The Overwhelming Implausibility of Using Directed Energy Beams to Demolish the World Trade Center Towers

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> *"In fact, the whole interview with Greg Jenkins was very troublesome to me because it was so clear that he was seeking to put words in Judy's mouth and demand an exactitude of answers that she was going to be unable to provide which he knew going in.",* [44] *Dr. James Fetzer during the Dynamic Duo radio broadcast on 02/06/07 regarding an interview conducted at the National Press Club on 01/10/07*
> *(http://video.google.com/videoplay?docid=-5580962406694803017)*

As Dr. James Fetzer suggests, Dr. Judy Wood may be unable to provide answers to basic questions regarding her own speculative hypothesis. However, this paper does quantitatively analyze those issues raised during the interview as well as address other evidence advanced by Dr. Judy Wood and others that the WTC towers may have been destroyed by directed energy weapons. The following arguments will prove that the degree of implausibility places the hypothesis squarely in the realm of the impossible.

Dr. Wood's hypothesis is predominantly based upon the premise that large amounts of debris were 'missing' from the post-collapse rubble. A detailed analysis clearly demonstrates that all the debris is accounted for if sublevel collapses are considered. This paper addresses the massive energy requirements, issues involving the use of directed energy weapons, and misinterpreted phenomena used to support the thesis such as the Richter scale measurements, Bathtub damage, holes in adjacent buildings, charred cars, etc.

Part 1: What Missing Debris?

Analysis of the Debris

Skyscrapers are designed to be mostly empty space by volume. To illustrate this point, if all the steel in the upper 110 floors of a WTC tower were hypothetically melted down into its own footprint, the resulting slab would only be about seven feet high.[1] A direct measurement of the total mass of steel after collapse would be ideal to show whether any debris is 'missing' via a comparison to the known total mass before collapse. Without this direct data, it is possible to estimate the amount of steel after collapse by utilizing what is known as scaling arguments. By measuring the volumetric compression associated with a collapse of a similar skyscraper, it is possible to make an estimate regarding the volumetric compression associated with the WTC towers.

There are possible risks associated with this type of analysis. First, the buildings would be designed differently as the WTC towers were not conventional steel-framed buildings, rather they were a unique design that incorporated 47 core columns and 236 perimeter columns.[17] However, the support structure was composed of structural steel. Second, there is no collapsed building of comparable size. The nearest comparison is with WTC 7 which had approximately 1/5th the potential energy of WTC 7.[19] We might expect the Towers to produce more deformation of the steel beams and possibly more compaction of the debris due to the larger collision energies involved.

Dr. Wood uses a similar scaling argument which is fraught with error. In her analysis published on her website[2], she attempts to compare the volume of the Kingdome in Seattle before and after collapse. Since the Kingdome is a sports stadium, the empty space by volume obviously cannot be directly compared to a skyscraper. Furthermore, her estimates of the before and after collapse volume are misguided. The initial collapse height was taken at the approximate center of mass of the building which does not correlate to the initial volume of the building in any fundamental manner. The after-collapse height was taken only at the rim of the stadium, which again is a poor estimate of the average after-collapse height. Also, the rim was primarily structural concrete. The amount of concrete in structural concrete buildings occupies a large volume compared to the steel in steel-framed buildings, a testament to the strength of steel compared to concrete. Dr. Wood used this flawed analysis to support the claim that massive amounts of debris appear to be missing from the WTC tower collapse site. She offers no analytical measurement of the debris present after the WTC tower collapse. Instead, she vaguely and non-quantitatively refers to pictures where it is speculatively assumed to be self-evident.

Instead of using the Kingdome, we will use WTC 7. This is a more suitable structure, as suggested above, being a steel-framed skyscraper. The before-collapse height of WTC 7 was 610 feet[14]. The initial volume of WTC 7 was 610 "*ft x footprint*" where the unit '*footprint*' is the cross-sectional area of building 7. The after-collapse volume I estimated to be 70 ± 10 *ft x footprint*.[15] Taking the ratio yields a volumetric compression given by:

$$\frac{70 \pm 10\,ft \cdot footprnt}{610\,ft \cdot footprnt} = 11.5 \pm 1.6\%\,.$$

Most of the debris from all the collapsed buildings in the WTC complex, excluding Building 7, collapsed within the sublevels (see reference 13 for the analysis details). I estimated the initial volume of all the collapsed and partially collapsed buildings (WTC 1, 2, 3, 4, & 6). I then estimated the volume associated with sublevel collapses. If all the building debris were compacted into the damaged sublevels, then this would yield a volumetric compression ratio of 10.2%. This is within the error of the compression ratio for WTC 7, $11.5 \pm 1.6\%$. ***This means that, within error, all of the debris in the WTC complex can be accounted for within the sublevel collapses***. If 14% of the debris resided on the surface either in piles or scattered about, then the volumetric compression ratio would exactly match that of WTC 7, 11.5%. This clearly shows that all the debris can easily be accounted for if the sublevel collapses are included in the analysis.

Some proponents of the 'missing debris' hypothesis prefer to "count" the debris from photographs. This is an inherently reckless approach to the problem. Photographs

offer no way to directly view all the individual steel beams in debris piles or debris occupying sublevel collapses. For instance, any attempt to "count" the beams or "wall sections" in the debris pile of WTC 7 will fall short of accounting for the total mass of the building for the simple reason that the debris is located in a pile and all photographs only show the surface. That does not mean that the rubble pile does not contain the mass of the building. Even if the debris were spread out somewhat, the same problem applies when attempting to "count" the debris.

Potential Energy Versus Richter Scale Readings

Seismograph readings were used by Dr. Wood as evidence that much of the debris from the towers never hit the ground. She used an erroneous scaling argument in which the Richter scale reading measured from the collapse of the Kingdome is compared directly to the potential energy of the Kingdome. Based upon this analysis, she then scales the potential energy to obtain a hypothetical Richter scale reading. This hypothetical Richter scale reading is significantly larger than that actually measured from either WTC tower collapses. Her analysis is profoundly flawed as will be discussed in detail below.

As described in a paper by Furlong and Ross[22], the plane crash does not appear on the seismograph charts. Spikes in the chart occur up to 14 seconds too early for the North Tower, presumably from sub-basement explosions which are corroborated by 37 eyewitness testimonials. No spike occurs at the time of the plane impact. This implies weak coupling between the upper floors of the building to ground movement as measured by the Richter scale.

Furthermore, seismograph readings of the surface waves only measured about 6 seconds[23] of seismic activity compared to a 14 second collapse time as measured by video evidence.[30] The seismic duration time, 5-6 seconds, makes sense if the initial debris generated from the collapse fell at roughly free-fall speed which would take about 8 seconds before impacting the ground. The duration of debris impacting the ground can be calculated as $14 - 8 \sim 6$ seconds which is the time duration of measured seismic activity. This means that the vibrations coupled into the ground through the building during the initial 8 seconds of collapse caused no significant seismic activity. This shows that the energy released during the initial stages of the collapse was not coupled effectively into ground movement.

The energy associated with the measured surface waves (M_L, similar to a Richter scale reading) were directly compared to the approximate potential energy of the building:

> The gravitational potential energy associated with the collapse of each tower is at least 10^{11} J. The energy propagated as seismic waves for an M_L of 2.3 is about 10^6 to 10^7 J. Hence, only a very small portion of the potential energy was converted into seismic waves. Most of the energy went into deformation of buildings and the formation of rubble and dust. The perception of people in the vicinity of the collapses as reported in the media seems to be in full accord with the notion that ground shaking was not a major contributor to the collapse or damage to surrounding buildings. [23]

There are other reasons for the weak coupling of the potential energy of the building into ground movement other than those already mentioned. The most obvious is that the period (peak-to-peak time of wave) of the measured surface waves (Rayleigh waves, Rg) generated from the collapse was about 1 second, and the "seismic energy from the collapse was delivered over 5-6 seconds"[23] to four separate seismograph stations. Many separate pieces of debris were impacting the ground over a duration much longer than the period of the wave. This is a very inefficient way to generate a surface wave, and much of the kinetic energy impacting the ground cancelled the ground movement from other debris hitting the ground at a different time. This is analogous to pushing a child on a swing much faster than the natural period of the swing. Most of the energy will be wasted. .

By contrast, small earthquakes are generated over a relatively short time duration. This is analogous to giving the child on the swing one hard push.

To drive home the point that the potential energy of buildings cannot be directly compared to Richter scale readings, consider the following example. The M_L reported for the North Tower is 2.3. The M_L from the raw amplitude seismograph readings for WTC 7 is 1.0.[20] Even though the potential energy of the North Tower compared to WTC 7 was about 5 times larger,[19] the energy derived from the Richter scale measurements is 87 times larger. [20] To conclude from this that most of the debris from Building 7 never hit the ground would clearly be absurd.

It is therefore obviously not appropriate to attempt to compare the Richter scale readings of two such dissimilar buildings when the relatively similar buildings, WTC 7 and WTC 1, both steel skyscrapers, give such disparate readings.

Bathtub Damage

Another source of data that is cited by proponents of the 'missing debris' hypothesis relates to the non-catastrophic damage to the Bathtub, the ground zero region which was encircled by subterranean walls to hold back water from the Hudson River. No credible analysis or quantitative measurements have been offered by the proponents of the 'missing' debris hypothesis to support the claim that the Bathtub should have been catastrophically damaged.

