West Virginia
Purchasing Division
2019 Washington Street, East
Charleston, WV 25305
Telephone: 304-558-2306
General Fax: 304-558-6026
Bid Fax: 304-558-3970

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Solicitation Response(SR) | **Dept:** 0313 **ID:** ESR03082100000006068 **Ver.:** 1 **Function:** New **Phase:** Final

Modified by batch , 03/09/2021

Header 1

List View

General Information | Contact | Default Values | Discount | Document Information | Clarification Request

Procurement Folder: 838030

Procurement Type: Central Master Agreement

Vendor ID: VS0000037533

Legal Name: Smith Adjusting, Inc.

Alias/DBA: Smith Adjusting, Inc.

Total Bid: $56,000.00

Response Date: 03/08/2021

Response Time: 11:16

Responded By User ID: Adjuster

First Name: Denise

Last Name: Smith

Email: dsmith@smithadjusting.c

Phone: 606-928-0399

SO Doc Code: CRFQ

SO Dept: 0313

SO Doc ID: DEP2100000021

Published Date: 3/3/21

Close Date: 3/9/21

Close Time: 13:30

Status: Closed

Solicitation Description: Open-end contract for a Claims Administrator and Adjustor

Total of Header Attachments: 1

Total of All Attachments: 1

Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

State of West Virginia
Solicitation Response

Proc Folder: 838030

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Proc Type: Central Master Agreement

Solicitation Closes	Solicitation Response	Version
2021-03-09 13:30	SR 0313 ESR03082100000006068	1

VENDOR

VS0000037533
Smith Adjusting, Inc.

Solicitation Number: CRFQ 0313 DEP2100000021

Total Bid: 56000 **Response Date:** 2021-03-08 **Response Time:** 11:16:44

Comments:

FOR INFORMATION CONTACT THE BUYER
Joseph E Hager III
(304) 558-2306
joseph.e.hageriii@wv.gov

Vendor Signature X **FEIN#** **DATE**

All offers subject to all terms and conditions contained in this solicitation

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
1	Claims Administrator	400.00000	HOUR	50.000000	20000.00

Comm Code	Manufacturer	Specification	Model #
84000000			

Commodity Line Comments: This rate could fluctuate depending on the amount of administrative duties required to complete the services rendered.
Smith Adjusting, Inc. is willing to negotiate this rate depending on circumstances and need.

Extended Description:

Claims Administrator. Quantity hours are estimated for bid purposes only.

Line	Comm Ln Desc	Qty	Unit Issue	Unit Price	Ln Total Or Contract Amount
2	Claims Adjustor	400.00000	HOUR	90.000000	36000.00

Comm Code	Manufacturer	Specification	Model #
84000000			

Commodity Line Comments: This BID is for the Claims Adjuster; Professional Adjuster Position
Professional Services Rate is $90/hr
Drive Time $45/hr (pro-rated where applicable)

Extended Description:

Claims Administrator. Quantity hours are estimated for bid purposes only.

SMITH ADJUSTING INC

CLAIMS ADJUSTERS ♦ ADMINISTRATORS ♦ CONSULTANTS

2931 HULTZ ROAD ♦ CATLETTSBURG, KY 41129 ♦ (606) 928-0399 ♦ Fax: (606) 928-0828

Claim Investigation Report

Claimant

Pikeville, Kentucky

Prepared for

Casualty Claim Specialist
P. O. Box 25588
Shawnee Mission, KS 66225

Prepared by:

Smith Adjusting, Inc.
2931 Hultz Road
Catlettsburg, Kentucky 41129

Submitted by

David A. Smith, AIC, GA
Blasting Investigator

Date: May 9,
File No.: 5531; Job No.: Client:
Claim No.: 684-429554
Closing Report

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2931 HULTZ ROAD ♦ CATLETTSBURG, KY 41129 ♦ (606) 928-0399 ♦ Fax (606) 928-0828

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INTRODUCTION

The objective of this evaluation is to determine if the conditions of concern at the claimant's residence are the result of blasting activities for the HAWKEYE CONTRACTING project in

PROCEDURE

In order to evaluate this claim the following information was collected and reviewed:

- Documentation and observations from a site visit to the claimant's home;
- Pre-blast inspection report of the claimant's residence, and
- Vibration data collected during blasting activities on the project.

