Direct Evidence for Explosions: Flying Projectiles and Widespread Impact Damage

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Claims have been made that there is no direct proof that explosions occurred in the World Trade Center on September 11, 2001, but there are in fact visible photographs of collapse results that provide that proof. One such photograph posted in late 2005 is shown in Figure 1, which shows the rapidly expanding cloud of the North Tower that directly exhibits explosions shattering material with hundreds of pieces of metal cladding and beams flying in the air at the edge of the dust cloud. However, there is also a whole set of photographs posted on the web which can be shown through physics calculations to graphically exhibit the direct effects of explosions in the World Trade Center towers, yet these facts have not been previously investigated.

Figure 1. Explosive dust cloud from the North Tower, which clearly shows large metal pieces like cladding and beams in the air. (After Jim Hoffman in [1].)

Photographs for the case that I claim clearly provide proof that multiple explosions occurred, but have never been presented as such, are shown in Figures 2 and 3. The figures show cases of unmistakable evidence of damage from the World Trade Center collapses. These are just 2 examples of many cars that were pelted and devastated by such material from the collapsing World Trade Center buildings. Photos of many of these cars were posted by Prof. Judy Wood, who claims that they show damage from directed-energy laser-beam weapons. The laser-beam proposal was strongly challenged recently, although without proposing alternative models. Neither described the cause examined here. [2,3]

Figure 2. Vehicle damaged by World Trade Center explosions. (From [2].) Note that the uneven bending and twisting of metal, shattered windows, and swath of surface damage over a large area of metal. This combination of damage strongly suggests it was hit with force by a wide stream of debris which was apparently hot and possibly corrosive to the metal. This car was located on FDR Drive, and (reference [4]) was evidently towed to that location.

Figure 3. Vehicle damaged by World Trade Center explosions posted in reference [2]. The material caked on the exterior as well present inside the car apparently came from debris material streaming at high-speeds, shattering the windows. The seat has some projectile material on it, but was largely undamaged, probably because the car metal shielded it from any direct hit. The vehicle does not exhibit fire or heat damage.

The video frame in Figure 4 of the World Trade Center North Tower taken by KTLA channel 5 news shows a "squib" -- a line of ejecting material from the tower -- right before it collapsed. Such squib ejections are driven by massive overpressure inside the building relative to the atmospheric pressure outside, and that overpressure is created by explosions. A number of squibs were observed coming from all 3 of Buildings 1, 2, and 7 a short second or 2 after each one started to collapse, and there are several websites that show photograph of them on all 3 buildings. The one displayed as Figure 4 shows ejecting material (bits of material large enough to have little air resistance) streaming out of the North Tower, which has traveled a distance from the tower in the horizontal direction, whereas the distance it has descended in the vertical direction because of gravitation pull is small.

