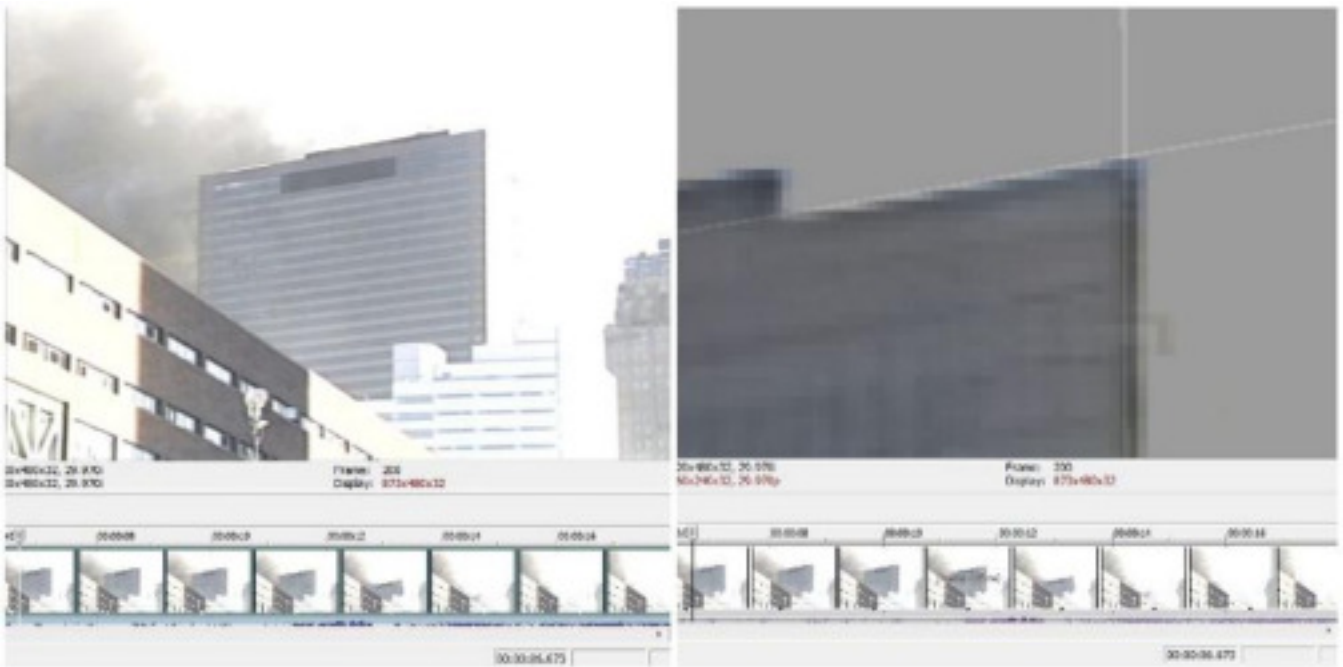


Figure 13 – At frame 200 (6.673 s, NIST "-2.67 s"), the northwest corner has continued to move so that it is now showing westward displacement.

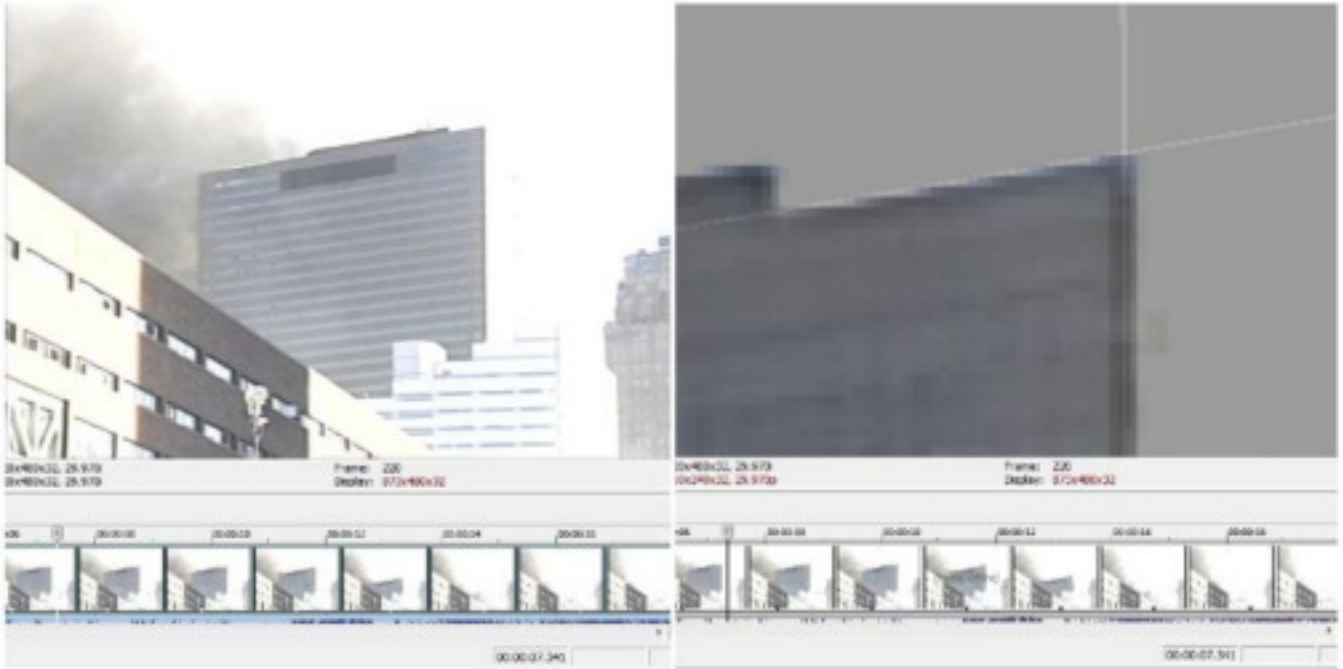


Figure 14 – At frame 220 (7.341 s, NIST "-2.00 s"), the northwest corner has returned to its baseline position.