The measured seismic activity explains why there was no catastrophic damage to the Bathtub:

> Earthquakes of M_L 2.3 are not known to cause any structural damage in buildings. In the eastern U.S. that threshold is believed to be close to or above M_L 4 to 4.5. [23]

From a paper by James Gourley, the Bathtub survived much more substantial seismic activity in the past:

> Additional credible data is available that indicates NYC is located in an active seismic zone. A search of the Advanced National Seismic System catalog of earthquakes from 1970 to 2005, inside an area between 38N and 43N Latitude, and between 71W and 76W Longitude (an area that runs from

just south of New Jersey north to the middle of New York state, and from just west of New Jersey east to Rhode Island) reveals that at least 21 earthquakes having a magnitude greater than 3.0 occurred in that area during those 34 years.[24]

Part 2: Analysis of a Hypothetical Method of Destruction: Directed Energy Weapons

The Associated Massive Energy Scale

It is a simple matter to calculate the amount of energy required to vaporize the steel in the upper 110 floors in one of the WTC towers.

$$E = (C_S \, \Delta T_1 + C_F + C_L \, \Delta T_2 + C_V) M = 5.7 \times 10^{14} \, J \qquad \text{(Equation 1)}$$

The terms in the equation relate to the energy required to raise the steel from room temperature to the melting point, change phase from solid to liquid, raise the temperature from the melting point to the boiling point, and change phase from liquid to gas, respectively.[3]

If you consider that this amount of energy, $5.7 \times 10^{14} \, J$, which is only 50% of the energy required to vaporize all the steel from both towers was pumped into the towers during the collapse time, approximately 10 seconds, then the power necessary to vaporize the steel would be 5.7×10^{13} Watts. This is over 5 times the total power output of the entire earth[26] including all carbon combustion, nuclear power, wind power, hydroelectric power, etc. This is with *no loss*.

If you take into account losses from scattering and absorption in the atmosphere, reflection by aluminum and steel in the building, and inefficiencies from storing this huge amount of energy and generating photons, then the power required swells to at least thousands of earths worth of power (see next section). The scenario becomes more bleak when considering beams of particles that have mass since the ionization energies required would add massive amounts of energy in conjunction with the aforementioned inefficiencies.

Most of the energy required to vaporize steel is contained in the term relating to the latent heat of vaporization, approximately 75% of the total energy calculated in Equation 1.[3] This is the amount of energy required to vaporize steel once it is already at the boiling point. Since this is the dominating factor in the energy scale, it can be thought of as the energy required to break all the bonds which hold the steel together. Any magical method which hypothetically could be used to 'dustify' (a word evidently invented by Dr. Wood) the steel would necessarily involve breaking the bonds holding it together. *In short, the energy required to 'dustify' steel, if such a thing were possible, would be about the same as the energy required to vaporize steel*.

Although I am currently unaware of any hypothesis which has been proposed by directed energy beam proponents to dissociate steel into pieces larger in size than atomized steel, I will nevertheless pre-empt the argument by addressing it. Structural steel is, like most non-amorphous solids, composed of 'grains' which are typically

between 1 and 100 microns in size.[43] The local chemical composition of the differing grains vary, and the structure of the local lattice within each grain may be misaligned with respect to other grains. The individual atomic bonding energies which exist between grains vary widely and are, on average, about the same as the bonding energies between atoms within grains. These facts rule out electromagnetic resonance as a method to dissociate steel along grain boundaries. The size, shape, mass, and exact chemical composition of each individual grain is very sensitive to the annealing and rolling process used in the steel manufacturing process. However, the large variance in grain size and shape which exists in structural steel would preclude using mechanical resonances (such as sonic waves) to dissociate steel along grain boundaries.

No matter what method is used to hypothetically dissociate the steel in the WTC towers, there should have been massive amounts of iron in the dust. USGS sampled the dust at many locations around the WTC site. The chemical analysis reveals only a 2% iron content on average.[31] Structural steel is composed of over 98% iron.[3]

In the upper 110 floors of the towers, steel composed about 80% of the building by weight compared to that of concrete.[27] If an appreciable amount of steel was dissociated, iron should have appeared in the dust in roughly the same percentage. Instead, it was only 2%, a reasonable number considering the iron content of the concrete aggregate and gypsum wall boards. [31]

There is no direct evidence that a significant amount of steel was vaporized or "dustified", only speculation which is left entirely unsupported by proponents of 'missing' debris. Currently available evidence directly contradicts the unsupported hypothesis.

Furthermore, photographic and video evidence does not support that significant amounts of debris moved upwards during either collapse of the World Trade Center towers. An example of such a picture used to support the claim is shown in the earlier letter publication[33] and highlighted in an interview of Dr. Judy Wood by the author.[34]

Analysis of All Known Energy Beams

There are only two types of directed energy beams: those that have mass (particle beams such as protons, ions, neutral atoms, or electrons) and those that do not have mass (photons). Particle beams can be ruled out based upon direct observation. In order for particle beams to strike the metal and concrete in the towers, the dust and smoke that existed before and during the collapse would necessarily have to be driven out of the way before striking any part of the building. A beam of particles with mass certainly could not penetrate the dust without 'pushing' it out of the way via collisions. Simply put, if visible light cannot penetrate the dust, then a particle beam most certainly would not. If a particle beam were impinging the towers from above, the large number of highly energetic particles required to vaporize the steel would collide with the smoke and dust, rapidly accelerating the dust and smoke in a downward direction. This would have appeared like a gigantic wind blowing from above. This was not observed. Displacing a large percentage of the pulverized concrete and building material before impacting the steel would have required much more energy. [11]

We are left with photon beams which include any part of the electromagnetic spectrum (microwaves, infrared, visible, x-rays, etc.). Visible light, which has a small

wavelength compared to the dust size, did not penetrate the smoke and dust as observed in photographs. There is a physical principle behind this phenomenon. If the wavelength of the photon is about the same size or smaller than the dust, then the photons, much like the particle beams, would necessarily collide and scatter imparting momentum to the dust. In order to avoid appreciable scattering from the dust, the wavelength would have to be roughly ten times the size of the dust in the air. A conservatively small estimate of the average size of the dust is $70\,\mu m$ [25] which means that the photon wavelength would necessarily be greater than about $700\,\mu m$ or equivalently, converting to frequency, [29] less than 430 GHz. Similarly, the size of the cross sectional area of the steel beams in the towers (as viewed from above) sets a lower limit on the frequency. That is, if the wavelength is larger than the cross sectional area of the steel beam, then more of the incident photons would necessarily scatter off the steel beam merely due to the geometry. If we consider the outer steel beams, for instance, they were about 1 ft^2 in cross section,[35] resulting in a lower bound of about 1GHz. All metals, including steel, are highly reflective in the spectral range 1 to 430 GHz.

It is possible to calculate the reflection of mild carbon steel in this spectral range. Since we are in the low frequency limit (well below the electron relaxation time) and in the good metal limit (conductivity is high compared to the frequency times the imaginary part of the dielectric constant), we can calculate the fraction of photons which will be reflected by the steel. Using an undergraduate text book on electrodynamics,[4] the reflectivity is given by

$$R \cong 1 - \sqrt{(16\pi f \varepsilon_0 \rho_{Steel})} \qquad\qquad \text{(Equation 2)}$$

in 'mks' units. Substituting the dielectric constant of free space, $\varepsilon_0 = 8.85 \times 10^{-12}\,\dfrac{C^2}{N\,m^2}$,

the DC resistivity of mild carbon steel,[3a] $\rho_{Steel} \approx 2 \times 10^{-7}\,\Omega m$, and the appropriate frequencies, f=1 and f=430 GHz, yields a reflection coefficient of 0.9997 and 0.9938. The fraction of energy absorbed by the steel is 1-R which gives 3×10^{-4} and 6×10^{-3}, respectively.

What we have calculated are the losses from reflection alone which would be a factor of from 3400 (corresponding to 1 GHz) to 160 (corresponding to 430 GHz). Take special note of the fact that as the frequency decreases, the reflectivity of steel increases. This is important when hypothetically considering photons generated from the HAARP project. Also, the resistivity of aluminum is substantially less than steel resulting in higher reflective losses for aluminum.

The reflectivity of steel is highly significant. Well over 99% of the incoming photons would be reflected off the steel scattering into other objects at ground zero. People, who are made mostly of water, would readily absorb the scattered beam. Many people would have been vaporized, and others farther away from ground zero would have suffered severe burns. The tar in the streets would have melted. The stone façade in some of the surrounding buildings would have cracked and crumbled from the stress generated by the heat. The effects of large amounts of microwave energy randomly scattered about lower Manhattan would undoubtedly have been unambiguously observable in a variety of ways.

Other losses include generating, distributing, and storing the energy required to generate photons. For instance, the electric company loses about 50% of the total energy generated through the power lines alone.[28] Generators only operate at roughly 50% efficiency. An extremely conservative estimate of these types of losses is a factor of 4.

Water absorption in the atmosphere is another severe loss mechanism.[32] It is difficult to estimate these losses since water absorption occurs at discrete energies. However, this spectral range is plagued by many absorbing rotational energy states of H_2O. Since water in the atmosphere moves at relatively high velocities, these discrete absorption lines are significantly broadened by the Doppler effect.

Air turbulence causes another loss mechanism if the photon beam was to traverse hundreds of kilometers of atmosphere. Note that the above analysis assumes the entire photon beam is tightly focused onto the steel. Any photon beam which is either larger than the cross section of the target or misaligned would be another loss mechanism. For example, air turbulence causes fluctuations in the density of air resulting in fluctuations in the index of refraction which results in a poorly focused beam. This effect can be corrected with complex active optics, but with the huge powers involved to evaporate the steel in the towers, incorporating active reflectors is highly dubious.

Ignoring atmospheric water absorption as well as other loss mechanisms, and only considering the reflectivity of steel and a very conservative estimate of generated power losses, the minimal amount of energy required to vaporize the steel in one WTC tower in the spectral range 1 to 430 GHz is 13,500 and 650 earths of power, respectively.

There is another severe problem to consider. The collapse of both towers initiated on floors well below the roof. If we consider beams directed at the buildings from space, dozens of floors would necessarily be impervious to the directed energy beam. This is patently impossible with all known types of directed energy beams that fit our criteria.

