CASE STUDY

RELATING BLAST EFFECTS TESTS

TO THE

EVENTS OF APRIL 19, 1995
ALFRED P. MURRAH FEDERAL BUILDING
OKLAHOMA CITY, OKLAHOMA

UTILIZING:

TEST RESULTS FROM:
ARMAMENT DIRECTORATE
WRIGHT LABORATORY
EGLIN AIR FORCE BASE

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INTRODUCTION

This study has been undertaken and this report has been prepared in order to develop parametric data for use in analyzing the event of April 19, 1995 in which the Alfred P. Murrah Federal Building was destroyed by a terrorist attack utilizing explosive compounds.

Due to a limited amount of information in the public domain regarding blast effects against structures, a study was undertaken in which photographic data combined with known test parameters was analyzed to provide baseline data for estimating the effectiveness of explosive devices against reinforced concrete structures. The maximum potential blast pressure is used as the determinate factor in establishing resistance to blast and overall blast effect.

A study was conducted to map the pressure regions on a vertical face wall of a reinforced concrete test structure to provide baseline data. Data for the study was obtained from General Benton K. Partin, USAF (Ret). This information was supplied to him at his request by the Armament Directorate, Wright Laboratory, Eglin Air Force Base, Florida. A copy of this memorandum can be found in Appendix B.

Utilizing data from this study various conclusions can be drawn about the nature and components of the event of April 19, 1995 at the Murrah Federal Building.

This report is limited in scope to providing basic data and furnishing certain limited conclusions about the events in Oklahoma City and is being produced as part of a larger more detailed study of the events which occurred there.

TEST STRUCTURE CONSTRUCTION

The test structure constructed at Eglin Air Force Base while not as large as the Alfred P. Murrah Federal Building in Oklahoma City has many similarities and therefore provides an excellent source for data.

The Eglin Test Structure (ETS) was constructed of reinforced concrete and had a footprint of 80 feet in length and 40 feet in width. The ETS was comprised of

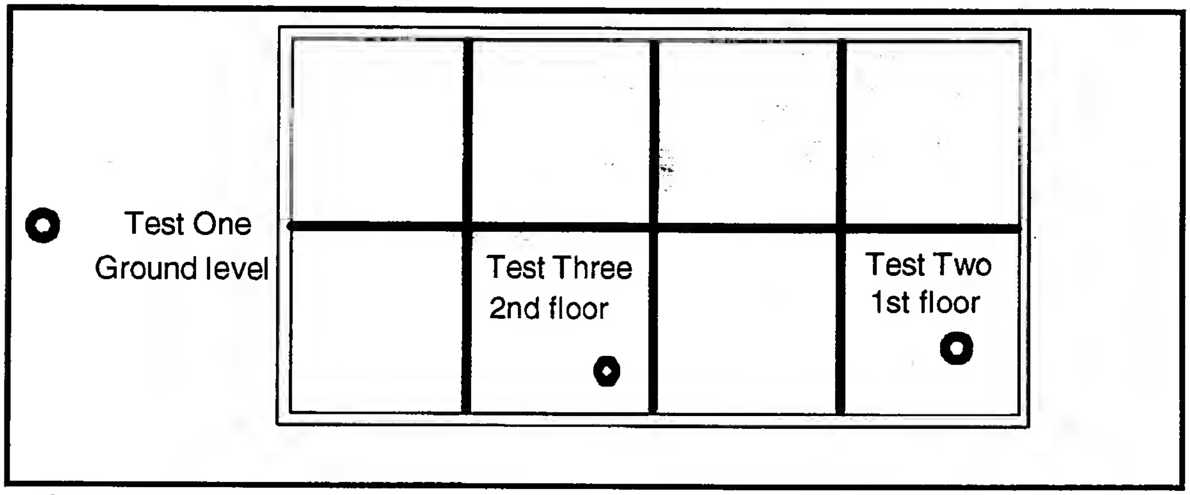

Figure 1 The Eglin Test Structure layout

three stories with a total height of 30 feet. The ETS is similar to Murrah in its basic layout with three rows of columns in the long axis and a series of narrow bays in the shorter axis. The ETS was constructed of six inch thick concrete panels similar to the six inch thick floor panels of Murrah. In addition a series of 14 inch square columns supported the panels in the corners of each room and at the edge of the floor panels. This configuration bears a similarity to the Murrah buildings system of columns, T-beams and floor panels.

The ETS does not appear to have the extensive series of piers that the Murrah Building had for its' foundation. The ETS appears to be built on a spread footing which would be consistent with the design in the area of Eglin Air Force Base. The walls and columns are monolithically poured one story at a time. On top of the column the next floor and edge beam combination is formed then poured and then the next story is formed and poured on top of this. The building appears to have several cold joints in the walls thereby producing a structure that has diminished strength. The normal concrete strength utilized in this type of construction and in this area of the country is 3,000 psi. The Murrah building was constructed with 4,000 psi concrete and it would be reasonable to expect that the Murrah building concrete would have tested in the area of 4,500 psi or above on April 19, 1995.

Steel reinforcement for the ETS is provided by a single layer of #4 (1/2") rebar placed 18 inches on center in the wall and floor panels and the columns which are 14 inches square appear to have two #4 rebar vertical reinforcing bars. The reinforcement in the Murrah Federal building by contrast was much greater, with approximately five times the amount of steel in a typical floor panel. Typical reinforced would call for two layers of #5 rebar with a spacing of nine inches.

The ETS while similar to Murrah must be considered an inferior structure in terms of strength and blast resistance, however direct application of the data will be used to estimate probable damage to the Murrah Federal Building even though the Murrah Federal Building should be expected to provide significantly more blast resistance than the ETS.

#1

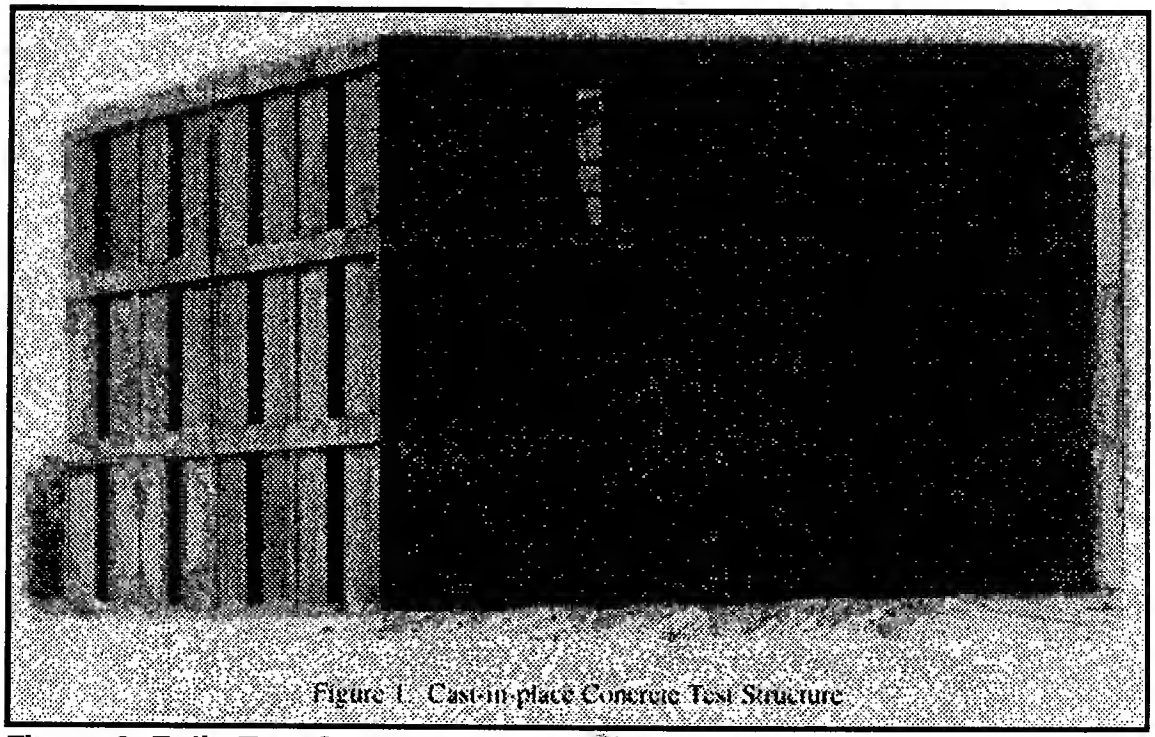

Figure 1. Cast-in-place Concrete Test Structure

Figure 2 Eglin Test Structure prior to Blast Effect Testing

The ETS while having a slab on grade and a second floor 10 feet above the first and the third 10 feet above the second was not constructed with a roof panel as can be seen in the photo of the structure. This lack of roof panel it should be noted reduces the overall rigidity of the structure and in particular the third story wall panels making the third story more susceptible to damage from an explosive device.

While no age for the ETS is given, it is known that this is a purpose built test structure and all indications are that the testing was conducted soon after the structure was completed thereby ruling out additional strength development by the concrete as a function of time. This process is normal to concrete as the strength ratings for concrete are for 28 day cures. Concrete while attaining the specified strength in 28 days will continue to increase in strength over time as a natural process.

In general it can be noted that the ETS exhibits some minor flaws in construction but it can be generally assumed to have been constructed correctly due to the general appearance as shown in the photos. The reinforcement however is not up to industry standards as a general rule for structural purposes. This structure is actually more indicative of some structures to be found in third world countries and is not representative of concrete structures to be found in the United States.

THE BLAST EFFECT TEST SERIES

The United States Air Force conducted a series of live fire tests on the ETS in order to demonstrate-determine the efficacy of various weapon systems components and explosives. Three different explosives tests were conducted on the ETS.

The first test used 704 lbs. of Tritonal which is equivalent to 830 lbs. of TNT or roughly 2,200 lbs. of properly prepared Ammonium Nitrate and Fuel Oil mixture. Because this test most closely parallels the Truck bomb at the Murrah Building this test will be of particular interest to this report. The device was placed 25 feet from the vertical surface of the 40 foot side wall of the ETS. It was encased in a light aluminum case thereby closely duplicating the lightweight enclosure of the device used on the Murrah Federal Building. This is important because the Murrah device was composed of ammonium nitrate - fuel oil contained in blue plastic drums in the back of the Ryder truck, which either was constructed of aluminum skin or of plastic laminate on the cargo body itself. This is in contrast to the other devices in the testing which had heavy casings around the explosive. The heavy casings while providing shrapnel which then causes damage, consume a lot of the energy of the explosive in order to break up the casing itself. This energy consumption is manifested in a reduced peak blast pressure in the shock wave which emanates from the explosion. It is a tradeoff in which a denser mass (bomb casing) is accelerated and causes damage by colliding with the target. This effect will be described in looking at test two and three.

The second test used a standard Mk-82 warhead placed inside the structure on the first floor approximately four feet from the exterior wall. The Mk-82 is a heavy cased weapon designed to hit its' target and provide damage from the case fragmenting and becoming shrapnel when the explosive is detonated as well the damage provided from the resultant shock wave which follows the shrapnel. The casing provides close in mechanical coupling of the blast energy which is always preferable to attempting to destroy a target with an air coupled blast wave. Figure three provided by Wright Laboratory shows a large area of catastrophic structural failure resultant from the target being damaged by first the shrapnel and then in a weakened condition the blast wave which follows. This is a good example of what direct mechanical coupling of explosive energy can produce in terms of damage when contrasted with damage produced from air coupled blast waves alone.

Analysis of the photograph (figure 3) of the post-test structure shows nearly complete destruction of the wall panel and column from the first floor, This is due to damage caused by the shrapnel effect of the bomb casing striking the structure at high velocities and causing the concrete to shatter from the impact. Blast wave effect upon the column would be negligible while the overpressure

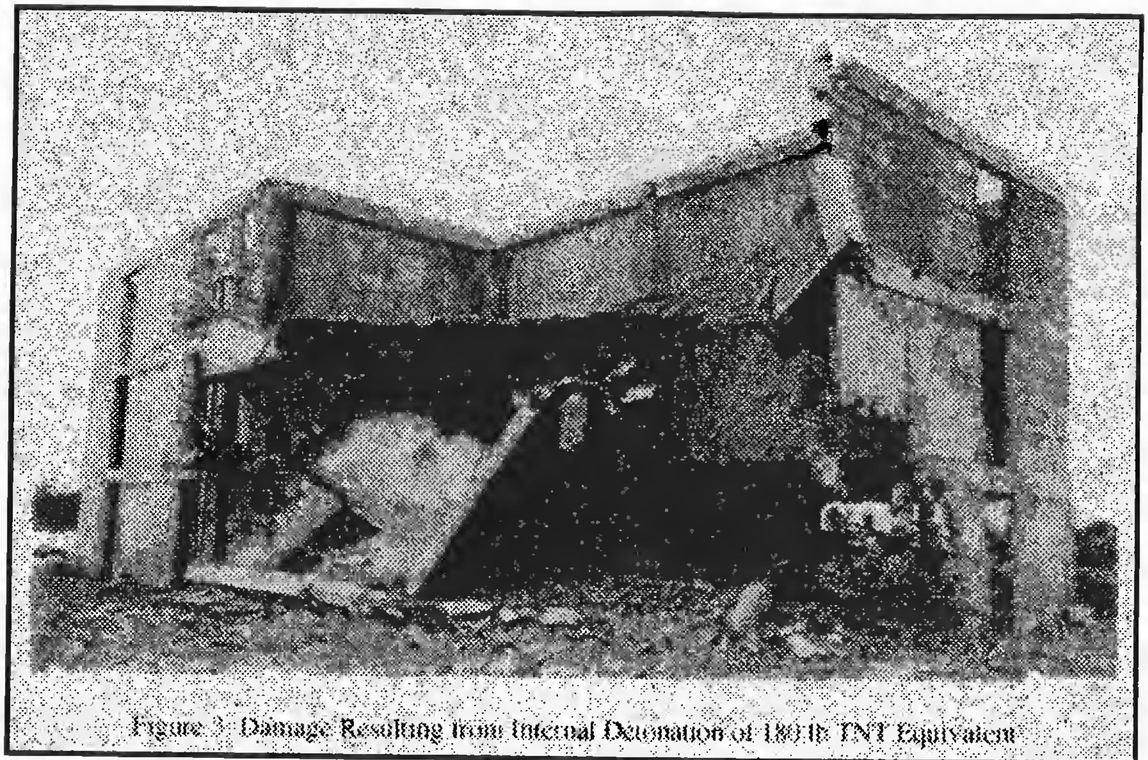

Figure 3 Mk-82 Warhead test result

generated from the explosion of the device placed internally would exceed the limits of the six inch panel. However due to the light reinforcement, peripheral damage caused by loads induced from the panel deflections would be highly improbable due to insufficient reinforcing steel to carry the loads before complete break-up of the panel. While the second floor panel had direct pressure damage, the third floor panel is indicative of gravity induced failure caused by the direct damage to the wall panel, column, and second floor panel from the Mk-82 warhead on the first floor.

The third test involved a 250 lb. class penetrating type warhead with an explosive charge equivalent to 35 lbs. of TNT. Once again as can be seen in the image in Figure three as supplied by Wright Laboratory, the damage caused by even a small amount of explosive when mechanically coupled to the target can be considerable. In this case the Mk-82 device was placed on the second floor in an outside corner approximately 2.5 feet from the walls. As in the case of the Mk-82 warhead, considerable damage is actually produced by the shrapnel effect of the casing of the device itself. It should also be noted that the second test involving the Mk-82 warhead was conducted adjacent to this area. The second test occurred to the right of the third test are as shown in the photograph.

Two things should be noted from the photo. The first item is that the area was cleaned and the remaining second and third floor panels were removed prior to the third test. A visual reference can be seen in the ladder from the Figure four photograph, this ladder can be seen just to the left of the damaged area in figure three. The generally smooth appearance of the third floor support beam in Figure four indicates that the structure was constructed with cold joints in certain areas and is not truly monolithic in terms of floor construction. This condition reduces the stiffness of the structure as well as its total strength. The second item is some of the damage shown in Figure four, particularly in the case of the first floor wall panel must be attributed to the second test and not the third. This damage also provides the third test with a locally weakened structure so as to effectively produce somewhat more damage than would be effected by the same explosive device on an undamaged structure.

Figure four also provides an excellent example of erosion damage caused by the bomb casing. The second floor column in the blast area shows a definite pattern of damage caused by the bomb case fragments impacting and shattering the concrete. This is manifested by the irregular pattern on the edges as can be seen in the photograph. Also bare rebar can be seen in the third floor beam just to the left of the column where this type of damage has occurred. This shows the pattern of damage in which concrete is damaged by debris and then carried away in the trailing shock wave.

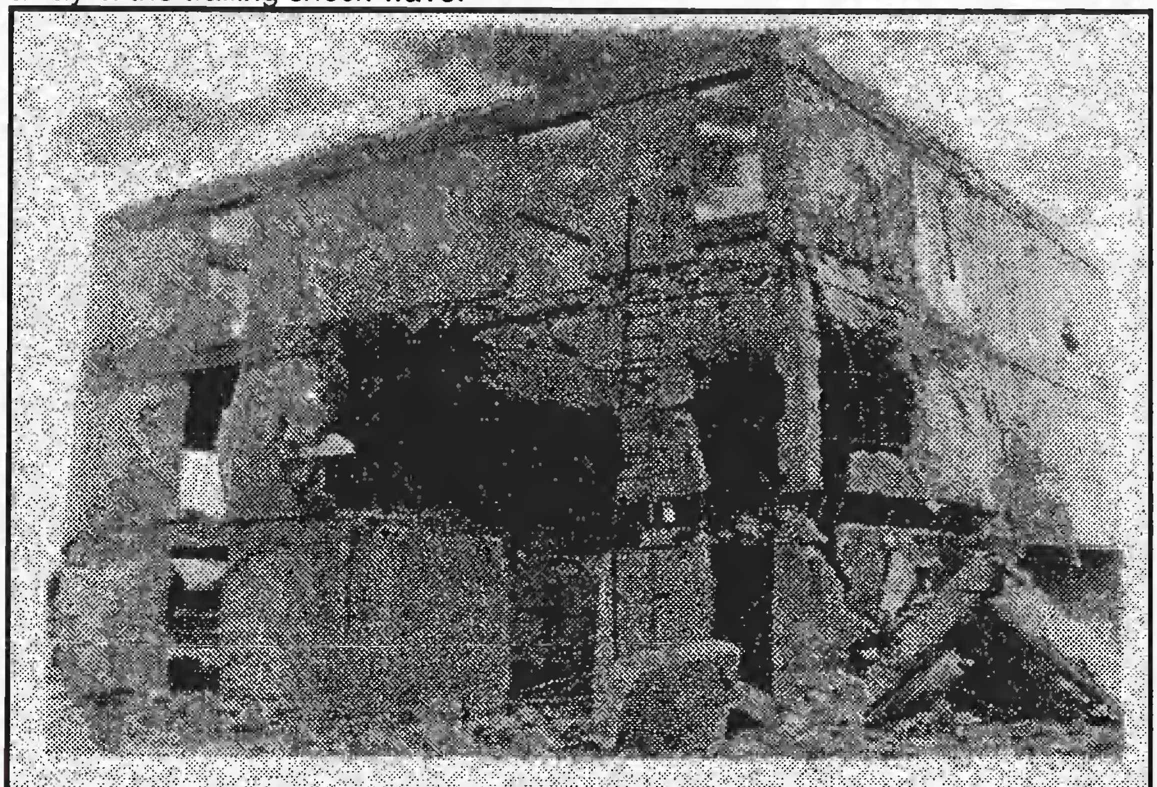

Figure 4: Damage Resulting from Internal Detonation of 35 lb TNT Equivalent

Figure 4 250 lb. Penetrating warhead test result

This photograph also reveals the inherent toughness of concrete, in that much of the structure is remaining even after significant damage caused by the third test.

It should be noted that both the Mk-82 and the 250 lb. penetrator are designed for gravity drop from aircraft and not for static deployment as was the case in these series of tests on the ETS.

The first test is of particular interest because of the similarities to the Murrah Building device and conditions, however tests two and three are of interest because they show the inherent resistance of monolithically constructed reinforced concrete structures and the characteristics of damage caused by mechanical coupling of the explosive forces to the target.

ANALYSIS OF THE FIRST BLAST EFFECT TEST

Detailed analysis of the first blast effect test was undertaken in order to provide a baseline for predictive yield points of reinforced concrete in explosive conditions. The method devised was to compile a matrix of the maximum potential blast pressure for the face of the structure as calculated from the maximum possible yield of the aluminum cased device based upon the information supplied by the Armament Directorate at Wright Laboratory, Eglin Air Force Base, Florida.

A pressure map matrix was prepared for the vertical face of the structure by mapping the structure in a one foot grid with allowance for the 1.22 foot radius of the explosive material. This pressure map matrix was then transferred to the stations laid out on an elevation of the north face. The maximum potential blast pressures at various damage areas could thus be noted in this manner. The entire pressure map matrix is found in Appendix A. of this study.

Maximum potential blast pressure was calculated by using the straight line distance from the center of the explosive device to the station on the face of the test structure. Maximum potential blast pressure is calculated as the inverse function of the distance (in radius units) cubed, or it can be expressed as the following equation:

$$p2 = p1 / (d \cdot d \cdot d) \quad \text{or} \quad p2 = p1 / d^3$$

where:

p1 is the blast pressure of the explosive(in this case TNT is 1,500,000psi.)

p2 is the blast pressure at the distance from the center of the device

d is the distance expressed in radius units of the sphere of explosive material (in the case of TNT 830 lbs. is a sphere of 2.4 feet in diameter therefore producing a radius of 1.2 feet)

In this equation the explosive material is assumed to be in spherical form.

Straight line distances for the matrix were calculated with standard trigonometric right triangle equations with the center of the explosive device placed at 25 feet from the vertical face per the data given by the Armament Directorate, and 1.2 feet from the horizontal plane which is assumed to be the ground. Maximum dynamic pressure or maximum potential blast pressure occurred at a point 20 feet from the corner of the building in the center of the face and 1.2 feet in altitude from the ground, the maximum pressure at this point is calculated at 174.3 psi.

It should be noted that these are maximum potential blast pressures and actual pressures can be affected by the final configuration of the explosive, chemical efficiency of the explosive charge ambient conditions such as temperature and pressure at the site. Also the actual pressure experienced by the test structure in the case of the first test could be higher due to reflectance caused by the placement of the explosive directly on the ground. This is in contrast to the Murrah truck bomb where the center of the device was some six feet above the street thereby allowing a four foot air gap which would significantly reduce this phenomenon.