Figure 15 - At frame 260 (8.675 s, NIST "-0.67 s"), the swaying movement has continued, with the northwest corner once again showing eastward displacement.



Figure 16 – At frame 280 (9.343 s, NIST's "0.0 s"), there is still slight displacement eastward as the northwest corner is oscillating back to its baseline position.



Figure 17 – At frame 295 (9.843 s, NIST's "0.5 s"), the northwest corner has returned to baseline. There remains *no* vertical displacement. Contrary to NIST's claim, although the building is clearly experiencing some kind of shock wave, causing it to sway side-to-side, global collapse is *not* yet underway.

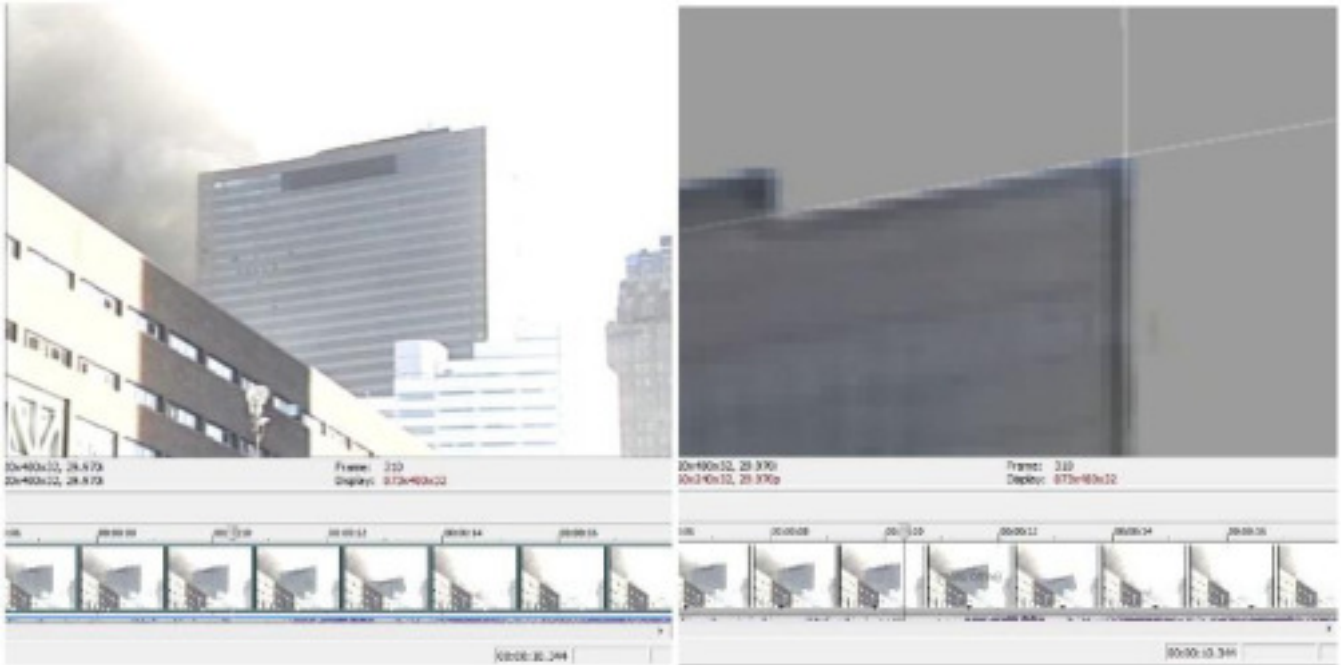


Figure 18 – At frame 310 (10.344 s, NIST "1.0 s"), the building continues to oscillate, with the northwest corner once again showing eastward, but still no vertical displacement.