Regarding this last point, a skeptic may complain that long wavelength (low frequency) photons, such as radio waves, are able to penetrate the building without a problem. This may be true. However, the lower the frequency, the higher the reflectivity of steel will be. Larger losses from reflection would swell the already astronomical power requirements (13,500 earths of power) even further. Also, when considering long wavelengths, the penetration depth of steel (the depth into steel that the electromagnetic radiation drives the electrons) requires careful consideration. For instance, the exterior columns were composed of only ¼" plate steel on average. As a rule of thumb, the penetration depth for good conducting metals is only about 1/10th of the wavelength. If the penetration depth is larger than the thickness of the steel, then an appreciable fraction of the energy will be transmitted straight through the metal. This would be yet another mechanism of loss in that the energy is not fully coupled into evaporating the steel since some of the energy passes through.

Part 3: Analysis of Specific Directed Energy Sources and Miscellaneous Phenomena

MIRACL Laser Operation Specifications[38]

The largest known laser in the western hemisphere throughout the 1990's was the MIRACL laser (**M**id-**I**nfra**r**ed **A**dvanced **C**hemical **L**aser). A joint Israeli-American project located at the White Sands Missile Range in New Mexico, the laser facility boasts the ability to destroy Katyusha rockets. The laser is continuous-wave with a maximum output of roughly 1 MW of power encompassing the wavelengths 3.6 to $4.0 \mu m$. Maximum run-time is 30 seconds at maximum power.

The operation of the laser is quite telling. Ethylene (C_2H_4) and nitrogen trifluoride (NF_3) are burned at the input of the laser cavity. Excited fluorine atoms are liberated during the combustion. Further downstream, deuterium and helium (an exchange gas probably used to adjust the de-excitation time scales) are injected into the stream where the deuterium combines with the free fluorine atoms to form deuterium fluoride (DF) in vibrational and rotational excited states. The laser cavity is actually perpendicular to the flow of gases, and evidently supports 10 modes concurrently.

The massive amount of gas flow can only be compared to a jet engine. The gas is drawn through the laser cavity by creating a vacuum of 150 Torr on one end. Since the quantity of gas is so large, the vacuum is produced by condensing massive amounts of steam into water.

The exhaust gas leaves the laser cavity at 1127C and is cooled to 40C. The toxic gas is reacted with a 1% sodium hydroxide solution to remove HF and DF gas from the exhaust. The resulting sodium fluoride is treated with lime resulting in fluorspar (CaF_2) sludge.

It is instructive to consider the logistics and sheer amount of resources utilized in an *average* run (not necessarily at maximum power for the maximum allowable time duration) of the laser: 340,650L of water, 11,355L of diesel fuel, 16 kg of deuterium gas, 4.5 kg of ethylene gas, and 381 kg of nitrogen trifluoride gas. Fluorspar sludge (630 kg) is generated as a byproduct. The facility, only including the actual housing of the laser as well as gas handling and water handling peripherals, occupies an area of approximately 1.48 sq km. Due to the logistical nightmare, only 6 to 10 laser tests were performed annually throughout the 1990's.

Energy Comparisons to the MIRACL Laser and Ramifications

The power required to evaporate the steel in one of the WTC towers is astronomically large. To get a feel for the huge size of this number, we will compare to the largest laser in the western hemisphere, the MIRACL laser. Recall that the power required to evaporate the steel in a WTC tower was 5.7×10^{13} Watts. The power output of the mammoth size MIRACL laser is 10^6 Watts. This means that we would need 5.7×10^7, or 57 million MIRACL lasers of power!

To put these numbers into perspective, we can scale the resources used by the behemoth MIRACL laser by a factor of 57 million. The necessary amount of water is 4% of the water in Lake Erie,[9] the land area occupied by the facility would be 9 times the total land area of the United States,[10] the amount of nitrogen trifluoride required exceeds 11,000 times the worldwide supply,[7] and the amount of diesel fuel would be equal to the daily US demand of all distillate fuels.[8]

Suffice to say that any known method to generate the energy required to vaporize the steel in the upper 110 stories of the WTC towers is not going to be space-based.

By contrast, the MIRACL laser is designed to destroy Katyusha rockets to "heat up the skin of the missile and then the internal pressure of the fuel tank actually causes the missile to explode".[6] The power required to heat the entire shell to 600C of a Katyusha rocket requires 1 MW over 4.2 seconds[6] which physically explains why the MIRACL laser works for its intended purpose.

Reflecting Satellites

Ignoring the inconceivably large amount of power required to vaporize the steel in the WTC tower, let us hypothetically consider what would happen if the necessary number of photons were actually generated.

The facility would most certainly not be space-based, but what if it were land based? A satellite with a reflecting surface might possibly be able to reflect and direct the energy towards the WTC complex.

A problem appears immediately. Photons have momentum, and bouncing many photons off a mirror will impart momentum to that mirror. We can calculate this total momentum transfer to a satellite knowing the total energy required to vaporize all the steel:

$$Total\ Momentum\ Transfer = 2\frac{E}{c}$$

Where the factor of 2 is from changing the direction of the photons, $E = 5.7 \times 10^{14} J$, and c is the speed of light, $3.8 \times 10^8 m/\sec$. Here I will include a very conservative estimate of losses from reflection by the steel which was calculated to be a minimum factor of 160. The resulting momentum transfer to a satellite would be $6 \times 10^8 kg\ m/\sec$ which means that the average force required to keep the satellite in its orbit would be (dividing the momentum by 10 seconds) $6 \times 10^7 N$. This corresponds to the maximum thrust of 1137 space shuttles![36] If no counter force is provided, then a massive reflecting satellite of 22,400 kg, the maximum payload of the space shuttle, [36] would accelerate toward the outer reaches of the solar system at 276 g. It would be traveling at 60,000 miles/hour away from the earth after demolishing one WTC tower.

There is another problem if we analyze the reflector itself. What do you make it out of? Space is nearly a perfect insulator, so the heat generated in any conventional metallic or layered dielectric mirror would cause catastrophic failure in the optic. Any dust or imperfections on the optic would cause local heating, destroying that part of the reflector. The failure in one part of the optic would rapidly lead to total catastrophic failure of the entire optic. This is a common concern when dealing with high intensity laser beams in the laboratory.

Due to the huge photon flux from an incredibly intense laser and atmospheric water absorption in the GHz spectrum, virtually all the water in the path of the beam would be energetically dissociated. This, in turn, would rapidly (very fast compared to the collapse time) heat the air via collisions. This heated air in the path of the beam would have a lower index of refraction than the surrounding air leading to visible optical distortions which were not observable in any picture or video of which I am aware.

Ablation of the air, a phenomenon in which the air becomes ionized along the path of a very intense laser beam, would also have to be considered. If the beam reflected off a satellite, a conducting path created by the ions and freed electrons would most likely cause serious electrostatic discharge (resembling lightning bolts).

Directed Energy Beams from WTC 7, HAARP, and Plasmoids

Dr. Fetzer has proposed as a purely speculative possibility that a directed energy beam emanated from WTC 7.[38] Videos of the collapse of the South Tower show a top section initially falling *away* from WTC Building 7, the opposite of what would be expected from any known directed energy beam which would vaporize the steel in a line-of-sight fashion. The North Tower collapsed more or less symmetrically where the core columns evidently were severed first, which would be very difficult to explain using any method of a directed energy beam impinging the building asymmetrically as from the side.

Smoke and debris during the collapse would be impenetrable to all beams except possibly in the spectral range from 1 to 430 GHz photons for the same reasons as detailed earlier. The astronomical energy requirements are the same as well.

The power output of the electrical substation at the base of WTC 7 does not supply nearly enough power to generate the required energy to vaporize the steel in the WTC towers. Recall that we need *thousands* of earths worth of power which dwarfs the power output of one electrical substation!

Dr. Fetzer has also suggested the HAARP project as a possible source of directed energy. The HAARP is a rectangular planar array of horizontally polarized antenna elements covering the frequency range from 2.8 to10 MHz. There are at most 180 radiating elements which produce a maximum power output of 3.6 MW.[11] The first problem with this hypothesis is that the maximum power output of HAARP is roughly equal to the MIRACL laser power output which pales in comparison to the power required to evaporate the steel in the WTC towers. The second problem is the very low frequency range which allows only a small fraction of the radiated power to be absorbed by steel. If we insert 2.8 MHz and 10 MHz into Equation 2, we find reflective losses would swell to a factor of 63,000 to 34,000, respectively. Lastly, the wavelength in this spectral range is large compared to the cross-sectional area of the steel beams which would result in even larger amounts of scattering losses.

To evaporate the steel in the towers with any kind of plasma weapon would involve a much larger energy input. The ionization energies involved in generating a large quantity of plasma would exceed the minimum energy requirements to evaporate the steel in a WTC tower by many orders of magnitude. The transfer mechanism from the heat in the plasma to the steel would be very inefficient resulting in further increasing the required energy. Note that plasmas are electrically neutral on average so no current can

be generated in metal when in contact with plasma (unless a potential difference between the tower and a point in the plasma stream is externally applied). Plasmoids and plasmas behave as a fluid so much of the energy would merely flow around the steel columns. Furthermore, plasmas would rapidly heat surrounding air causing noticeable optical distortions.

Perpetual Motion Machines: the Violation of the Law of Conservation of Energy

Since the energy scale to vaporize steel is astronomical, some proponents argue that some 'secret' method may have been employed which dissociates the bonds holding the steel lattice together with only a small fraction of the energy normally required. Let us consider a hypothetical situation in which the bonds holding molecules together are dissociated using less energy than the bonding strength. We now set aside fundamental tenets and sensibilities which have been established in science over the last 400 years through arduous and tedious experiments, particularly the law of conservation of energy.

