Comments on the Draft Report „A Structural Reevaluation of the Collapse of World Trade Center 7“ (JL Hulsey et al, September 2019)

Prepared by:

[Oystein]

Table of Contents

All three Key Objectives are not met....1
- Objective (1): Structural response to fire loads....2
  - Fire load and structural response were considered only on 2 floors (floors 12+13)....2
  - Failure to model fire effects over time....3
  - It is unclear how NIST‘s temperature distribution was translated by the JL Hulsey team....3
- Objective (2): Ruling out scenarios....3
  - General objections....3
  - 1. Scenario: NIST....4
  - 2. Scenario: Arup....4
  - 3. Scenario: Weidlinger....5
- Objective (3): Identify types of failures and their locations that may have caused the total collapse to occur as observed....6
  - General objections....6
  - „Three key features“ - forced into animation as input, not result of any hypothesis....6
  - „We could not find“ ≠ „Does not exist“....7
  - Failure to recreate other features....8

NIST misconstrued....8
- Modeling of the exterior steel framing....8
- Conflating ANSYS and LS-DYNA models....10

Short and assorted remarks....12
- References....12
- Excise irrelevant sections....12
- Invalid linear static analysis results....12
- Unrealistic dynamic analysis results....12

Principal conclusion refuted....12

All three Key Objectives are not met

According to the Abstract, page i, and repeated verbatim in Section 1.2, page 13,

> „The objective of the study was threefold: (1) Examine the structural response of WTC 7 to fire loads that may have occurred on September 11, 2001; (2) Rule out scenarios that could not have caused the observed collapse; and (3) Identify types of failures and their locations that may have caused the total collapse to occur as observed.“

We find that the study fails to fulfill any of its three key objectives.

In short:

(1) Hulsey et al failed to model most of the fires / heating, and all of the fire histories, and thus cannot possibly have accounted for all structural responses

(2) Hulsey et al could not have, and did not, account for all possible or plausible collapse initiating events. Instead, they looked at only three that have been proposed by three previous studies. Because of the incompleteness of Hulsey et al‘s models, Hulsey were not in a position to fully appraise these three hypotheses.

(3) Hulsey et al do not actually propose any „types of failures“ (as in „failure mode“). Their animations only mimic the observed collapse of 9/11/2001 in a very limited number of features, but fail to replicate many other features. Hulsey et al do not explain why these few features are even significant. The few features they do mimic arise not as a result (output) of any theory, any comprehensive and falsifiable hypothesis as to the material cause of the collapse. Rather, they are explicitly input to the animations: All columns are simply, without explanation, conjured away at opportune times. This is non-explanatory.

In detail:

Objective (1): Structural response to fire loads

JL Hulsey and his team chose to limit their analysis of „*fire loads that may have occurred on September 11, 2001*“, and of „*the structural response of WTC 7 to [those] fire loads*“ as follows:

Fire load and structural response were considered on 2 floors only

Page 23: „*We then used both ABAQUS and SAP2000 to evaluate the fire damage to the floor framing at Floors 12 and 13*“. Page 40: „*After the entire WTC 7 was modeled in SAP2000, boundary conditions for Floors 12 and 13 assembly were modeled*“. Page 42: „*The loading condition for the Floor 12 and 13 assembly was calculated by imposing axial forces acting on the top of Floor 13*“. Page 44: „*After modeling the boundary conditions for Floors 12 and 13, we modeled the concrete slab of Floors 12 and 13*“. Page 48: „*Using wire (beam) elements, Floors 12 and 13 were simulated using a finite element model in ABAQUS (see Figure 2.30 below)*“. Page 62: „*The WTC 7 fire loading analysis was based on NIST's fire modeling for Floors 12 and 13*“. Page 63: „*Note that the models in this analysis consist only of Floors 12 and 13*“.

Thus, the JL Hulsey team chose to ignore the very substantial fires on other floors, particularly floors 7, 8, 9 and 11 – which created (in the „worst“ Case B) >1,000 °C of gas temperatures in all those floors[1], slab temperatures >675 °C on floor 7[2] and steel temperatures >600 °C on floor 8[3]. As a result, NIST had found numerous connection failures after 4 h in the framings of all floors 8 to 144. Failing to model the elevated heat profiles in floors 7, 8, 9, 10, 11 and 14 made sure from the outset that the JL Hulsey study could not possibly evaluate the full structural response to all the fires on those floors.