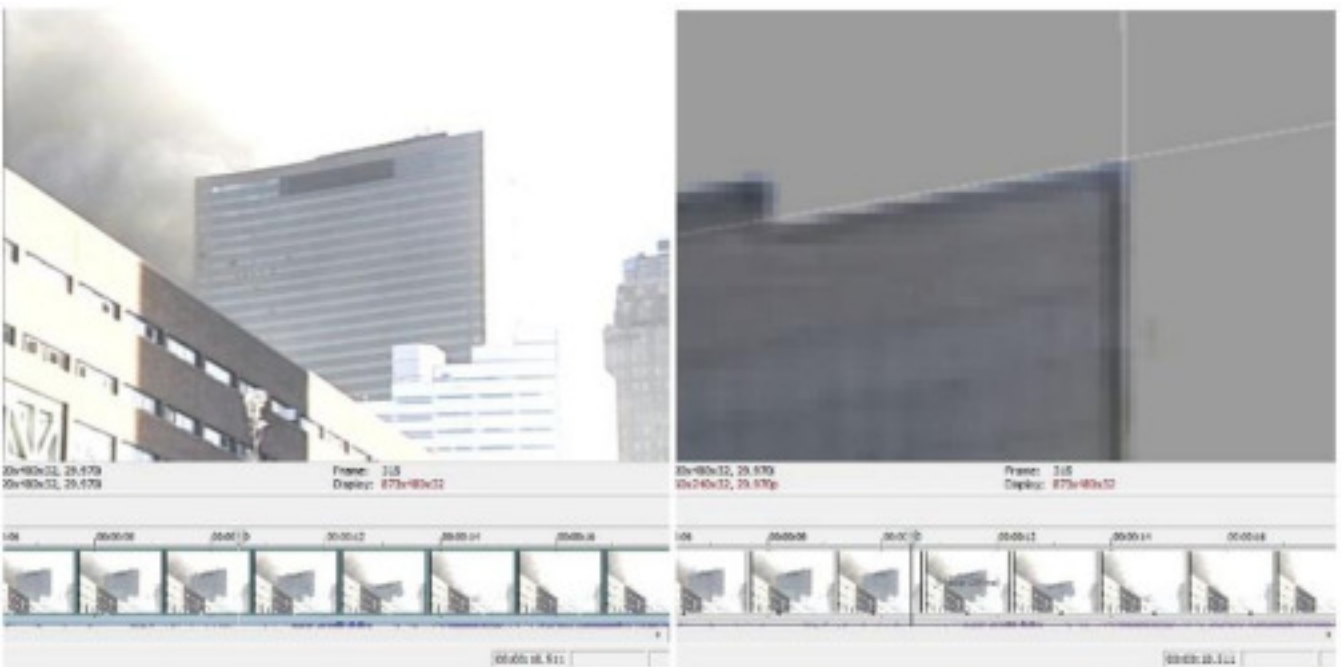


Figure 19 – At frame 315 (10.511 s, NIST "1.5 s"), the eastward displacement is more significant, but there remains no vertical displacement. There is displacement towards the center of the roofline, but this could be attributed to the increasing "pull-in" of the façade.

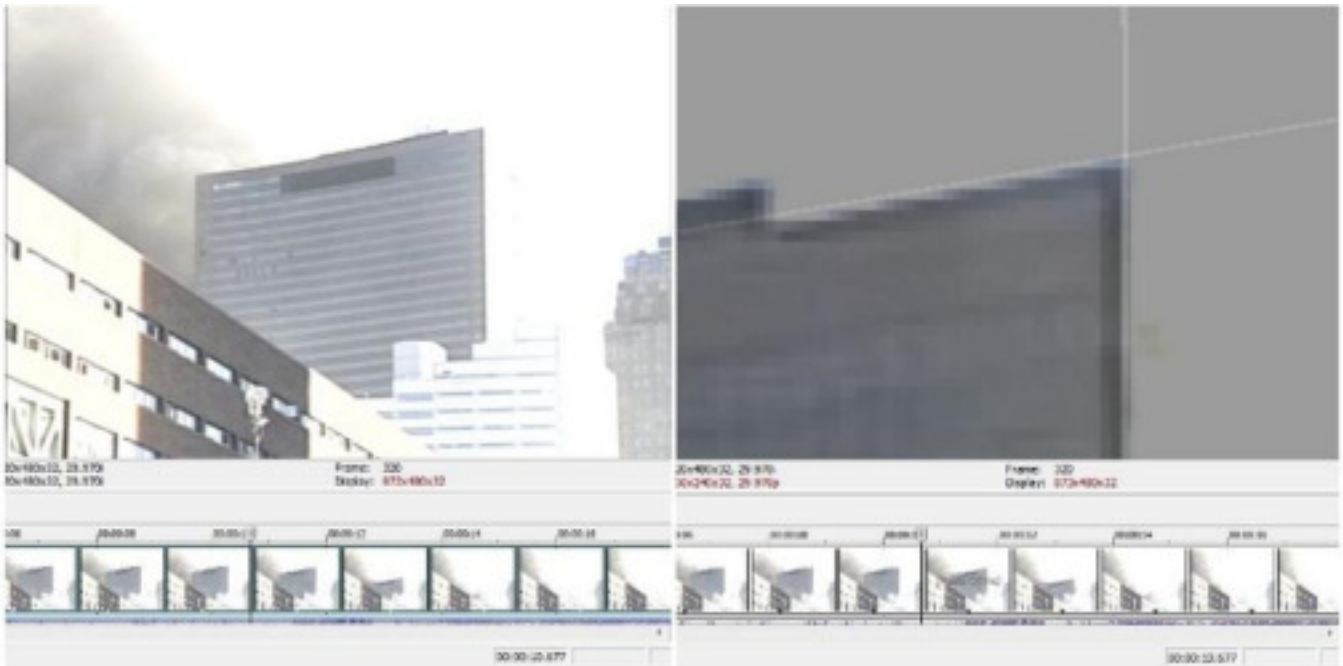


Figure 20 – At frame 320 (10.677 s, NIST "1.67 s"), the displacement of the roofline is significant. The eastward displacement of the northwest corner has continued, though only slightly increased from frame 315. The pixels at the corner of the building have brightened somewhat, but vertical displacement is not unambiguously apparent.