Analysis of the ETS was conducted without adding a factor for reflectance which in effect then produces a lower possible yield point pressure for damage. This provides a very conservative damage estimation tool for analyzing the expected damage potential of any air coupled explosive device, thereby insuring that the results produced will not result in higher allowable pressures for anticipating damage in reinforced concrete structures.

Because the explosive device was located on the ETS face center line, the determinate factor in assessing damage from the blast is a symmetrical pattern of damage on both the left and right halves of the face. Damage not manifested in a symmetrical pattern is classified as peripheral and is caused by the local stiffness of the reinforced concrete panel as an indirect product of the blast wave.

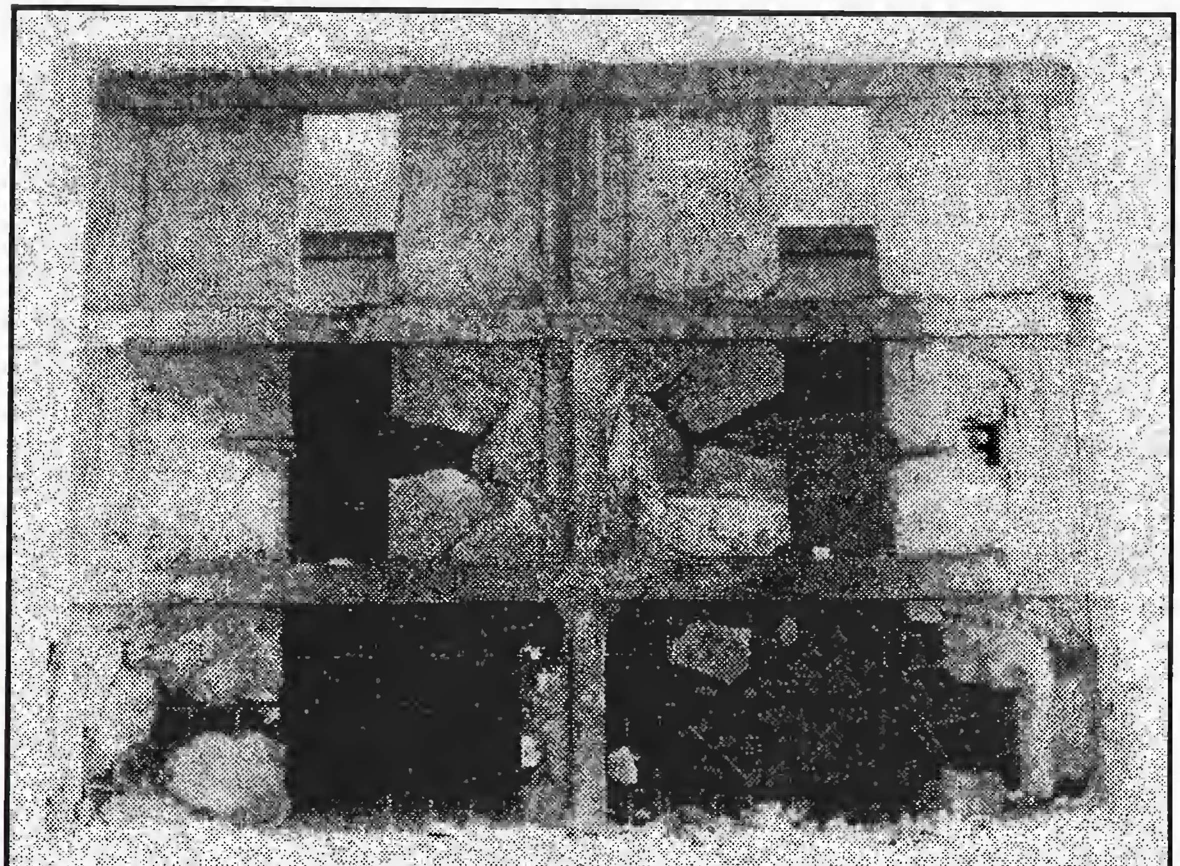

Figure 2: Damage Resulting from External Detonation of 830 lb TNT Equivalent

Figure 5 Test One, air coupled blast effect test, In viewing the post test photo of the ETS from the first test is important to note the lack of damage caused by shrapnel from the explosion. This is consistent with lightly cased explosive devices and in particular with air coupled blast damage. The reinforcing steel can still be seen in place on the photograph showing in particular the failure mode of the concrete panel. In the case of the air coupled blast wave, the concrete simply breaks up as its' elastic limit is reached leaving the steel reinforcement in place. This is important to note because the yield strength of the steel is approximately 20 times higher then that of the concrete which surrounds it. As the concrete breaks up the steel remains unaffected other than some deflection as the concrete moves. The force required to deflect or bend the #4 rebar is quite low and can easily be duplicated by hand efforts by the typical adult. The other item of importance to note is that the 14 inch columns and beams remain unaffected either by the blast pressure wave or by stresses produced by the reinforcing steel as the six inch concrete panels break up. As the concrete panels break up some pulling force or tension is generated upon the length of the reinforcing bars and is absorbed by the columns and beams to which they are anchored.

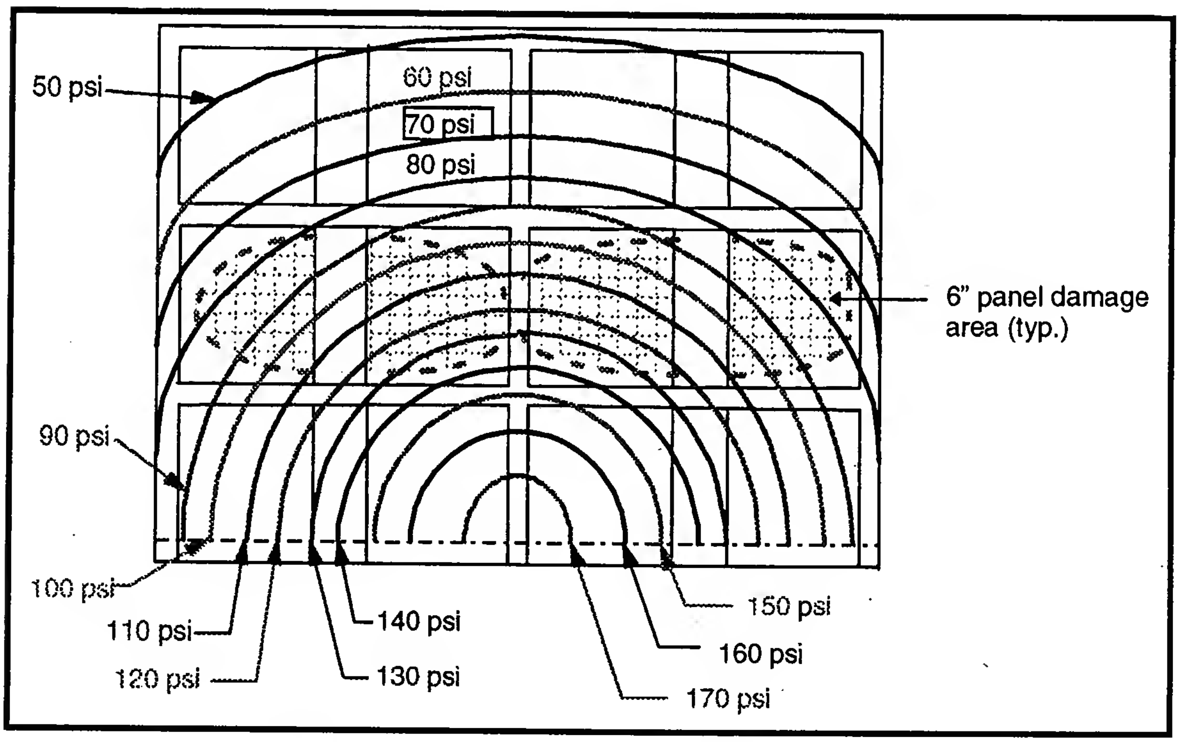

Figure 6 Pressure Map Overlay of the first blast test

The vertical face of the ETS in test one experienced a range of maximum blast pressure from 34 psi to 174 psi. Maximum blast pressure on the first floor wall panel of which the six inch panel was completely destroyed ranged from 74 psi to the maximum experienced of 174 psi. The second floor which experienced serious damage to the wall panels had a range of maximum blast pressures of 53 psi to 141 psi. Three third floor which experienced no damage had maximum blast pressures of 34 psi to 84 psi.

In examining the resultant pressures and the damage caused by the test, a general selection has been made of 70 psi as being the yield factor for six inch concrete panel of 3,000 psi strength and light steel reinforcement. While the third floor panels experienced blast pressures in excess of 70 psi in certain areas, it is generally felt that the area experiencing 70 psi to the maximum of 84 psi is small and has been generally discounted in arriving at the 70 psi figure. This figure will be used to identify the probable damage zones from a blast pressure wave resulting from the detonation of 4,800 lbs. of Ammonium Nitrate - Fuel Oil (ANFO) as it relates to six inch concrete panel which is the primary component of the Murrah Federal Building floors. It should be noted that this pressure value is relevant for blast pressure waves intersecting the panel in near perpendicular paths of travel. Blast pressure waves striking panels from other than right angles do so with reduced effectiveness, as the angle increase the effectiveness is reduced. A blast pressure wave striking a target at 45 degrees has only 70% effectiveness i.e.: the target while struck with 100 psi would only reasonably absorb or experience approximately 70 psi. of blast pressure.

The blast pressure overlay while not directly taking into account these angles, is relevant to the Murrah explosion because the truck placement roughly correlates to the placement of the device in the ETS test when comparing relative placement of structure and configuration of that structure. Because of a variety of factors inherent to explosions, it is impossible to exactly duplicate some effects down to the tiniest detail, however by choosing the weaker structure (ETS) as our basis for estimating potential damage from blast effect. an essentially accurate estimate of anticipated damage can be formulated from these test results.

RELATING THE EGLIN TEST DATA TO THE MURRAH FEDERAL BUILDING

The bombing of the Murrah Federal Building and the resulting collapse of so much of the building has raised many questions as to the efficacy of the truck bomb. Utilizing the data from the Eglin Test Series it is possible to produce an expected radius from the center of the device in which damage to six inch panel would be expected. The floor panels in Murrah are of the same thickness and starting with the third floor have a similar positional relationship with the explosive device. The second floor panels terminate some ten feet inside the north line of the building and are placed so as to be roughly perpendicular with the blast wave direction of travel.

The columns and beams of the Murrah building are anticipated to behave in roughly the same manner as their counterparts on the ETS. While some maximum blast pressures will be higher than those experienced on the ETS the Murrah columns and beams are much larger, constructed of higher strength concrete, have many times more steel reinforcement and are ballasted by the weight of the building, factors not present in the ETS, which had no damage to the columns and beams after the first test.

The floor panels are far more susceptible to blast pressure damage due to their large surface area and small cross section, the wall panels of the ETS demonstrated this phenomenon in the first test as well as in the second and third.

The floor panels in the Murrah Federal Building as outlined earlier had approximately five times as much steel reinforcement for a given cross section as the ETS. The larger contrast however is in the columns and beams where the steel fill in the Murrah Building was much higher than the ETS in most cases by a factor of 10 or more. In addition while the ETS did not use stirrups in its' columns and beams the Murrah Federal Building did thereby increasing strength to a level far above the ETS.

In identifying the areas of probable damage on the Murrah Federal Building we must first determine at what radius from the device will manifest a blast pressure of 70 psi or more. It is within this radius that we would find predicted damage potential to the six inch panel in the structure. To find the distance we must know the blast pressure of ammonium nitrate and the diameter of the explosive material based upon the total weight. To find the distance we can use the following equation:

$$dr = \sqrt[3]{p1/70}$$

where:
p1 is the blast pressure of the explosive(in this case ANFO is 500,000psi.)
dr is the distance expressed in radius units of the sphere of explosive material (in the case of ANFO 4,800 lbs. is a sphere of 4.4 feet in diameter therefore producing a radius of 2.2 feet)

70 is the blast pressure expressed in pounds per square inch (psi) at the point we are seeking the radius distance for.

In this equation the explosive material is assumed to be in spherical form.

The distance in feet can then be calculated by the following equation:

$$d = dr \cdot 2.2$$

where:
d is the distance from the center of the explosive material expressed in feet
dr is the distance expressed in radius units of the sphere of explosive material (in the case of ANFO 4,800 lbs. is a sphere of 4.4 feet in diameter therefore producing a radius of 2.2 feet)

In this equation the explosive material is assumed to be in spherical form.

Therefore:

$$dr = \sqrt[3]{500{,}000/70}$$

$$dr = 19.26$$

Thus:

$$d = 19.26 \cdot 2.2$$

$$d = 42.37 \text{ feet}$$

It can therefore be expected that within a radius of 42.37 feet from the center of the explosive, any six inch reinforced concrete panel positioned so as to have a major face perpendicular or nearly perpendicular to the travel path of the blast pressure wave from the explosion would be damaged. This damage would in general be confined to the six inch panel itself and based upon the findings in the ETS first test, that damage would be found in the center of the panel as defined by framing of larger structural members and then would be expected to radiate outward.

A limited area of the third and fourth floors of the Murrah Federal Building immediately adjacent to the position of the Ryder truck would be affected. On the third floor a roughly circular shape extending 25 feet into the building and approximately 40 feet down the north face of the building from a center point adjacent to the center point of the explosive which was located some 14.5 feet north of the north face of the building. This circular area contained approximately 1,250 square feet of six inch panel, it should be noted that the northern edge of the third floor terminated with a transfer beam of some three foot in width and five feet in depth. This beam carried the load from the remaining six floors and the roof which was transferred to it by a column placed in the middle of its' 40 foot span. The transfer beam itself weighed 60,000 lbs. and was found essentially intact and undamaged by the effects of the blast pressure wave.

The fourth floor panel that experienced 70 psi and above was limited to a roughly circular shaped pattern of approximately 400 square feet. In the case of both the third and fourth floor some failure of the six inch panel would be expected to be found in the center of each panels 16 foot span and emanating outward. In general a central rupture with loss of concrete would be expected based upon the post test appearance of the ETS.

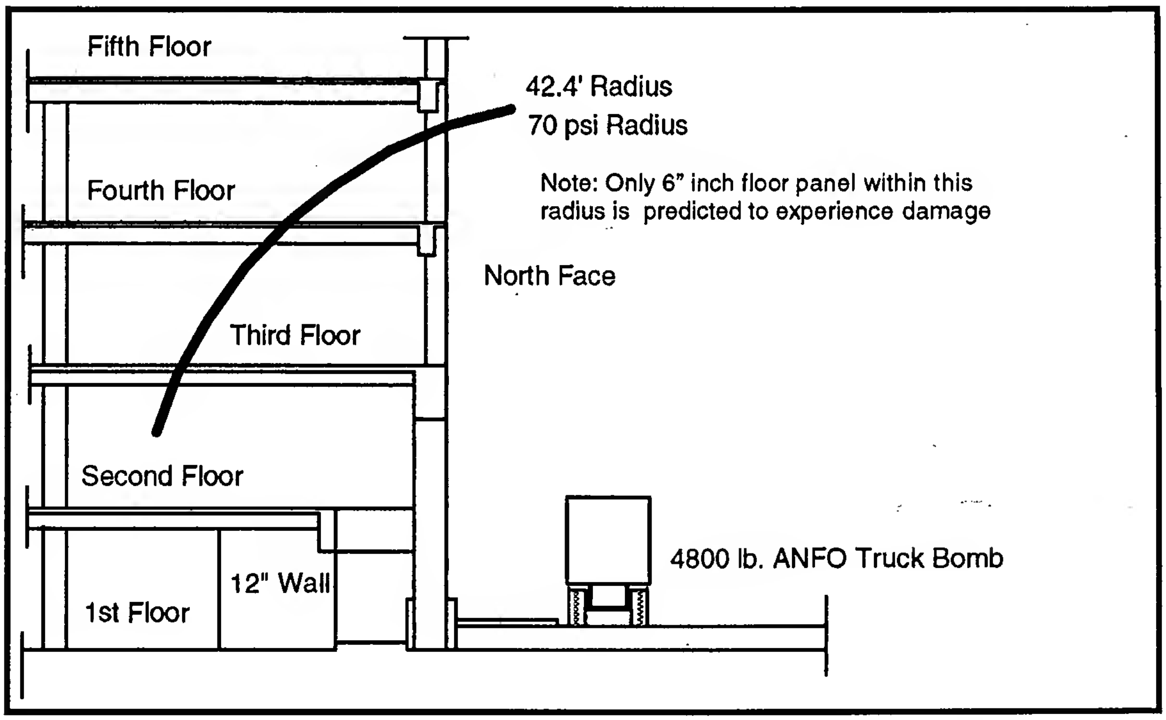

Figure 7 Cross section of the Murrah Federal Building showing the relation of the truck bomb to the structure and floor panels

Because the floor panels were supported by T-beams running north-south every 20 feet and these T-beams were of 22 inches depth and 48 inches width the floor panels were only 16 feet in width between the beams. Due to the sizing and mass of the T-beams they should remain unaffected as in the case of the 14 inch beams on the ETS. The six inch panels on the Murrah building should be expected to have additional resistance when compared to the ETS because they are in the horizontal plane and have the effect of gravity which provides some measure of dampening whereas the ETS panels were in the vertical plane without the effect of gravity. In addition no floor damage to the second or third floors of the ETS in the first test can be seen in the photograph or was noted in the memorandum from Wright Laboratory. This fact suggests that more than the 70 psi threshold is required to damage floor panels in events similar to the Murrah bombing or the ETS first test.

No peripheral damage would be expected from transfer of loads imposed by the explosion on the panels to the structure because as demonstrated on the ETS concrete separates from the steel reinforcement before sufficient tension can be applied to the rebar to overload the support members. In the case of the Murrah building although the rebar is slightly larger 5/8" versus 1/2" in diameter and spaced 9" on center as opposed to 18" on center the panel would be expected to rupture in the center long before sufficient loads can be imposed on the structural members that would even approach exceeding structural limits.

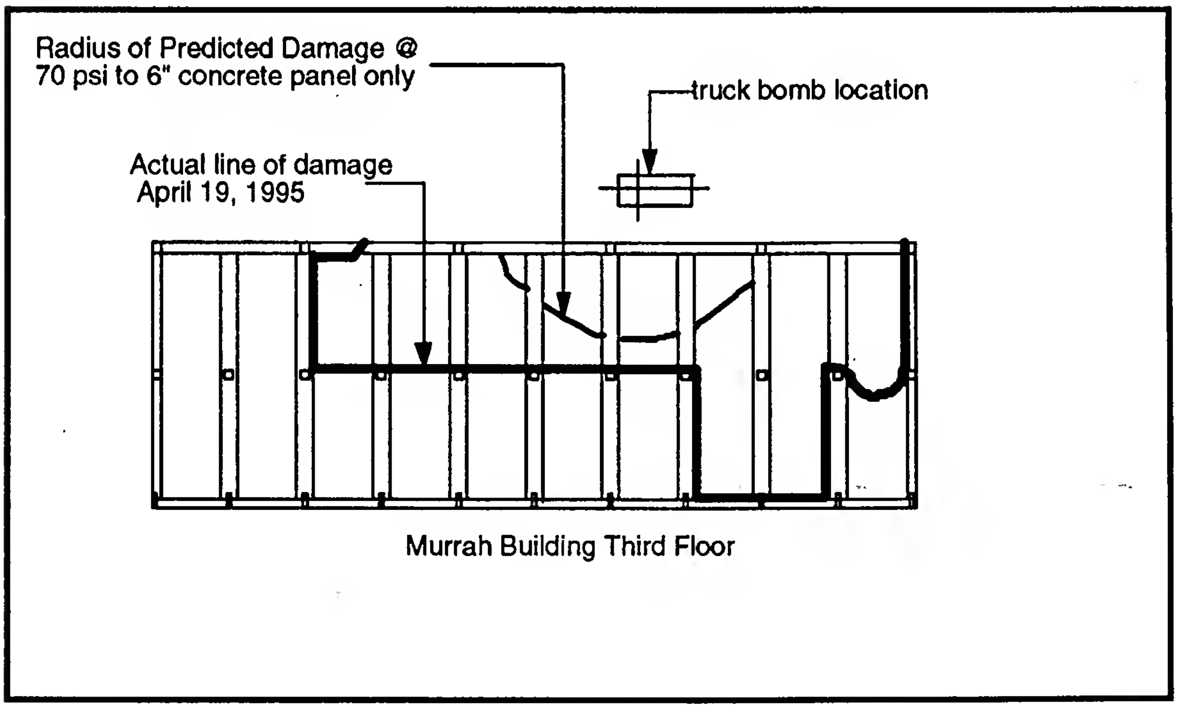

Figure 8 Floor plan showing maximum predicted damage to third floor and the actual line of damage experienced on April 19, 1995.

CONCLUSION

While the truck bomb at the Murrah Federal Building, and the test device at the ETS were not identical devices with identical conditions, the two events have similarities that are significant enough for comparison. Further with the ETS having less integral strength than the Murrah Federal Building conclusions drawn directly from the ETS have a built in margin of error thereby eliminating the likelihood of drawing erroneous conclusions with respect to the minimal effects anticipated from an explosive blast.

It should also be noted that the test device at Eglin had the benefit of highly trained individuals constructing it. Furthermore the explosive material was small enough to be assembled in a single dense package and was of a high energy compound thereby assuring peak performance.

The Murrah device was composed of individual drums of approximately 600 lbs. maximum capacity. Eight drums would be the minimum required containment for 4,800 lbs. of ANFO. By having the explosive mixture in many containers efficiency is lost because the explosive is not densely packed. With air gaps between the drums they become in effect eight separate explosive devices working in unison. Efficiency would also be reduced if detonation was not obtained simultaneously by all eight barrels. If some of the barrels depended upon others for detonation you have what would in effect be staggered explosions, while for all purposes these would be indistinguishable, this would result in a variety of shock waves leaving the assembly at different times.

The air gaps would also result in the barrels attempting to cancel each other out as the individual shock waves meet in the air gap. The net effect would be to produce an initial shock wave pattern that is elliptical in nature and would result in much of the explosive energy taking a focus directly vertical from the assembly. While the pattern would eventually circularize and form a spherical shape much energy and therefore efficiency is lost in this transition.