Failure to model fire effects over time

The JL Hulsey team considered the temperature distribution at only one point in time („5:00 pm" according to the NIST timeline for structural heating). This ensures that possible effects of the dynamics of increasing *and decreasing* temperatures could not possibly have been detected by the JL Hulsey team. This is significant as the Arup team hypothesized that a critical girder connection occurred as cooling, contracting beams pulled a girder off its seat at column 79. JL Hulsey's modeling would be blind to such an occurrence.

Failing to model the dynamics of extended multi-floor fires ensured that the JL Hulsey study could not possibly evaluate the full structural response to all the fires on those floors.

It is unclear how NIST's temperature distribution was translated by the JL Hulsey team

Page 63: *„We inputted the temperature distribution given by NIST into SAP2000 using three different zones of temperature distribution: high temperature at 1211°F, medium temperature at 941°F, and low temperature, which was room temperature, at 68°F"*.

These three values correspond to 655, 505 and 20 °C, respectively. NIST's temperature distribution, as per the color coding in Figure 2.53, is more finely grained in intervals of ca. 20 °C (although sometimes the color gradients are difficult to perceive; for example, light blues between ca. 150 °C and ca. 250 °C are almost impossible to discern). Why were those three values chosen, and how were NIST temperatures above and below those values translated into SAP2000 input values?

It is not obviously clear that this simplification of the temperature distributions is valid – an argument ought to be presented for the validity.

Objective (2): Ruling out scenarios

Hulsey brings up only three „*scenarios that could not have caused the observed collapse*" (NIST, Arup, Weidlinger), and primarily focuses on only a detail in only one of them (the NIST hypothesis of the girder A2001 walk-off at column 79, floor 13).

General objections

First, it must be pointed out that these three scenarios do not exhaust the entire envelop of possibilities. For this reason alone, the JL Hulsey team cannot possibly have „*[r]uled out*" *all* scenarios as „*could not have caused the observed collapse*".

1 NIST NCSTAR 1-9, Figures 9–9 (floor 7), 9–10 (floor 8) and 9–12 (floor 12); the fire simulations for floors 9 and 11 were „copied"and time-shifted from the simulations of fires on floors 8 and 12, respectively.
2 NIST NCSTAR 1-9, Figure 10–26
3 NIST NCSTAR 1-9, Figure 10–29

All three scenarios agree that structural damage was widespread and occurring on multiple (>2) floors in the lower east part of the building – something that the JL Hulsey team did not even consider. The three cited studies disagree, essentially, on which proverbial straw broke the camel‘s back. This implies that at least two of the three scenarios are „wrong“ in the limited sense that they disagree with reality on the specific connection failure which started the transition from gradual destruction to rapid, progressive collapse. They could even all be wrong in the same limited sense – and that would in no way rule out the global conclusion that accumulating fire damage caused the total collapse as observed[4].

But in addition to this failure of top-level logic, the JL Hulsey team also failed to rule out any of the three specific scenarios:

1. Scenario: NIST

As documented previously, JL Hulsey and team failed to model fires and damage accumulation on most of the fire-affected floors, and failed to model the time-histories of the fires and the structural heating they caused. It is unclear, and unlikely, that a single snap-shot taken at an essentially arbitrary point in time, and covering only 2 floors, is sufficient to capture the complexities of the damage patterns that many hours of raging multi-story fires can accumulate in a structure like this.

Also, while NIST‘s own summary narrative somewhat singles out the A2001 girder walk-off on floor 13 as the initiating event[5], their actual LS-DYNA analysis does not[6], and instead stresses the presence of multiple failures on multiple floors as contributing to the buckling of column 79, particularly local collapses on floor 14 – which the JL Hulsey team did not consider.