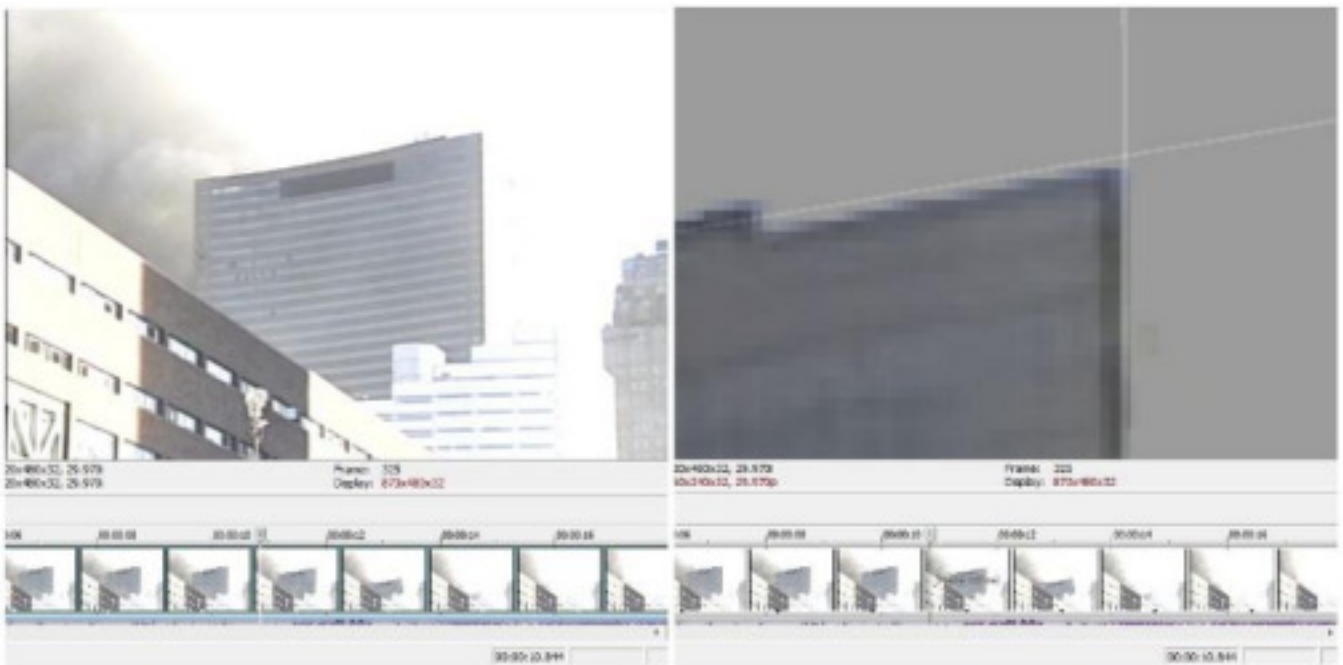


Figure 21 – At frame 325 (10.844 s, NIST "1.83 s"), downward displacement is noticeable. Global collapse is underway.



Figure 22 – f 40, 1.334 s, NIST "-8.01 s"

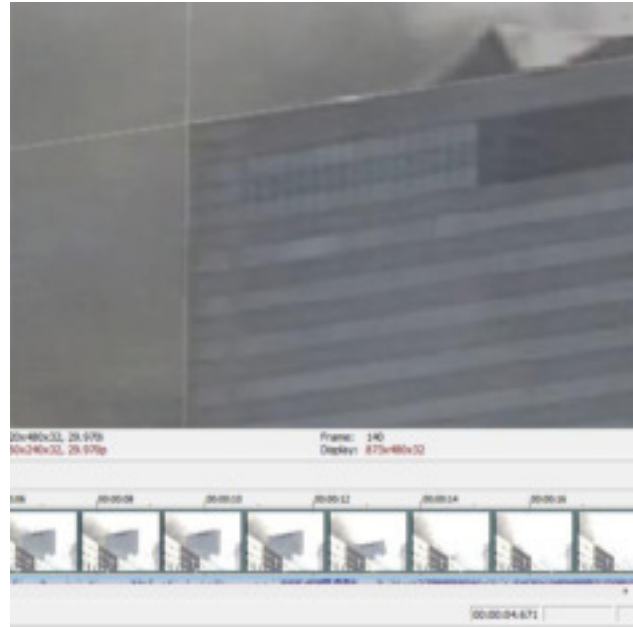


Figure 23 – f 140, 4.671 s, NIST "-4.67 s"



Figure 24 – f 160, 5.339 s, NIST "-4.00 s"



Figure 25 – f 200, 6.673 s, NIST "-2.67 s"

Further observations were made of the northeast corner at the same time intervals. Frame 40 establishes a baseline (**Figure 22**). Frame 140 shows the east penthouse collapsing (**Figure 23**). By frame 160, the east penthouse has disappeared, and the northeast corner is showing lateral displacement that *appears* eastward (**Figure 24**). Interestingly, at this same point in time, the northwest corner is oscillating westward, in the opposite direction (**Figure 12**). This reinforces the conclusion that the *perception* of eastward displacement of the northeast corner is actually due to *northward* displacement. This displacement is slightly more apparent in frame 200 (**Figure 25**).

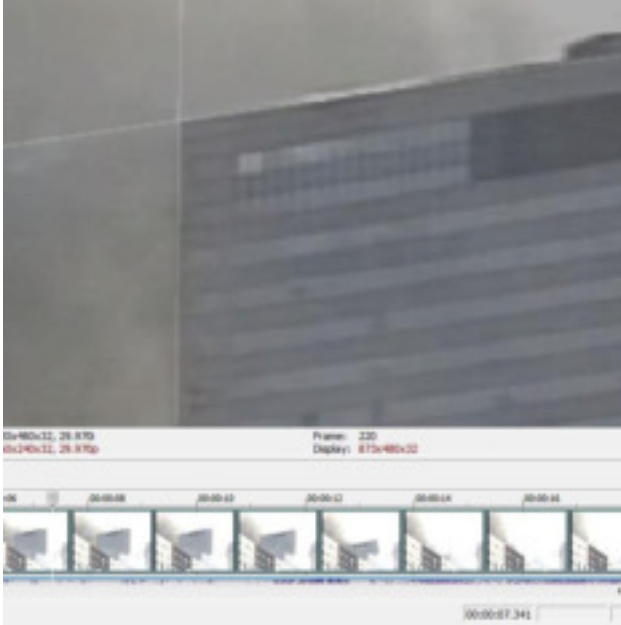


Figure 26 – f 220, 7.341 s, NIST "-2.00 s"