Because ANFO is also a low energy explosive (approximately 30% that of TNT) and due to the inherent inefficiency of eight barrels forming the explosive assembly, it is doubtful that the device produced blast pressures close to the calculated maximum potential blast pressure. This being the case it is doubtful that the radius of damage even approached the 42.37 foot range as calculated herein.

Due to these conditions it is impossible to ascribe the damage that occurred on April 19, 1995 to a single truck bomb containing 4,800 lbs. of ANFO. In fact the maximum predicted damage to the floor panels of the Murrah Federal building is equal to approximately 1% of the total floor area of the building. Furthermore due to the lack of symmetrical damage pattern at the Murrah Building it would be inconsistent with the results of the ETS test one to state that all of the damage to the Murrah Building is the result of the truck bomb.

The damage to the Murrah Federal Building is consistent with damage resulting from mechanically coupled devices placed locally within the structure as there are certain similarities with the resultant damage to the Murrah Building and with tests two and three.

It must be concluded that the damage at the Murrah Federal Building is not the result of the truck bomb itself, but rather due to other factors such as locally placed charges within the building itself. As can be seen from the tests conducted at Eglin Air Force Base under known conditions producing damage to reinforced concrete structures is difficult. Reinforced Concrete exhibits damage resistance that is far above other types of construction including precast concrete and masonry.

The procedures used to cause the damage to the Murrah building are therefore more involved and complex than simply parking a truck and leaving. Additional study beyond the scope of this case study will be required in order to properly interpret the damage, describe the actual chain of events and fix the cause of the damage which occurred there on April 19, 1995.

APPENDIX "A"

Appendix "A" contains the tables with the pressure values relative to position on the vertical face of the Eglin Test Structure (ETS). The method for calculating these blast pressure values is outlined below in the description of the data tables.

The tables were developed by defining a series of stations on the vertical face of the ETS. Looking face on to the ETS the lower left corner is identified as horizontal station -002 which is the horizontal line running along the ground and is -1.22 feet vertical from the center of the explosive device. Horizontal station 0 is the horizontal line running at 1.22 feet above the ground or in direct alignment with the center of the explosive device. Each page of the tables is the full data for each horizontal station line.

The coordinate or vertical station is identified in column "A" on the data tables and these represent points on the horizontal station line and station coordinates are located by one foot spacing. The left vertical edge of the structure is vertical station line 1, vertical station line 2 is located one foot to the right of vertical station line 1.

Column "B" has the value for the base distance on horizontal station line 0 from the center point of the explosive device. The value is the hypotenuse of a right triangle with a base distance of 25 feet and the altitude of the triangle defined as the distance from the center of the structure along horizontal station line 0 to the coordinate point defined in column "A".

Column "C" is the altitude of the horizontal station line relative to the vertical spacing from a horizontal plane defined as the center of the explosive device.

Column " D" is the Mean Blast Distance, this the straight-line distance from the center of the explosive device to the coordinate position on the vertical face of the ETS. This value is expressed in feet, and is the hypotenuse of a right triangle where the base is the Column "B' base value for the coordinate and the altitude of the triangle is the altitude value in Column "C" for the coordinate.

Column "E" is the Mean Distance in "r" units, this is the Mean Blast distance as expressed in radius ("r") units. This is calculated by taking the Mean Blast Distance in feet for a given coordinate and dividing it by 1.22 which is the value in feet for the radius of the explosive device.

The equation for this column is expressed as:

$$\mathbf{dr = d / 1.22}$$

Where:

dr is the distance in radius units
d is the mean blast distance in feet
1.22 is the value of radius of the explosive material in feet

Column "F" is the Blast Pressure expressed in pounds per square inch (PSI). This is the maximum potential blast pressure for the specific coordinate based upon the straight line distance to the coordinate location from the center of the explosive device. It is calculated by dividing the blast pressure of the explosive at its' source (1,500,000 psi) by the value of the radius units cubed. The equation for this column is expressed as:

$$\mathbf{p2 = 1{,}500{,}000 / r^3}$$

Where:

p2 is the blast pressure at the coordinate in psi
1,500,000 is the value of the blast pressure at the source in psi
r^3 is the value in radius units cubed

The data tables can thus be utilized to find the maximum potential blast pressure for any coordinate on the vertical face of the ETS used in test one.