Consider breaking the bonds of H_2O using a magical dissociation machine. The constituents of water, hydrogen and oxygen, could then be used in a chemical reaction (burning) generating heat and water as a byproduct. Since the (heat) energy released in such a chemical reaction is equivalent to the bonding energy, then the amount of energy generated is more than what was initially used. By repeating this process indefinitely, any amount of energy could be released in the form of heat which could then be used to power, for example, generators. The generator could, in turn, be used to power the magical dissociation machine.

This would be a perpetual motion machine which, of course, violates fundamental laws of thermodynamics. There does not currently exist any known perpetual motion machine. Some proponents of the directed energy beam hypothesis would have us believe that such a machine debuted as a demolition machine to destroy the WTC towers.

Holes in Adjacent Buildings

Some adjacent buildings suffered partial, localized collapses. These buildings were steel-framed buildings and were designed and constructed to maximize the mostly empty space by volume. For example, in WTC 6, an eight-story building with a large hole in which all eight stories appeared to have collapsed, the debris would only be expected to be about 1 story high (8 stories times the collapse ratio calculated for WTC 7, 11.5%) across the area of the collapse. One sublevel collapse could account for nearly all the debris from WTC 6. Three sublevel collapses may have occurred beneath WTC 6.[13] We do not expect to see much debris in the holes, and this matches observation.

The damage to the surrounding WTC buildings is consistent with the expected impulse damage from falling debris generated by the collapsing towers as explained in detail by Tony Szamboti in reference 17.

Charred Vehicles

Explosives or thermate can reach temperatures above the melting point of steel. Localized hot spots after and during the collapse, could account for the burning of some cars and other material in the area. Furthermore, debris impacting vehicles can smash gas tanks and oil pans releasing highly combustible fluids in the vicinity of other vehicles. Any sufficient heat or spark can ignite the flammable fluids such as burning paper[40] or hot metal (a photograph of a 'localized hot)[37]. Adjacent vehicles may be scorched by flames from burning vehicles by varying amounts and burn patterns (see pictures of the police car at ground zero)[37], or may even ignite themselves (see video of K-Mart parking lot fire)[37]. Directed energy beams are not needed to explain burning cars and trucks.

Evidence suggests that the charred cars that were located on FDR drive were towed to that location from the vicinity of ground zero.[24]

A word needs to be said about the shattering of glass in vehicles. Glass in vehicles is designed to shatter under stress. Large fragments of sharp glass in an automobile accident would be unnecessarily deadly, so engineers intentionally chose a type of glass which shatters into small pieces when subjected to stress. If a relatively intense amount of heat is quickly (on the time scale of the heat conduction of glass) applied to glass, local stress develops between the hot area and the relatively cool areas. This type of stress is known to cause automobile glass to shatter.

Paper

Paper can act as a "sail". That is, it has a large surface area and low weight. A large blast of air, either from the displacement of air from the collapse or conventional explosives, can push the paper efficiently. For example, some paper is observed leading the dust during the collapse.

Not all of the paper was blown out of the building and survived. I would suppose some, or more likely most, of the paper was incinerated[40] or merely trapped within the falling debris. Furthermore, the flames from vehicles would have surely ignited at least some paper in the vicinity. Sheets of loose paper would completely burn in a matter of seconds which may constitute the statistical reason that few photographs exist of paper actually burning. Spotting small, crumpled, black remains of burnt paper from photographs is near impossible upon a background consisting of various sorts of debris and dust.

Disappearing Acts of Steel

Dr. Fetzer, in his Tucson lecture given in November 2006,[38] repeatedly tells his audience what to observe in a video regarding the spires from the North Tower. He wants the viewer to believe that steel, in the vein of magician David Copperfield and the Statue of Liberty, disappears before the viewers' eyes.

Two video perspectives in reference 41, unobstructed by dust, clearly and unambiguously show the spires merely falling. In the words of Dr. Fetzer, 'who are you

going to believe, me or your lying eyes?".[38] I leave such credibility judgments to the viewer.

Even though Dr. Fetzer was notified of the two video clips earlier than December 4th, 2006,[41] both he and Dr. Judy Wood continue to promote the misinterpretation of the spires turning to dust on their websites as of February 23rd, 2007.[42]

Conclusion

Sublevel collapses together with minimal surface debris easily account for all the debris from the WTC towers, WTC 4, WTC 3, and holes in WTC 6. The percentage of iron in dust samples shows that no significant amount of steel was dissociated into dust. The minimum amount of power required to dissociate the steel in one of the WTC towers is astronomically large, over 5 times the total power output of the world. A very conservative estimate of loss mechanisms swell this to at least thousands of worlds of power. Any method used to dissociate steel would require at least this massive amount of energy. Any mechanism claiming to dissociate the steel with less than the minimum required energy is breaking fundamental tenets of physics and can be labeled a perpetual motion machine.

Power requirements were shown to be absurdly large to vaporize half of the steel in both WTC towers. Since the power requirements are so large, any hypothetical beam weapon would necessarily be ground based. Any reflecting satellite, if we falsely assume the reflector would survive, would require unrealistically colossal thrust to oppose the momentum transfer of the beam.

The potential energy of buildings does not directly correlate to Richter scale measurements. Non-catastrophic Bathtub damage is a natural result of minimal surface waves generated during the collapse of the WTC towers.

Other phenomena which have been ascribed to the directed energy beam to support the hypothesis such as burning vehicles, intact paper, and videos supposedly showing disappearing acts of steel, were shown to have much more plausible explanations.

Reference

1. $Density\ of\ Steel = M/V, \quad V = Area \times Height \Rightarrow Height = \dfrac{M}{Area \times Density\ of\ Steel}$

Where $Density\ of\ Steel = 7.86\ g/cm^3$, $Area$ is the cross sectional area of a tower $= (208\ ft)^2$, and M is the mass of steel in the upper 110 floors of WTC tower $= 6.8 \times 10^7\ kg$.[27] Substitution gives a $Height$ of 7'.

2. http://janedoe0911.tripod.com/

3. Specifications of steel:

    a. AISI 1018 steel:
        http://www.matweb.com/search/SpecificMaterial.asp?bassnum=M1018I

        i.

Component	% Weight
C	.14-.2
Fe	98.81-99.26
Mn	.6-.9
P	Max 0.04
S	Max 0.05

        ii. Electrical Resistivity: $1.59 \times 10^{-5}\ \Omega\,cm$ annealed condition (0°C), Electrical Resistivity at Elevated Temperature $2.19 \times 10^{-5}\ \Omega\,cm$ annealed condition (100°C), Electrical Resistivity at Elevated Temperature $2.93 \times 10^{-5}\ \Omega\,cm$ annealed condition (200°C)

    b. Since steel is over 98% iron, the latent and specific heat values of steel are very similar to that of iron, so I use the iron values (CRC Handbook of Physics and Chemistry, 52nd Edition). Note that I ignore the temperature dependence of some quantities since the latent heat of vaporization is dominant in the energy calculation: room temperature = 20°C, melting point =1538°C, boiling point temperature =2861°C, atomic weight of iron = 55.845 g/mol, C_S (specific heat of solid iron) = 452 J/kg °C, C_F (latent heat of fusion) = 247 kJ/kg, C_L (specific heat of liquid iron) = 825 J/kg °C, C_V (latent heat of vaporization) = 6343 kJ/kg. Using Equation 1 and a mass of 68 million kg[27], gives $5.7 \times 10^{14}\ J$. The latent heat of vaporization term alone gives $4.3 \times 10^{14}\ J$ which contributes approximately 75% to the total energy.

4. David J. Griffiths, *Introduction to Electrodynamics Second Edition*, page 377 formula 8.169:

5. Specifications of World Trade Center buildings 3,4,5, & 6:

    a. 3 WTC, the Vista Hotel, rises 265 feet above street level and contains 821 guest rooms. 4 WTC, also called the Southeast Plaza Building, rises nine stories, is 119 feet tall, and has 600,000 rentable square feet. 5 WTC, the Northeast Plaza Building, is nine stories, 119 feet tall, and has 700,000 square feet available for rental. 6 WTC is the NY/NJ metro region

consolidated Customs House and is eight stories, 130 feet tall, and contains 800,000 square feet of space. U.S. Fire Administration/Technical Report Series, "The World Trade Center Bombing: Report and Analysis", New York City, New York, USFA-TR-076/February 1993, Homeland Security

    b.   NIST NCSTAR1 p.2

1.2   THE WORLD TRADE CENTER COMPLEX

1.2.1   The Site

By 2001, the WTC complex had become an integral part of Manhattan. It was composed of seven buildings (here referred to as WTC 1 through WTC 7) on a site toward the southwest tip of Manhattan Island (Figures 1–1 and 1–2). Whether viewed from close up, from the Statue of Liberty across the Upper Bay or from an aircraft descending to LaGuardia Airport, the towers were a sight to behold. The two towers, WTC 1 (North Tower) and WTC 2 (South Tower), were each 110 stories high, dwarfing the other skyscrapers in lower Manhattan and seemingly extending to all Manhattan the definition of "tall" previously set by midtown's Empire State Building. WTC 3, a Marriott Hotel, was 22 stories tall, WTC 4 (South Plaza Building) and WTC 5 (North Plaza Building) were each 9-story office buildings, and WTC 6 (U.S. Customs House) was an 8-story office building. These six buildings were built around a 5-acre Plaza named in honor of Austin Tobin. WTC 7 was a 47-story office building on Port Authority land across Vesey Street on the north side of the Plaza complex. Built over the ConEd substation serving the WTC complex, it was completed in 1987 and was operated by Silverstein Properties, Inc.

Below the 11 western acres of the site, underneath a large portion of the Plaza and WTC 1, WTC 2, WTC 3, and WTC 6, was a 6-story underground structure. The structure was surrounded by a wall that extended from ground level down 70 ft to bedrock. Holding back the waters of the Hudson River, this wall had enabled rapid excavation for the foundation and continued to keep groundwater from flooding the underground levels.

