Showing that the South Tower of World Trade Center Collapsed from Forces More Powerful than Gravitation

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Abstract

There is a straightforward yet very powerful application of Newton's principles of motion. It is one of direct application to the debate on 9/11 issues, and helps one grasp important scientific facts in that debate. That application is showing that the forces that ripped the South Tower of the World Trade Center in the United States apart were about an order of magnitude larger than the force of gravity. The application could be presented in any discussion of mechanics from Newton's principles of motion.

1 Introduction

Nothing can be accepted as certain in science, and viable theories have to be continually tested for many years before they can begin to be accepted as principles. There are no "proofs" of a scientific theory like those in mathematics, in which the topic material is often taught through a theorem-proof procedure. The closest thing to a proof in physics is the establishment from observations of what cannot explain a phenomenon – what the philosopher Karl Popper calls a "falsification".[Bartley, 1964]

The current debate about what brought the buildings of the World Trade Center (WTC) down on September 11, 2001 is certainly not settled, particularly among citizens of this United States, but also around the world. It often seems difficult to extract what is scientifically correct and what is not. However, there are facts that anyone can establish and verify scientifically, and it is amazing how some of these lead to conclusions that cut across this debate.

The case that will be examined in this article is that of the collapse of the South Tower in the WTC (analyzed previously by Grabbe [2008a; 2009]). On that fateful day this Tower was the hit by a plane after the North Tower had similarly been struck, and it was hit to one side on floors 78 through 83, but it was the first Tower in the WTC to collapse, and did so 56 minutes after the plane collision. Some observations of the early part of that collapse are discussed in the next section, and the physics is analyzed in the section after that.

2 Observations of the Initial South Tower Collapse

What did the collapse look like? Figure 1 shows both Towers just before the South Tower collapses, in which an observer would begin to notice changes just below the fire zone. The South Tower is on the left-hand side, and in Figure 2 we see kinetic material streams being ejected horizontally from the tower in an eastern direction at high speeds. They appear to be coming through the walls, and an obvious physics question is: where did all the momentum come from in that horizontal direction. Momentum is conserved, and there clearly is substantial momentum in those streams, so where did it originate?[Grabbe, 2008b] That was never answered in the Final Report of the Collapse of the World Trade Center Towers the National Institute of Standards & Technology, which only studied the plane collisions and resulting fires, concluding they brought the Tower down.[NIST, 2005]

Figure 3 shows that Tower 0.75 seconds later. Now you can see that the top of the Tower is leaning by about 9°, and it began this leaning in Figure 2 with energetic streams coming out the east side. The white clouds formed by the material streams are growing larger, and gray clouds are starting to come out above them. Now compare Figure 3 to Figure 4, which is 0.75 s later. In Figure 4 the top segment of the Tower has been wrested from the lower segment by sudden forces pulling the 2 apart right at the base of the top segment. For reference, the Towers are 64 m wide, and the top segment has been separated from the bottom segment about 12 m to the right and into the page. Notice also the suddenly shooting out of new white horizontal streams in the easterly direction at this time, including one stream that is travelling nearly 144 km/hr (40 m/s).

In Figure 5, 0.25 s later, the top segment has moved further at its base, and the top of the top segment has gone down further in height (about 15 m). In the 0.75 s between Figure 3 and Figure 5, the base of the top segment has moved about 21 m with respect to the bottom segment.

3 Analyzing the Physics in the Initial Collapse

The physics of the movement of the top segment with respect to the bottom segment can be expressed as a result of a total force $\mathbf{F_T}$ made up of a powerful breakup force $\mathbf{F_b}$ that breaks up the 2 segments of the Tower, and a shifting force $\mathbf{F_s}$ that moves the top segment with respect to the bottom segment:

$$\mathbf{F_T} = \mathbf{F_b} + \mathbf{F_s} \tag{1}$$

While $\mathbf{F_b}$ required to break the components of the building apart is unknown, $\mathbf{F_s}$ can be determined from the acceleration required to rapidly move the top segment to the

Figure 1: South tower (on the left-hand side) 56 minutes after a jet collides with floors 78 through 83.[NBC, 2001] A subtle whitening of the floor just below and at the bottom of the fire zone gives a clue of something about to happen in this distant view of the towers.

Figure 2: Towers 1.5 s later, in which the South Tower now shows substantial rapidly-moving horizontal material travelling roughly 40 mph outside of the 77th floor from which they were ejected, which was 2 floors below the lowest floor on fire.[NBC, 2001] Note the sudden leaning of the top of the South Tower at about 9°, which shows no evidence of being produced by the fire. This and a subsequent horizontal ejection at floors just below this of rapidly-moving white material form the white clouds that continually develop, while the top smoke-filled segment has just started collapsing, producing the gray clouds on the right-hand side of it.