	A	B	C	D	E	F
1	Horiz. Sta. -002v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
2	1	32.016	-1.22	32.03883649	26.26134138	82.82101396
3	2	31.401	-1.22	31.42429125	25.75761578	87.77569509
4	3	30.806	-1.22	30.82994832	25.27044945	92.95063494
5	4	30.232	-1.22	30.25700596	24.80082456	98.33155308
6	5	29.682	-1.22	29.70666219	24.34972311	103.8984762
7	6	29.155	-1.22	29.18031465	23.9182907	109.6227871
8	7	28.653	-1.22	28.679061	23.50742705	115.4718086
9	8	28.178	-1.22	28.20439831	23.11835927	121.4004323
10	9	27.731	-1.22	27.75762361	22.7521505	127.3573176
11	10	27.313	-1.22	27.34023352	22.41002748	133.2797262
12	11	26.926	-1.22	26.95342475	22.0929711	139.1005622
13	12	26.571	-1.22	26.59869355	21.80220783	144.7404217
14	13	26.249	-1.22	26.27713648	21.53863646	150.1193381
15	14	25.962	-1.22	25.99014972	21.30340141	155.1473662
16	15	25.71	-1.22	25.73882977	21.09740145	159.7365713
17	16	25.495	-1.22	25.52427323	20.92153544	163.7987549
18	17	25.318	-1.22	25.34737706	20.77653858	167.2521368
19	18	25.179	-1.22	25.20893858	20.66306441	170.0227634
20	19	25.08	-1.22	25.10955563	20.58160298	172.0496011
21	20	25.01	-1.22	25.03973842	20.52437575	173.4927729
22	21	25	-1.22	25.0297503	20.51618877	173.7005526
23	22	25.01	-1.22	25.03973842	20.52437575	173.4927729
24	23	25.08	-1.22	25.10955563	20.58160298	172.0496011
25	24	25.179	-1.22	25.20893858	20.66306441	170.0227634
26	25	25.318	-1.22	25.34737706	20.77653858	167.2521368
27	26	25.495	-1.22	25.52427323	20.92153544	163.7987549
28	27	25.71	-1.22	25.73882977	21.09740145	159.7365713
29	28	25.962	-1.22	25.99014972	21.30340141	155.1473662
30	29	26.249	-1.22	26.27713648	21.53863646	150.1193381
31	30	26.571	-1.22	26.59869355	21.80220783	144.7404217
32	31	26.926	-1.22	26.95342475	22.0929711	139.1005622
33	32	27.313	-1.22	27.34023352	22.41002748	133.2797262
34	33	27.731	-1.22	27.75762361	22.7521505	127.3573176
35	34	28.178	-1.22	28.20439831	23.11835927	121.4004323
36	35	28.653	-1.22	28.679061	23.50742705	115.4718086
37	36	29.155	-1.22	29.18031465	23.9182907	109.6227871
38	37	29.682	-1.22	29.70666219	24.34972311	103.8984762
39	38	30.232	-1.22	30.25700596	24.80082456	98.33155308
40	39	30.806	-1.22	30.82994832	25.27044945	92.95063494
41	40	31.401	-1.22	31.42429125	25.75761578	87.77569509
42	41	32.016	-1.22	32.03883649	26.26134138	82.82101396
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	A	B	C	D	E	F
52	Horiz. Sta. -001v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
53	1	32.016	-1	32.03121358	26.2550931	82.88015818
54	2	31.401	-1	31.41651923	25.75124527	87.84085475
55	3	30.806	-1	30.82202644	25.2639561	93.02232397
56	4	30.232	-1	30.24893403	24.79420822	98.41029348
57	5	29.682	-1	29.69844068	24.34298416	103.9847877
58	6	29.155	-1	29.17194479	23.91143016	109.7171713
59	7	28.653	-1	28.67054481	23.50044656	115.5747371
60	8	28.178	-1	28.19573876	23.11126128	121.5123212
61	9	27.731	-1	27.74882464	22.74493823	127.4785087
62	10	27.313	-1	27.33130017	22.40270506	133.4104581
63	11	26.926	-1	26.94436315	22.08554357	139.2409512
64	12	26.571	-1	26.58951106	21.7946812	144.8904285
65	13	26.249	-1	26.26784158	21.53101769	150.278754
66	14	25.962	-1	25.98075215	21.29569848	155.3157834
67	15	25.71	-1	25.72934041	21.08962329	159.9133761
68	16	25.495	-1	25.51470407	20.91369186	163.9831196
69	17	25.318	-1	25.3377411	20.76864025	167.4430278
70	18	25.179	-1	25.19924968	20.65512269	170.2189559
71	19	25.08	-1	25.09982837	20.57362981	172.2497086
72	20	25.01	-1	25.02998402	20.51638034	173.6956868
73	21	25	-1	25.01999201	20.50819017	173.9038718
74	22	25.01	-1	25.02998402	20.51638034	173.6956868
75	23	25.08	-1	25.09982837	20.57362981	172.2497086
76	24	25.179	-1	25.19924968	20.65512269	170.2189559
77	25	25.318	-1	25.3377411	20.76864025	167.4430278
78	26	25.495	-1	25.51470407	20.91369186	163.9831196
79	27	25.71	-1	25.72934041	21.08962329	159.9133761
80	28	25.962	-1	25.98075215	21.29569848	155.3157834
81	29	26.249	-1	26.26784158	21.53101769	150.278754
82	30	26.571	-1	26.58951106	21.7946812	144.8904285
83	31	26.926	-1	26.94436315	22.08554357	139.2409512
84	32	27.313	-1	27.33130017	22.40270506	133.4104581
85	33	27.731	-1	27.74882464	22.74493823	127.4785087
86	34	28.178	-1	28.19573876	23.11126128	121.5123212
87	35	28.653	-1	28.67054481	23.50044656	115.5747371
88	36	29.155	-1	29.17194479	23.91143016	109.7171713
89	37	29.682	-1	29.69844068	24.34298416	103.9847877
90	38	30.232	-1	30.24893403	24.79420822	98.41029348
91	39	30.806	-1	30.82202644	25.2639561	93.02232397
92	40	31.401	-1	31.41651923	25.75124527	87.84085475
93	41	32.016	-1	32.03121358	26.2550931	82.88015818
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	A	B	C	D	E	F
103	Horiz. Sta. 000v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
104	1	32.016	0	32.0156	26.24229508	83.00147596
105	2	31.401	0	31.4006	25.73819672	87.97452107
106	3	30.806	0	30.8058	25.25065574	93.16939524
107	4	30.232	0	30.2324	24.78065574	98.57184285
108	5	29.682	0	29.6816	24.32918033	104.1618841
109	6	29.155	0	29.1548	23.89737705	109.9108462
110	7	28.653	0	28.6531	23.48614754	115.785961
111	8	28.178	0	28.178	23.09672131	121.7419508
112	9	27.731	0	27.7308	22.73016393	127.7272481
113	10	27.313	0	27.313	22.38770492	133.6787996
114	11	26.926	0	26.9258	22.07032787	139.5291358
115	12	26.571	0	26.5707	21.7792623	145.1983774
116	13	26.249	0	26.2488	21.51540984	150.6060401
117	14	25.962	0	25.9615	21.27991803	155.6615701
118	15	25.71	0	25.7099	21.07368852	160.2764036
119	16	25.495	0	25.4951	20.89762295	164.3616876
120	17	25.318	0	25.318	20.75245902	167.8350122
121	18	25.179	0	25.1794	20.63885246	170.6218395
122	19	25.08	0	25.0799	20.55729508	172.6606413
123	20	25.01	0	25.01	20.5	174.1123895
124	21	25	0	25	20.49180328	174.321408
125	22	25.01	0	25.01	20.5	174.1123895
126	23	25.08	0	25.0799	20.55729508	172.6606413
127	24	25.179	0	25.1794	20.63885246	170.6218395
128	25	25.318	0	25.318	20.75245902	167.8350122
129	26	25.495	0	25.4951	20.89762295	164.3616876
130	27	25.71	0	25.7099	21.07368852	160.2764036
131	28	25.962	0	25.9615	21.27991803	155.6615701
132	29	26.249	0	26.2488	21.51540984	150.6060401
133	30	26.571	0	26.5707	21.7792623	145.1983774
134	31	26.926	0	26.9258	22.07032787	139.5291358
135	32	27.313	0	27.313	22.38770492	133.6787996
136	33	27.731	0	27.7308	22.73016393	127.7272481
137	34	28.178	0	28.178	23.09672131	121.7419508
138	35	28.653	0	28.6531	23.48614754	115.785961
139	36	29.155	0	29.1548	23.89737705	109.9108462
140	37	29.682	0	29.6816	24.32918033	104.1618841
141	38	30.232	0	30.2324	24.78065574	98.57184285
142	39	30.806	0	30.8058	25.25065574	93.16939524
143	40	31.401	0	31.4006	25.73819672	87.97452107
144	41	32.016	0	32.0156	26.24229508	83.00147596
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	A	B	C	D	E	F
154	Horiz. Sta. +001\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
155	1	32.016	0.78	32.02510021	26.25008214	82.927631
156	2	31.401	0.78	31.41028622	25.74613625	87.89315813
157	3	30.806	0.78	30.81567318	25.25874851	93.07987096
158	4	30.232	0.78	30.24246038	24.78890195	98.47350361
159	5	29.682	0.78	29.691847	24.33757951	104.0540788
160	6	29.155	0.78	29.16523209	23.90592795	109.7929466
161	7	28.653	0.78	28.66371469	23.4948481	115.6573758
162	8	28.178	0.78	28.18879359	23.10556852	121.6021581
163	9	27.731	0.78	27.74176758	22.73915376	127.5758188
164	10	27.313	0.78	27.32413528	22.3968322	133.5154336
165	11	26.926	0.78	26.93709535	22.07958635	139.353686
166	12	26.571	0.78	26.58214624	21.78864446	145.0108915
167	13	26.249	0.78	26.26038654	21.524907	150.4067779
168	14	25.962	0.78	25.97321471	21.28952025	155.4510408
169	15	25.71	0.78	25.7217293	21.08338467	160.0553743
170	16	25.495	0.78	25.50702891	20.90740075	164.1311936
171	17	25.318	0.78	25.33001232	20.76230518	167.5963469
172	18	25.179	0.78	25.19147841	20.64875279	170.376536
173	19	25.08	0.78	25.0920263	20.56723467	172.4104354
174	20	25.01	0.78	25.02216018	20.50996736	173.8586694
175	21	25	0.78	25.01216504	20.50177462	174.0671802
176	22	25.01	0.78	25.02216018	20.50996736	173.8586694
177	23	25.08	0.78	25.0920263	20.56723467	172.4104354
178	24	25.179	0.78	25.19147841	20.64875279	170.376536
179	25	25.318	0.78	25.33001232	20.76230518	167.5963469
180	26	25.495	0.78	25.50702891	20.90740075	164.1311936
181	27	25.71	0.78	25.7217293	21.08338467	160.0553743
182	28	25.962	0.78	25.97321471	21.28952025	155.4510408
183	29	26.249	0.78	26.26038654	21.524907	150.4067779
184	30	26.571	0.78	26.58214624	21.78864446	145.0108915
185	31	26.926	0.78	26.93709535	22.07958635	139.353686
186	32	27.313	0.78	27.32413528	22.3968322	133.5154336
187	33	27.731	0.78	27.74176758	22.73915376	127.5758188
188	34	28.178	0.78	28.18879359	23.10556852	121.6021581
189	35	28.653	0.78	28.66371469	23.4948481	115.6573758
190	36	29.155	0.78	29.16523209	23.90592795	109.7929466
191	37	29.682	0.78	29.691847	24.33757951	104.0540788
192	38	30.232	0.78	30.24246038	24.78890195	98.47350361
193	39	30.806	0.78	30.81567318	25.25874851	93.07987096
194	40	31.401	0.78	31.41028622	25.74613625	87.89315813
195	41	32.016	0.78	32.02510021	26.25008214	82.927631
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	A	B	C	D	E	F
205	Horiz. Sta. +002\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
206	1	32.016	1.78	32.06504395	26.28282291	82.61810561
207	2	31.401	1.78	31.4510108	25.77951705	87.55217266
208	3	30.806	1.78	30.85718253	25.29277256	92.70474051
209	4	30.232	1.78	30.2847554	24.82357	98.06150175
210	5	29.682	1.78	29.73492523	24.37288953	103.6024912
211	6	29.155	1.78	29.20908699	23.94187459	109.299155
212	7	28.653	1.78	28.70833572	23.53142272	115.1189189
213	8	28.178	1.78	28.23416519	23.14275835	121.0168647
214	9	27.731	1.78	27.78786909	22.77694188	126.941907
215	10	27.313	1.78	27.37094023	22.43519691	132.8316607
216	11	26.926	1.78	26.98457162	22.11850133	138.6194486
217	12	26.571	1.78	26.63025532	21.82807813	144.2263989
218	13	26.249	1.78	26.30908401	21.56482296	149.5731252
219	14	25.962	1.78	26.02244958	21.32987671	154.5703619
220	15	25.71	1.78	25.77144462	21.12413494	159.1308784
221	16	25.495	1.78	25.55716189	20.94849335	163.1672068
222	17	25.318	1.78	25.38049495	20.80368439	166.5982709
223	18	25.179	1.78	25.2422381	20.6903591	169.3507694
224	19	25.08	1.78	25.14298678	20.60900555	171.3642207
225	20	25.01	1.78	25.07326265	20.55185463	172.7977968
226	21	25	1.78	25.06328789	20.5436786	173.0041906
227	22	25.01	1.78	25.07326265	20.55185463	172.7977968
228	23	25.08	1.78	25.14298678	20.60900555	171.3642207
229	24	25.179	1.78	25.2422381	20.6903591	169.3507694
230	25	25.318	1.78	25.38049495	20.80368439	166.5982709
231	26	25.495	1.78	25.55716189	20.94849335	163.1672068
232	27	25.71	1.78	25.77144462	21.12413494	159.1308784
233	28	25.962	1.78	26.02244958	21.32987671	154.5703619
234	29	26.249	1.78	26.30908401	21.56482296	149.5731252
235	30	26.571	1.78	26.63025532	21.82807813	144.2263989
236	31	26.926	1.78	26.98457162	22.11850133	138.6194486
237	32	27.313	1.78	27.37094023	22.43519691	132.8316607
238	33	27.731	1.78	27.78786909	22.77694188	126.941907
239	34	28.178	1.78	28.23416519	23.14275835	121.0168647
240	35	28.653	1.78	28.70833572	23.53142272	115.1189189
241	36	29.155	1.78	29.20908699	23.94187459	109.299155
242	37	29.682	1.78	29.73492523	24.37288953	103.6024912
243	38	30.232	1.78	30.2847554	24.82357	98.06150175
244	39	30.806	1.78	30.85718253	25.29277256	92.70474051
245	40	31.401	1.78	31.4510108	25.77951705	87.55217266
246	41	32.016	1.78	32.06504395	26.28282291	82.61810561
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256	Horiz. Sta. +003\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
257	1	32.016	2.78	32.13607075	26.3410416	82.07151048
258	2	31.401	2.78	31.52342114	25.83886979	86.95022678
259	3	30.806	2.78	30.93098307	25.35326481	92.04274905
260	4	30.232	2.78	30.35994746	24.88520284	97.33470213
261	5	29.682	2.78	29.81150413	24.43565912	102.8061474
262	6	29.155	2.78	29.28704087	24.00577121	108.4287051
263	7	28.653	2.78	28.78764561	23.59643083	114.1700807
264	8	28.178	2.78	28.31480327	23.20885514	119.9858702
265	9	27.731	2.78	27.8697985	22.84409713	125.8256738
266	10	27.313	2.78	27.45411388	22.50337203	131.6280534
267	11	26.926	2.78	27.06893248	22.18764957	137.3274528
268	12	26.571	2.78	26.71573504	21.89814347	142.8464226
269	13	26.249	2.78	26.39560383	21.63574084	148.1071234
270	14	25.962	2.78	26.10991923	21.40157314	153.0221029
271	15	25.71	2.78	25.8597633	21.1965273	157.5060045
272	16	25.495	2.78	25.64621851	21.02149058	161.4733057
273	17	25.318	2.78	25.4701693	20.87718795	164.8448016
274	18	25.179	2.78	25.33240187	20.76426383	167.5489244
275	19	25.08	2.78	25.23350519	20.68320097	169.5266591
276	20	25.01	2.78	25.16403187	20.62625563	170.934636
277	21	25	2.78	25.15409311	20.6181091	171.1373327
278	22	25.01	2.78	25.16403187	20.62625563	170.934636
279	23	25.08	2.78	25.23350519	20.68320097	169.5266591
280	24	25.179	2.78	25.33240187	20.76426383	167.5489244
281	25	25.318	2.78	25.4701693	20.87718795	164.8448016
282	26	25.495	2.78	25.64621851	21.02149058	161.4733057
283	27	25.71	2.78	25.8597633	21.1965273	157.5060045
284	28	25.962	2.78	26.10991923	21.40157314	153.0221029
285	29	26.249	2.78	26.39560383	21.63574084	148.1071234
286	30	26.571	2.78	26.71573504	21.89814347	142.8464226
287	31	26.926	2.78	27.06893248	22.18764957	137.3274528
288	32	27.313	2.78	27.45411388	22.50337203	131.6280534
289	33	27.731	2.78	27.8697985	22.84409713	125.8256738
290	34	28.178	2.78	28.31480327	23.20885514	119.9858702
291	35	28.653	2.78	28.78764561	23.59643083	114.1700807
292	36	29.155	2.78	29.28704087	24.00577121	108.4287051
293	37	29.682	2.78	29.81150413	24.43565912	102.8061474
294	38	30.232	2.78	30.35994746	24.88520284	97.33470213
295	39	30.806	2.78	30.93098307	25.35326481	92.04274905
296	40	31.401	2.78	31.52342114	25.83886979	86.95022678
297	41	32.016	2.78	32.13607075	26.3410416	82.07151048
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307	Horiz. Sta. +004v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
308	1	32.016	3.78	32.23797517	26.42456982	81.29568252
309	2	31.401	3.78	31.62729961	25.92401607	86.09628514
310	3	30.806	3.78	31.03684445	25.44003644	91.10413144
311	4	30.232	3.78	30.46779299	24.97360081	96.30476205
312	5	29.682	3.78	29.92132648	24.52567745	101.6782873
313	6	29.155	3.78	29.39882248	24.09739547	107.1965834
314	7	28.653	3.78	28.90135878	23.68963835	112.8277602
315	8	28.178	3.78	28.43040774	23.3036129	118.5281447
316	9	27.731	3.78	27.98724118	22.94036162	124.2483071
317	10	27.313	3.78	27.57332713	22.60108781	129.9281429
318	11	26.926	3.78	27.1898346	22.28674967	135.5036688
319	12	26.571	3.78	26.8382283	21.99854779	140.8994254
320	13	26.249	3.78	26.51957582	21.73735723	146.0397334
321	14	25.962	3.78	26.23524123	21.50429609	150.8396673
322	15	25.71	3.78	25.98629173	21.30023913	155.216477
323	16	25.495	3.78	25.7737953	21.12606172	159.0873422
324	17	25.318	3.78	25.59862348	20.98247826	162.3756541
325	18	25.179	3.78	25.4615511	20.87012385	165.0122477
326	19	25.08	3.78	25.36315801	20.78947377	166.9401385
327	20	25.01	3.78	25.2940408	20.73282033	168.3123977
328	21	25	3.78	25.28415314	20.72471569	168.5099365
329	22	25.01	3.78	25.2940408	20.73282033	168.3123977
330	23	25.08	3.78	25.36315801	20.78947377	166.9401385
331	24	25.179	3.78	25.4615511	20.87012385	165.0122477
332	25	25.318	3.78	25.59862348	20.98247826	162.3756541
333	26	25.495	3.78	25.7737953	21.12606172	159.0873422
334	27	25.71	3.78	25.98629173	21.30023913	155.216477
335	28	25.962	3.78	26.23524123	21.50429609	150.8396673
336	29	26.249	3.78	26.51957582	21.73735723	146.0397334
337	30	26.571	3.78	26.8382283	21.99854779	140.8994254
338	31	26.926	3.78	27.1898346	22.28674967	135.5036688
339	32	27.313	3.78	27.57332713	22.60108781	129.9281429
340	33	27.731	3.78	27.98724118	22.94036162	124.2483071
341	34	28.178	3.78	28.43040774	23.3036129	118.5281447
342	35	28.653	3.78	28.90135878	23.68963835	112.8277602
343	36	29.155	3.78	29.39882248	24.09739547	107.1965834
344	37	29.682	3.78	29.92132648	24.52567745	101.6782873
345	38	30.232	3.78	30.46779299	24.97360081	96.30476205
346	39	30.806	3.78	31.03684445	25.44003644	91.10413144
347	40	31.401	3.78	31.62729961	25.92401607	86.09628514
348	41	32.016	3.78	32.23797517	26.42456982	81.29568252
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358	Horiz. Sta. +005v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
359	1	32.016	4.78	32.3704656	26.53316853	80.30154711
360	2	31.401	4.78	31.76233745	26.03470283	85.00282994
361	3	30.806	4.78	31.17444007	25.55281973	89.90312042
362	4	30.232	4.78	30.60794684	25.08848102	94.98787146
363	5	29.682	4.78	30.06402798	24.64264589	100.2372746
364	6	29.155	4.78	29.54404784	24.21643266	105.6235493
365	7	28.653	4.78	29.04907123	23.81071413	111.1153341
366	8	28.178	4.78	28.5805543	23.42668385	116.6698955
367	9	27.731	4.78	28.13975246	23.06537087	122.2390407
368	10	27.313	4.78	27.72811514	22.72796323	127.7643545
369	11	26.926	4.78	27.34679333	22.41540437	133.1838378
370	12	26.571	4.78	26.99723131	22.12887812	138.4245334
371	13	26.249	4.78	26.68047791	21.86924419	143.4134678
372	14	25.962	4.78	26.39787647	21.63760367	148.0688742
373	15	25.71	4.78	26.15047529	21.43481581	152.311253
374	16	25.495	4.78	25.93932389	21.2617409	156.0611472
375	17	25.318	4.78	25.76527749	21.11907991	159.2451737
376	18	25.179	4.78	25.62909644	21.0074561	161.7971492
377	19	25.08	4.78	25.53134904	20.92733528	163.662606
378	20	25.01	4.78	25.46268839	20.87105606	164.9901379
379	21	25	4.78	25.45286624	20.86300512	165.1812184
380	22	25.01	4.78	25.46268839	20.87105606	164.9901379
381	23	25.08	4.78	25.53134904	20.92733528	163.662606
382	24	25.179	4.78	25.62909644	21.0074561	161.7971492
383	25	25.318	4.78	25.76527749	21.11907991	159.2451737
384	26	25.495	4.78	25.93932389	21.2617409	156.0611472
385	27	25.71	4.78	26.15047529	21.43481581	152.311253
386	28	25.962	4.78	26.39787647	21.63760367	148.0688742
387	29	26.249	4.78	26.68047791	21.86924419	143.4134678
388	30	26.571	4.78	26.99723131	22.12887812	138.4245334
389	31	26.926	4.78	27.34679333	22.41540437	133.1838378
390	32	27.313	4.78	27.72811514	22.72796323	127.7643545
391	33	27.731	4.78	28.13975246	23.06537087	122.2390407
392	34	28.178	4.78	28.5805543	23.42668385	116.6698955
393	35	28.653	4.78	29.04907123	23.81071413	111.1153341
394	36	29.155	4.78	29.54404784	24.21643266	105.6235493
395	37	29.682	4.78	30.06402798	24.64264589	100.2372746
396	38	30.232	4.78	30.60794684	25.08848102	94.98787146
397	39	30.806	4.78	31.17444007	25.55281973	89.90312042
398	40	31.401	4.78	31.76233745	26.03470283	85.00282994
399	41	32.016	4.78	32.3704656	26.53316853	80.30154711
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409	Horiz. Sta. +006v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
410	1	32.016	5.78	32.53316836	26.66653144	79.10276588
411	2	31.401	5.78	31.92813932	26.170606	83.68544341
412	3	30.806	5.78	31.34335198	25.69127212	88.45745326
413	4	30.232	5.78	30.77996767	25.2294817	93.40417161
414	5	29.682	5.78	30.23914315	24.78618291	98.50591473
415	6	29.155	5.78	29.72222675	24.36248094	103.7353369
416	7	28.653	5.78	29.23026753	23.95923568	109.0617295
417	8	28.178	5.78	28.76470205	23.57762463	114.4434948
418	9	27.731	5.78	28.32676594	23.21866061	119.8339208
419	10	27.313	5.78	27.91788618	22.88351327	125.1766008
420	11	26.926	5.78	27.53919217	22.57310834	130.4118816
421	12	26.571	5.78	27.19210361	22.28860951	135.4697509
422	13	26.249	5.78	26.87764687	22.03085809	140.2804078
423	14	25.962	5.78	26.59714049	21.80093483	144.7657782
424	15	25.71	5.78	26.35161016	21.59968046	148.8501512
425	16	25.495	5.78	26.14208339	21.42793721	152.457981
426	17	25.318	5.78	25.96939591	21.28639009	155.5196281
427	18	25.179	5.78	25.83429086	21.17564825	157.9723637
428	19	25.08	5.78	25.73732278	21.09616622	159.764632
429	20	25.01	5.78	25.66921308	21.04033859	161.0397494
430	21	25	5.78	25.65946999	21.03235245	161.223263
431	22	25.01	5.78	25.66921308	21.04033859	161.0397494
432	23	25.08	5.78	25.73732278	21.09616622	159.764632
433	24	25.179	5.78	25.83429086	21.17564825	157.9723637
434	25	25.318	5.78	25.96939591	21.28639009	155.5196281
435	26	25.495	5.78	26.14208339	21.42793721	152.457981
436	27	25.71	5.78	26.35161016	21.59968046	148.8501512
437	28	25.962	5.78	26.59714049	21.80093483	144.7657782
438	29	26.249	5.78	26.87764687	22.03085809	140.2804078
439	30	26.571	5.78	27.19210361	22.28860951	135.4697509
440	31	26.926	5.78	27.53919217	22.57310834	130.4118816
441	32	27.313	5.78	27.91788618	22.88351327	125.1766008
442	33	27.731	5.78	28.32676594	23.21866061	119.8339208
443	34	28.178	5.78	28.76470205	23.57762463	114.4434948
444	35	28.653	5.78	29.23026753	23.95923568	109.0617295
445	36	29.155	5.78	29.72222675	24.36248094	103.7353369
446	37	29.682	5.78	30.23914315	24.78618291	98.50591473
447	38	30.232	5.78	30.77996767	25.2294817	93.40417161
448	39	30.806	5.78	31.34335198	25.69127212	88.45745326
449	40	31.401	5.78	31.92813932	26.170606	83.68544341
450	41	32.016	5.78	32.53316836	26.66653144	79.10276588
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460	Horiz. Sta. +007\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
461	1	32.016	6.78	32.72563282	26.8242892	77.71531134
462	2	31.401	6.78	32.12422887	26.33133514	82.16230546
463	3	30.806	6.78	31.54307711	25.85498124	86.78777975
464	4	30.232	6.78	30.9833247	25.39616779	91.57705978
465	5	29.682	6.78	30.4461127	24.95583008	96.51064079
466	6	29.155	6.78	29.93277072	24.53505797	101.5617075
467	7	28.653	6.78	29.4443295	24.13469631	106.7003254
468	8	28.178	6.78	28.98220288	23.755904	111.8862129
469	9	27.731	6.78	28.54760355	23.39967504	117.0743567
470	10	27.313	6.78	28.14193257	23.06715785	122.2106338
471	11	26.926	6.78	27.76629442	22.75925772	127.2380422
472	12	26.571	6.78	27.42208049	22.47711516	132.0898805
473	13	26.249	6.78	27.11029143	22.22155035	136.6998986
474	14	25.962	6.78	26.83221724	21.99362069	140.9941412
475	15	25.71	6.78	26.58885778	21.79414572	144.9011085
476	16	25.495	6.78	26.38121536	21.62394702	148.349591
477	17	25.318	6.78	26.21010347	21.48369137	151.2740885
478	18	25.179	6.78	26.0762456	21.3739718	153.6156854
479	19	25.08	6.78	25.9801806	21.29523	155.3260342
480	20	25.01	6.78	25.91270924	21.2399256	156.5425072
481	21	25	6.78	25.90305773	21.23201454	156.7175561
482	22	25.01	6.78	25.91270924	21.2399256	156.5425072
483	23	25.08	6.78	25.9801806	21.29523	155.3260342
484	24	25.179	6.78	26.0762456	21.3739718	153.6156854
485	25	25.318	6.78	26.21010347	21.48369137	151.2740885
486	26	25.495	6.78	26.38121536	21.62394702	148.349591
487	27	25.71	6.78	26.58885778	21.79414572	144.9011085
488	28	25.962	6.78	26.83221724	21.99362069	140.9941412
489	29	26.249	6.78	27.11029143	22.22155035	136.6998986
490	30	26.571	6.78	27.42208049	22.47711516	132.0898805
491	31	26.926	6.78	27.76629442	22.75925772	127.2380422
492	32	27.313	6.78	28.14193257	23.06715785	122.2106338
493	33	27.731	6.78	28.54760355	23.39967504	117.0743567
494	34	28.178	6.78	28.98220288	23.755904	111.8862129
495	35	28.653	6.78	29.4443295	24.13469631	106.7003254
496	36	29.155	6.78	29.93277072	24.53505797	101.5617075
497	37	29.682	6.78	30.4461127	24.95583008	96.51064079
498	38	30.232	6.78	30.9833247	25.39616779	91.57705978
499	39	30.806	6.78	31.54307711	25.85498124	86.78777975
500	40	31.401	6.78	32.12422887	26.33133514	82.16230546
501	41	32.016	6.78	32.72563282	26.8242892	77.71531134
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511	Horiz. Sta. +008\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
512	1	32.016	7.78	32.94733742	27.00601428	76.15699162
513	2	31.401	7.78	32.35005534	26.5164388	80.45363435
514	3	30.806	7.78	31.77303438	26.0434708	84.91700593
515	4	30.232	7.78	31.21740556	25.58803734	89.53242169
516	5	29.682	7.78	30.68429205	25.15105906	94.28061963
517	6	29.155	7.78	30.17500229	24.73360843	99.13541204
518	7	28.653	7.78	29.6905463	24.33651336	104.0677549
519	8	28.178	7.78	29.23231233	23.96091174	109.0388445
520	9	27.731	7.78	28.80148726	23.60777645	114.0055534
521	10	27.313	7.78	28.39944311	23.27823206	118.9162702
522	11	26.926	7.78	28.02725648	22.97316105	123.7168882
523	12	26.571	7.78	27.68628719	22.69367803	128.344302
524	13	26.249	7.78	27.37750722	22.44057969	132.7360974
525	14	25.962	7.78	27.10217486	22.21489743	136.8227522
526	15	25.71	7.78	26.86126129	22.01742729	140.537281
527	16	25.495	7.78	26.65574092	21.84896797	143.813109
528	17	25.318	7.78	26.48640262	21.71016609	146.5891483
529	18	25.179	7.78	26.35394817	21.60159686	148.8105386
530	19	25.08	7.78	26.25889914	21.52368782	150.4323382
531	20	25.01	7.78	26.19214577	21.46897194	151.5854488
532	21	25	7.78	26.18259727	21.46114531	151.7513537
533	22	25.01	7.78	26.19214577	21.46897194	151.5854488
534	23	25.08	7.78	26.25889914	21.52368782	150.4323382
535	24	25.179	7.78	26.35394817	21.60159686	148.8105386
536	25	25.318	7.78	26.48640262	21.71016609	146.5891483
537	26	25.495	7.78	26.65574092	21.84896797	143.813109
538	27	25.71	7.78	26.86126129	22.01742729	140.537281
539	28	25.962	7.78	27.10217486	22.21489743	136.8227522
540	29	26.249	7.78	27.37750722	22.44057969	132.7360974
541	30	26.571	7.78	27.68628719	22.69367803	128.344302
542	31	26.926	7.78	28.02725648	22.97316105	123.7168882
543	32	27.313	7.78	28.39944311	23.27823206	118.9162702
544	33	27.731	7.78	28.80148726	23.60777645	114.0055534
545	34	28.178	7.78	29.23231233	23.96091174	109.0388445
546	35	28.653	7.78	29.6905463	24.33651336	104.0677549
547	36	29.155	7.78	30.17500229	24.73360843	99.13541204
548	37	29.682	7.78	30.68429205	25.15105906	94.28061963
549	38	30.232	7.78	31.21740556	25.58803734	89.53242169
550	39	30.806	7.78	31.77303438	26.0434708	84.91700593
551	40	31.401	7.78	32.35005534	26.5164388	80.45363435