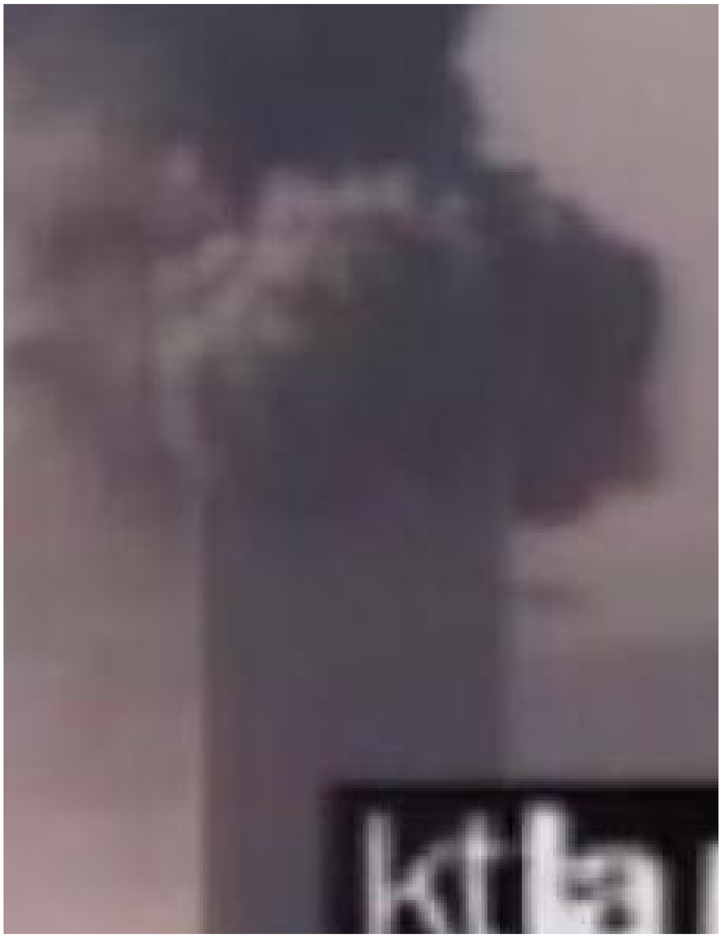

Figure 4. Photograph from a video of the North Tower collapse by KTLA channel 5 news, which shows a streaming squib that has traveled out over 70 feet from the tower with very little descent [5].

Note the quantitative information that can be gathered from the ejection photograph in Figure 4. We can estimate that, at the front end, the ejecting plume has apparently fallen no more than roughly 3 feet (an estimate that might have up to a factor of 2 in error), whereas the horizontal distance of the front from building is about 1/3 the width of the North Tower, or about 70 feet. If we neglect air friction resistance over the length of the streamer, from fall distance $s=0.5gt^2$, where $g=32$ feet/sec^2 is the gravitational acceleration, we estimate 0.43 sec as the time since the front end first ejected from the building. That means that material in that squib is traveling horizontally at roughly 163 feet/sec, which means the squibs are effectively "bullets" of bits of material produced by the explosions. Since the distance fallen is quite small there may be a fairly large uncertainly in its estimate. Allowing for an error of up to a factor of 2 in the measurement of the fall distance s, the velocity could be down to 41% lower or up to 30% higher, so it could range from 100 feet/s to over 200 feet/s.

The mechanics of the motion can be examined to determine where the debris in the ejection plume hits the ground. At such high velocities air resistance can actually be an important factor in that distance, so it is incumbent on us to examine the mechanical equations of the

squib ejections like Figure 4 with those terms included. Thus in the ejection the downward acceleration is given by:

(1) $a = dv/dt = g - \alpha v^2$.

where the Rayleigh drag coefficient for objects at high velocity v is:

(2) $\alpha = \rho AC_d/2m$

where ρ is the air density = 1.293 kg/m^3 at 1 atmosphere pressure and 0^o C, A is the area at the front of the moving material in the plume, m the material's mass, and C_d is a dimensionless drag coefficient. C_d can be 0.25 for sleek automobiles, and will taken as 0.5 in our calculations. Note that this can be rewritten in terms of the ratio of air density to the density of the ejected material by designating l as the typical length of the ejected projectile, as:

(3) $\alpha = (\rho_{air}/\rho_{eject})\ C_d/2ml$

A table below summarizes some typical values of α for various material parameters.

Table: Values of α for selected material parameters

material	α	l
cement, glass	0.001	5 in
	0.003	1.5 in
	0.01	0.5 in
steel	0.001	1.7 in
	0.003	0.6 in
	0.01	0.2 in

Solving (1) for v(t) by separation of variables yields the downward velocity v_d and downward distance y:

(4) $v_d(t) = (g/\alpha)^{1/2} \tanh [(g\alpha)^{1/2} t]$

(5) $y(t) = (1/\alpha) \ln \cosh [(g\alpha)^{1/2} t]$

So where does this squib material hit the ground? If we take y to be the height of the ejection, we can solve the last equation for t, the time the material remains in the air. Multiply that t by the horizontal velocity v_h of the squib material, and we have the horizontal distance x it travels. The equation of motion for the horizontal movement of the material is:

(6) $a = dv/dt = - \alpha v^2$

which solves by separation of variables, yielding:

(7) $v_h(t) = v_o/(1 + \alpha\, v_o t)$

(8) $x(t) = (1/\alpha) \ln (1 + \alpha\, v_o t)$

where v_o is the velocity of initial ejection from the tower. Taking t to be the time the material remains in the air from (5) (solving for t after setting y=h) gives x(t) = xhit, the distance the material travels away from the tower. Graphs of that distance xhit versus the α for the material are shown in Figures 5 and 6 for ejections from about 1304 feet (400 meters) and 489 feet (150 m).

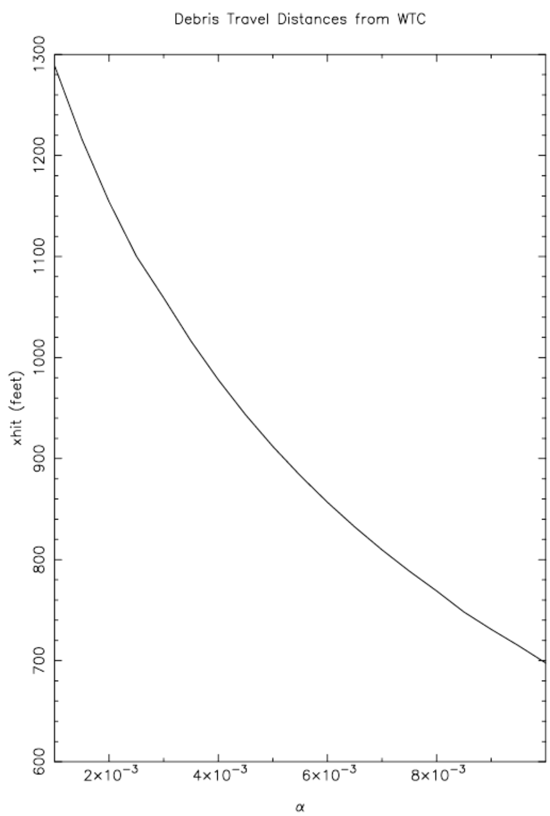

Figure 5. Graph of the horizontal distance the squib material travels from the center (xhit) as a function of the air resistivity α , assuming it hits no invervening object (e.g. another building) before hitting at the ground level. The height of the squib origin in the tower is taken as 1304 feet (400 m, a feasible height for the North Tower).

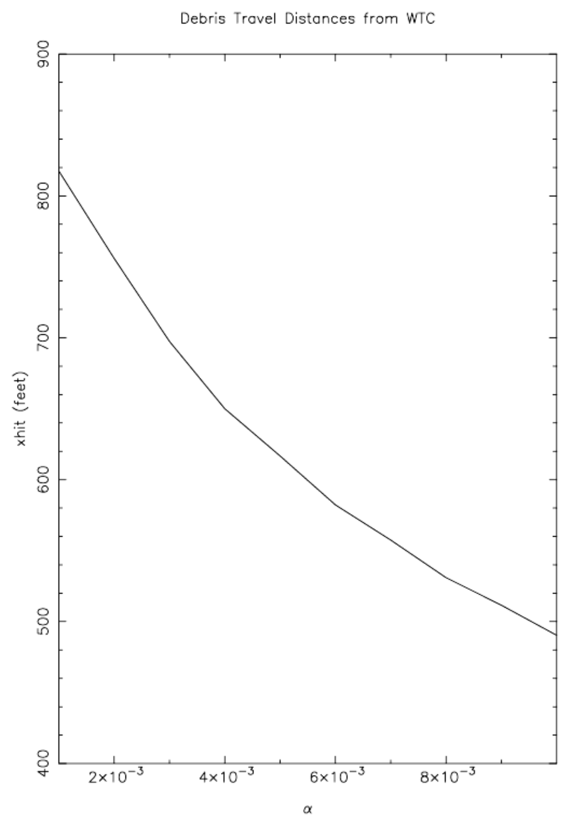

Figure 6. Graph of the distance the squib travels from the center (xhit) versus of the air resistivity α of the squib.
The height of the squib origin in the tower is taken as 489 feet (150 m, a feasible height on WTC7).