Figure 3: South tower 0.75 s after Figure 2 in which gray clouds coming from the lower part of the top segment have quickly grown to a large size, at the same time at which the top of the top segment has moved down in height. The bottom segment has not moved, but the top segment is disintegrating near its bottom. [NBC, 2001]

Figure 4: Photo 0.75 s after Figure 3, in which a new set of building material have ejected out horizontally on at least 2 different floors.[NBC, 2001] With those ejections the top tower at its very base moved substantially to the right and into the page, which indicate a significant forces have separated the 2 segments and moved the top one. The top of the top segment has also moved down in altitude from Figure 3, indicating further disintegration into the gray clouds near its bottom, which have grown substantially.

Figure 5: Photo 0.25 s after Figure 4, in which the top segment has moved further at its base with respect to the bottom (a total of about 21 m), and in which the top of the top segment has moved down in altitude over 15 m more. [NBC, 2001] The latter indicates further disintegration of the segment into the gray clouds near the bottom, which have grown substantially in size.

right once the breakup is complete:

$$\mathbf{F_s} = m_t \mathbf{a_t} \tag{2}$$

where m_t and $\mathbf{a_t}$ are the mass and acceleration of the moving base of that top segment to the right. Although $\mathbf{a_t}$ has a small variation in time t over the 0.75 s top segment movement, for simplicity we are going to replace it by a time-averaged value $\mathbf{a_{ta}}$ through the time.

Now the distance s moved by the base of that top segment in the short time t between the figures is easily integrated:

$$s(t) = v_o t + a_{ta} t^2/2 \tag{3}$$

where v_o is the initial velocity, and the acceleration $a_{ta} = |\mathbf{a_{ta}}|$ is taken to be an average over the short time t. Examining Figure 3 shows that $v_o = 0$ (the 2 segments are still intact initially). The estimates of movements between figures can be used to estimate the average acceleration for those short intervals:
Between Figures 3 and 4 the distance $s_1 \approx 12$ m and $t_1 = 0.75$ s, so $a_{ta} \approx 43$ m/s^2.
Between Figures 3 and 5 the distance $s_2 \approx 21$ m and $t_1 = 1.0$ s, so $a_{ta} \approx 42$ m/s^2.
Comparing the magnitude resulting shift force $|\mathbf{F_s}|$ to that of the force of gravity $\mathbf{F_g} = m_t \mathbf{g}$ yields for both cases:

$$|\mathbf{F_s}|/|\mathbf{F_g}| = a_{ta}/g \approx 4.4 \tag{4}$$

where $g = |\mathbf{g}| = 9.8$ m/s^2 is the gravitational acceleration. Thus the shift force is over 4 times as large as the force of gravity, whereas the breakup force is as large if not larger (likely considerably so) than than the shift force. That is because breaking two segments of the Tower apart should be harder than moving the top one once they are broken. Thus Eq 4 leads to an **inescapable conclusion**. *At a minimum* $\mathbf{F_T}$ *is an order of magnitude larger than the force of gravity, and it may well be larger depending on how large the force* $\mathbf{F_b}$ *needed to break the 2 segments of the building apart is.*

What this force that was much stronger than gravity actually is has not been answered by the United States government studies on the 9/11 disaster, which conclude gravity brought the Towers down after substantial destruction by fires.[NIST, 2005] Figures 2 shows major kinetic energy driving those rapid streams of material horizontally through the wall, and Figure 4 shows second major energy set similarly driving rapids streams of material horizontally, as well as breaking up the Tower in a general horizontal direction. In addition, this horizontal force are not the only unusual force in the collapse.

Figures 2-5 show another unusual force – that causing the top of the South Tower to descend rapidly. In the 0.75 s between Figures 2 and 3, the top has fallen about

15 m, while in the 0.75 s between Figures 3 and 4 it has fallen about another 20 m. If gravity was bringing it down with force gt, the most it could fall in 0.75 s is 3 m, and in the full 1.5 s is 11 m. Thus it is falling several times faster than gravity can bring it down, and there has to be *a separate vertical force much larger than the force of gravity.* This further adds to the conclusion that $\mathbf{F_T}$ is an order of magnitude larger than the force of gravity.

The sets of energy producing both the vertical and horizontal force components must come from a large source because of conservation of energy.[Grabbe, 2008b] These sets of energy likely have to have been produced by chemical explosives, as they are well too large to be gravitational (and clearly not nuclear). Evidence from multiple independent samples of WTC dust has been analyzed recently, and all samples show the presence of nano-thermitic material used in such explosives in the WTC dust, still chemically active after 7 years since 9/11.[Harrit et al, 2009] This most likely what produced these forces.

It is very clear conclusion that much larger forces were responsible for bringing the South Tower down than the force of gravity, so it could not have collapsed from fires. Furthermore, that fact can be can be directly shown using Newton's laws of motion – physics principles that have been continually verified for 500 years. This straighforward derivation is the closest thing to a "proof" in science. It should be presented in college and university seminars and physics classes to educate everyone about what has been up till now the worst disaster and attack in the United States in the 21st Century.

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