2. Scenario: Arup

JL Hulsey et al misconstrue the initiating event as hypothesized by Arup as follows (page 86):

> „The Arup report concluded that the girder (A2001) that NIST reported was pushed off its seat by thermally expanding beams to the east of the girder was actually pulled off its seat by the sagging of beams to the east of the girder.“

In reality, Arup proposed two distinct „Initiating Failures“[7]:

> „[…] the triggering event is either the unseating of Girder 44-79 at its connection to Column 79 at Floor 13 (Scenario A) or at Floor 10 (Scenario B). A failure on Floor 13 corresponds to a failure during the cooling phase of the fire and a failure on Floor 10 corresponds to a failure during the heating phase“

4 Keeping in mind the perils of analogies, here is one: Suppose you observe an avalanche of rocks going down across a mountain trail, and a man collapsing amidstit. You later find him dead. Three investigators find three different rocks that they claim delivered the fatal strike. Now, even if all three identify the wrong rock, that does not mean the man’s death wasn’t caused accidentally by the rock avalanche! It does not make a proposition more likely that he was instead murdered with a shotgun.

5 NIST NCSTAR 1A, page 22: “Fire-induced thermal expansion of the floor system surrounding Column 79 led to the collapse of Floor 13, which triggered a cascade of floor failures.”

6 NIST NCSTAR 1-9, page 572: “[…] floor sections surrounding Columns 79 to 81 on Floors 13 and 14 collapsed to the floors below, as shown in Figure 12–42. The LS-DYNA analysis calculated the dynamic response of the structure to the floor failures and resulting debris impact loads on the surrounding structure. The thermally weakened floors below Floors 13 and 14 could not withstand the impact from the collapsing floors, resulting in sequential floor collapses.”

7 United States Court of Appeals for the Second Circuit, Case 11-4403, Document 79-1, 02/14/2012, 525397, page JA-3971

Hulsey et al only considered Scenario A – and could not have considered Scenario B, as they failed to model floor 10.

The second error in the Draft‘s paraphrasing of the Arup hypothesis is the claim that „*the girder was actually pulled off its seat by the sagging of beams to the east of the girder*“. The remark by Arup that „*failure on Floor 13 corresponds to a failure during the cooling phase of the fire*“ suggests that not sagging, but thermal contraction, was the cause of this initiating failure. JL Hulsey et al could not have considered this, as they failed to model heating dynamics, including cooling cycles.

Hulsey et al go on to claim (page 86) that „*[t]he Nordenson report instead put forth the idea that these girder connections failed due to stress raisers (cracking) caused by repeated heating and cooling cycles*“. This seems to contradict what they wrote earlier („*pulled off its seat by the sagging of beams*“). Where does the Nordenson report put forth the idea of repeated heating and cooling cycles? Citation, please!

Uncredited work used: Hulsey et al then focus for three pages (p. 86 to 89) on a detail of the Arup report – the notion that the falling 13th floor bay would hit the floor below with such force that it, too, would fail. While this discussion convincingly argues that Nordenson‘s calculation is missing a significant term, the entire argument, including Figure 3.15 and the numbers and calculations, appear to be the work of an uncredited author, who happens to also be a representative of the study‘s sponsor (AE911Truth): Anthony Szamboti. This work was first shown in January 2016 at the internet forum „Metabunk“[8]. The finding that several pages of the Hulsey report have essentially been written by a representative of AE911Truth almost 4 years ago of course immediately raises concerns what other portions of the draft might be the work not of Hulsey but of his sponsor.

The calculation, that seems to disprove that a floor collapse would propagate, of course was done under the assumption that the remaining structure is pristine – that the geometry is not significantly distorted, that no other of the connections involved are damaged or weakened, etc. An assumption, which is questionable after many hours of devastating fires. This has not been assessed by Hulsey et al (Nordenson didn‘t need to for his purposes).

3. Scenario: Weidlinger

As Hulsey et al put it, the Weidlinger reports posits

> „that Floors 9 and 10 were simultaneously heated to between 750° and 800°C in the exact same area of each floor. This extreme heating eventually caused Floor 10 to give way and break through Floor 9, which was possible only because of the extreme heating of Floor 9.“[9]

8 The FEA graphic, with the exact same value for Mode 2 frequency ("+5.1693E-01") that Hulsey used in his calculation ("0.51693 hz"), is attached to this post: https://www.metabunk.org/does-the-exclusion-of-stiffness-from-nordensons-falling-girder-calculations-demonstrate-anything.t7185/page-5#post-174345 . Szamboti's calculation was done a little earlier: https://www.metabunk.org/posts/174332/