Commuter trains brought tens of thousands of workers and visitors to Manhattan from Brooklyn and New Jersey into a new underground station below the plaza. A series of escalators and elevators took the WTC employees directly to an underground shopping mall and to the Concourse Level of the towers.

6.   Katyusha rocket information:

    a.   First shot down by laser at White Sands in 1998: http://wohlstetter.typepad.com/letterfromthecapitol/2006/10/what_next_ii_fo.html

    b.   Effective laser range 6-8km, presumably from atmospheric (water) absorption:http://archive.globes.co.il/ENGLISH/index.asp?ID=1000122336

    c.   "The effect that it wants to gain on these tactical ballistic missiles is that it heats up the skin of the missile and then the internal pressure of the fuel tank actually causes the missile to explode." http://news.com.com/Are+laser+weapons+ready+for+duty+-+page+2/2008-1008_3-6059967-2.html

    d.   "The heat of the laser weakens the missile's skin, and the internal pressures and supersonic aerodynamic flight stresses cause it to explode." http://www.wslfweb.org/docs/SBLWP.pdf

    e.   The diameter is .122 m and length is 2.8m (http://www.reference.com/browse/wiki/Qassam_rocket). Using the density of steel of 7860 kg/m^3 and estimating the steel shell thickness to be 1/16" yields a mass of steel in the shell of

$$Thickness \times Length \times \pi(\frac{diameter}{2})^2 \times Steel\ Density = 16.1\ \text{kg. Using the}$$

first term of Equation 1 with a final temperature of 600C gives $4.2 \times 10^6\ J$. Since the MIRACL laser puts out ~1 MW, the relevant amount of energy can be pumped into the rocket in about 4.2 seconds.

7. MIRACL laser nitrogen trifluoride scaling analysis: nitrogen trifluoride worldwide productions in 2001 was less than 2×10^6 kg (http://www.mitpressjournals.org/doi/pdf/10.1162/jiec.2007.1075?cookieSet=1); 380kg x $5.7 \times 10^7 / 2 \times 10^6$ ~11,000 times the global output of NF_3
   a. NF_3 is expensive. It is a significant expense in the production of semiconductors. Cost is approximately $1 per liter of gas in large quantities. (that is $320/kg) which values worldwide production at about $800M (retail).

8. MIRACL diesel fuel scaling analysis: US daily demand for all distillate fuels is 6.5×10^{11} L/day http://www.npra.org/publications/statistics/2002RefiningCapacityReport.pdf; 11,355L x 5.7×10^7 ~ 6.5×10^{11}

9. MIRACL water scaling analysis: 340,650L x $5.7 \times 10^7 = 1.9 \times 10^{13}\ L$; Lake Erie volume of water = $116\ mi^3 = 4.8 \times 10^{14}\ L$

   (http://www.epa.gov/glnpo/factsheet.html), so $1.9 \times 10^{13}\ L / 4.8 \times 10^{14}\ L$ ~ 4% of the water in Lake Eerie

10. MIRACL land scaling analysis: area of MIRACL laser site ~ 1.48 sq km., so 1.48 x $(5.7 \times 10^7) = 8.4 \times 10^7$ sq km; total land area of US is 9,161,923 sq km (https://www.cia.gov/cia/publications/factbook/print/us.html), so $8.4 \times 10^7 /(9,161,923)=9.2$ times the total land area of the US

11. If we hypothetically pulverized all the concrete and pumped many photons (of small wavelength relative to the dust size) with a total energy of $5.7 \times 10^{14}\ J$ into the dust cloud, then an average dust particle would only be imparted with an

    added downward velocity of $\dfrac{E_{Total}}{M\ c}$ ~ $2\ cm/\sec$, where M is the total mass of

    concrete in a WTC tower[27] and c is the velocity of light. Much more energy would be required to move the dust out of the way quickly so that the photon beam could vaporize the steel.

12. Specifications of HAARP:
    a. The HAARP IRI is a rectangular planar array of horizontally polarized antenna elements covering the frequency range of 2.8 - 10 MHz, Each transmitter produces a maximum power output of 10 kW, 48 antenna elements, resulting in an array with a total transmitter power of 960 kW. Additional expansion is planned in two phases, one ending at the 108-element (2.16 megawatt [MW]) size and the final IRI at the 180-element (3.6-MW) size. http://www.haarp.alaska.edu/haarp/news/qst996.html

b. HAARP's power output is nearly twice that of any other ionospheric heater combined with the rapid beam-steering ability and broad frequency range of its transmitter, will permit the IRI to modify higher-altitude areas of the ionosphere from greater distances than ever. A bank of six 2.5megawatt, 3,600-horsepower diesel generators powers the IRI prototype, while the rest of the facility taps electricity from a nearby power line.
http://arcticcircle.uconn.edu/VirtualClassroom/HAARP/acf.html

13. Sublevel collapse analysis of the WTC complex:
http://www.nytimes.com/library/national/index_WALL.html

A schematic representation of the damaged sublevels published in the above NY Times article is used to estimate the volume of sublevel collapses. "The diagrams are based on floor-by-floor assessments of the basement levels of the World Trade Center complex by Mueser Rutledge Consulting Engineers, which is advising the city." A representative map for sublevel 1 is shown here:
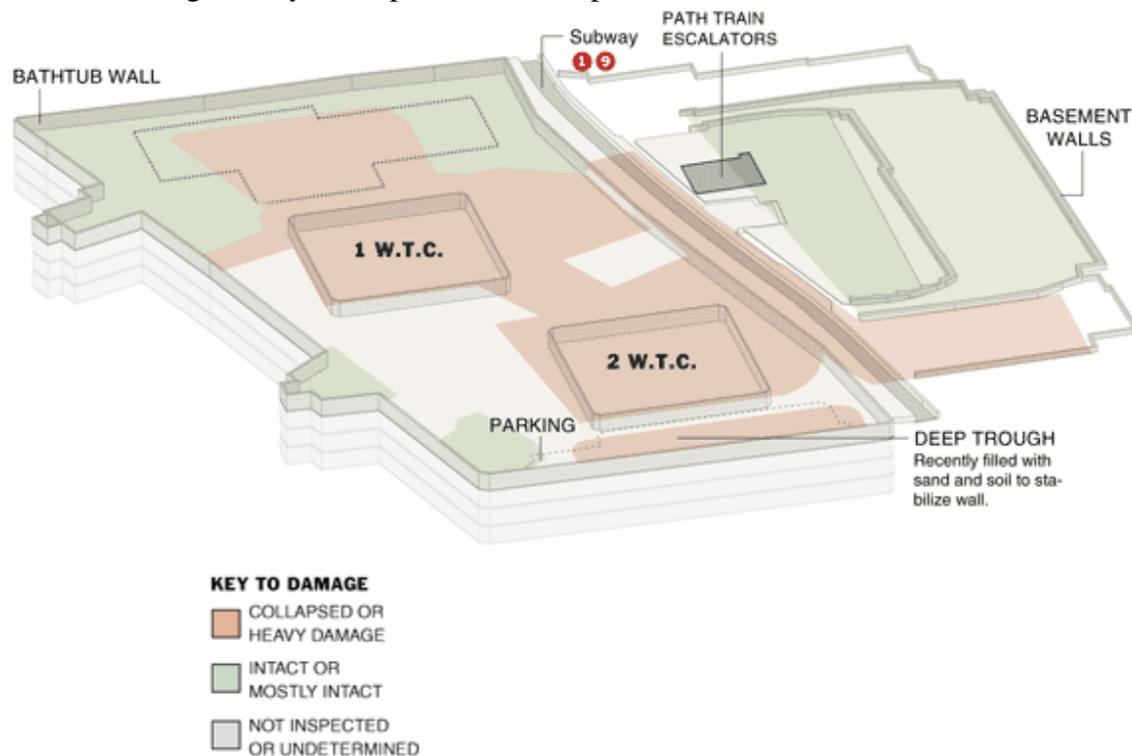
In all, there were 7 stories of sublevels within the area west of the subway of which the lowest sublevel 6 was two stories tall. The area east of the subway was 2 sublevels as depicted in the diagram.

Using AutoCad, I estimated the 'collapsed or heavy damaged' as well as the 'undetermined' area per floor normalized to the footprint of the WTC tower. The total volume in the sublevels yields 28.3 *story x footprint* for the 'collapsed or heavy damaged' volume and 21.7 *story x footprint* for the 'undetermined' volume.

The total volume of buildings above ground for all buildings in the WTC complex which collapsed, excluding WTC 7, was estimated (see reference 21 for

the aerial photograph as well as schematic of the area). The before collapse volumes of the WTC towers and WTC 3 which suffered total collapses as well as WTC 6 and WTC 4 which suffered partial collapses are given below:

WTC #	Collapsed Area (*footprint*)	# of stories above ground	Volume (*story x footprint*)
1	1.00	110	110.00
2	1.00	110	110.00
3	0.63	22	13.78
4	1.31	9	11.79
6	0.41	8	3.31

The total initial volume of all the buildings which suffered total or partial collapses taken above ground is 248.87 *story x footprint*. This is conceptually equivalent to stacking all the pieces of buildings which suffered collapses (WTC 1, 2, 3, 4, and 6) on top of one world trade center footprint resulting in one building 248.87 stories tall.

I define the following:

$$Collapse\ Ratio = \frac{Total\ Volume\ After\ Collapse}{Total\ Volume\ Before\ Collapse}$$

Assuming that all of the debris from all the collapsed buildings occupy the 'collapsed or heavy damaged' sublevel volume and assuming the 'undetermined' volume suffered no collapse yields a collapse ratio of (28.3 *story x footprint*)/(248.87 *story x footprint* + 28.3 *story x footprint*)= 10.2%. Recall from reference 15 that the collapse ratio of WTC building 7 is $11.5 \pm 1.6\%$. **This means that, within our errors, all the debris from all the buildings in the WTC complex, excluding building 7, could be accounted for within the sublevel collapses.**

Note that all the 'collapsed or heavy damaged' volume was not necessarily total collapses. However, we also assumed no surface debris above the sublevels and none of the 'undetermined' volume suffered collapse.