Figures 5 and 6 show these high-speed squibs shot out material up to 1/4 mile or more from the towers. This ejection distance xhit is not all that sensitive to the height of origin: raising or lowering the ejection height by over 800 feet changes xhit by less than 500 feet for the low resistivity side, and just over 200 feet on the high resistivity side. Similarly, I found that

lowering the ejection velocity v_o by 25% lowers xhit by around 200 feet on the low resistivity side, and less than 100 feet on the high resistivity side. The debris material would clearly be spread over a substantial area (40 acres or more) depending its ejection velocity, its content, and how fine it was broken up when it was ejected, since several such squibs in all directions were observed. Furthermore, it is likely that explosions are also occurring after the growing dust cloud envelopes the area (e.g., higher up on the North Tower in Fig. 4), so squibs producing all of that ejected material would not have been observed. This high speed material would likely damage whatever it hit on the ground, if it did not hit and damage a building before reaching the ground level. Figures 2 and 3 show examples of such damage when it hit vehicles at the ground level.

Reference [2] reports that around 1400 cars were seriously damaged like those in Figures 2 and 3. Some of the damage was because of fires started by ejections from the towers, since a number of cars were not in direct line of fire of the towers, but many were also hit at high speeds with debris. Clearly multiple explosions would be necessary to produce this damage. The damage is not likely be produced by laser directed-energy beam weapons as Judy Wood and Morgan Reynolds theorize, since the nature of destruction in that case clearly would be different: there would be evidence of melting of metal, likely burning into or through the metal, and burning of tires, but there would not be most of the surface impacts and bending and twisting of metal observed. If the tire in Figure 2 was burned off by a laser there would likely also be evidence of laser damage to the rim. Laser damage is quite inconsistent with that of the vehicle in Figure 3, which exhibits shattered windows with no melting or burning on the exterior surface or the inside seat, and corroded material in the rear.

The damage to these vehicles was most likely from being hit by a large swath of small high-speed objects of material that may have been hot and/or somewhat corrosive in nature. Many damaged vehicles, such as the one in Figure 2, show evidence of being scorched or burned by inflamed material, and both Figures 2 and 3 show possible corrosion. The windows in both vehicles were shattered, just like they were in many vehicles and in nearby buildings. It should also be noted that, similar to Figure 2, many of the vehicles clearly show damage primarily on one side or on part of the vehicle. Furthermore, photos also show shattered windows and other directed-damage in buildings for some distance from the base of the towers. This is good evidence of that the nearby vehicles and buildings were hit by "directed-energy weapons" from the tower. However, that directed energy came from the material shot out from the tower at high velocity because of explosions, rather than postulated sources like laser-beam weapons. The shattered windows and apparent impact damage in both cases provide strong evidence of being hit by material from explosives.

In summary, a number of photographs show the destructive impacts of explosions on many vehicles, such as those of Figure 2 and 3, as well as on a several nearby buildings in the vicinity of the towers. Calculations using a range of estimates from observations show the destruction from these explosions range up to 1/4 mile or more in most directions. These strongly enhance the evidence presented in previous studies, such the photo in Figure 1 which shows the rapidly expanding huge dust clouds from the towers resulting from

massive pulverization of the non-metallic parts of the towers in mid-air, along with hundreds of pieces of metal cladding and beams flying through the air on their rim. All of them provide dramatic examples of the devastation of the explosions in the World Trade Center towers 6 years ago.

References

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5. First photograph in 9-11 Research, "Squibs" posted at http://911research.wtc7.net/wtc/analysis/collapses/squibs.html