9 This misconstrues the values in the Weidlinger report (Najib N. Abboud: WTC 7 Collapse Analysis and Assessment Report (October 15, 2010);
Downloadable from http://www.thorntontomasetti.com/projects/world_trade_center_7_collapse_investigation/):
First, according to Najib Figure 81, the relevant beams in the 9th floor east of column 80 were nowhere hotter than about 600 °C.
Secondly, Najib writes explicitly on page B-85: „*failure initiates […] after 4.5 hours of continual heating where the secondary beam in question has achieved average temperatures of 420°C, 720°C, and 750°C in the top flange, web, and bottom flange, respectively. The temperature of the finplate connection is 680°C*“. Also, Figure 81 nowhere shows any relevant bit of steel above 794 °C. It is unclear why Hulsey et al claim that two floors (!) were

Since Hulsey et al did not consider fires, heat and damage on floors 9 and 10, their modeling work cannot possibly address the Weidlinger findings. Instead, without reference or work, Hulsey et al merely brush aside the hypothesis (page 90) – I quote *in full* their discussion of the Weidlinger report:

> „However, the details of the thermal analysis by Dr. Beyler are not shown in the Weidlinger report, and Beyler's analysis has not been made public, despite its central importance to Weidlinger's hypothesis. It is important to understand that steel structural members reaching temperatures of 750°C due to office fires can be considered extraordinary. Without any analysis provided to substantiate such temperatures, Weidlinger's collapse initiation hypothesis must be viewed skeptically and can only be assumed to have a very low probability of occurrence."

Hulsey et al imply that Weidlinger have done no analysis – when clearly they have. It is, in fact, Hulsey et al who have not done any analysis here. It is unclear why they call these temperatures „extreme". Have Hulsey et al reached out to Dr. Beyler and asked for the thermal analysis?

In short, **Hulsey et al simply did not analyze the Weidlinger scenario** and thus cannot rule it out as having caused a progressive collapse and the buckling of columns 79 to 81.

Objective (3): Identify types of failures and their locations that may have caused the total collapse to occur as observed

General objections

What does „types of failures" mean, really?

The three earlier studies that Hulsey et al cite all identify specific failure modes (buckling, shearing, tearing, sagging, expanding, walking off, …) with specific causes, which go back to a plausible initial state: The building as built, with realistic fuel load, and fire ignited somewhere at some time. There is an unbroken chain of causes and effects from initial state to total collapse. That is what one would expect from any forensic engineering report – including Hulsey's.

But it's not what this draft delivers: Chapter 4 entirely ignores the fires and the damage they accumulated, and then conjures up, without explanation, the sudden total removal of columns, to force the structure above them move down.

There is no explanation to what may have caused this sudden removal of columns. As a matter of fact, JL Hulsey was asked at his September 03 presentation in Fairbanks[10]: „*You said that the fire did not cause the collapse. Do you any hypotheses of what DID cause the collapse?*", and his answer was, ominously, and to a round of laughs: „*I'm not going there.*"

So at this point, the objective has failed – on purpose: JL Hulsey is not going there – is not going to identify the „*types of failures*".

But the entire effort to „identify types of failures and their locations" fails on more counts:

- Hulsey et al attempted to mimic only a few arbitrarily selected features, which NIST also managed to mimic

---

(the entire relevant areas?) „simultaneously heated to between 750° and 800°C". They were not.

10 https://www.youtube.com/watch?v=TAEHhDCTaBw&t=1h8m35s

- They did so not as a result of theory but as a forced, straightforward input
- They failed to mimic many other observed features, or at least did not check whether they were mimicked.

In detail:

„Three key features“ - forced into animation as input, not result of any hypothesis

Chapter 4 is the place that purports to address the third objective. The goal here appears to be to generate a collapse simulation that „*closely resemble[s] the observed collapse*“ (page 91). To this end, Hulsey et al identify

> „three key features that occurred during the collapse of WTC 7, which we then attempted to replicate in our simulations of the collapse. These three key features are as follows:
>
> 1. The collapse of the east penthouse, which begins approximately 6.9 seconds prior to the descent of the north face roof-line
>
> 2. The collapse of the screenwall and west penthouse, which begins approximately 0.5 to 1 second prior to the descent of the north face roof-line; and
>
> 3. The descent of the north face roof-line, which progresses at a rate of free fall for approximately 2.25 to 2.5 seconds over a distance of approximately 105 feet or 8 stories, during which the building's sheathing remains attached to the exterior steel framing and does not experience visible differential movements.“