If we were to hypothetically compress the volume of all the buildings (WTC 1, 2, 3, 4, 6) to the same collapse ratio as WTC building 7 (11.5%) into the sublevels of the 'collapsed or heavy damaged' volume, then only 14% of all the building debris would be left over above the sublevels.

We can estimate an upper bound of the collapse ratio. The volume above street level of the WTC 1 is conservatively 2 *story x footprint*. Furthermore, if we assume 20% of the 'undetermined' volume and 100% of the 'collapsed or heavy damaged' volume suffered total collapse, the collapse ratio becomes ~ 12.2%. This upper bound accounts for more than all the debris.

A lower bound estimate assumes 80% total collapse of the 'collapsed or heavy damaged' volume, no surface debris, and no collapses in the 'undetermined' areas. These assumptions yield a collapse ratio of 8.3%. If we were to compress the debris into this same volume but only to the WTC 7 compression ratio of 11.5%, then 38% of all the collapsed buildings would reside outside of the sublevels.

Summarizing, the estimate of the WTC trade center complex (excluding WTC building 7) yields a collapse ratio of $10.2^{+2.0}_{-1.9}\,\%$. This agrees well with that of building 7, $11.5^{+1.6}_{-1.6}\,\%$. Directly comparing the compression of the materials in WTC trade complex of 10.2% with the WTC 7 collapse ratio of 11.5% yields an amount of 14% debris above ground which, within the error, is certainly consistent with observation.

14. Height of World trade Center 7: 610'
http://wtc.nist.gov/progress_report_june04/appendixl.pdf

15. Debris Height of WTC 7 after collapse:

I used the following photographs from http://www.studyof911.com/gallery/ to construct a contour plot of the WTC 7 debris field: WTC_Pile_03, Tom16, normal_WTC_Pic_01, 9_16_pic09, b7pile, phil29, phil32, 2316_G,132105581_a75a50d39a_0, and wtc_pile. Each blue contour is labeled by the number of stories in height. The actual photograph used as the background does not depict all of the debris since some has been removed during cleanup, but was chosen due to the aerial perspective. By cross referencing with other earlier photographs of the WTC 7 debris, I have estimated the debris field height before debris was removed from the WTC 7 site.

The area between contour lines was measured in AutoCad and normalized by the area of the footprint of WTC 7 (shown in red). The area between contour 0 and 2 was multiplied by 1 story, the area between 2 and 3 was multiplied by 2 stories, etc. By using 1 story = 12 ft and summing up the volumes associated with each contour, the total volume of the debris field is found to be $70 \pm 10\,ft\ x$ *footprint*. Conceptually, this is equivalent to piling up all the debris into the footprint of WTC building 7 and measuring the total height.

The final volumetric collapse ratio is $\dfrac{70 \pm 10\,ft \cdot footprnt}{610\,ft \cdot footprnt} = 11.5 \pm 1.6\%$

16. Height of WTC tower: 1 WTC (the North Tower, which featured a massive 360 foot high TV antenna added in 1978) stood 1,368 feet high, and 2 WTC (the South Tower, which contained the observation deck) was 1,362 feet high, http://en.wikipedia.org/wiki/World_Trade_Center; Average height of the two towers was 1365'

17. Tony Szamboti ,"The Damage to WTC Bldg's 3 and 6, the debate between the controlled demolition and beam weapons" , Journal of 9/11 Studies, Letter B, (January 26, 2007)

18. WTC tower specs: 47 core columns and 236 perimeter columns; above the seventh floor there were 59 perimeter columns along each face of the building. The perimeter columns had a square cross section, 14 inches on a side (36 cm), and were constructed of welded steel plate; The core of each tower was a rectangular area 87 by 135 feet (27 by 41 m) and contained 47 steel columns running from the bedrock to the top of the tower (http://en.wikipedia.org/wiki/World_Trade_Center)

19. Potential energy of WTC 7 compared to WTC tower:
I assume the density of building 7 is roughly the same as the WTC towers. The potential energy is given by Mgh where M is the mass of the building, g is the gravitational constant, and h is the height of the center of mass of the building.

The height of the center of mass of the building is defined as $\dfrac{h_0}{2\alpha}$ where h_0 is the height of the building and α is greater than but close to 1 since skyscrapers are denser near the bottom. I assume α is about the same for both buildings. The mass of the building is then given by $Area \times h \times \rho$ where $Area$ is the cross

sectional area of the building, $h = \dfrac{h_0}{2\alpha}$, and ρ is the density of the building. Note that the density can be a function of normalized height and the analysis would still be valid. The ratio of the two potential energies associated with the buildings is then:

$$\frac{PE_{WTC7}}{PE_{WTC\,Tower}} = \frac{Area_{WTC7} \times h_{0,WTC7}^2}{Area_{WTC\,Tower} \times h_{0,WTC\,Tower}^2} = \frac{41{,}600\,ft^2 \times (610\,ft)^2}{43{,}264\,ft^2 \times (1365\,ft)^2} \sim 20\%$$

20. Seismograph readings:

The following three seismograph charts for the WTC North Tower, WTC South Tower, and WTC 7, respectively, are from http://www.ldeo.columbia.edu/LCSN/Eq/20010911_WTC/.

The Richter scale reading and associated energy of the waves are given by the formulae (http://www.seismo.unr.edu/ftp/pub/louie/class/100/magnitude.html):
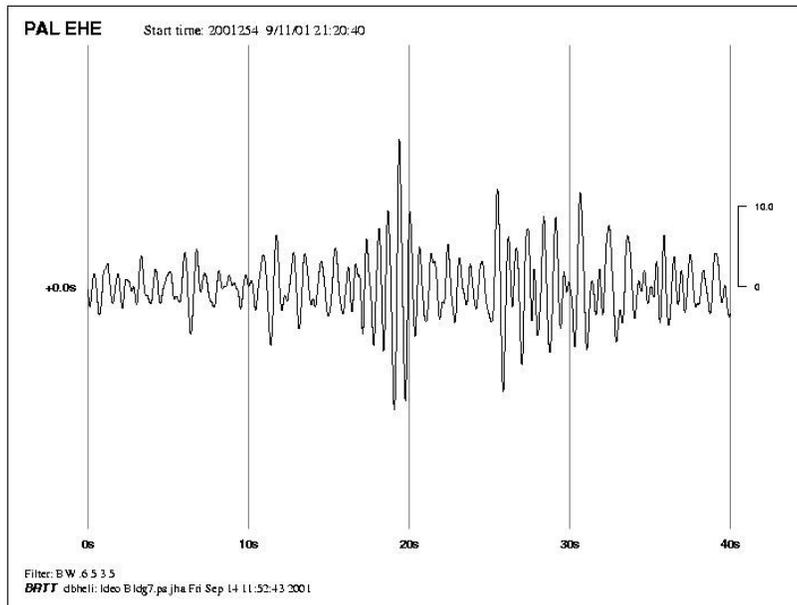
$$M_L = Log_{10}(Amplitude) + c$$

$$Energy = 10^{11.5+1.5 \times M_L} \times 10^{-7}$$

Where c is approximately zero for our case, the amplitude is half the maximum peak-to-peak values measured off the graphs, and the energy is measured in Joules (J). The amplitudes are 311, 220, and 16.6 which gives an M_L of 2.3, 2.1, and 1.0, and an energy of 87 MJ, 52 MJ, and 1 MJ respectively.

PAL EHE   Start time: 2001254 9/11/01 14:28:30

+0.0s

100.0
0

0s   10s   20s   30s   40s

Filter: B W 0.6 5 3.5
BRTT dbheli: ldeo dbheli.ldeo.PAL.EHE.25464 l.pa antelope Tue Sep 11 16:13:37 2001