552	41	32.016	7.78	32.94733742	27.00601428	76.15699162
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562	Horiz. Sta. +009v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
563	1	32.016	8.78	33.19769636	27.21122652	74.44694934
564	2	31.401	8.78	32.60500085	26.72541053	78.58109993
565	3	30.806	8.78	32.0325727	26.25620713	82.869609
566	4	30.232	8.78	31.4815249	25.8045286	87.29783428
567	5	29.682	8.78	30.95296074	25.37127929	91.84682764
568	6	29.155	8.78	30.44816518	24.95751245	96.49112502
569	7	28.653	8.78	29.96812539	24.56403721	101.2026814
570	8	28.178	8.78	29.5142014	24.19196836	105.9443112
571	9	27.731	8.78	29.08755178	23.84225556	110.6749266
572	10	27.313	8.78	28.68951671	23.5159973	115.3456057
573	11	26.926	8.78	28.32114238	23.21405113	119.9053191
574	12	26.571	8.78	27.98375419	22.93750343	124.2947598
575	13	26.249	8.78	27.67829296	22.68712538	128.4555419
576	14	25.962	8.78	27.4059826	22.46392016	132.3227805
577	15	25.71	8.78	27.16776321	22.26865837	135.8341911
578	16	25.495	8.78	26.96457906	22.10211399	138.9280104
579	17	25.318	8.78	26.79719246	21.96491186	141.5477155
580	18	25.179	8.78	26.66628179	21.85760802	143.6426335
581	19	25.08	8.78	26.57234999	21.78061475	145.1713311
582	20	25.01	8.78	26.50638602	21.72654592	146.2578536
583	21	25	8.78	26.49695077	21.7188121	146.4141514
584	22	25.01	8.78	26.50638602	21.72654592	146.2578536
585	23	25.08	8.78	26.57234999	21.78061475	145.1713311
586	24	25.179	8.78	26.66628179	21.85760802	143.6426335
587	25	25.318	8.78	26.79719246	21.96491186	141.5477155
588	26	25.495	8.78	26.96457906	22.10211399	138.9280104
589	27	25.71	8.78	27.16776321	22.26865837	135.8341911
590	28	25.962	8.78	27.4059826	22.46392016	132.3227805
591	29	26.249	8.78	27.67829296	22.68712538	128.4555419
592	30	26.571	8.78	27.98375419	22.93750343	124.2947598
593	31	26.926	8.78	28.32114238	23.21405113	119.9053191
594	32	27.313	8.78	28.68951671	23.5159973	115.3456057
595	33	27.731	8.78	29.08755178	23.84225556	110.6749266
596	34	28.178	8.78	29.5142014	24.19196836	105.9443112
597	35	28.653	8.78	29.96812539	24.56403721	101.2026814
598	36	29.155	8.78	30.44816518	24.95751245	96.49112502
599	37	29.682	8.78	30.95296074	25.37127929	91.84682764
600	38	30.232	8.78	31.4815249	25.8045286	87.29783428
601	39	30.806	8.78	32.0325727	26.25620713	82.869609
602	40	31.401	8.78	32.60500085	26.72541053	78.58109993
603	41	32.016	8.78	33.19769636	27.21122652	74.44694934
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613	Horiz. Sta. +010\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
614	1	32.016	9.78	33.47606672	27.43939895	72.60515829
615	2	31.401	9.78	32.88838823	26.95769527	76.56723777
616	3	30.806	9.78	32.32097947	26.49260612	80.6709574
617	4	30.232	9.78	31.77493367	26.0450276	84.90177954
618	5	29.682	9.78	31.25133243	25.61584625	89.24114529
619	6	29.155	9.78	30.75143514	25.20609438	93.6644064
620	7	28.653	9.78	30.27620418	24.8165608	98.14461479
621	8	28.178	9.78	29.82696907	24.4483353	102.6463189
622	9	27.731	9.78	29.40485791	24.10234255	107.1305897
623	10	27.313	9.78	29.01117662	23.77965297	111.5513221
624	11	26.926	9.78	28.64693885	23.48109742	115.860684
625	12	26.571	9.78	28.31343318	23.20773212	120.0032894
626	13	26.249	9.78	28.01156728	22.96030105	123.9248851
627	14	25.962	9.78	27.7425284	22.73977738	127.565323
628	15	25.71	9.78	27.50722374	22.54690471	130.8670977
629	16	25.495	9.78	27.30656558	22.38243081	133.7733205
630	17	25.318	9.78	27.14128818	22.24695752	136.2320783
631	18	25.179	9.78	27.01204517	22.14102063	138.1969153
632	19	25.08	9.78	26.9193199	22.06501631	139.6299236
633	20	25.01	9.78	26.85420824	22.0116461	140.6480432
634	21	25	9.78	26.84489523	22.00401248	140.7944744
635	22	25.01	9.78	26.85420824	22.0116461	140.6480432
636	23	25.08	9.78	26.9193199	22.06501631	139.6299236
637	24	25.179	9.78	27.01204517	22.14102063	138.1969153
638	25	25.318	9.78	27.14128818	22.24695752	136.2320783
639	26	25.495	9.78	27.30656558	22.38243081	133.7733205
640	27	25.71	9.78	27.50722374	22.54690471	130.8670977
641	28	25.962	9.78	27.7425284	22.73977738	127.565323
642	29	26.249	9.78	28.01156728	22.96030105	123.9248851
643	30	26.571	9.78	28.31343318	23.20773212	120.0032894
644	31	26.926	9.78	28.64693885	23.48109742	115.860684
645	32	27.313	9.78	29.01117662	23.77965297	111.5513221
646	33	27.731	9.78	29.40485791	24.10234255	107.1305897
647	34	28.178	9.78	29.82696907	24.4483353	102.6463189
648	35	28.653	9.78	30.27620418	24.8165608	98.14461479
649	36	29.155	9.78	30.75143514	25.20609438	93.6644064
650	37	29.682	9.78	31.25133243	25.61584625	89.24114529
651	38	30.232	9.78	31.77493367	26.0450276	84.90177954
652	39	30.806	9.78	32.32097947	26.49260612	80.6709574
653	40	31.401	9.78	32.88838823	26.95769527	76.56723777
654	41	32.016	9.78	33.47606672	27.43939895	72.60515829
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664	Horiz. Sta. +011\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
665	1	32.016	10.78	33.78175607	27.68996399	70.65193911
666	2	31.401	10.78	33.19948916	27.21269603	74.43488939
667	3	30.806	10.78	32.63748939	26.75204048	78.34666602
668	4	30.232	10.78	32.09682866	26.30887595	82.37290449
669	5	29.682	10.78	31.57856518	25.88406982	86.49551152
670	6	29.155	10.78	31.08393095	25.47863192	90.6907398
671	7	28.653	10.78	30.61386189	25.09332942	94.93282295
672	8	28.178	10.78	30.16965502	24.72922543	99.18813365
673	9	27.731	10.78	29.7524061	24.38721811	103.4199853
674	10	27.313	10.78	29.36338484	24.06834823	107.5851674
675	11	26.926	10.78	29.00357057	23.7734185	111.6391066
676	12	26.571	10.78	28.67421313	23.50345338	115.530386
677	13	26.249	10.78	28.37618546	23.25916841	119.2089079
678	14	25.962	10.78	28.11063646	23.0415053	122.6192668
679	15	25.71	10.78	27.87843894	22.85117946	125.7087175
680	16	25.495	10.78	27.68047189	22.68891138	128.4252093
681	17	25.318	10.78	27.51744036	22.55527898	130.7213877
682	18	25.179	10.78	27.38997233	22.45079699	132.5549562
683	19	25.08	10.78	27.2985308	22.37584492	133.8914759
684	20	25.01	10.78	27.23432577	22.32321784	134.8406592
685	21	25	10.78	27.22514279	22.31569081	134.9771495
686	22	25.01	10.78	27.23432577	22.32321784	134.8406592
687	23	25.08	10.78	27.2985308	22.37584492	133.8914759
688	24	25.179	10.78	27.38997233	22.45079699	132.5549562
689	25	25.318	10.78	27.51744036	22.55527898	130.7213877
690	26	25.495	10.78	27.68047189	22.68891138	128.4252093
691	27	25.71	10.78	27.87843894	22.85117946	125.7087175
692	28	25.962	10.78	28.11063646	23.0415053	122.6192668
693	29	26.249	10.78	28.37618546	23.25916841	119.2089079
694	30	26.571	10.78	28.67421313	23.50345338	115.530386
695	31	26.926	10.78	29.00357057	23.7734185	111.6391066
696	32	27.313	10.78	29.36338484	24.06834823	107.5851674
697	33	27.731	10.78	29.7524061	24.38721811	103.4199853
698	34	28.178	10.78	30.16965502	24.72922543	99.18813365
699	35	28.653	10.78	30.61386189	25.09332942	94.93282295
700	36	29.155	10.78	31.08393095	25.47863192	90.6907398
701	37	29.682	10.78	31.57856518	25.88406982	86.49551152
702	38	30.232	10.78	32.09682866	26.30887595	82.37290449
703	39	30.806	10.78	32.63748939	26.75204048	78.34666602
704	40	31.401	10.78	33.19948916	27.21269603	74.43488939
705	41	32.016	10.78	33.78175607	27.68996399	70.65193911
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715	Horiz. Sta. +012v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
716	1	32.016	11.78	34.11403001	27.96231968	68.60751191
717	2	31.401	11.78	33.53753241	27.48978067	72.20668962
718	3	30.806	11.78	32.98129339	27.03384704	75.9220109
719	4	30.232	11.78	32.44636204	26.59537872	79.7393556
720	5	29.682	11.78	31.93377176	26.17522275	83.64117023
721	6	29.155	11.78	31.44472552	25.77436518	87.60468385
722	7	28.653	11.78	30.98013137	25.3935503	91.60538115
723	8	28.178	11.78	30.54125217	25.03381325	95.61152266
724	9	27.731	11.78	30.12914982	24.69602444	99.58871308
725	10	27.313	11.78	29.74505621	24.38119362	103.4966682
726	11	26.926	11.78	29.38991503	24.09009429	107.2940798
727	12	26.571	11.78	29.06493589	23.82371795	110.9334815
728	13	26.249	11.78	28.77095587	23.58275071	114.3688828
729	14	25.962	11.78	28.50908421	23.36810181	117.5495446
730	15	25.71	11.78	28.28015838	23.18045769	120.4273803
731	16	25.495	11.78	28.08502313	23.02051076	122.9550565
732	17	25.318	11.78	27.9243536	22.88881443	125.0896464
733	18	25.179	11.78	27.79875149	22.78586188	126.7928832
734	19	25.08	11.78	27.70865901	22.71201558	128.0336795
735	20	25.01	11.78	27.64540649	22.66016925	128.9145126
736	21	25	11.78	27.63636011	22.65275419	129.0411492
737	22	25.01	11.78	27.64540649	22.66016925	128.9145126
738	23	25.08	11.78	27.70865901	22.71201558	128.0336795
739	24	25.179	11.78	27.79875149	22.78586188	126.7928832
740	25	25.318	11.78	27.9243536	22.88881443	125.0896464
741	26	25.495	11.78	28.08502313	23.02051076	122.9550565
742	27	25.71	11.78	28.28015838	23.18045769	120.4273803
743	28	25.962	11.78	28.50908421	23.36810181	117.5495446
744	29	26.249	11.78	28.77095587	23.58275071	114.3688828
745	30	26.571	11.78	29.06493589	23.82371795	110.9334815
746	31	26.926	11.78	29.38991503	24.09009429	107.2940798
747	32	27.313	11.78	29.74505621	24.38119362	103.4966682
748	33	27.731	11.78	30.12914982	24.69602444	99.58871308
749	34	28.178	11.78	30.54125217	25.03381325	95.61152266
750	35	28.653	11.78	30.98013137	25.3935503	91.60538115
751	36	29.155	11.78	31.44472552	25.77436518	87.60468385
752	37	29.682	11.78	31.93377176	26.17522275	83.64117023
753	38	30.232	11.78	32.44636204	26.59537872	79.7393556
754	39	30.806	11.78	32.98129339	27.03384704	75.9220109
755	40	31.401	11.78	33.53753241	27.48978067	72.20668962
756	41	32.016	11.78	34.11403001	27.96231968	68.60751191
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766	Horiz. Sta. +013v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
767	1	32.016	12.78	34.4721198	28.2558359	66.49159946
768	2	31.401	12.78	33.90171206	27.78828857	69.90461665
769	3	30.806	12.78	33.35154739	27.33733393	73.42142102
770	4	30.232	12.78	32.82265086	26.90381218	77.02820749
771	5	29.682	12.78	32.31602975	26.48854897	80.70803124
772	6	29.155	12.78	31.83285666	26.09250546	84.43916113
773	7	28.653	12.78	31.37401058	25.71640211	88.19838549
774	8	28.178	12.78	30.94071887	25.36124497	91.95588995
775	9	27.731	12.78	30.53400839	25.02787573	95.67958636
776	10	27.313	12.78	30.15507203	24.71727215	99.33210538
777	11	26.926	12.78	29.80481682	24.43017772	102.8753629
778	12	26.571	12.78	29.48441111	24.16755009	106.2657659
779	13	26.249	12.78	29.19465536	23.93004537	109.461323
780	14	25.962	12.78	28.93661836	23.71853964	112.4158171
781	15	25.71	12.78	28.71110165	23.53368988	115.0856515
782	16	25.495	12.78	28.5189152	23.37616	117.428022
783	17	25.318	12.78	28.36070387	23.24647858	119.4042364
784	18	25.179	12.78	28.23704277	23.14511702	120.9798707
785	19	25.08	12.78	28.14835313	23.0724206	122.1270253
786	20	25.01	12.78	28.08609086	23.02138595	122.941034
787	21	25	12.78	28.07718647	23.01408727	123.0580396
788	22	25.01	12.78	28.08609086	23.02138595	122.941034
789	23	25.08	12.78	28.14835313	23.0724206	122.1270253
790	24	25.179	12.78	28.23704277	23.14511702	120.9798707
791	25	25.318	12.78	28.36070387	23.24647858	119.4042364
792	26	25.495	12.78	28.5189152	23.37616	117.428022
793	27	25.71	12.78	28.71110165	23.53368988	115.0856515
794	28	25.962	12.78	28.93661836	23.71853964	112.4158171
795	29	26.249	12.78	29.19465536	23.93004537	109.461323
796	30	26.571	12.78	29.48441111	24.16755009	106.2657659
797	31	26.926	12.78	29.80481682	24.43017772	102.8753629
798	32	27.313	12.78	30.15507203	24.71727215	99.33210538
799	33	27.731	12.78	30.53400839	25.02787573	95.67958636
800	34	28.178	12.78	30.94071887	25.36124497	91.95588995
801	35	28.653	12.78	31.37401058	25.71640211	88.19838549
802	36	29.155	12.78	31.83285666	26.09250546	84.43916113
803	37	29.682	12.78	32.31602975	26.48854897	80.70803124
804	38	30.232	12.78	32.82265086	26.90381218	77.02820749
805	39	30.806	12.78	33.35154739	27.33733393	73.42142102
806	40	31.401	12.78	33.90171206	27.78828857	69.90461665
807	41	32.016	12.78	34.4721198	28.2558359	66.49159946
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817	Horiz. Sta. +014v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
818	1	32.016	13.78	34.85522978	28.56986048	64.32309019
819	2	31.401	13.78	34.29119538	28.10753719	67.54961483
820	3	30.806	13.78	33.74738084	27.66178757	70.86805824
821	4	30.232	13.78	33.22478608	27.23343121	74.26499755
822	5	29.682	13.78	32.72439119	26.82327146	77.72415772
823	6	29.155	13.78	32.2473373	26.43224369	81.22489718
824	7	28.653	13.78	31.79447341	26.06104378	84.74534296
825	8	28.178	13.78	31.36699036	25.71064783	88.25761756
826	9	27.731	13.78	30.9658791	25.38186812	91.73192545
827	10	27.313	13.78	30.59229264	25.07564971	95.13376312
828	11	26.926	13.78	30.24710078	24.79270556	98.42818821
829	12	26.571	13.78	29.93142994	24.53395897	101.5753565
830	13	26.249	13.78	29.64604361	24.30003574	104.5371178
831	14	25.962	13.78	29.39196969	24.09177843	107.2715801
832	15	25.71	13.78	29.16997357	23.9098144	109.7394159
833	16	25.495	13.78	28.98083029	23.75477892	111.9021112
834	17	25.318	13.78	28.82515436	23.62717571	113.7249687
835	18	25.179	13.78	28.70349429	23.52745433	115.1771801
836	19	25.08	13.78	28.61625035	23.45594291	116.2338361
837	20	25.01	13.78	28.55500832	23.40574452	116.9833026
838	21	25	13.78	28.54625019	23.39856573	117.0910088
839	22	25.01	13.78	28.55500832	23.40574452	116.9833026
840	23	25.08	13.78	28.61625035	23.45594291	116.2338361
841	24	25.179	13.78	28.70349429	23.52745433	115.1771801
842	25	25.318	13.78	28.82515436	23.62717571	113.7249687
843	26	25.495	13.78	28.98083029	23.75477892	111.9021112
844	27	25.71	13.78	29.16997357	23.9098144	109.7394159
845	28	25.962	13.78	29.39196969	24.09177843	107.2715801
846	29	26.249	13.78	29.64604361	24.30003574	104.5371178
847	30	26.571	13.78	29.93142994	24.53395897	101.5753565
848	31	26.926	13.78	30.24710078	24.79270556	98.42818821
849	32	27.313	13.78	30.59229264	25.07564971	95.13376312
850	33	27.731	13.78	30.9658791	25.38186812	91.73192545
851	34	28.178	13.78	31.36699036	25.71064783	88.25761756
852	35	28.653	13.78	31.79447341	26.06104378	84.74534296
853	36	29.155	13.78	32.2473373	26.43224369	81.22489718
854	37	29.682	13.78	32.72439119	26.82327146	77.72415772
855	38	30.232	13.78	33.22478608	27.23343121	74.26499755
856	39	30.806	13.78	33.74738084	27.66178757	70.86805824
857	40	31.401	13.78	34.29119538	28.10753719	67.54961483
858	41	32.016	13.78	34.85522978	28.56986048	64.32309019
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868	Horiz. Sta. +015v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
869	1	32.016	14.78	35.26254448	28.90372499	62.11976585
870	2	31.401	14.78	34.70513046	28.44682825	65.16129505
871	3	30.806	14.78	34.16790473	28.00647929	68.28348979
872	4	30.232	14.78	33.65184111	27.58347632	71.4733704
873	5	29.682	14.78	33.15789165	27.17859971	74.71538298
874	6	29.155	14.78	32.68716511	26.79275829	77.99001085
875	7	28.653	14.78	32.24047983	26.42662281	81.27673723
876	8	28.178	14.78	31.81898936	26.08113882	84.54960964
877	9	27.731	14.78	31.42364824	25.75708872	87.78108355
878	10	27.313	14.78	31.05556905	25.45538447	90.93944023
879	11	26.926	14.78	30.71558408	25.17670827	93.99276303
880	12	26.571	14.78	30.40477756	24.92194882	96.90479332
881	13	26.249	14.78	30.12387594	24.69170159	99.64102814
882	14	25.962	14.78	29.87386621	24.48677558	102.1636631
883	15	25.71	14.78	29.65547771	24.30776861	104.4373824
884	16	25.495	14.78	29.46945069	24.15528745	106.4276883
885	17	25.318	14.78	29.31636956	24.02981111	108.1036078
886	18	25.179	14.78	29.1967564	23.93176754	109.4376936
887	19	25.08	14.78	29.11099078	23.86146785	110.4078089
888	20	25.01	14.78	29.05079173	23.81212437	111.0955933
889	21	25	14.78	29.04218311	23.80506813	111.1944147
890	22	25.01	14.78	29.05079173	23.81212437	111.0955933
891	23	25.08	14.78	29.11099078	23.86146785	110.4078089
892	24	25.179	14.78	29.1967564	23.93176754	109.4376936
893	25	25.318	14.78	29.31636956	24.02981111	108.1036078
894	26	25.495	14.78	29.46945069	24.15528745	106.4276883
895	27	25.71	14.78	29.65547771	24.30776861	104.4373824
896	28	25.962	14.78	29.87386621	24.48677558	102.1636631
897	29	26.249	14.78	30.12387594	24.69170159	99.64102814
898	30	26.571	14.78	30.40477756	24.92194882	96.90479332
899	31	26.926	14.78	30.71558408	25.17670827	93.99276303
900	32	27.313	14.78	31.05556905	25.45538447	90.93944023
901	33	27.731	14.78	31.42364824	25.75708872	87.78108355
902	34	28.178	14.78	31.81898936	26.08113882	84.54960964
903	35	28.653	14.78	32.24047983	26.42662281	81.27673723
904	36	29.155	14.78	32.68716511	26.79275829	77.99001085
905	37	29.682	14.78	33.15789165	27.17859971	74.71538298
906	38	30.232	14.78	33.65184111	27.58347632	71.4733704
907	39	30.806	14.78	34.16790473	28.00647929	68.28348979
908	40	31.401	14.78	34.70513046	28.44682825	65.16129505
909	41	32.016	14.78	35.26254448	28.90372499	62.11976585
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919	Horiz. Sta. +016v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
920	1	32.016	15.78	35.69323526	29.25675021	59.89809462
921	2	31.401	15.78	35.14265329	28.80545352	62.7577128
922	3	30.806	15.78	34.61221914	28.37067142	65.68745216
923	4	30.232	15.78	34.10287979	27.95318015	68.67482931
924	5	29.682	15.78	33.61555858	27.55373654	71.70505191
925	6	29.155	15.78	33.15133124	27.17322233	74.75974865
926	7	28.653	15.78	32.710985	26.81228279	77.81975971
927	8	28.178	15.78	32.29563568	26.47183252	80.86102447
928	9	27.731	15.78	31.9062011	26.15262385	83.85818464
929	10	27.313	15.78	31.54375325	25.85553545	86.782199
930	11	26.926	15.78	31.20908691	25.58121878	89.60403423
931	12	26.571	15.78	30.90324414	25.33052799	92.29082587
932	13	26.249	15.78	30.62691466	25.10402841	94.81149747
933	14	25.962	15.78	30.38104479	24.90249573	97.13206826
934	15	25.71	15.78	30.16632822	24.72649854	99.22095327
935	16	25.495	15.78	29.98347085	24.57661545	101.0473752
936	17	25.318	15.78	29.8330274	24.45330115	102.583797
937	18	25.179	15.78	29.71549401	24.3569623	103.8058639
938	19	25.08	15.78	29.63122988	24.28789334	104.6939819
939	20	25.01	15.78	29.57208988	24.23941794	105.3233583
940	21	25	15.78	29.56363306	24.23248612	105.4137689
941	22	25.01	15.78	29.57208988	24.23941794	105.3233583
942	23	25.08	15.78	29.63122988	24.28789334	104.6939819
943	24	25.179	15.78	29.71549401	24.3569623	103.8058639
944	25	25.318	15.78	29.8330274	24.45330115	102.583797
945	26	25.495	15.78	29.98347085	24.57661545	101.0473752
946	27	25.71	15.78	30.16632822	24.72649854	99.22095327
947	28	25.962	15.78	30.38104479	24.90249573	97.13206826
948	29	26.249	15.78	30.62691466	25.10402841	94.81149747
949	30	26.571	15.78	30.90324414	25.33052799	92.29082587
950	31	26.926	15.78	31.20908691	25.58121878	89.60403423
951	32	27.313	15.78	31.54375325	25.85553545	86.782199
952	33	27.731	15.78	31.9062011	26.15262385	83.85818464
953	34	28.178	15.78	32.29563568	26.47183252	80.86102447
954	35	28.653	15.78	32.710985	26.81228279	77.81975971
955	36	29.155	15.78	33.15133124	27.17322233	74.75974865
956	37	29.682	15.78	33.61555858	27.55373654	71.70505191
957	38	30.232	15.78	34.10287979	27.95318015	68.67482931
958	39	30.806	15.78	34.61221914	28.37067142	65.68745216
959	40	31.401	15.78	35.14265329	28.80545352	62.7577128
960	41	32.016	15.78	35.69323526	29.25675021	59.89809462
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970	Horiz. Sta. +017\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
971	1	32.016	16.78	36.14646654	29.62825126	57.67308752
972	2	31.401	16.78	35.60289427	29.18270022	60.35522002
973	3	30.806	16.78	35.07942009	28.75362302	63.09770094
974	4	30.232	16.78	34.57696357	28.34177342	65.88858698
975	5	29.682	16.78	34.09641885	27.94788431	68.71387631
976	6	29.155	16.78	33.63882821	27.57281	71.55634912
977	7	28.653	16.78	33.20494752	27.2171701	74.39818773
978	8	28.178	16.78	32.79585468	26.8818481	77.21717184
979	9	27.731	16.78	32.41243077	26.56756621	79.99004562
980	10	27.313	16.78	32.05570728	26.2751699	82.69031766
981	11	26.926	16.78	31.72644174	26.00528012	85.29167642
982	12	26.571	16.78	31.42563442	25.75871673	87.76444065
983	13	26.249	16.78	31.15393878	25.53601539	90.0807233
984	14	25.962	16.78	30.91226103	25.33791888	92.21008764
985	15	25.71	16.78	30.70125988	25.16496711	94.1243863
986	16	25.495	16.78	30.52160749	25.01771106	95.79625733
987	17	25.318	16.78	30.37382959	24.89658163	97.20130483
988	18	25.179	16.78	30.25839692	24.80196469	98.31799296
989	19	25.08	16.78	30.17564886	24.73413841	99.12903968
990	20	25.01	16.78	30.11757792	24.68653928	99.70355027
991	21	25	16.78	30.10927432	24.67973305	99.78606245
992	22	25.01	16.78	30.11757792	24.68653928	99.70355027
993	23	25.08	16.78	30.17564886	24.73413841	99.12903968
994	24	25.179	16.78	30.25839692	24.80196469	98.31799296
995	25	25.318	16.78	30.37382959	24.89658163	97.20130483
996	26	25.495	16.78	30.52160749	25.01771106	95.79625733
997	27	25.71	16.78	30.70125988	25.16496711	94.1243863
998	28	25.962	16.78	30.91226103	25.33791888	92.21008764
999	29	26.249	16.78	31.15393878	25.53601539	90.0807233
1000	30	26.571	16.78	31.42563442	25.75871673	87.76444065
1001	31	26.926	16.78	31.72644174	26.00528012	85.29167642
1002	32	27.313	16.78	32.05570728	26.2751699	82.69031766
1003	33	27.731	16.78	32.41243077	26.56756621	79.99004562
1004	34	28.178	16.78	32.79585468	26.8818481	77.21717184
1005	35	28.653	16.78	33.20494752	27.2171701	74.39818773
1006	36	29.155	16.78	33.63882821	27.57281	71.55634912
1007	37	29.682	16.78	34.09641885	27.94788431	68.71387631
1008	38	30.232	16.78	34.57696357	28.34177342	65.88858698
1009	39	30.806	16.78	35.07942009	28.75362302	63.09770094
1010	40	31.401	16.78	35.60289427	29.18270022	60.35522002
1011	41	32.016	16.78	36.14646654	29.62825126	57.67308752
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1021	Horiz. Sta. +018\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1022	1	32.016	17.78	36.62140144	30.01754216	55.45821296
1023	2	31.401	17.78	36.08498414	29.57785585	57.96838416
1024	3	30.806	17.78	35.56860573	29.15459486	60.52993769
1025	4	30.232	17.78	35.07315797	28.74849014	63.13150422
1026	5	29.682	17.78	34.59950547	28.36025038	65.7598898
1027	6	29.155	17.78	34.14865683	27.99070232	68.39901893
1028	7	28.653	17.78	33.72133656	27.64043981	71.03238742
1029	8	28.178	17.78	33.31858466	27.3103153	73.63954844
1030	9	27.731	17.78	32.94124571	27.00102107	76.19924984
1031	10	27.313	17.78	32.59031097	26.71336965	78.68740767
1032	11	26.926	17.78	32.26650129	26.44795188	81.08025781
1033	12	26.571	17.78	31.97077569	26.20555385	83.35107982
1034	13	26.249	17.78	31.70375217	25.9866821	85.47493081
1035	14	25.962	17.78	31.46629756	25.79204718	87.42463248
1036	15	25.71	17.78	31.25903642	25.622161	89.17517937
1037	16	25.495	17.78	31.08260806	25.47754759	90.70231975
1038	17	25.318	17.78	30.93750998	25.35861474	91.98450631
1039	18	25.179	17.78	30.8241883	25.26572811	93.0027529
1040	19	25.08	17.78	30.74296316	25.19915013	93.74186229
1041	20	25.01	17.78	30.68596585	25.15243102	94.26519256
1042	21	25	17.78	30.67781609	25.14575089	94.34033898
1043	22	25.01	17.78	30.68596585	25.15243102	94.26519256
1044	23	25.08	17.78	30.74296316	25.19915013	93.74186229
1045	24	25.179	17.78	30.8241883	25.26572811	93.0027529
1046	25	25.318	17.78	30.93750998	25.35861474	91.98450631
1047	26	25.495	17.78	31.08260806	25.47754759	90.70231975
1048	27	25.71	17.78	31.25903642	25.622161	89.17517937
1049	28	25.962	17.78	31.46629756	25.79204718	87.42463248
1050	29	26.249	17.78	31.70375217	25.9866821	85.47493081
1051	30	26.571	17.78	31.97077569	26.20555385	83.35107982
1052	31	26.926	17.78	32.26650129	26.44795188	81.08025781
1053	32	27.313	17.78	32.59031097	26.71336965	78.68740767
1054	33	27.731	17.78	32.94124571	27.00102107	76.19924984
1055	34	28.178	17.78	33.31858466	27.3103153	73.63954844
1056	35	28.653	17.78	33.72133656	27.64043981	71.03238742
1057	36	29.155	17.78	34.14865683	27.99070232	68.39901893
1058	37	29.682	17.78	34.59950547	28.36025038	65.7598898
1059	38	30.232	17.78	35.07315797	28.74849014	63.13150422
1060	39	30.806	17.78	35.56860573	29.15459486	60.52993769
1061	40	31.401	17.78	36.08498414	29.57785585	57.96838416
1062	41	32.016	17.78	36.62140144	30.01754216	55.45821296
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1072	Horiz. Sta. +019v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1073	1	32.016	18.78	37.11720684	30.42394003	53.26536287
1074	2	31.401	18.78	36.58805926	29.99021251	55.60996601
1075	3	30.806	18.78	36.07888182	29.57285395	57.99780314
1076	4	30.232	18.78	35.59053821	29.1725723	60.4181029
1077	5	29.682	18.78	35.12386338	28.79005195	62.85848557
1078	6	29.155	18.78	34.67983222	28.42609199	65.30400065
1079	7	28.653	18.78	34.25913805	28.08126069	67.73941709
1080	8	28.178	18.78	33.86278317	27.75637965	70.14598239
1081	9	27.731	18.78	33.49157608	27.45211154	72.50433848
1082	10	27.313	18.78	33.14646842	27.16923641	74.7926568
1083	11	26.926	18.78	32.82814502	26.90831559	76.98953935
1084	12	26.571	18.78	32.53752447	26.67010202	79.0709994
1085	13	26.249	18.78	32.27519018	26.45507392	81.01479192
1086	14	25.962	18.78	32.04197064	26.26391036	82.79671319
1087	15	25.71	18.78	31.83845722	26.09709608	84.39460903
1088	16	25.495	18.78	31.66525737	25.95512899	85.78704027
1089	17	25.318	18.78	31.52284131	25.83839451	86.95502497
1090	18	25.179	18.78	31.41163135	25.74723882	87.88186711
1091	19	25.08	18.78	31.33192915	25.68190914	88.55423667
1092	20	25.01	18.78	31.27600518	25.63606982	89.03011245
1093	21	25	18.78	31.26800921	25.62951575	89.09843123
1094	22	25.01	18.78	31.27600518	25.63606982	89.03011245
1095	23	25.08	18.78	31.33192915	25.68190914	88.55423667