Hulsey et al correctly point out that „*NIST's progressive collapse simulation does show the three key features listed above*“. But it bears pointing out that, in the NIST simulation, these features all arise as a result (output) of the chain of analysis they did, from fire models to structural heating to damage accumulation from fires to onset of rapid collapse all the way through a global collapse model: NIST actually **explains** the observed collapse features as ultimately **caused** by the fires they modeled in the first step.

Hulsey et al on the other hand

1. **forced** the „collapse of the east penthouse […] approximately 6.9 seconds prior to the descent of the north face roof-line“ by making the columns underneath the east penthouse disappear, without cause and explanation, 7 seconds prior to making the columns low across the entire perimeter disappear, without cause and explanation,
2. **forced** the „collapse of the screenwall and west penthouse […] approximately 0.5 to 1 second prior to the descent of the north face roof-line“ by making the columns underneath the west penthouse disappear, without cause and explanation, about a second6 prior to making the columns low across the entire perimeter disappear, without cause and explanation and
3. **forced** the „descent of the north face roof-line […] at a rate of free fall […] over a distance of […] 8 stories“ by making the columns low across the entire perimeter disappear over a distance of 8 stories, without cause and explanation

In other words, all three features arise not as a result (output) of any model that represents a theory, but as a **forced input** to an animation. **This is entirely non-explanatory**.

„We could not find“ ≠ „Does not exist“

On page 2:

> „no other sequence of failures that we simulated produced the observed behavior. We cannot completely rule out the possibility that an alternative scenario may have caused the observed collapse; however, the near-simultaneous failure of every column is the only scenario we identified that was capable of producing the observed behavior.“

Exactly. You cannot completely rule out the possibility that an alternative scenario may have caused the observed collapse. So don‘t rule it out, and retract the „*secondary conclusion of our study is that the collapse of WTC 7 was a global failure involving the near-simultaneous failure of every column in the building*.“ It‘s logically invalid.

Failure to recreate other features

No attempt is made to justify why these three features, and not any of the many others that one could pick out, were selected as the target for simulation. Here is an incomplete list of further features, which were in fact observed, but not chosen by Hulsey et al as „*key features*“, and which also do not appear to have arisen as a result of their simulation:

1. The development of the kink in the north wall
2. Daylight visible through windows in the upper eastern corned of the north wall, seconds after the east penthouse began to collapse
3. The east-to-west onset of drop of of the screen wall and west penthouse
4. The building‘s exterior twists or turns counter-clockwise (north-east corner falls towards north, the western corners fall towards south)
5. Part of the west wall impacted the face of the Verizon building
6. Part of the north wall impacted Fiterman Hall

NIST misconstrued

Modeling of the exterior steel framing

Hulsey et al claim on page 2:

> „During our nonlinear connection study (Section 2.1.3.2), we discovered that NIST overestimated the rigidity of the outside frame by not modeling its connections, essentially treating the exterior steel framing as thermally fixed, which caused all thermally-induced floor expansion to move away from the exterior. The exterior steel framing was actually flexible, while the stiffest area resistant to thermal movements, i.e., the point of zero thermal movement, was near the elevator shafts.“

It is unclear why Hulsey et al claim here that NIST did not model the outside frame connections. In Section 2.1.3.2 (page 28), they describe it correctly:

„In the NIST investigation, the failure of the floor-framing connections and the shear studs was modeled with break elements on Floors 8 to 14. Outside the selected area in Figure 2.4 shown below, structural damage — such as buckling of the steel frame and crushing and cracking of the concrete slab — was modeled over the entire floor, but connection failures were not modeled over the entire floor.“

Correct: NIST did not model connection **failures** outside a defined are. Notice: Connection *failures* are a thing quite different from *connections*. One can model connections as stiff or flexible, but without a break element; or with a break element. NIST described where they included break elements, and where they did not. The next sentence then (page 29) is wrong:

„Connections were also not modeled in the exterior moment frame, as no failures were observed there prior to the onset of global collapse (NIST, 2008, NCSTAR 1A).“

First of all, the reference is wrong: NCSTAR 1A does not go into any detail about which connections have break elements and which don‘t. You find this actually in NCSTAR 1-9, page 475f (Section 11.2.5 Modeling Connections). Here is NIST‘s actual wording:

„The floor area where failure of floor framing connections and shear studs was modeled with break elements on Floors 8 to 14 is shown in Figure 11–9. This area is east of the north-south line passing through Column 76 and the core area east of Column 73.