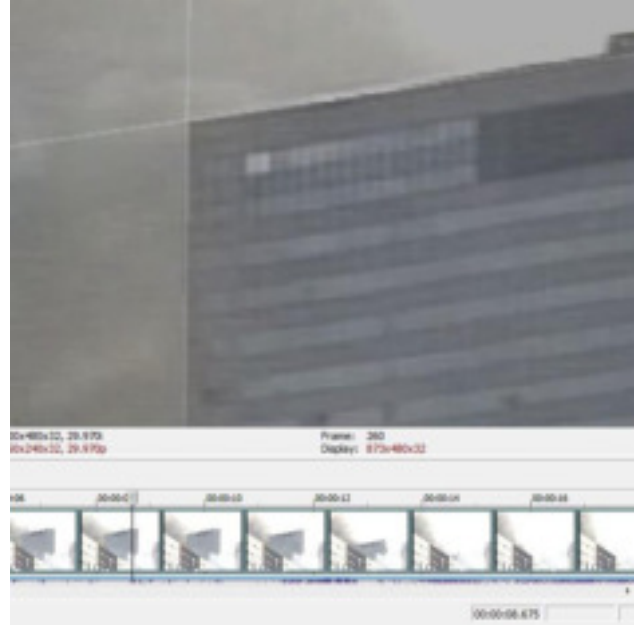


Figure 27 – f 260, 8.675 s, NIST "-0.67 s"

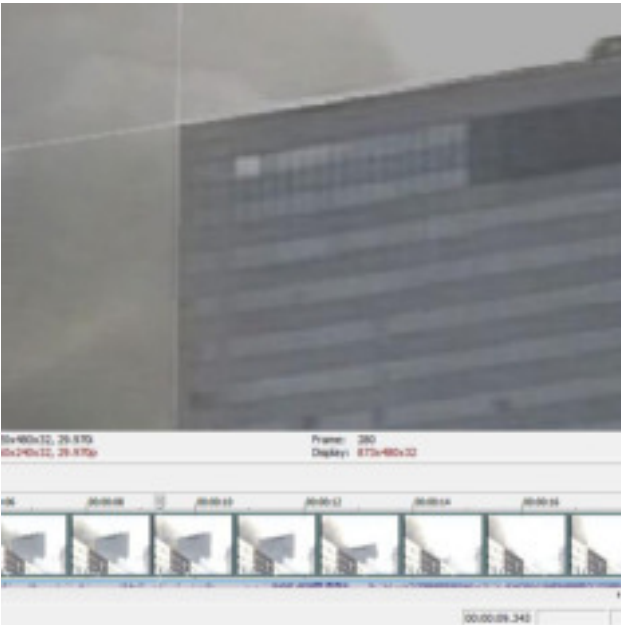


Figure 28 – f 280, 9.343 s, NIST "0.0 s"



Figure 29 – f 295, 9.843 s, NIST's "0.5 s"

There is little motion of the façade through frames 220, 260, 280, and 295 (**Figures 26-29**). Note that frame 280 is NIST "0.0 s", the ostensible onset of global collapse.

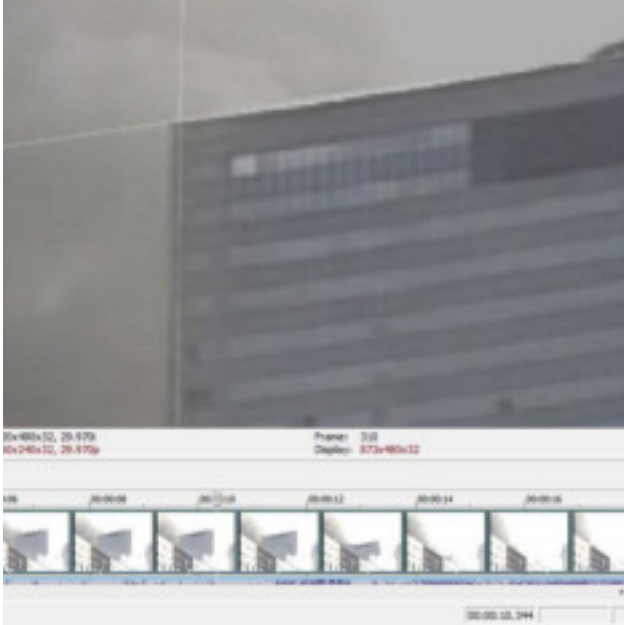


Figure 30 – f 310, 10.344 s, NIST "1.0 s"

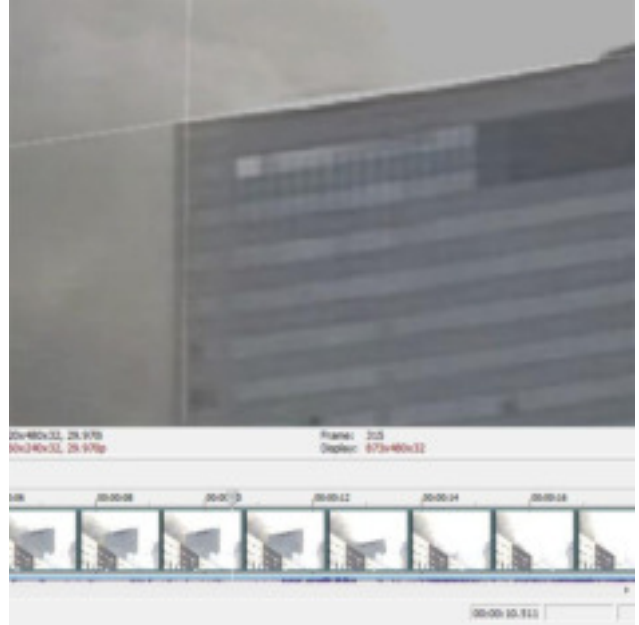


Figure 31 – f 315, 10.511 s, NIST "1.5 s"



Figure 32 – f 320, 10.677 s, NIST "1.67 s"



Figure 33 – f 325, 10.844 s, NIST "1.83 s"

Stills from frames 310, 315, and 320 show further displacement of the roofline, as well as further lateral displacement of the northeast corner (**Figures 30-32**). Vertical displacement of the northeast corner is not observed until frame 325 (**Figure 33**). This corresponds with approximately the same time vertical displacement of the northwest corner is observed (**Figure 21**).