1096	24	25.179	18.78	31.41163135	25.74723882	87.88186711
1097	25	25.318	18.78	31.52284131	25.83839451	86.95502497
1098	26	25.495	18.78	31.66525737	25.95512899	85.78704027
1099	27	25.71	18.78	31.83845722	26.09709608	84.39460903
1100	28	25.962	18.78	32.04197064	26.26391036	82.79671319
1101	29	26.249	18.78	32.27519018	26.45507392	81.01479192
1102	30	26.571	18.78	32.53752447	26.67010202	79.0709994
1103	31	26.926	18.78	32.82814502	26.90831559	76.98953935
1104	32	27.313	18.78	33.14646842	27.16923641	74.7926568
1105	33	27.731	18.78	33.49157608	27.45211154	72.50433848
1106	34	28.178	18.78	33.86278317	27.75637965	70.14598239
1107	35	28.653	18.78	34.25913805	28.08126069	67.73941709
1108	36	29.155	18.78	34.67983222	28.42609199	65.30400065
1109	37	29.682	18.78	35.12386338	28.79005195	62.85848557
1110	38	30.232	18.78	35.59053821	29.1725723	60.4181029
1111	39	30.806	18.78	36.07888182	29.57285395	57.99780314
1112	40	31.401	18.78	36.58805926	29.99021251	55.60996601
1113	41	32.016	18.78	37.11720684	30.42394003	53.26536287
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1123	Horiz. Sta. +020v	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1124	1	32.016	19.78	37.63305785	30.84676873	51.10486281
1125	2	31.401	19.78	37.11126622	30.41907067	53.29094646
1126	3	30.806	19.78	36.60936647	30.00767744	55.51292494
1127	4	30.232	19.78	36.12819411	29.61327386	57.76063913
1128	5	29.682	19.78	35.66855448	29.23652006	60.02251977
1129	6	29.155	19.78	35.23138889	28.87818761	62.28471167
1130	7	28.653	19.78	34.81735974	28.53881946	64.5332068
1131	8	28.178	19.78	34.42743214	28.21920668	66.75085889
1132	9	27.731	19.78	34.06237908	27.91998285	68.92008706
1133	10	27.313	19.78	33.72311328	27.64189613	71.02116093
1134	11	26.926	19.78	33.41028443	27.38547904	73.03486526
1135	12	26.571	19.78	33.12477167	27.15145219	74.93972082
1136	13	26.249	19.78	32.86712493	26.94026634	76.71593882
1137	14	25.962	19.78	32.6381354	26.75257	78.34201396
1138	15	25.71	19.78	32.43836244	26.58882167	79.79836352
1139	16	25.495	19.78	32.26838273	26.44949404	81.06607626
1140	17	25.318	19.78	32.12864025	26.33495102	82.12846657
1141	18	25.179	19.78	32.01953442	26.24552001	82.97088316
1142	19	25.08	19.78	31.94134913	26.18143371	83.58165836
1143	20	25.01	19.78	31.88649401	26.1364705	84.01376362
1144	21	25	19.78	31.87865116	26.13004194	84.07578653
1145	22	25.01	19.78	31.88649401	26.1364705	84.01376362
1146	23	25.08	19.78	31.94134913	26.18143371	83.58165836
1147	24	25.179	19.78	32.01953442	26.24552001	82.97088316
1148	25	25.318	19.78	32.12864025	26.33495102	82.12846657
1149	26	25.495	19.78	32.26838273	26.44949404	81.06607626
1150	27	25.71	19.78	32.43836244	26.58882167	79.79836352
1151	28	25.962	19.78	32.6381354	26.75257	78.34201396
1152	29	26.249	19.78	32.86712493	26.94026634	76.71593882
1153	30	26.571	19.78	33.12477167	27.15145219	74.93972082
1154	31	26.926	19.78	33.41028443	27.38547904	73.03486526
1155	32	27.313	19.78	33.72311328	27.64189613	71.02116093
1156	33	27.731	19.78	34.06237908	27.91998285	68.92008706
1157	34	28.178	19.78	34.42743214	28.21920668	66.75085889
1158	35	28.653	19.78	34.81735974	28.53881946	64.5332068
1159	36	29.155	19.78	35.23138889	28.87818761	62.28471167
1160	37	29.682	19.78	35.66855448	29.23652006	60.02251977
1161	38	30.232	19.78	36.12819411	29.61327386	57.76063913
1162	39	30.806	19.78	36.60936647	30.00767744	55.51292494
1163	40	31.401	19.78	37.11126622	30.41907067	53.29094646
1164	41	32.016	19.78	37.63305785	30.84676873	51.10486281
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1174	Horiz. Sta. +021\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1175	1	32.016	20.78	38.16814173	31.28536208	48.98551771
1176	2	31.401	20.78	37.65376582	30.86374247	51.02059268
1177	3	30.806	20.78	37.1591942	30.4583559	53.08500809
1178	4	30.232	20.78	36.68523422	30.06986411	55.16922237
1179	5	29.682	20.78	36.23266176	29.69890309	57.26246398
1180	6	29.155	20.78	35.80238488	29.34621711	59.35193469
1181	7	28.653	20.78	35.39503552	29.0123242	61.42479186
1182	8	28.178	20.78	35.01154215	28.69798537	63.46540114
1183	9	27.731	20.78	34.65264303	28.40380576	65.457838
1184	10	27.313	20.78	34.31921283	28.13050232	67.3843118
1185	11	26.926	20.78	34.01186713	27.87857961	69.22760862
1186	12	26.571	20.78	33.73144673	27.64872683	70.96853596
1187	13	26.249	20.78	33.47846922	27.44136821	72.58952844
1188	14	25.962	20.78	33.25368975	27.25712275	74.07151529
1189	15	25.71	20.78	33.05763691	27.0964237	75.39722038
1190	16	25.495	20.78	32.89085776	26.95971947	76.54999249
1191	17	25.318	20.78	32.75377114	26.84735339	77.51519083
1192	18	25.179	20.78	32.64675458	26.7596349	78.27998033
1193	19	25.08	20.78	32.57007498	26.69678277	78.83416575
1194	20	25.01	20.78	32.51628054	26.65268897	79.22607954
1195	21	25	20.78	32.50858963	26.64638495	79.28232292
1196	22	25.01	20.78	32.51628054	26.65268897	79.22607954
1197	23	25.08	20.78	32.57007498	26.69678277	78.83416575
1198	24	25.179	20.78	32.64675458	26.7596349	78.27998033
1199	25	25.318	20.78	32.75377114	26.84735339	77.51519083
1200	26	25.495	20.78	32.89085776	26.95971947	76.54999249
1201	27	25.71	20.78	33.05763691	27.0964237	75.39722038
1202	28	25.962	20.78	33.25368975	27.25712275	74.07151529
1203	29	26.249	20.78	33.47846922	27.44136821	72.58952844
1204	30	26.571	20.78	33.73144673	27.64872683	70.96853596
1205	31	26.926	20.78	34.01186713	27.87857961	69.22760862
1206	32	27.313	20.78	34.31921283	28.13050232	67.3843118
1207	33	27.731	20.78	34.65264303	28.40380576	65.457838
1208	34	28.178	20.78	35.01154215	28.69798537	63.46540114
1209	35	28.653	20.78	35.39503552	29.0123242	61.42479186
1210	36	29.155	20.78	35.80238488	29.34621711	59.35193469
1211	37	29.682	20.78	36.23266176	29.69890309	57.26246398
1212	38	30.232	20.78	36.68523422	30.06986411	55.16922237
1213	39	30.806	20.78	37.1591942	30.4583559	53.08500809
1214	40	31.401	20.78	37.65376582	30.86374247	51.02059268
1215	41	32.016	20.78	38.16814173	31.28536208	48.98551771
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1225	Horiz. Sta. +022\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1226	1	32.016	21.78	38.72166116	31.73906653	46.91468558
1227	2	31.401	21.78	38.21473643	31.32355445	48.80655402
1228	3	30.806	21.78	37.72751931	30.92419616	50.72195691
1229	4	30.232	21.78	37.26078917	30.54163047	52.65196748
1230	5	29.682	21.78	36.81529273	30.17646945	54.58659152
1231	6	29.155	21.78	36.39190519	29.82943048	56.51404253
1232	7	28.653	21.78	35.99122865	29.50100709	58.42258018
1233	8	28.178	21.78	35.61415567	29.19193088	60.29798412
1234	9	27.731	21.78	35.26139062	28.9027792	62.12586429
1235	10	27.313	21.78	34.93377118	28.63423867	63.89021319
1236	11	26.926	21.78	34.6318799	28.38678681	65.57564195
1237	12	26.571	21.78	34.35652047	28.16108235	67.16503283
1238	13	26.249	21.78	34.10817939	27.95752409	68.64282294
1239	14	25.962	21.78	33.88757711	27.77670255	69.99212751
1240	15	25.71	21.78	33.69521269	27.61902679	71.19772964
1241	16	25.495	21.78	33.53160485	27.48492201	72.24498947
1242	17	25.318	21.78	33.39714844	27.37471184	73.12107883
1243	18	25.179	21.78	33.29220005	27.28868857	73.81476886
1244	19	25.08	21.78	33.21701046	27.22705776	74.3171628
1245	20	25.01	21.78	33.16426541	27.1838241	74.67231316
1246	21	25	21.78	33.15672481	27.17764329	74.72327134
1247	22	25.01	21.78	33.16426541	27.1838241	74.67231316
1248	23	25.08	21.78	33.21701046	27.22705776	74.3171628
1249	24	25.179	21.78	33.29220005	27.28868857	73.81476886
1250	25	25.318	21.78	33.39714844	27.37471184	73.12107883
1251	26	25.495	21.78	33.53160485	27.48492201	72.24498947
1252	27	25.71	21.78	33.69521269	27.61902679	71.19772964
1253	28	25.962	21.78	33.88757711	27.77670255	69.99212751
1254	29	26.249	21.78	34.10817939	27.95752409	68.64282294
1255	30	26.571	21.78	34.35652047	28.16108235	67.16503283
1256	31	26.926	21.78	34.6318799	28.38678681	65.57564195
1257	32	27.313	21.78	34.93377118	28.63423867	63.89021319
1258	33	27.731	21.78	35.26139062	28.9027792	62.12586429
1259	34	28.178	21.78	35.61415567	29.19193088	60.29798412
1260	35	28.653	21.78	35.99122865	29.50100709	58.42258018
1261	36	29.155	21.78	36.39190519	29.82943048	56.51404253
1262	37	29.682	21.78	36.81529273	30.17646945	54.58659152
1263	38	30.232	21.78	37.26078917	30.54163047	52.65196748
1264	39	30.806	21.78	37.72751931	30.92419616	50.72195691
1265	40	31.401	21.78	38.21473643	31.32355445	48.80655402
1266	41	32.016	21.78	38.72166116	31.73906653	46.91468558
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1276	Horiz. Sta. +023\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1277	1	32.016	22.78	39.29283705	32.20724348	44.89837155
1278	2	31.401	22.78	38.79337676	31.7978498	46.65497899
1279	3	30.806	22.78	38.31351868	31.40452351	48.43001839
1280	4	30.232	22.78	37.85401445	31.02788069	50.21516805
1281	5	29.682	22.78	37.41558203	30.66850986	52.00118433
1282	6	29.155	22.78	36.99906435	30.32710193	53.77724211
1283	7	28.653	22.78	36.60503435	30.00412651	55.53263678
1284	8	28.178	22.78	36.2343495	29.70028648	57.25446276
1285	9	27.731	22.78	35.88768129	29.41613221	58.92974377
1286	10	27.313	22.78	35.56583148	29.15232089	60.54410338
1287	11	26.926	22.78	35.2693508	28.90930393	62.08380898
1288	12	26.571	22.78	34.99900711	28.68771074	63.53361679
1289	13	26.249	22.78	34.75525718	28.48791572	64.87975954
1290	14	25.962	22.78	34.53878808	28.31048204	66.10730718
1291	15	25.71	22.78	34.35007071	28.15579567	67.20287373
1292	16	25.495	22.78	34.18959672	28.02425961	68.15360244
1293	17	25.318	22.78	34.05773809	27.91617876	68.94826575
1294	18	25.179	22.78	33.95483153	27.83182912	69.57704997
1295	19	25.08	22.78	33.8811125	27.77140369	70.03219924
1296	20	25.01	22.78	33.82940289	27.72901876	70.35383148
1297	21	25	22.78	33.82201058	27.7229595	70.39997221
1298	22	25.01	22.78	33.82940289	27.72901876	70.35383148
1299	23	25.08	22.78	33.8811125	27.77140369	70.03219924
1300	24	25.179	22.78	33.95483153	27.83182912	69.57704997
1301	25	25.318	22.78	34.05773809	27.91617876	68.94826575
1302	26	25.495	22.78	34.18959672	28.02425961	68.15360244
1303	27	25.71	22.78	34.35007071	28.15579567	67.20287373
1304	28	25.962	22.78	34.53878808	28.31048204	66.10730718
1305	29	26.249	22.78	34.75525718	28.48791572	64.87975954
1306	30	26.571	22.78	34.99900711	28.68771074	63.53361679
1307	31	26.926	22.78	35.2693508	28.90930393	62.08380898
1308	32	27.313	22.78	35.56583148	29.15232089	60.54410338
1309	33	27.731	22.78	35.88768129	29.41613221	58.92974377
1310	34	28.178	22.78	36.2343495	29.70028648	57.25446276
1311	35	28.653	22.78	36.60503435	30.00412651	55.53263678
1312	36	29.155	22.78	36.99906435	30.32710193	53.77724211
1313	37	29.682	22.78	37.41558203	30.66850986	52.00118433
1314	38	30.232	22.78	37.85401445	31.02788069	50.21516805
1315	39	30.806	22.78	38.31351868	31.40452351	48.43001839
1316	40	31.401	22.78	38.79337676	31.7978498	46.65497899
1317	41	32.016	22.78	39.29283705	32.20724348	44.89837155
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1327	Horiz. Sta. +024\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1328	1	32.016	23.78	39.88091076	32.68927112	42.94133556
1329	2	31.401	23.78	39.38890809	32.28599024	44.5706457
1330	3	30.806	23.78	38.91639389	31.89868352	46.21393825
1331	4	30.232	23.78	38.46409247	31.52794465	47.86348102
1332	5	29.682	23.78	38.03269355	31.17433897	49.51074928
1333	6	29.155	23.78	37.62300843	30.8385315	51.14582538
1334	7	28.653	23.78	37.23558163	30.52096855	52.75897201
1335	8	28.178	23.78	36.87123654	30.22232503	54.33849968
1336	9	27.731	23.78	36.53061276	29.94312521	55.87272844
1337	10	27.313	23.78	36.21447734	29.68399782	57.34876713
1338	11	26.926	23.78	35.92335042	29.4453692	58.75437987
1339	12	26.571	23.78	35.65796543	29.22784052	60.07600881
1340	13	26.249	23.78	35.4187507	29.03176287	61.30149065
1341	14	25.962	23.78	35.20636139	28.85767327	62.417637
1342	15	25.71	23.78	35.02124153	28.70593568	63.41268421
1343	16	25.495	23.78	34.86385699	28.57693196	64.27535098
1344	17	25.318	23.78	34.73455807	28.47094923	64.99581864
1345	18	25.179	23.78	34.63366259	28.38824802	65.56551642
1346	19	25.08	23.78	34.56139152	28.32900945	65.97768778
1347	20	25.01	23.78	34.51070124	28.28746003	66.26884465
1348	21	25	23.78	34.5034549	28.28152041	66.31060633
1349	22	25.01	23.78	34.51070124	28.28746003	66.26884465
1350	23	25.08	23.78	34.56139152	28.32900945	65.97768778
1351	24	25.179	23.78	34.63366259	28.38824802	65.56551642
1352	25	25.318	23.78	34.73455807	28.47094923	64.99581864
1353	26	25.495	23.78	34.86385699	28.57693196	64.27535098
1354	27	25.71	23.78	35.02124153	28.70593568	63.41268421
1355	28	25.962	23.78	35.20636139	28.85767327	62.417637
1356	29	26.249	23.78	35.4187507	29.03176287	61.30149065
1357	30	26.571	23.78	35.65796543	29.22784052	60.07600881
1358	31	26.926	23.78	35.92335042	29.4453692	58.75437987
1359	32	27.313	23.78	36.21447734	29.68399782	57.34876713
1360	33	27.731	23.78	36.53061276	29.94312521	55.87272844
1361	34	28.178	23.78	36.87123654	30.22232503	54.33849968
1362	35	28.653	23.78	37.23558163	30.52096855	52.75897201
1363	36	29.155	23.78	37.62300843	30.8385315	51.14582538
1364	37	29.682	23.78	38.03269355	31.17433897	49.51074928
1365	38	30.232	23.78	38.46409247	31.52794465	47.86348102
1366	39	30.806	23.78	38.91639389	31.89868352	46.21393825
1367	40	31.401	23.78	39.38890809	32.28599024	44.5706457
1368	41	32.016	23.78	39.88091076	32.68927112	42.94133556
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1378	Horiz. Sta. +025\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1379	1	32.016	24.78	40.48514596	33.18454587	41.04720809
1380	2	31.401	24.78	40.000576	32.78735738	42.55709901
1381	3	30.806	24.78	39.53537294	32.40604339	44.07712217
1382	4	30.232	24.78	39.0902342	32.04117557	45.60011457
1383	5	29.682	24.78	38.66582184	31.69329659	47.11823507
1384	6	29.155	24.78	38.26291629	31.36304614	48.62241751
1385	7	28.653	24.78	37.88203452	31.05084797	50.103823
1386	8	28.178	24.78	37.52396679	30.75734983	51.5518817
1387	9	27.731	24.78	37.18932197	30.4830508	52.95609709
1388	10	27.313	24.78	36.87883362	30.22855215	54.30492524
1389	11	26.926	24.78	36.59299258	29.99425621	55.58747773
1390	12	26.571	24.78	36.33249921	29.78073705	56.79170835
1391	13	26.249	24.78	36.0977548	29.5883236	57.90688179
1392	14	25.962	24.78	35.88938398	29.41752785	58.92135684
1393	15	25.71	24.78	35.70780528	29.26869285	59.82480305
1394	16	25.495	24.78	35.55346008	29.1421804	60.60732725
1395	17	25.318	24.78	35.42667814	29.03826077	61.26034751
1396	18	25.179	24.78	35.3277594	28.95717984	61.77638191
1397	19	25.08	24.78	35.25691115	28.8991075	62.14954699
1398	20	25.01	24.78	35.20722227	28.85837891	62.41305843
1399	21	25	24.78	35.20011932	28.85255682	62.45084863
1400	22	25.01	24.78	35.20722227	28.85837891	62.41305843
1401	23	25.08	24.78	35.25691115	28.8991075	62.14954699
1402	24	25.179	24.78	35.3277594	28.95717984	61.77638191
1403	25	25.318	24.78	35.42667814	29.03826077	61.26034751
1404	26	25.495	24.78	35.55346008	29.1421804	60.60732725
1405	27	25.71	24.78	35.70780528	29.26869285	59.82480305
1406	28	25.962	24.78	35.88938398	29.41752785	58.92135684
1407	29	26.249	24.78	36.0977548	29.5883236	57.90688179
1408	30	26.571	24.78	36.33249921	29.78073705	56.79170835
1409	31	26.926	24.78	36.59299258	29.99425621	55.58747773
1410	32	27.313	24.78	36.87883362	30.22855215	54.30492524
1411	33	27.731	24.78	37.18932197	30.4830508	52.95609709
1412	34	28.178	24.78	37.52396679	30.75734983	51.5518817
1413	35	28.653	24.78	37.88203452	31.05084797	50.103823
1414	36	29.155	24.78	38.26291629	31.36304614	48.62241751
1415	37	29.682	24.78	38.66582184	31.69329659	47.11823507
1416	38	30.232	24.78	39.0902342	32.04117557	45.60011457
1417	39	30.806	24.78	39.53537294	32.40604339	44.07712217
1418	40	31.401	24.78	40.000576	32.78735738	42.55709901
1419	41	32.016	24.78	40.48514596	33.18454587	41.04720809
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1429	Horiz. Sta. +026\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1430	1	32.016	25.78	41.10482993	33.69248355	39.21860882
1431	2	31.401	25.78	40.62765167	33.30135383	40.61678931
1432	3	30.806	25.78	40.1697114	32.92599295	42.02179663
1433	4	30.232	25.78	39.73168018	32.56695097	43.42701295
1434	5	29.682	25.78	39.31419309	32.22474844	44.82524293
1435	6	29.155	25.78	38.9180005	31.90000041	46.20821509
1436	7	28.653	25.78	38.54359272	31.59310879	47.56792097
1437	8	28.178	25.78	38.19172795	31.30469504	48.8948172
1438	9	27.731	25.78	37.86298547	31.03523399	50.17948349
1439	10	27.313	25.78	37.55806663	30.78530052	51.41159372
1440	11	26.926	25.78	37.27743427	30.55527399	52.5814686
1441	12	26.571	25.78	37.0217571	30.34570254	53.67841331
1442	13	26.249	25.78	36.7914107	30.15689402	54.69296021
1443	14	25.962	25.78	36.58699061	29.98933657	55.61483898
1444	15	25.71	25.78	36.40889119	29.84335344	56.43498215
1445	16	25.495	25.78	36.25753058	29.71928736	57.14471685
1446	17	25.318	25.78	36.13321912	29.61739272	57.73654435
1447	18	25.179	25.78	36.03623988	29.53790154	58.20393455
1448	19	25.08	25.78	35.96678724	29.48097314	58.54176522
1449	20	25.01	25.78	35.91808041	29.44104951	58.78024557
1450	21	25	25.78	35.91111806	29.43534267	58.81444066
1451	22	25.01	25.78	35.91808041	29.44104951	58.78024557
1452	23	25.08	25.78	35.96678724	29.48097314	58.54176522
1453	24	25.179	25.78	36.03623988	29.53790154	58.20393455
1454	25	25.318	25.78	36.13321912	29.61739272	57.73654435
1455	26	25.495	25.78	36.25753058	29.71928736	57.14471685
1456	27	25.71	25.78	36.40889119	29.84335344	56.43498215
1457	28	25.962	25.78	36.58699061	29.98933657	55.61483898
1458	29	26.249	25.78	36.7914107	30.15689402	54.69296021
1459	30	26.571	25.78	37.0217571	30.34570254	53.67841331
1460	31	26.926	25.78	37.27743427	30.55527399	52.5814686
1461	32	27.313	25.78	37.55806663	30.78530052	51.41159372
1462	33	27.731	25.78	37.86298547	31.03523399	50.17948349
1463	34	28.178	25.78	38.19172795	31.30469504	48.8948172
1464	35	28.653	25.78	38.54359272	31.59310879	47.56792097
1465	36	29.155	25.78	38.9180005	31.90000041	46.20821509
1466	37	29.682	25.78	39.31419309	32.22474844	44.82524293
1467	38	30.232	25.78	39.73168018	32.56695097	43.42701295
1468	39	30.806	25.78	40.1697114	32.92599295	42.02179663
1469	40	31.401	25.78	40.62765167	33.30135383	40.61678931
1470	41	32.016	25.78	41.10482993	33.69248355	39.21860882
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1480	Horiz. Sta. +027\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1481	1	32.016	26.78	41.73927459	34.21252016	37.45726471
1482	2	31.401	26.78	41.26943276	33.8274039	38.7512086
1483	3	30.806	26.78	40.81869319	33.45794524	40.04916457
1484	4	30.232	26.78	40.38770122	33.10467313	41.34503337
1485	5	29.682	26.78	39.97706566	32.7680866	42.63222612
1486	6	29.155	26.78	39.58750766	32.44877677	43.90320946
1487	7	28.653	26.78	39.21949183	32.14712445	45.15073915
1488	8	28.178	26.78	38.87374543	31.86372576	46.36620938
1489	9	27.731	26.78	38.5508193	31.59903221	47.54117531
1490	10	27.313	26.78	38.25138388	31.35359335	48.66640827
1491	11	26.926	26.78	37.97587531	31.12776665	49.73331093
1492	12	26.571	26.78	37.72493205	30.92207545	50.7323935
1493	13	26.249	26.78	37.49890534	30.73680765	51.65531104
1494	14	25.962	26.78	37.298363	30.57242869	52.49300527
1495	15	25.71	26.78	37.12367652	30.42924305	53.23751948
1496	16	25.495	26.78	36.97524204	30.30757544	53.88125147
1497	17	25.318	26.78	36.8533516	30.20766524	54.41764955
1498	18	25.179	26.78	36.75827233	30.12973141	54.84101426
1499	19	25.08	26.78	36.69018648	30.07392335	55.14688597
1500	20	25.01	26.78	36.64244124	30.0347879	55.36273679
1501	21	25	26.78	36.63561655	30.02919389	55.39368241
1502	22	25.01	26.78	36.64244124	30.0347879	55.36273679
1503	23	25.08	26.78	36.69018648	30.07392335	55.14688597
1504	24	25.179	26.78	36.75827233	30.12973141	54.84101426
1505	25	25.318	26.78	36.8533516	30.20766524	54.41764955
1506	26	25.495	26.78	36.97524204	30.30757544	53.88125147
1507	27	25.71	26.78	37.12367652	30.42924305	53.23751948
1508	28	25.962	26.78	37.298363	30.57242869	52.49300527
1509	29	26.249	26.78	37.49890534	30.73680765	51.65531104
1510	30	26.571	26.78	37.72493205	30.92207545	50.7323935
1511	31	26.926	26.78	37.97587531	31.12776665	49.73331093
1512	32	27.313	26.78	38.25138388	31.35359335	48.66640827
1513	33	27.731	26.78	38.5508193	31.59903221	47.54117531
1514	34	28.178	26.78	38.87374543	31.86372576	46.36620938
1515	35	28.653	26.78	39.21949183	32.14712445	45.15073915
1516	36	29.155	26.78	39.58750766	32.44877677	43.90320946
1517	37	29.682	26.78	39.97706566	32.7680866	42.63222612
1518	38	30.232	26.78	40.38770122	33.10467313	41.34503337
1519	39	30.806	26.78	40.81869319	33.45794524	40.04916457
1520	40	31.401	26.78	41.26943276	33.8274039	38.7512086
1521	41	32.016	26.78	41.73927459	34.21252016	37.45726471
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	A	B	C	D	E	F
1531	Horiz. Sta. +028\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1532	1	32.016	27.78	42.38781716	34.74411242	35.76412418
1533	2	31.401	27.78	41.92524395	34.36495406	36.96102071
1534	3	30.806	27.78	41.48163104	34.00133692	38.15955295
1535	4	30.232	27.78	41.05759868	33.65376941	39.35411178
1536	5	29.682	27.78	40.65373019	33.32272967	40.53867497
1537	6	29.155	27.78	40.27071843	33.0087856	41.70639178
1538	7	28.653	27.78	39.90900324	32.71229774	42.85071845
1539	8	28.178	27.78	39.56928208	32.43383777	43.96390279
1540	9	27.731	27.78	39.25207853	32.17383486	45.03838137
1541	10	27.313	27.78	38.95803343	31.93281429	46.06591195
1542	11	26.926	27.78	38.6875575	31.71111271	47.03886297
1543	12	26.571	27.78	38.44126037	31.50922981	47.94881693
1544	13	26.249	27.78	38.21947019	31.32743458	48.78842112
1545	14	25.962	27.78	38.0227285	31.1661709	49.54968704
1546	15	25.71	27.78	37.85138515	31.02572554	50.22563316
1547	16	25.495	27.78	37.70581552	30.90640616	50.80959533
1548	17	25.318	27.78	37.58629436	30.808438	51.29584862
1549	18	25.179	27.78	37.49307382	30.73202772	51.67941755
1550	19	25.08	27.78	37.42632475	30.67731537	51.95641849
1551	20	25.01	27.78	37.37951979	30.63895065	52.15183544
1552	21	25	27.78	37.3728297	30.63346697	52.17984748
1553	22	25.01	27.78	37.37951979	30.63895065	52.15183544
1554	23	25.08	27.78	37.42632475	30.67731537	51.95641849
1555	24	25.179	27.78	37.49307382	30.73202772	51.67941755
1556	25	25.318	27.78	37.58629436	30.808438	51.29584862
1557	26	25.495	27.78	37.70581552	30.90640616	50.80959533
1558	27	25.71	27.78	37.85138515	31.02572554	50.22563316
1559	28	25.962	27.78	38.0227285	31.1661709	49.54968704
1560	29	26.249	27.78	38.21947019	31.32743458	48.78842112
1561	30	26.571	27.78	38.44126037	31.50922981	47.94881693
1562	31	26.926	27.78	38.6875575	31.71111271	47.03886297
1563	32	27.313	27.78	38.95803343	31.93281429	46.06591195
1564	33	27.731	27.78	39.25207853	32.17383486	45.03838137
1565	34	28.178	27.78	39.56928208	32.43383777	43.96390279
1566	35	28.653	27.78	39.90900324	32.71229774	42.85071845
1567	36	29.155	27.78	40.27071843	33.0087856	41.70639178
1568	37	29.682	27.78	40.65373019	33.32272967	40.53867497
1569	38	30.232	27.78	41.05759868	33.65376941	39.35411178
1570	39	30.806	27.78	41.48163104	34.00133692	38.15955295
1571	40	31.401	27.78	41.92524395	34.36495406	36.96102071
1572	41	32.016	27.78	42.38781716	34.74411242	35.76412418
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	A	B	C	D	E	F
1582	Horiz. Sta. +029\	Base	Altitude	Mean Blast Distance	Mean Distance "r"	Blast Pressure PSI
1583	1	32.016	28.78	43.04982048	35.2867381	34.13946546
1584	2	31.401	28.78	42.5944372	34.91347311	35.24618352
1585	3	30.806	28.78	42.15786657	34.55562834	36.35254965
1586	4	30.232	28.78	41.74070447	34.21369219	37.45341541
1587	5	29.682	28.78	41.34350951	33.88812255	38.54328552
1588	6	29.155	28.78	40.9669472	33.57946492	39.61593812
1589	7	28.653	28.78	40.61143361	33.28806033	40.66546936
1590	8	28.178	28.78	40.27763752	33.01445698	41.6849019
1591	9	27.731	28.78	39.96605646	32.75906267	42.66746673
1592	10	27.313	28.78	39.67730295	32.52237946	43.60580625
1593	11	26.926	28.78	39.41176354	32.30472422	44.49314916
1594	12	26.571	28.78	39.1700204	32.1065741	45.3220304
1595	13	26.249	28.78	38.95237992	31.92818026	46.08597276
1596	14	25.962	28.78	38.75935864	31.7699661	46.77793056
1597	15	25.71	28.78	38.59128604	31.63220167	47.39177737
1598	16	25.495	28.78	38.44851784	31.51517856	47.92166986
1599	17	25.318	28.78	38.33131258	31.41910867	48.36260414
1600	18	25.179	28.78	38.23990827	31.34418711	48.7102351
1601	19	25.08	28.78	38.17446508	31.29054515	48.96117937
1602	20	25.01	28.78	38.12857852	31.25293321	49.13816196
1603	21	25	28.78	38.12201988	31.24755728	49.16352799
1604	22	25.01	28.78	38.12857852	31.25293321	49.13816196
1605	23	25.08	28.78	38.17446508	31.29054515	48.96117937
1606	24	25.179	28.78	38.23990827	31.34418711	48.7102351
1607	25	25.318	28.78	38.33131258	31.41910867	48.36260414
1608	26	25.495	28.78	38.44851784	31.51517856	47.92166986
1609	27	25.71	28.78	38.59128604	31.63220167	47.39177737
1610	28	25.962	28.78	38.75935864	31.7699661	46.77793056
1611	29	26.249	28.78	38.95237992	31.92818026	46.08597276
1612	30	26.571	28.78	39.1700204	32.1065741	45.3220304
1613	31	26.926	28.78	39.41176354	32.30472422	44.49314916
1614	32	27.313	28.78	39.67730295	32.52237946	43.60580625
1615	33	27.731	28.78	39.96605646	32.75906267	42.66746673
1616	34	28.178	28.78	40.27763752	33.01445698	41.6849019
1617	35	28.653	28.78	40.61143361	33.28806033	40.66546936
1618	36	29.155	28.78	40.9669472	33.57946492	39.61593812
1619	37	29.682	28.78	41.34350951	33.88812255	38.54328552
1620	38	30.232	28.78	41.74070447	34.21369219	37.45341541
1621	39	30.806	28.78	42.15786657	34.55562834	36.35254965
1622	40	31.401	28.78	42.5944372	34.91347311	35.24618352
1623	41	32.016	28.78	43.04982048	35.2867381	34.13946546