Outside the selected area, structural damage–such as buckling of the steel frame and crushing and cracking of the concrete slab–was modeled over the entire floor, but connection failures were not modeled. The extent of the area with detailed connection models was based on the results of single floor fire simulations, where connection damage west of Columns 73 through 76 were not found to contribute to an initial failure event on the east side of the structure. The area where break elements were modeled was selected to reduce the model size without biasing the results for simulating the initial failure event.

Framing connections outside of the selected area, or on other floors not subjected to fire, were modeled as either fixed or pinned, using typical modeling approaches. Connections were not modeled in the exterior moment frame, as no failures were observed there prior to the onset of global collapse. Column splices were also not modeled for interior columns, as the purpose of the ANSYS model was to accumulate local failures up to the point of buckling in a column. When column buckling appeared to be imminent, the analyses were continued in the LS-DYNA 47 story model.“

Read in context, it seems likely that there is a slight error in this text: „*Connections were not modeled in the exterior moment frame, as no failures were observed there prior to the onset of global collapse.*“ This should probably read „Connection **failures** were not modeled in the exterior frame …“, for the sentence goes on to talk about the absence of failures. An inquiry with NIST could have cleared this up.

Hulsey et al misunderstand how NIST modeled connections in their next paragraph (page 29):

„First, by not modeling connections in the outside frame, NIST overestimated the rigidity of the outside frame. That assumption and inconsistent modeling for the framing connections resulted in the stiffness of the east side of the building being different than that of the west side. This resulted in the stiffness being compromised across the plan of the building.“

The first sentence *might* be correct *if* I am wrong about NIST mistyping. However, the rest of the paragraph is mostly wrong: NIST did not model connections in the west fundamentally different, or just stiffer, than in the east: The only significant difference is that the connections in the east had break elements, meaning that they could possibly fail (and thus lose their stiffness). It was determined in a preliminary „*single floor fire simulations, [that] connection damage west of Columns 73 through 76 [would not] contribute to an initial failure event on the east side of the structure*“. It‘s a matter of engineering judgment whether or not it‘s significant if some connections at a distance from columns 79 to 81 had failed or not.

Conflating ANSYS and LS-DYNA models

In the next paragraph (page 29), Hulsey go too far in conflating the ANSYS (NCSTAR 1-9 Chapter 11) and LS-DYNA (NCSTAR 1-9 Chapter 12) models:

> „The NIST simulation of the collapse illustrated that the west side of the building acted differently from the east side. The structural response to failure would more closely resemble the actual collapse if the connections had been accounted for throughout the structural frame. By not modeling the connection failures outside the selected area shown in Figure 2.4 above, NIST appears to have reduced the stiffness in the area outside the selected area and separated its progressive collapse simulation into two parts (see Figure 2.5).“

Figure 2.5 juxtaposes two different models:

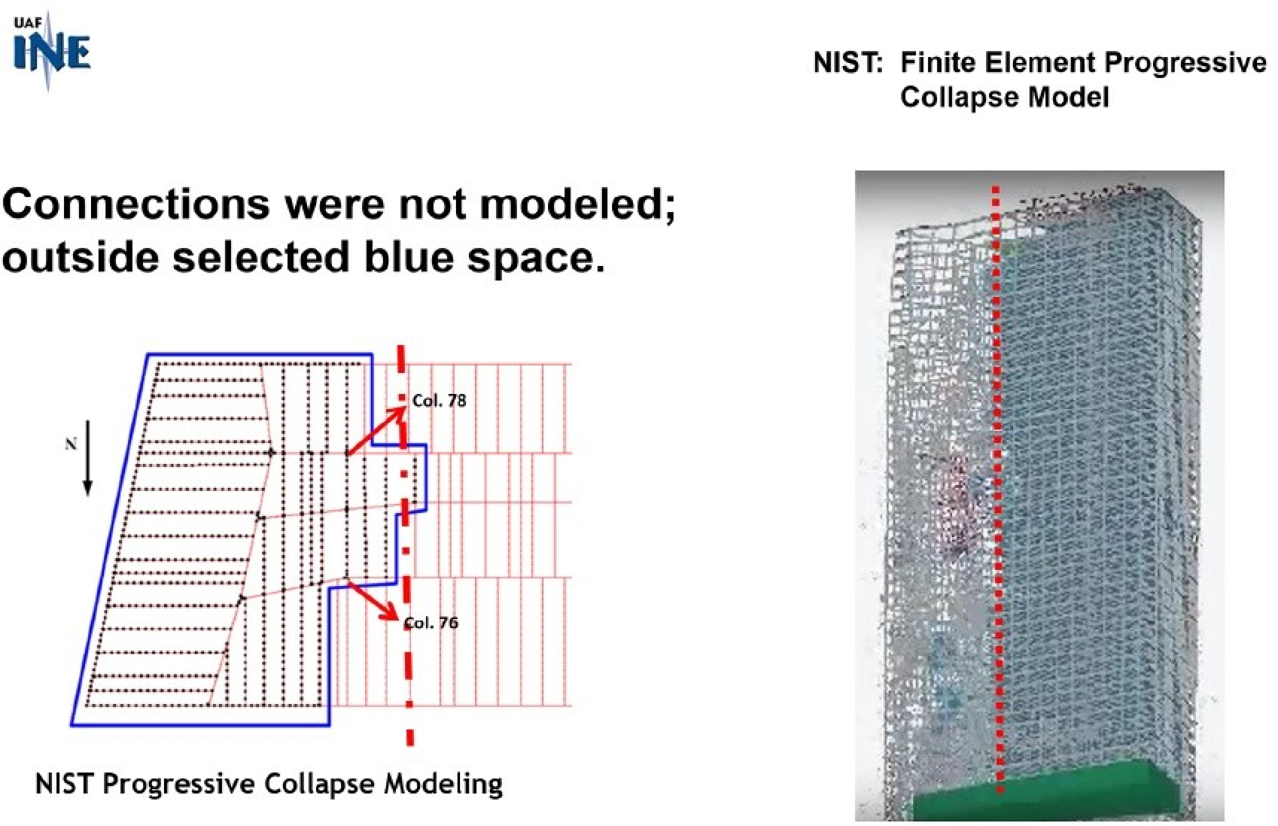

Figure 2.5 Progressive collapse separated into two parts.

The floor connections east and west are modeled differently only in the ANSYS model (left), not in the LS-DYNA model (right)! It seems reasonable that, in the right image, the east art looks less stable because it is *already* collapsing! NIST concentrated on the east part of the building, and modeled it somewhat more sophisticatedly, because the real WTC7 was observed to collapse in its east part first. So the causation is that the ANSYS model has the blue area because that‘s what collapsed first (became unstable; lost stiffness) first, and not: The LS-DYNA model looks unstable in the east because of the blue area.

In addition: It may be true that some connections west of columns 76-78 would have been detected as failed had the ANSYS model included break elements there, and these failed connections would have been transferred to the LS-DYNA model as starting conditions, making the west core somewhat less stiff. However (NCSTAR 1-9 page 539, my emphasis):

> „The global LS-DYNA model had the following input data:
>
> • Extent of initial damage to the building due to debris impact from the collapse of WTC 1 (Chapter 5).
>
> • Mechanical properties of steel (Appendix E and NIST NCSTAR 1-3D) and concrete (NCSTAR NIST 1-6A) used in the construction of WTC 7.
>
> • **Temperature-dependent mechanical properties of steel** (Appendix E and NIST NCSTAR 1-3D).
>
> • **Temperatures of structural components and connections**, at the time when the ANSYS results were transferred to the LS-DYNA analysis (Chapter 10).
>
> • Fire-induced damage to floor beams, girders, and their connections from the 16 story ANSYS analysis (Chapter 11).“

and it was then run with the following loading sequence (page 563):