From the above observations, it is clear that choosing a point along the center of the roofline is an invalid methodology by which to determine the onset of global collapse, while examining for vertical displacement of either corner would offer a much more reliable means by which to make that judgment. The northwest corner offers the clearest and most reliable measurement point, because the northeast corner is partially obscured by smoke and because its dramatic lateral movement makes it more difficult to determine down to a single frame at which point in time global collapse has begun. Further observations were thus made of the northwest corner to try and determine whether a single frame representative of the onset of global collapse could be found. A baseline was established, and magnification was increased on the northwest corner so that individual pixels clearly stand out. Moving forward through the video, it was difficult to judge a single frame that represented the onset of downward displacement. Moving backward, however, first by scrubbing and then by stepping frame-by-frame, it was possible to determine the onset of collapse down to a single frame. While this is not as apparent in still frames, it is possible to observe by a comparison of pixels. The resolution of the video is not high enough to show movement of the building downward from the baseline at this stage of the collapse (that is to say, the resolution is not high enough to *measure* the distance the building has moved downward), but this downward movement is indicated by the brightening of these pixels between frames.

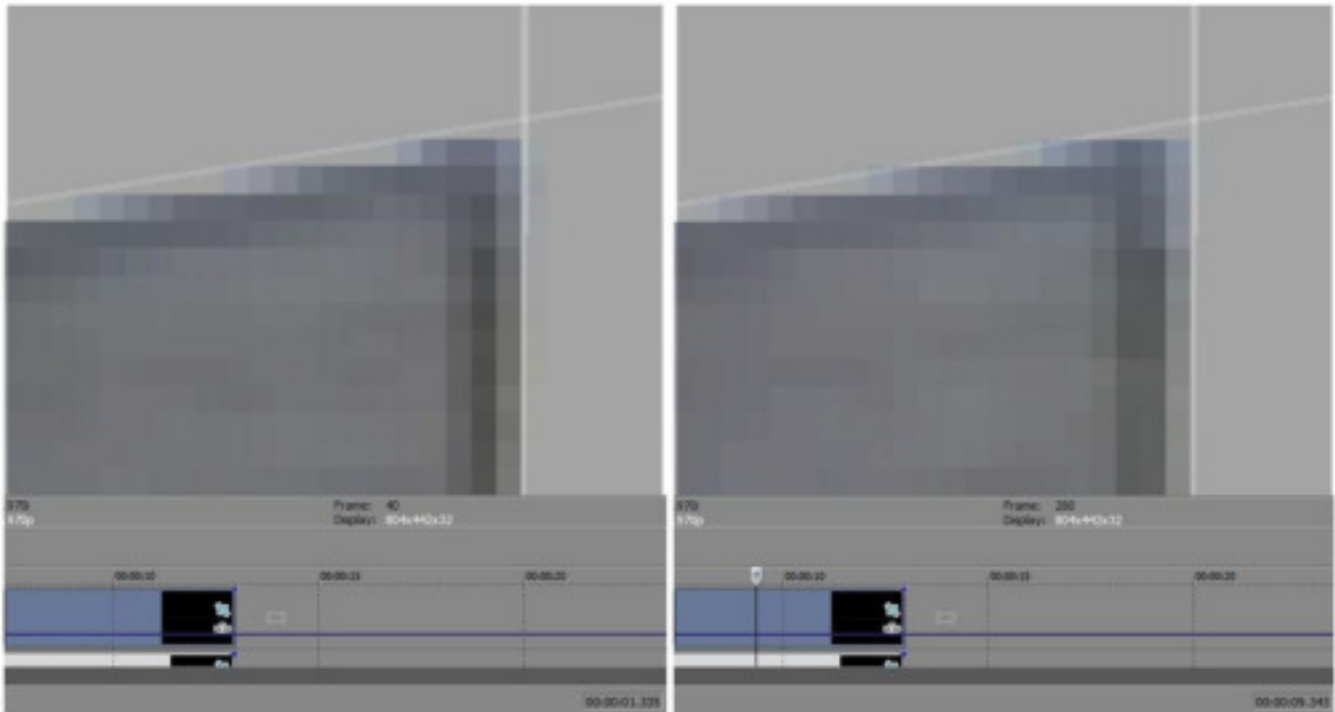


Figure 33 – Frame 40 (1.335 s, NIST "-8.01 s", left) establishes a baseline. Frame 280 (9.343 s, NIST "0.0 s", right) is NIST's claimed onset of global collapse. At this point in time, while the northwest corner has oscillated laterally, no downward displacement is occurring. No downward motion of the northwest corner is visible until many frames later.