Figure 3. Damage Resulting from Internal Detonation of 180 lb TNT Equivalent

Figure 4. Damage Resulting from Internal Detonation of 35 lb TNT Equivalent

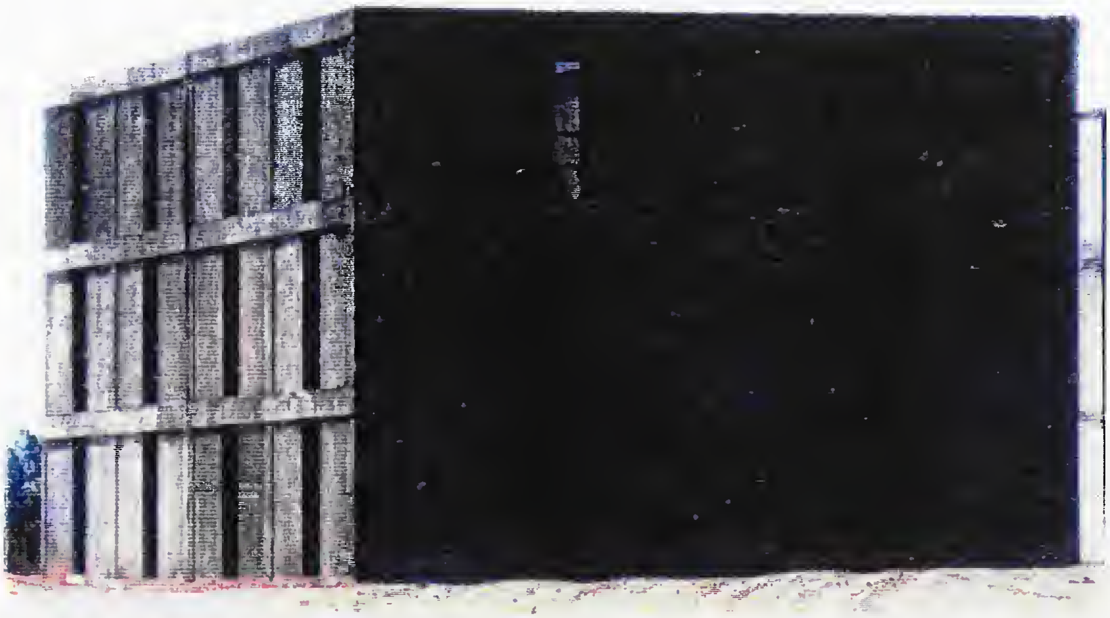

Figure 1: Cast-in-place Concrete Test Structure

Figure 2: Damage Resulting from External Detonation of 830 lb TNT Equivalent

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APPLIED MECHANICS/STRUCTURAL DYNAMICS

17 April 1998

William Jasper
The New American
P.O. Box 8040
Appleton, WI 54913

Dear Mr. Jasper:

The reports you sent relative to bomb destruction of structures were very interesting, and I appreciate your making them available to me. Part of my 45 years as an aerospace engineer in the field of structural mechanics and dynamics had been devoted to the topography of failed structural systems and structural components.

Structural elements present different fracture surface topographies depending on three main factors and several subfactors related thereto. The three main factors are (1) loading conditions, (2) type of material out of which structure was built, and (3) geometry of structural system or element. A complete list of the subfactors involved would exceed the scope of this letter, but I shall give a couple of examples to show what I mean.

For instance, a slowly applied load to failure of a structural element made out of a ductile material will result in a different fracture surface topography from that obtained when the same element is loaded cyclically (repeated load applications) to failure. If that same element is loaded to failure with a high rate loading such as impact, shock, or explosive force, the fracture surface geometry will again be different from the two situations just previously described.

In summary, an engineer who knows the laws of physics and is experienced in fracture mechanics and dynamics of materials can look at a failed part and tell you what kind of loading conditions caused the failure. Given more time, he can probably quantify the loading conditions that would have caused failure (sometimes called forensic analysis).

A number of years ago I received training in the U.S. Army Engineers Corps at Ft. Leonard Wood, MO. Part of that training involved the use of explosives to destroy different types of structures. Based on that training alone, I would say that a 4800 lb ANFO truck bomb is an extremely inefficient way to bring down any structure. It might blow a hole in the curtain wall closest to the truck, but it would hardly touch the supporting columns of the building, because air is such a poor coupling agent. In fact, to be assured of destroying any structure, one would have to place the correct amount of explosive charge in <u>intimate contact</u> with the pertinent supporting members.

The damage pattern of any structure will indicate how the loading conditions which caused failure were applied. In the case of the OKC Murrah Building, the failure pattern demonstrated to me that individual charges were placed on each of the failed columns inside the building. I was glad when I read about General Partin's analysis in *The New American*, because his quantitative analysis certainly confirmed my qualitative analysis. In addition, the report on the bomb destruction of the reinforced concrete structure at Eglin AFB, which I read in detail, gives further confirmation that additional charges had to be placed at the bases of the supporting columns of the OKC Murrah Building in order to cause the resultant pattern of destruction.

In closing, I want to thank you again for the reports you sent. I would surmise any scientist or engineer that works in the field of accident reconstruction or failure analysis would agree with General Partin's careful analysis and conclusions about what really caused the OKC Murrah Building tragedy. I hope what I have written will be of help to you. If your need more detail, let me know.

Yours sincerely,

Ernest B. Paxson

Ernest B. Paxson, PhD, PE

UNIVERSITY OF OREGON

13 February 1998

Charles D. Key
State Representative of Oklahoma, Dist. 90
Oklahoma City, Oklahoma

Dear Representative Key,

I have carefully reviewed the following two reports which present technical information relating to assessment of damage to the Murrah Federal Building, Oklahoma City, Oklahoma, on 19 April 1995:

"Bomb Damage Analysis of the Alfred P. Murrah Federal Building, Oklahoma City, Oklahoma", Benton K. Partin, 30 July 1995.

"Memo for Brig.Gen. Benton K. Partin, USAF (ret), re: Blast Effects on Conventional Urban Structures", Dr.Robert Whalen, Eglin Air Force Base, Florida, April 1996.

Based on my knowledge regarding blast waves in air and a somewhat limited knowledge of detonation waves in chemically active solids, I judge both of the above reports to have been prepared by highly competent professionals and that the conclusions reached in them are valid. Before I provide a few additional comments of my own, I will briefly review my experience which pertains to the problem.

I was a research scientist with NACA and NASA from 1950 to 1961 and again from 1967 to 1982. I became Chief of the Fluid Mechanics Branch and later the Physical Gasdynamics Branch at the Ames Research Center of NASA. In that position I supervised the construction and operation of the most powerful research shock tube in the world known as the EAST (Electric Arc Driven Shock Tube) facility. This was used to duplicate conditions similar to gas produced in the stagnation region of space vehicles returning from lunar mission. In this work I attained some international recognition as an expert on exceedingly high temperature air, and a monograph which I prepared for NASA, "Molecular Physics of Equilibrium Gases" NASA SP-3096, 1976, was used at times as a text for graduate courses in astronautics at various universities including Stanford, MIT, and Nagoya University. In addition to studying properties of shock heated air, I was involved in research using explosives to accelerate models to velocities up to 30,000 ft/sec and beyond, in order to measure the aerodynamics and heating of very high speed vehicles in gaseous media. This gave me some understanding of detonation waves in solids and explosives.

DEPARTMENT OF PHYSICS
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In addition to the above, I was Head of Earth and Astro Sciences at the General Motors Defense Research Laboratories in Santa Barbara, California, 1961-1976. I was part time Prof. of Physics at San Jose State, California 1959-1961 and part time Prof. of Aeronautics and Astronautics at Stanford 1972-1982. I was full time Prof. of Mechanical Engineering at MIT 1965-1966; Prof. of Aeronautics at Nagoya University, Japan 1982; Prof. of Chemistry at Indian Institute of Technology, New Delhi, India 1983; Prof. of Aeronautics at Indian Institute of Science, Bangalore, India 1983; and Prof. of Aeronautics at Cheng Kung University, Tainan, Taiwan 1984-1985--teaching graduate courses in high energy shock wave properties. From 1985-1989 I was President of JAI Associates, a private research company developing advanced computer codes for aerodynamics, and since 1990 I have been Prof. of Physics at the University of Oregon where I have continued research on very high temperature gases and published a number of papers on this subject.

Comments about the Benton and Whalen reports follow:

1. I agree with Gen. Parton that blast through air is a very inefficient coupling mechanism against structures. Only by containing or focusing the blast can extensive damage be inflicted on reinforced structures. Large panels, such as walls or ceilings or windows, that are not reinforced can be collapsed by relatively small pressure waves, the order of 10 psi. But T-bar reinforced concrete columns require blast pressures that exceed several thousands of psi.

2. Three dimensional blast pressures in air fall off rapidly. The exact fall off is complex for high energy shocks, depending on reactions such as dissociation and ionization of the air molecules, but a decrease in pressure as the inverse cube of distance from the blast source gives a reasonably good approximation; in fact the measured decrease is usually somewhat greater than this.

3. I do not have direct knowledge that the initial blast produced by ANFO explosion is about 500,000psi, but this seems reasonable since much faster burning TNT explosions produce initial pressures the order of 1,500,000 psi. I can say that unless the ANFO is very tightly packed it will not support detonation wave but will instead produce a lesser blast by very rapid burning similar to gunpowder. Also complete conversion of a sizable mass of explosive requires sophisticated ignition methods. My group was never able to get 100% energy conversion except from very small samples of explosive, which incidentally is the same problem that occurs with nuclear explosion. In the absence of a sophisticated ignition scheme, I would be surprised if 4800 lbs. of ANFO stored in separate barrels resulted in more than about 75% conversion efficiency.