PAL EHE   Start time: 2001254 9/11/01 13:59:07

+0.0s

100.0
0

0s   10s   20s   30s   40s

Filter: B W 0.6 5 3.5
BRTT dbheli: ldeo dbheli.ldeo.PAL.EHE.25471 l.pa antelope Tue Sep 11 16:15:39 2001
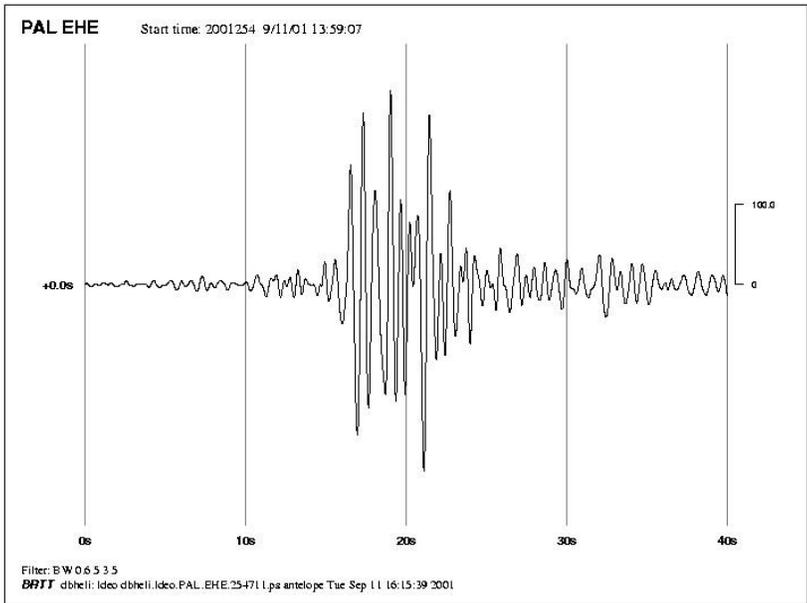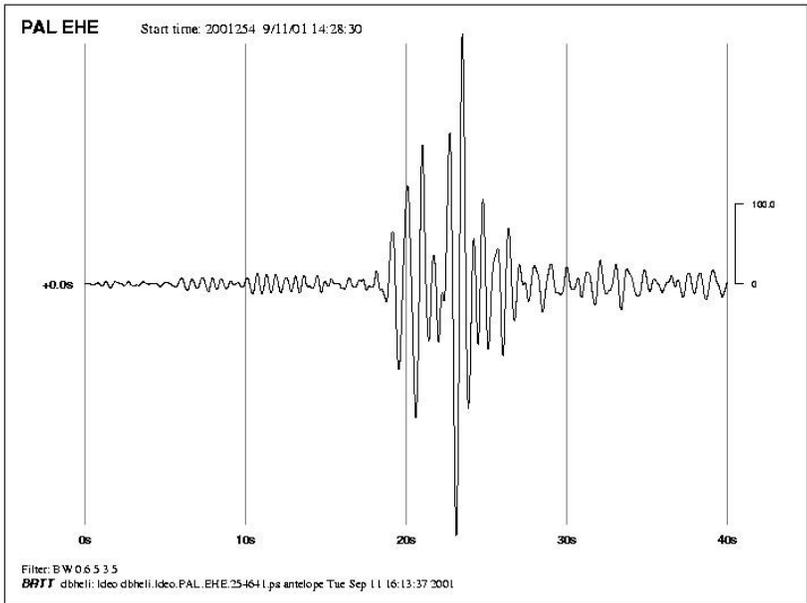
21. Radius of Debris field: Overlays of aerial debris pictures taken on September 23, 2001 from (http://www.noaanews.noaa.gov/wtc/images/wtc-photo.jpg) and schematic from (http://en.wikipedia.org/wiki/Image:WTC_Building_Arrangement_and_Site_Plan.jpg), Outer circles centered upon WTC 1 and 2 depict a radius 2.5 times the radius of the footprint ($Outer\ Circle\ Radius = 2.5 \times \dfrac{1}{\sqrt{\pi}}(Width\ of\ WTC\ Tower)$) and show that this radius is a conservative estimate of the debris field. The area associated with this radius is 6.25 *footprint* (where a *footprint* is the cross-sectional area of the tower before collapse).

Neither of the WTC towers fell into their own footprints. A conservative estimate of the radius of the falling debris is at least 2.5 times the radius of the tower or, equivalently, a debris field 6.25 times the footprint of the building. Using Dr. Wood's analysis method for the WTC tower of height 1365',[16] but using the WTC building 7 collapse ratio of 11.5%[15] and considering that the debris was spread out over 6.25 times the footprint, yields an average debris height of $25\,ft$ for one WTC tower spread out over an area 6.25 *footprints*. Partial collapses of the sublevels could fully account for the proclaimed 'missing' debris.[13]

22. Craig T. Furlong and Gordon Ross, "Seismic Proof – 9/11 Was An Inside Job (Updated Version II)", Journal for 9/11 Studies, Volume 3 (September 2006)

23. Won-Young Kim, L. R. Sykes, J. H. Armitage, J. K. Xie, K. H. Jacob, P.G Richards, M. West, F. Waldhauser, J. Armbruster, L. Seeber, W. X. Du, and A. Lerner-Lam, Lamont-Doherty Earth Observatory of Columbia University, Palisades, N.Y. and also Dept. Earth and Environmental Sciences, Columbia University, "Seismic Waves Generated by Aircraft Impacts and Building Collapses at World Trade Center, New York City"

24. James Gourley, "Scientific Critique of Judy Wood's Paper 'The Star Wars Beam Weapon'", Journal of 9/11 Studies, Letter B (January 9, 2007)

25. Estimate of the average dust size from the collapse of the WTC towers: I use a conservatively small estimate of $70\,\mu m$ for the average size particle of dust in the WTC collapse debris before it hits the ground (presumably, more pulverization occurs with collisions with the ground). There were many very large pieces of debris including steel beams and large chunks of concrete and other building materials that are not included in the referenced optical calculation. However, it should be noted that these considerations would further argue against the directed energy beam hypothesis.

   a. "~98% of the material that was in the dust was the super-coarse particles (>10um)"
   (http://pubs.acs.org/subscribe/journals/esthag/40/i22/html/111506feature_lioy.html)

b. Well over 50% of the total collected dust samples were over 53 um.

Table 1. General characteristics of settled dust and smoke samples (percent by mass) from the first days after the collapse and fires of the WTC.

Sample	Street		
	Cortlandt	Cherry	Market
Color	Pinkish gray	Pinkish gray	Pinkish gray
pH	11.5	9.2	9.3
Nonfiber (cement/carbon; %)[a]	50.0	49.2	37.0
Glass fiber (%)[a]	40.0	40.0	40.0
Cellulose (%)[a]	9.2	10.0	20.0
Chrysotile asbestos (%)[a]	0.8	0.8	3.0
Aerodynamically separated sample (% mass)			
< 2.5 μm diameter	1.12	0.88	1.30
2.5–10 μm diameter	0.35	0.30	0.40
10–53 μm diameter	37.03	46.61	34.69
> 53 μm diameter	61.50	52.21	63.60
Sieved sample (% mass)			
< 75 μm diameter	38.00	30.00	37.00
75–300 μm diameter	46.00	49.00	42.00
> 300 μm diameter	16.00	23.00	21.00
Anions/cations (ng/g)			
Fluoride	220	70	ND
Chloride	800	270	220
Nitrate	330	ND	ND
Sulfate	41,400	35,200	42,100
Calcium	18,200	14,000	17,700
Sodium	400	200	130
Potassium	60	170	270

ND, not detectable.
[a]Values reported to L.C. Chen by the Ambient Group, TNC (New York, NY), measured by polarized light microscopy (400–450×).

(www.ehponline.org/members/2002/**110**p703-714**lioy/lioy**-full.html)

c. Larger chunks of concrete were present in the debris: "Along with others, I examined the sample obtained by Janette MacKinlay at 113 Liberty Street, just across from the South Tower. The windows of her apartment were blown in during the collapse of this tower on 9/11/2001, and her apartment was filled with dust and debris. She collected a sample of this material in her own apartment in a plastic bag – which is good procedure – and the chain of custody went directly from her to me. (In the presence of other researchers, I collected more samples from her large plastic bag, while visiting in her home.) As we examined the WTC-debris sample, we found large chunks of concrete (irregular in shape and size, one was approximately 5cm X 3 cm X 3cm) as well as medium-sized pieces of wall-board (with the binding paper still attached). Thus, the pulverization was in fact NOT to fine dust, and it is a false premise to start with near-complete pulverization to fine powder (as might be expected from a mini-nuke or a "star-wars" beam destroying the Towers). Indeed, much of the mass of the MacKinlay sample was clearly in substantial pieces of concrete and wall-board rather than in fine-dust form.", Steven Jones, "From Hard Evidence Repudiates the Hypothesis that Mini-Nukes Were Used on the WTC Towers", Journal of 9/11 Studies, Letter A (January 19, 2007)

26. Worldwide power output: 300 Quads/year = 10^{13} *Watts*
http://energy.cr.usgs.gov/energy/stats_ctry/Stat1.html

27. Estimate of the Steel and Concrete in one of the WTC towers:

    a. Steel: "Roughly 200,000 tons of steel were used in the construction of the two WTC towers" from NIST NCSTAR 1,"Final Report on the Collapse of the World Trade Center Towers". This gives roughly 100,000 tons of steel per tower. If we estimate that 3/4 of this steel was in the upper 110 floors, then this yields 75,000 tons. Since 1 ton = 907.2 kg, the total amount of steel in the upper 110 floors is $6.8 \times 10^7 \, kg$.

    b. Concrete: For the tenant floors, the floor slabs were 4" thick and the floor area was 31400 ft^2 which yield a volume of concrete of 10466 ft^3 per floor. The density of the light concrete used in the tenant floor space was $110 \, lb / ft^3$ (NIST NCSTAR 1-6C p.9). That gives a concrete floor mass of $1.15 \times 10^6 \, lbs = 5.2 \times 10^5 \, kg$ per floor, or total of $5.7 \times 10^7 \, kg$ for 110 floors. The mechanical floors and core used a heavier concrete whose density was $150 \, lb / ft^3$ (NIST NCSTAR 1-6 p.xlv). I will ignore the contribution from the mechanical rooms, and assume the core contained the same average volume of concrete that was used on the tenant floors, namely 4" thickness over a core area of 11,800 ft^2 which yields a volume of 3,933 ft^3 of concrete. This gives a total mass of 590,000 lbs per floor, or $6.49 \times 10^7 \, lbs = 2.9 \times 10^7 \, kg$ for the entire core in the upper 110 floors. The combined total of the tenant floors plus the core estimate yield $8.6 \times 10^7 \, kg$.

    c. Ratio of total weight of steel to concrete in the upper 110 floors of one WTC tower is 6.8/8.6 ~ 80%

28. More than 50% of the power generated by the electricity grid is lost in the power lines: (http://www.swans.com/library/dossiers/pics/enflow00.jpg)

29. Converting electromagnetic radiation from wavelength to frequency: $frequency = c / wavelength$ where c is the velocity of light, $3 \times 10^8 \, m / \sec$

30. Video collapse time measured to be 14 ± 1 sec: http://video.google.com/videoplay?docid=857154317067257405&q=wtc+collapse&hl=en