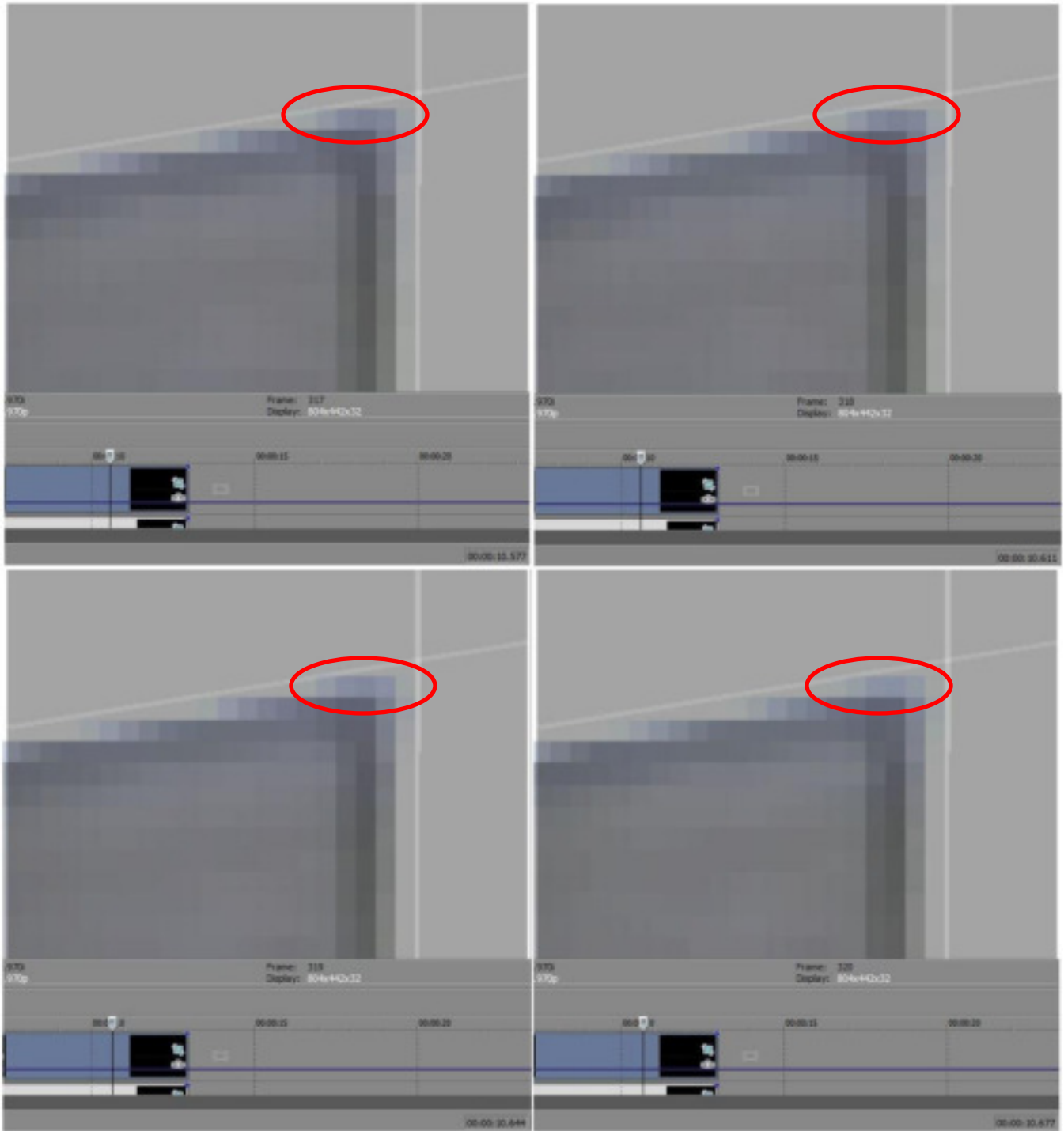


Figure 34 – Frames 317 (10.577 s, NIST "1.23 s", top left), 318 (10.611 s, NIST "1.27 s", top right), 319 (10.644 s, NIST "1.30 s", bottom left), and 320 (10.677 s, NIST "1.33 s", bottom right). No downward displacement is noticeable between frames 317 and 318 (note the similarity in position and brightness of the northwestern-most pixels). The pixels can be observed to brighten significantly from frames 318 to 320, indicating that the building is collapsing. Thus, frame 318 is determined to represent the onset of global collapse, 1.27 s after NIST claims collapse had already begun.

DISCUSSION

From these observations, NIST's claim of slight movement towards the center of the roofline can be verified by scrubbing the video. In fact, there was movement of the roofline *before* the point in time NIST chose as the onset of global collapse, and it is apparent that this movement occurred as a result of the collapse of the east penthouse and core columns to the east, resulting in "pull-in" of the north façade. Thus, NIST's time "0.0" appears to be rather arbitrary. In fact, there was movement of the roofline and a single pixel could have been chosen which would have resulted in a *longer* than 5.4 second "collapse time".

Furthermore, displacement of the roofline is slight for at least another 0.5 seconds, and no vertical displacement of either corner occurs for at least another 1.5 seconds. This is consistent with NIST's own finding that there was "Substantial movement of the building's upper edge" with "little movement of the northeast and northwest corners". It is also consistent with the hypothesis that this observed motion is the result of the façade being pulled inward. It follows that the initial movement towards the center of the roofline observed by NIST by examining a single pixel is *not* indicative of the onset of global collapse, as claimed by NIST.

A more scientific methodology would have been to examine vertical displacement of *either corner* of the building, with the northwest corner offering the least ambiguous location from which measure *downward* displacement (it is the displacement of the northwest corner that David Chandler chose to measure in performing his analysis calculating the rate of downward acceleration). Doing so, it can be observed that it is not for approximately one and a half seconds *after* NIST claims global collapse has begun that the northwest corner begins to fall. Using a similar methodology of examining for the brightening of pixels, but instead observing downward displacement of the northwest corner, results in an overall collapse time of 4.13 seconds for the first 18 stories.

As NIST observed, a collapse time of 5.4 seconds would be approximately "40 percent longer" than a free-fall time of 3.9 seconds. A collapse time of 4.13 seconds, however, is *just 6 percent longer than free-fall time*. This is consistent with NIST's measurements for its "Stage 2" of collapse, 2.25 seconds of free-fall, and "Stage 3", another 1.4 seconds of *near* free fall. It is also consistent with NIST's own acknowledgment that its claim of a 40 percent-longer-than-free-fall time was mostly due to its "Stage 1" of collapse, which is dependent upon NIST's chosen start time.