4. One element that may have been overlooked is the pressure increase that occurs when a shock wave is reflected. In ideal air the reflected shock pressure approaches a limit of 8 times the incident pressure. At column B3 which was demolished, a 500,000 psi. initial pressure wave would have reduced to about 30 psi. 57 feet from the explosion (my calculation agrees with Partin's). and

if the reflected wave were 8 times greater, this would still be far short of the 3500 psi or more required to exceed the yield strength of the column. Moreover, at the 3rd floor where column B3 failed, the shock intensity would have been reduced by about the cosine of 23 degrees and an extra 5 feet of spherical attenuation. Everything considered, it is hard to avoid the conclusion that only an explosive detonated right at the column could have sheared it.

You have my permission to use my comments in whatever way is helpful to your investigation. On another matter, Ms. McCauley of your staff asked about an expert on Seismology who could provide reliable interpretation of the earth tremors recorded at the time of the blast. Prof. Gene Humphreys at the University of Oregon Geology Department suggested that you contact Dave Simpson or Greg Van der Vink at IRIS, which is a university consortium on seismology which considers interpretations of pressure waves and reflections in earth. Simpson can be contacted by e-mail (simpson@iris.edu). I hope this may help.

Sincerely,

C. Frederick Hansen

C. Frederick Hansen
Prof. of Physics

cfh:mjm

FRIAS ENGINEERING
ROBERT FRIAS

1803 W. Park Row, Ste. A
Arlington, Texas 76013
Phone 817-274-8666
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5 February 1997

Dear Mr. Jasper:

I have been practicing engineering for more than forty years and am a registered engineer in Texas, New Mexico, and Louisiana.

After having reviewed the material made available by the U. S. Department of the Air Force on the blast effects on conventional urban structures (conducted to make comparisons between the test structure at Eglin Air Force Base and the Murrah Federal Building at Oklahoma City), I concur with the following observations:

1. That the test facility (described as ETS in the study) was similar to the Murrah Building in many respects but structurally not as strong as described on pages 3 and 4 of the study.

2. That the first test blast, using the equivalent of 4800 pounds of ammonium nitrate and fuel oil mixture and positioned 25 ft. from the 40 ft. side of the test structure, had sufficient explosive force to destroy 6" thick concrete panels, but insufficient to destroy the columns and beam structure of the test structure, even though its structural strength was substantially less than that of the Murrah Building. Additionally, the explosive force of the tritonal used in the first test was more powerful than what could have been expected from the truck explosives in the Murrah Building incident, as described on page 17 of the study.

My conclusion: The Murrah Building would still be standing and the upper floors would be intact had the truck loaded with explosives been the only culprit.

3. The 2nd and 3rd test blasts proved what would have been required to collapse the steel reinforced columns and beams, proving too the distance at which even the upper floor slabs would have remained intact had the truck been the only culprit.

My conclusion: This study implies many things not brought to light until now, but the most important is that the existing site and building components should be reexamined. Evidence of conspiracy is still indicated. Explosives had to have been placed near, or on, the structural columns inside the building to cause the collapse that occurred to the Murrah Building.

The deaths that occurred to occupants in the lower levels could well have been caused by the person(s) responsible for the truck detonation. The deaths that occurred to occupants in the upper levels could well have been caused by other person(s) responsible for the detonations causing the collapse of the columns, beams, and upper floor slabs.

Sincerely,

Robert Frias

RF/me

February 3, 1997

Mr. William Jasper
The New American
P.O. Box 8040
Appleton, WI 54913

Dear Mr. Jasper:

The Elgin Test Structure report that you sent me further reinforces--and **when combined with the seismic evidence of two explosions,** makes practically irrefutable--the conclusion that a substantial portion of the Murrah Federal Building damage was by internal explosions.

The report contains informative and useful statements regarding various explosives and the dependence of blast pressure upon explosive dimensions and the probable spacing of explosive containers in the Ryder truck.

There are however, a number of items in the report upon which I am somewhat at variance.

1. The report states that the blast pressure decreases with the inverse cube of the distance from the blast. This is probably an adequate approximation. The classic equation for a static mass of uniform temperature gas is: **PV=RT** where P is the pressure, V the volume, R a constant and T, the absolute temperature. Since the volume goes as the cube of the distance, the pressure would be proportional to the inverse cube of the distance. Complicating factors include:

A. The temperature of the expanding gas drops rapidly with the energy loss from expansion forces.

B. The blast expansion rate is greater than the velocity of sound in the surrounding atmosphere and is related to the velocity of sound within the blast.

The report should have contained at least a reference to the derivation of the inverse cube equation.

2. Blast damage as related to the duration of the blast pressure wave was not explicitly discussed or reference source information provided. An intense hypothetical pressure wave of one microsecond duration would cause localized compression damage with a powdering of concrete--much as was reported as evidence of explosives in contact with the columns at breakage points in the Murrah Building. A less intense pressure wave of much longer duration would cause bending fractures as with wall collapses.

3. There was an absence of mention of tests with the explosive in contact with a column.

Sincerely,

Ken Gow

Ken Gow

P.S. My formal education included a Masters Degree in Electrical Engineering from Rensselear. My 1/2 century of Aerospace Engineering experience started with working for the Cal Tech wind tunnel followed by 35 years with North American Aviation (merged with Rockwell) and 6 years with Northrop prior to a 1991 retirement. My specialty was system engineering for aircraft and missile inertial guidance with emphasis on instrument design, performance, and testing.

DEPARTMENT OF THE AIR FORCE
WRIGHT LABORATORY (AFMC)
EGLIN AIR FORCE BASE, FLORIDA

1 6 FEB [illegible]

MEMORANDUM FOR BRIGADIER GENERAL BENTON K. PARTIN, USAF (RET)
8908 CAPTAINS ROW
ALEXANDRIA VA 22308

FROM WL/MN
101 West Eglin Boulevard, Suite 101
Eglin AFB FL 32542-6810

SUBJECT: Requested Images of Blast Effects on Conventional Urban Structures

1. At your request, we have assembled imagery from several Armament Directorate test series conducted at Eglin AFB FL against simulated conventional urban buildings. Attached are images of the original test structure and the post-test damage caused by detonations of high explosives.

2. Figure 1 shows the three-story, cast-in-placed concrete test structure. The dimensions of this structure are 80 ft. long by 40 ft. wide by 30 ft. high. The walls and floors are 6-inches thick concrete with number 4 steel reinforcement bars located on 18-inch centers. The structure is supported by 14-inch thick concrete columns in the corners of each room and along the edges of the floor panels.

3. Several images of post-test damage to walls are given in Figures 2 through 4. Figure 2 shows the damage caused by detonation of 704 lb. of Tritonal contained in a light aluminum case (equivalent explosive weight: 830 lb. TNT) placed external to the structure 25 ft. from the exterior wall. Figure 3 shows the damaged caused by detonation of a Mk-82 warhead (equivalent explosive weight: 180 lb. TNT) placed within the first floor corner room approximately 4 ft. from the outer wall. Figure 4 shows the damage caused by detonation of a 250 lb.-class penetrating warhead (equivalent explosive weight: 35 lb. TNT) placed within the second floor corner room approximately 2.5 ft. from the two outer walls. Please note that some of the damage to the left side of the structure as shown in the image was caused by the test shown in Figure 3; however, this room was essentially intact prior to the test of the small warhead.

4. A data search was accomplished for tests with charges placed directly on a supporting member of a structure, but no data on this kind of test configuration could be found in the directorate's archives. Under current Department of Defense policy, a single organization has been assigned responsibility for structural integrity technology; this organization is the Army's Waterways Experimentation Station (WES).

5. The director of the Waterways Experimentation Station may be able to provide the information you requested. His address and phone number are:

DR. ROBERT WHALIN
CEWES-7A
3909 HALLS FERRY ROAD
VICKSBURG MS 39180
(601)634-2664

Gerry R. Daugherty
GERRY R. DAUGHERTY, Colonel, USAF
Director, Armament Directorate

Attachments
Figures 1-4

Sir,
Sorry we couldn't come up with more..
[illegible]

ALVIN V. NORBERG
Electrical Engineer

25748 Table Meadow Rd.
Auburn, CA 95602

January 31, 1997
(916) 269-1573

William Jasper, Senior Editor
The New American Magazine
6730 Sommersworth Drive
Citrus Heights, CA 95621

Subject: Bomb Damage Analysis of Alfred P. Murrah Federal Building Oklahoma City, Oklahoma

Dear Mr. Jasper,

On 1/30/97 I received from you a report based on data originating from the Department of the Air Force, Wright Laboratory (AFMC), Eglin Air Force Base, Florida. The report is based on information provided in a memo titled "Memorandum for Brigadier General Benton K. Partin, USAF (Ret.), 8908 Captains Row, Alexandria, VA 22308; From WL/MN, 101 West Eglin Blvd., Suite 101, Eglin AFB, IL 32542-6810, Subject: Requested Images of Blast Effects on Conventional Urban Structures". The report bears no wet signature or legible date. The report consists of: cover letter; two pages of photographs of an exemplar test structure; 18-page report; and 32 pages of "Blast Effect Testing - Pressure Mapping Project" data. You have requested my professional opinion which I offer as follows:

I have read and studied the above report and concur with the "conclusions" stated in the report, with no exceptions taken, that the damage to the Murrah Building on April 19, 1995 cannot be ascribed to a single truck bomb containing 4800 lbs of ANFO.

The damage pattern on the exemplar concrete, steel reenforced structure, identified as "ETS", with "before" and "after" photographs, and blast pressure attenuation data verifies that the severe structural damage to the Murrah Building was not caused by a truck bomb outside the building.

The damage pattern on the exemplar structure, as revealed by tests 1, 2, and 3, show that the collapse of the Murrah Federal Building was the result of "mechanically coupled devices" (bombs) placed locally within the structure adjacent to critical columns.

I have a copy of an analysis dated July 30, 1995 prepared by Benton K. Partin, Brigadier General, USAF (Ret.), complete with photograph evidence of the Murrah Building damage and calculated bomb pressure attenuation from the single truck bomb. The Partin analysis, with no exceptions taken, reveals that there were at least four (4) internal explosive devices placed strategically on certain columns that were triggered by "shock wave coupling" to the truck bomb.

The actual tests conducted by the U.S. Air Force, Wright Laboratory, on an exemplar structure with exemplar explosive devices prove conclusively that the Partin report of July 30, 1995 is correct.

Alvin V. Norberg, PE

REGISTERED PROFESSIONAL ENGINEER
ALVIN V. NORBERG
No. 3337
Exp 6-30-99
ELECTRICAL
STATE OF CALIFORNIA

Qualifications

Alvin V. Norberg holds a BS Degree from University of California, Berkeley, Dec. 1939, and is a currently licensed professional engineer in the State of California. He is the electrical engineer of record of over 5000 building construction projects and has served as "expert witness" in 150 fire and accident investigations and testified in Superior Court on a number of cases. Mr. Norberg resides at 25748 Table Meadow Rd., Auburn, CA 95602.

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A. LEE SMITH
Surveyor
MICHAEL D. SMITH
Engineer

WILLIAM C. SMITH
Surveyor

March 6, 1997

William Jasper
(414) 749-3785

Bill,

As per your request and the request of John Culbertson, following is the most "quotable" portion of my response letter to the Case Study relating blast effects at the Eglin Air Force Base Test Structure to the events of April 19, 1995 at the Alfred P. Murrah Federal Building, Oklahoma City, Oklahoma.

The results of the Blast Effect Test One on the Eglin Test Structure present strong evidence that a single Ammonium Nitrate and Fuel Oil device of approximately 4800 lbs placed inside a truck could not have caused the damage to the Murrah federal Building experienced on April 19, 1995. Even assuming that the building had structural deficiencies and that the ANFO device was constructed with racing fuel, the air coupled blast produced from this 4800 lb device would not have damaged the columns and beams of the Murrah Building enough to produce a catastrophic failure.

If you require further information, please call.

Sincerely,

Michael D. Smith

Michael D. Smith, PE

DEPARTMENT OF THE AIR FORCE
WRIGHT LABORATORY (AFMC)
EGLIN AIR FORCE BASE, FLORIDA

1 [illegible]

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GERRY R. DAUGHERTY, Colonel, USAF
Director, Armament Directorate

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ASMENEWS

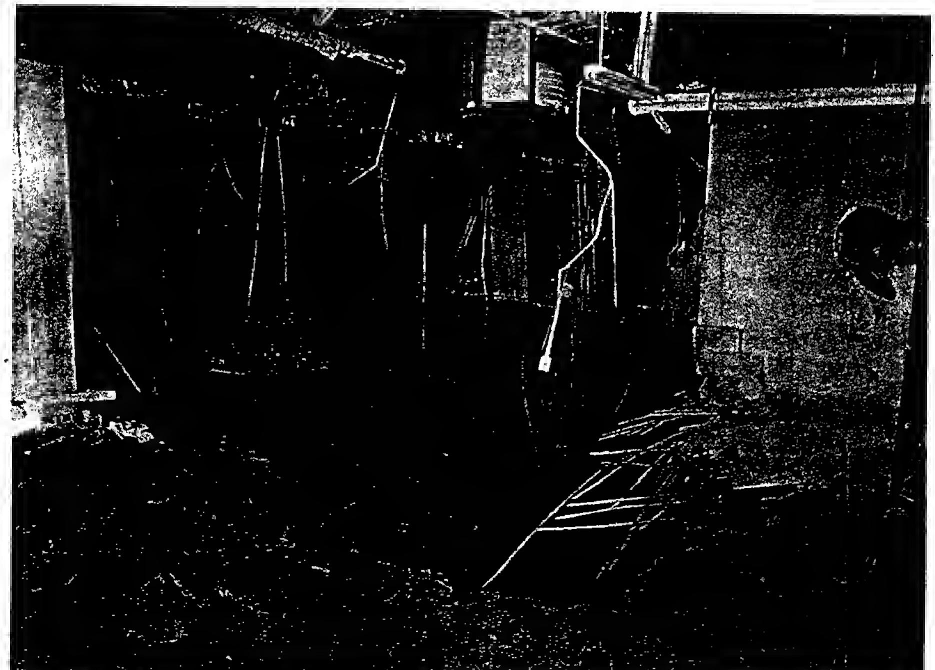
After the Blast, ASME VP Took the Stairs

Stephen M. Coveney
ASME, New York

John Parker, ASME's vice president for government relations, was completing a phone call at 12:18, Friday, February 26, when he heard a "big boom" and the lights in his office began to flicker. As the manager of planning and marketing at Ebasco Services Inc., Parker works on the 93rd floor of Tower Two of New York's World Trade Center.

"My computer didn't go down, so I thought it was thunder," Parker said. "A couple of minutes later, I heard sirens. When I looked out the window it seemed as though all the emergency vehicles in New York were descending on the building."

Parker revised his assessment of what had happened, believing that a transformer had exploded, and continued to work for 10 more minutes until



Aftermath. The crater from the February 26 explosion in an underground parking garage at the World Trade Center in New York. The Federal Bureau of Investigation confirmed the explosion was

Daman Urges U.S. To Aid Small Manufacturers

David I. Lewin
ASME, Washington, DC

Congress should pass legislation on a sound national technology policy that can aid small manufacturers, ASME Past-President Ernest L. Daman recently told members of the House Technology, Environment, and Aviation Subcommittee. Daman made the remarks on February 23, during a hearing on the National Competitiveness Act of 1993 (H.R. 820).

Provisions of the bill's Title II, the Manufacturing Technology and Extension Act of 1993, was the focus of the hearing. This legislation enlarges the role of the National Institute of Standards and Technology (NIST) in improving U.S. competithe lights went out. Still thinking that he was involved in a minor incident, Parker wandered to the south end of the building and mingled with coworkers waiting for instructions that were delayed in all the confusion. Parker later went back into his office and listened to the radio and learned that the Twin Towers, the second tallest buildings in the world and a magnet for 100,000 workers and visitors each day, may have been the target of a terrorist group. The blast, which occurred beneath the nearby Vista Hotel, killed six people, injured more than 1000, and caused about $1 billion damage, according to estimates by the New York Governor's office.

Parker stayed in his office until 3 p.m. and left using a stairwell that firemen had drawn most of the smoke out of. "The evacuation was very orderly," he said. "Because there were no lights, a couple of people used cigarette lighters and a few flashlights to guide our way. I never felt threatened." Parker said that being a jogger probably helped him down all 93 floors without much trouble.

Once on the street Parker headed for the subway and his home in Rowayton, CT. "I knew something was wrong but I didn't realize how bad it was until I got home and looked in the bathroom mirror and saw how dirty I was. My face was covered with soot everywhere except where my glasses had been." Parker said that he spent almost an hour on the phone assuring friends and relatives that he was fine. "Four of the people I work with were stuck in an elevator for more than an hour; others were trapped for at least six. If I hadn't been on the phone, I probably would have had to be rescued too."

Parker spent the week after the blast attending ASME meetings. When he did get back to his office, he had to go through two barricades, security checks, and was told he could only remain upstairs for a limited amount of time. "It was eerie to go into such a big building with no one in it," he said. "Half the lobby (about a third of an acre) was filled with fans, vacuum cleaners, and cleaning supplies."

Following a disaster recovery program the company had set up in January, more than 700 of Ebasco's World Trade Center staff of 1200 people moved to the company's Lyndhurst, NJ office. The other 500 worked at home. "Our mainframe went down briefly before our computer experts decided to shut it down for the weekend. They also brought over a backup from New Jersey. On Monday they reconstructed our computers and everything was normal. All we had to

Continued on Page 2

Technology Outreach Program and an Advanced Manufacturing Technology Development Program.

The bill, introduced by Representatives Tim Valentine (D-NC) and George Brown (D-CA), represents the House version of legislation to carry out the Clinton administration's proposals in technology policy. A similar Senate bill, S.4, was introduced by Senator Ernest Hollings (D-SC).

H.R. 820 strengthens existing technology programs within NIST and the National Science Foundation. It also establishes a program to coordinate information on foreign science and technology and increases the availability of capital for firms developing civilian technologies.

"More than 98 percent of U.S. manufacturing establishments have fewer than 500 workers," said Daman, who testified for the Engineers Public Policy Council as chair of the American Association of Engineering Societies. "As an aggregate, small and mid-sized manufacturers employ as many as 12 million workers and contribute more than half the value-added to manufactured goods." But these smaller firms have had the most difficulty in modernizing their manufacturing processes, he noted.

To help smaller manufacturers become more competitive, the federal government should help establish a nationwide network of manufacturing technology centers. These should be modeled, in part, on the Department of Agriculture's successful Agricultural Extension Service, Daman said. While the United States spends $1.1 billion annually on agricultural exten-

Continued on Page 4

Industry Engineers Believe Curricula Meet Basic Needs

Nearly two-thirds of industry engineers surveyed believe that the current four-year B.S. engineering curricula meet the basic needs of their companies, according to a recent study by the National Society of Professional Engineers. Respondents also indicated that a major overhaul in engineering education is not a top priority of U.S. industry.

Approximately 100 engineering deans and 1000 employers in industry and government took part in the two-year study. The survey asked what the best "first professional degree" might be for engineering students. Results showed that some curriculum modification is needed, but the respondents could not agree on what, how much, or how soon. Forty-six percent of the respondents said that change is needed, but they would limit the degree to four years. Only 10 percent would lengthen the degree to a five-year program.

"Industry is satisfied with the engineering education system," said Chor Tan, ASME Managing Director for Education. "After all, it often does its own training to reshape the engineers it hires into its own mold."

Most employers expect to provide in-house training to entry-level employees. Even if the curriculum were to change, nine out of 10 respondents said they would continue to supply their new recruits with additional training.

Copies of the NSPE report (Prod. No. 3059) are available at a member price of $9.95, or $12.95 for nonmembers. To obtain a copy, contact: *NSPE Customer Service, 1420 King St., Alexandria, VA 22314; (703) 684-2800*, or fax: *(703) 836-4875*. ■

retain careers in engineering, participate in ASME activities, and assume leadership roles.

Recently, I participated in the second national conference of the National Research Council's Committee on Women in Science and Engineering on "Women Scientists and Engineers Employed in Industry: Why So Few?" Approximately 200 representatives from industry, government and universities shared their experiences with innovative approaches to recruiting and retaining women scientists and engineers as well as workplace issues that still require resolution.

As a panelist speaker on the topic of minority women scientists and women the opportunity to share jobs, work part-time and otherwise balance work and family obligations. Additionally, many of the organizations represented at the conference have programs in place to recruit women scientists and successfully integrate them into a technical group. With an emphasis on career guidance and supervisor support, these companies were able to retain their women scientists at a higher than average rate. A full report from the NRC conference will be released this fall.

To obtain a copy of the report, contact: *National Academy Press, 1-800-624-6242.* For further information on the Board of Minorities and Women and its programs, contact: *Catherine A. Tang, (206) 425-2150, ext. 5534,* or, *Sonya Engle, ASME Washington office, (202) 785-3756.* ■

Business Meeting Set for SAM

The annual ASME Business Meeting will be held on Wednesday, June 16, during the 1993 Summer Annual Meeting at the Hyatt Regency in Dearborn, MI.

The meeting will be called to order at 5 p.m. by ASME President Joseph A. Falcon, who will present his 1992–93 State of the Society address and announce the locations and dates of the 1993 Winter Annual Meeting and the 1994 Summer Annual Meeting. In addition, the election of the 1994 National Nominating Committee and ratification of an auditor will take place. The meeting will adjourn by 5:30 p.m. ■

After the World Trade Center Blast

Continued from Page 1

do was put everything on disks so we could retrieve the information on computers we leased for the Lyndhurst office," he said. "This prompted one of our employees to put up a banner that said 'no bomb can stop us,' which was later amended after the recent blizzard to 'no bomb or blizzard can stop us."

Ebasco expected to move back to its World Trade Center office on April 1 but because Tower Two was the least damaged building in the complex, the company was able to reopen on March 22. Parker said that except for sore legs and a much longer commute, he was not terribly inconvenienced by the bombing. "Although my co-workers and I were practically sitting in each other's laps in the cafeteria of our Lyndhurst office, a sense of teamwork, camaraderie, developed," Parker said. "I can't speak for the others but I didn't have any qualms about working in the building again. I'm glad to be back." ■

John R. Parker

Members Have Options In Nominating

Many members of ASME may not be aware of how the National Nominating Committee selects candidates for Society offices. The nomination procedure is as follows:

Members propose candidates at the nominating meetings of the Society's Regions, Councils, and Boards. Members may also propose candidates on their own. Nominations are submitted to the NNC, which meets during each Summer Annual Meeting to interview and select one nominee for each elective office. In the fall, ASME sends out a proxy for the membership to rat-

Continued on Page 4