> „• First, gravity was applied slowly to the 47 floor structure over 4.5 s of elapsed simulation time to damp residual vibrations and eliminate dynamic response. The loads were applied smoothly with a sinusoidal load curve.
>
> • Then, the debris impact damage from the collapse of WTC 1 was applied to the structure instantaneously by removing damaged elements from the model that were no longer capable of bearing their loads. The structure was then allowed to damp residual vibrations for 2 s.
>
> • Next, **the structural temperatures were applied** smoothly with a sinusoidal curve and allowed to damp residual vibrations for 2 s.
>
> • Last, the fire-induced damage obtained from the 16 story ANSYS analysis, including damage to floor beams, girders, and connections, was applied instantaneously. The heated, damaged structure was then free to react.“

And this is interesting because (page 566):

> „the LS-DYNA model was able to predict damage due to the temperatures for a specific point in time and the subsequent dynamic progression of failures leading to the global collapse of WTC 7.“

So in short: The LS-DYNA model, being fed with the „Case B at 4 h“ structural temperatures throughout the entire floors 7 to 14, was able to model the connection damages that arose from those temperatures at that time and proceed from there. It is not true that this model had to do entirely without fire damage west of the blue area.

Short and assorted remarks

References

Hulsey et al should give more specific references: Quote the works of others wherever possible, instead of paraphrasing; provide page numbers etc.

The References (page 113) should conform to usual standards, to include full authors, correct and full titles, publishers, URLs where applicable, etc.

Excise irrelevant sections

Example: Pages 11 and 12 contain mostly speculation, the relevance of most of it remains unexplained. Why is hot corrosion in the debris pile an „anomaly“? Why is a brief episode of some part of a collapsing structure exhibiting freefall acceleration an „anomaly“? The statement „The debris pile of WTC 7 was contained mostly inside the building’s footprint“ is nearly meaningless: What does „mostly“ mean? Why would a collapsing building not fall „mostly“ into its footprint? Why is that an „anomaly“? Besides, WTC7 surely did not drop into its footprint at all, according to the way demolitions experts use the term (i.e. stay clear of adjacent infrastructure and other buildings): Its debris blocked streets all around and caused major damage to at least two other buildings across two different streets (the Verizon building, which had WTC7 exterior frame steel sticking out of its face; and Fiterman Hall, which was hit, on its roof even, by WTC7 debris so badly it had to be deconstructed eventually).

Example: The unreferenced speculation on page 22 that *„financial centers*“ would not *„have paper lying around*“.

Invalid linear static analysis results

Figures 4.14 and 4.15 show *„Visualization[s] of linear static analysis*“ of the building in states where it clearly has not been static anymore for quite some time – this type of analysis is no longer valid at this point.

Unrealistic dynamic analysis results

Figures 4.16 and 4.20 show „Dynamic analys[e]s results showing the building tipping…“, where it is obvious that the simulation does not apply relevant and necessary physics – the floors are passing through each other without any apparent interaction, no connection failures, no bending of anything. This is clearly unrealistic. Something went very wrong here.

I expect that other submitters will say more on these issues.

Principal conclusion refuted

Hulsey et al, page 1f:

> „**Fire Did Not Cause the Collapse of WTC 7**
>
> The principal conclusion of our study is that fire did not cause the collapse of WTC 7 on 9/11, contrary to the conclusions of NIST and private engineering firms that studied the collapse.
>
> This conclusion is based upon a number of findings from our different analyses. Together, they show that fires could not have caused weakening or displacement of structural members capable of initiating any of the hypothetical local failures alleged to have triggered the total collapse of the building, nor could any local failures, even if they had occurred, have triggered a sequence of failures that would have resulted in the observed total collapse.“

This is based, in essence on two approaches:

1. Proving NIST, Arup and Weidlinger wrong
2. Not finding an initial damage pattern that results in a simulation collapse that closely resembles the observed real collapse

Both approaches are invalid:

1. One can‘t prove a global negative („All possible combinations of fire initiation and building conditions could not have resulted in this collapse“) by disproving only a small subset of the possible scenarios – even assuming Hulsey had done enough to disprove the other studies. Which they have not
2. Not finding a solution does not imply that there exists none – unless one can rigorously prove ti have searched the entire solution space. Which Hulsey et al have not.

As a consequence, the study failed to prove its principal finding.