31. Only ~2% of dust samples were iron by weight:

    a. Bulk concrete and wallboard collected near ground zero contained 3.2% and .33% by weight, respectively, so the average is near 2%; Steven Jones, "Comparison of elemental concentrations observed in WTC dust, concrete and wallboard samples", To be published in Journal of 9/11 Studies

    b. Only ~2% of the dust samples collected by USGS were iron by weight

Chemistry Figure 1

http://pubs.usgs.gov/of/2001/ofr-01-0429/chem1/index.html
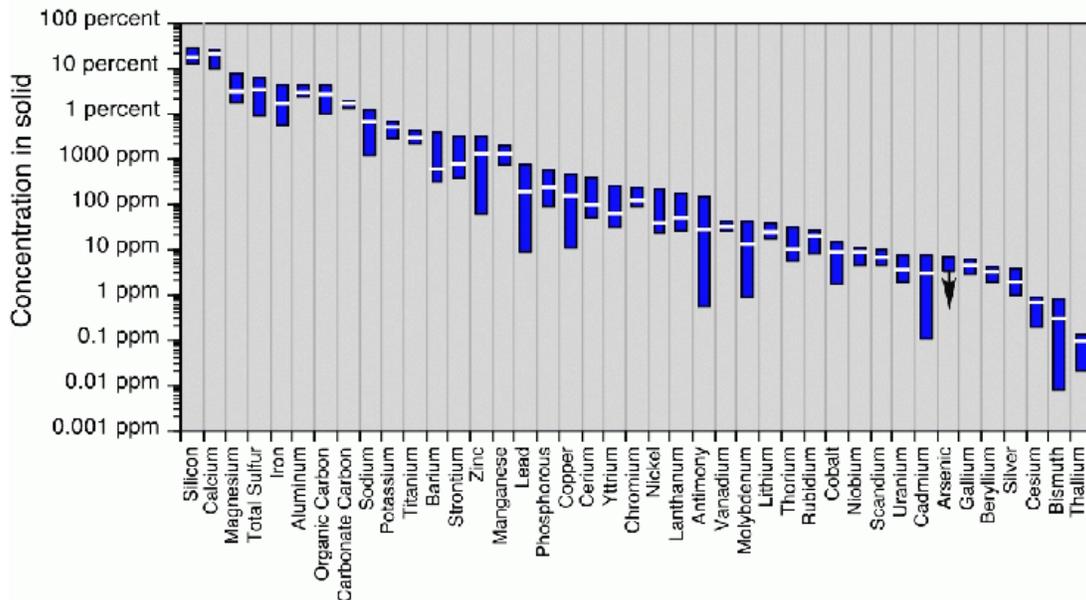
32. Atmospheric Absorption:
http://www.ipac.caltech.edu/Outreach/Edu/Windows/irwindows.html

33. Dr. Gregory S. Jenkins, "Introduction to an interview with Dr. Judy Wood", Journal of 9/11 Studies, Letter B, (February 9, 2007)

34. Video interview with Dr. Wood by Dr. Gregory S. Jenkins:
http://video.google.com/videoplay?docid=-558096240694803017

35. Outer perimeter columns of the WTC towers: Although the cross sectional area of a typical exterior beam is 14"x13.5" ~ 1 ft x 1 ft, the interior of the beam is mostly empty space. The average thickness of the plates which were welded together to form the outside perimeter columns were ¼" (the beams were more substantial near the bottom of the building compared to the top) (NIST NCSTAR1-6 p.98). The polarization of the incident photons would determine which dimension to consider for a given side. To quell arguments from proponents of the 'directed energy beam' hypothesis, I assume the larger 1ft dimension in order to favor a larger allowable spectral range.

36. Space shuttle maximum payload: 22,400 kg; space shuttle thrust: 53.367 kN (http://en.wikipedia.org/wiki/Space_Shuttle)

37. Burning cars and melted steel:
http://www.studyof911.com/gallery/thumbnails.php?album=19
    First photograph shows glowing steel (no flame or black smoke indicates that no carbon burning is occurring) indicating a localized hot spot which could easily ignite gasoline and oil (Steven Jones in his paper "Why Indeed", Journal of 9/11 Studies, September 2006, suggests the possibility that the white smoke is aluminum oxide residue from a thermate reaction). Second and third photographs show the same police car in the vicinity of a vehicle on fire both before and after the flames abate. Notice the back right fender of the police car is not scorched in

the earlier photograph. Evidently, scorching occurred only from the flames of an adjacent car, not from a directed energy weapon.

A video of a fire in the K-Mart parking lot shows a minivan aflame, and illustrates several pertinent points: http://www.youtube.com/watch?v=UHoIyk5Df58

- The pavement underneath the minivan is ablaze
- The car in the immediate vicinity of the minivan catches fire demonstrating how an entire parking lot or underground parking garage of cars parked close together, as is the case in NYC, can burn serially
- The driver-side front tire of the minivan is completely burned off
- The driver-side door handle is missing
- The burnt minivan resembles many of the same characteristics as burnt vehicles at ground zero including missing headlights and deformed hood

The idea that vehicles which have been smashed and then moved is vividly illustrated by the analysis done by 'totovader' showing the Ladder 3 fire-truck crushed by debris at ground zero. However, Judy Wood on her website asks "Why did this firetruck wilt?" implying that it could not have been crushed by debris and subsequently moved to a new location. The videos were released *last year*, yet the obvious misinterpretation remains on her website among a litany of other discredited items.
 http://youtube.com/watch?v=w_S6iLXJvv8 &
http://youtube.com/watch?v=E7J9pPD7bPU

38. Dr. James Fetzer, Lecture at University of Arizona, Tucson, November 2006; speculates that DEW emanated from WTC 7 possibly powered by the electrical substation located at the base of WTC 7; http://video.google.com/videoplay?docid=646337772656177512

39. MIRACL laser resource use and specifications: "Appendix A: HELSTF Lasers Detailed Technical Specifications", http://www.smdcen.us/pubdocs/files/helstf_final_ea_1998.pdf

40. "Paper on fire" http://www.vanadia.com/nycstories/911stories/mauricio_londono/ I was in building #4 of the world trade center since 7:30 am working for J&S futures ltd. This was a commodity Company inside the New York Board of Trade. The actual trading floor is on the eighth floor. It was about 8:50 am when I went to the copy room because I did not feel like eating breakfast that morning (I eat every morning at the plaza which is the courtyard) and a fellow co-worker yelled "holy sh*t, look out the window" after that he ran out the room. The window that he was talking about was facing the plaza of the WTC. I then proceeded toward the window slowly not knowing what to expect with 2 more co-workers. (I had thought the first co-worker that ran saw a famous celebrity or sports star and ran to meet them.) so as the 2 other co-workers and me approached the window with little smiles that immediately turned into frowns as we saw in the window flying debris of metal and *paper on fire* hitting the window. I took a look at the center of the WTC complex where I eat breakfast every morning and saw it covered by *papers on fire* along with a good amount of steel. I yelled out "I eat breakfast there".

41. In an e-mail exchange from Alex Floum to James Fetzer:
> I have emailed you several times 2 video clips showing that they did NOT turn to dust, and which prove that Judy was wrong, and misinterpreted an ambiguity in the first video:
>
> http://st12.startlogic.com/~xenonpup/video%20archive/collapse%2001_spire_clip.avi (from MIT-trained engineer and 9/11 truth activist Jeff King's site)
>
> and
>
> http://www.terrorize.dk/911/wtc1dem6/911.wtc.1.spire.close.up.avi
>
> However, you have not corrected this misstatement, the home page to our website still links to your site without any statement of correction.

Reply from James Fetzer, December 4th, 2006:
> Maybe it's because I am not convinced I am wrong! 400,000 tons of those buildings were turned into dust. That included a lot of steel, Alex, a lot of steel that has to have been converted into dust. Think about it!

42. http://911scholars.org/ YouTube link, and http://janedoe0911.tripod.com/why_indeed.html, Figures 15, 16, 17a and 17b

43. FEMA report, Appendix C

44. This update is to fulfill a request from James Fetzer to change the quote at the beginning of the paper. I had originally opted to drop the last five words of the quote, "which he knew going in", to spare him from an otherwise embarrassing allegation. At least Fetzer is consistent in applying his often self-proclaimed 'logical expertise' to all situations: he guesses what I knew at the time of the interview and assumes the issues I raise unsolvable. Without exception, every question I raised at the interview is thoroughly addressed in this paper, and I can state with certainty that I did not know Dr. Wood utterly incapable of answering rudimentary questions regarding her own work at the time of the interview. Since both assumptions are proveably false, the concluding allegation that I knew Dr. Wood incapable of addressing basic questions "which he knew going in" is maliciously false. Dr. Fetzer may have difficulty understanding, so I cast the assumptions and concluding allegation in a way that even an undergraduate student in logic might understand: False & False = False.

Fetzer does not engage in written scientific dialogue so I am forced to solely judge his verbal statements. Since he is not a scientist but merely a philosopher, he might be forgiven for this grossly negligent behaviour. However, he attempts to protect himself from embarrassing statements by indulging in a delusional fantasy where audio recordings do not exist. The full audio may be downloaded where the listener can judge the context with 1 full minute appended before and after the pertinent quote:

http://public.gregjenkins.promessage.com/FetzerQuote.mp3

Fetzer begins his request for a correction to the editors of the *Journal of 9/11 Studies* with the following verbiage:

> The latest addition to your "Letters" section begins with a quote from me that has the final clause in the sentence quoted edited out, which completely reverses its meaning. I said that, "because she has yet to commit herself to a specific version of one of these alternatives" (or words to that effect). I find it outrageous that you should trump this as a "peer reviewed" journal and publish obviously blatant rubbish like this.

and closes with:

> "It would not have required any "peer review" to discern this obvious abuse and I expect a formal apology."

I expect a formal apology from James Fetzer for false allegations publicly declared on his radio show, the false accusation that the final clause originally edited out of the quote "reverses its meaning", and the audacious misquote of himself, *or words to that effect*, ironically written in a formal letter requesting correction.

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