CONCLUSION

NIST's means of choosing a starting point representative of the onset of global collapse of WTC 7, choosing a point near the center of the roofline, is invalid because the *perception* of downward displacement from the point of view of the camera could be the result of "pull-in" of the façade that would occur due to the collapsing core of the building. Moreover, NIST's chosen start time resulting in a 5.4 second collapse time would seem to be completely arbitrary, but for the fact that it *exactly matches* the time it took their model to fall the same distance. Indeed, there is no other apparent logical explanation or rationale for NIST's chosen start time for the onset of global collapse. It follows that NIST's claim of a 5.4 second collapse time is not merely unscientific, but deceitful and fraudulent. It

was initially employed by NIST in an apparent attempt to *deny* that free-fall occurred. Yet even after being forced to acknowledge free-fall, NIST maintained this claim in an apparent attempt to obfuscate the implications of free-fall and the fact that it occurred with sudden onset. That NIST has been willfully deceptive with the public is further evident in the fact that it removed the assertion that a rate of acceleration that was 40 percent longer than free-fall was "consistent with physical principles" because the structure of the building provided resistance, replacing it instead, after acknowledging free-fall, with the meaningless declaration that the overall collapse time was "consistent with the results of global collapse analyses" on the basis of its fraudulent claim of a 5.4 second collapse time.

¹ NCSTAR 1-9 Vol. 2 Draft Report, "Structural Fire Response and Probable Collapse Sequence of World Trade Center Building 7, Volume 2 – Draft for Public Comment", *Federal Building and Fire Safety Investigation of the World Trade Center Disaster*, National Institute of Standards and Technology, August 21, 2008, p. 595-596, http://wtc.nist.gov/media/NIST_NCSTAR_1-9_vol2_for_public_comment.pdf.

² Mark Phillips, comments on the NIST draft report, September 9, 2008, <http://wtc.nist.gov/comments08/markPhillipswtc7comments.pdf>. David Chandler, comments on the NIST draft report, September 13, 2008, <http://wtc.nist.gov/comments08/davidChandlerwtc7comments.pdf>. The quotes are from comments made by Dr. Sunder at a technical presentation, following the release of the draft report, on August 26, 2008. The video of the presentation is no longer available at the NIST website.

³ David Chandler, Comments on the NIST draft report, September 13, 2008, <http://wtc.nist.gov/comments08/davidChandlerwtc7comments.pdf>.

⁴ NCSTAR 1-9 Vol. 2, "Structural Fire Responses and Probable Collapse Sequence of World Trade Center Building 7, Volume 2", *Federal Building and Fire Safety Investigation of the World Trade Center Disaster*, National Institute of Standards and Technology, November 2008, p. 602, <http://wtc.nist.gov/NCSTAR1/PDF/NCSTAR%201-9%20Vol%202.pdf>.

⁵ NCSTAR 1-9 Vol. 2, p. 603.

⁶ NCSTAR 1-9 Vol. 2, p. 603.

⁷ Comments by NIST Lead Investigator Dr. Shyam Sunder at a technical presentation on August 26, 2008. The video of the presentation is no longer available at the NIST website. The relevant remark is quoted in Mark Phillips, Comments on the NIST draft report, September 9, 2008, <http://wtc.nist.gov/comments08/markPhillipswtc7comments.pdf>. Phillips quotes Sunder as saying, "What the analysis shows...and...uh...the structural analysis shows, the collapse shows that same time that it took for the structural model to come down from the roof line all the way for those 17 [*sic*] floors to disappear is...um...5.4 seconds."

⁸ NCSTAR 1-9 Vol. 2 Draft Report, p. 596.

⁹ NCSTAR 1-9 Vol. 2, p. 600-602.

¹⁰ Public comments on the NIST presentation "WTC 7 Technical Approach and Status Summary" by Arthur Scheuerman, "The Collapse of Building 7", December 12, 2006, <http://wtc.nist.gov/media/ScheuermanStatementDec2006.pdf>. Available from "NCST Advisory Committee Meeting, December 14, 2006", <http://wtc.nist.gov/media/NCSTACmeetingDec06.htm>.

¹¹ NCSTAR 1-9 Vol. 1, p. 281, 283-284.

¹² NCSTAR 1-9 Vol. 1, "Structural Fire Responses and Probable Collapse Sequence of World Trade Center Building 7, Volume 1", *Federal Building and Fire Safety Investigation of the World Trade Center Disaster*, National Institute of Standards and Technology, November 2008, p. 271, <http://wtc.nist.gov/NCSTAR1/PDF/NCSTAR%201-9%20Vol%201.pdf>.

¹³ NCSTAR 1-9 Vol. 1, p. 273.

¹⁴ NCSTAR 1-9 Vol. 1, p. 274.

¹⁵ NCSTAR 1-9 Vol. 1, "Structural Fire Responses and Probable Collapse Sequence of World Trade Center Building 7, Volume 1", *Federal Building and Fire Safety Investigation of the World Trade Center Disaster*, National Institute of Standards and Technology, November 2008, p. 263 <http://wtc.nist.gov/NCSTAR1/PDF/NCSTAR%201-9%20Vol%201.pdf>. NCSTAR 1-9 Vol. 2, p. 600. Note that "Camera No. 3" was used for its analysis.

¹⁶ The International Center for 9/11 Studies website is: <http://www.ic911studies.org/>. The entire video collection is available for download as torrent file at: http://911datasets.org/index.php/NIST_FOIA_09-42_-_ic911studies.org_-_Release_14_-_x.264_Compressed. The copy of the "Camera No. 3" video chosen for this analysis is "CBS-NET Dub5 09. "Cumulus" refers to a database program NIST used to organize the videos.

¹⁷ Sony Vegas Movie Studio Platinum 9.0 was primarily used for observations. Later observations were made using an updated version of the software, Sony Vegas HD Movie Studio Platinum 10.0.