The information gathered is presented in this report along with a discussion/analysis of this information. Additional research was performed relevant to the information gathered and this research is also discussed.

DATA REVIEW

summary of the data collected during this investigation is as follows.

Site Visit

On May 7, 2013 a visit was made to the claimant's residence. Claimant, and her daughter, were present to point out and discuss the various items of concern. The items of concern were documented and photographs are attached to this report.

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Items of Concern

Item#	*Pre-Blast Photograph No. 6 compared to Post-Blasting Photograph No. 4*

Location:	Right top of entrance porch
Description:	One (1) brick vertical by ½"
General Comments:	Please note: mortar bridge on the ½" separation remains intact from pre to post-blasting inspection. This weakened defect remained unchanged from our pre to post-blasting level although the claimant felt it was the result of ground vibration.

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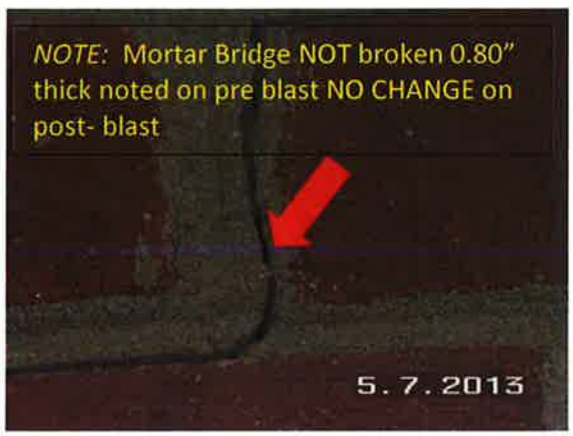
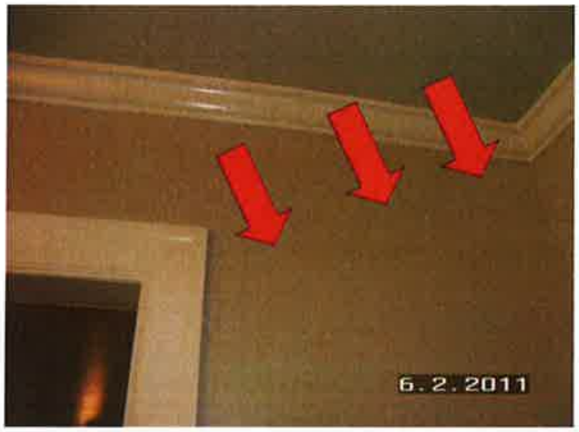
Item#2 *Pre-Blast Photograph No. 9 compared to Post-Blasting Photograph Nos. 8 & 11*



Location: Left top of garage door
Description: Five (5) brick stair step 1/8" to hairline
General Comments: NO CHANGE from pre to post-blasting level.

Item#3 *Pre-Blast Photograph No. 41 compared to Post-Blasting Photograph No. 17*



Location: Right top of door leading from dining room into Kitchen
Description: 18" drywall crack by 1/32" to hairline
General Comments: This defect was re-measured and was exactly 18" by 1/32" to hairline from pre to post-blasting level.

The same is true for the adjacent kitchen and utility room, in which the pre-blasting inspection had DEFECTS previously documented with NO CHANGE in LENGTH or WIDTH on the post-blasting inspection.

Observations/Comments

The claimant's daughter, when we initially arrived, advised there were several places in the exterior brick which warranted repairs as the result of blasting and she doubted that due to the age of the structure, the brick would be able to be matched and corrected.

Additionally, these were the same comments on the interior; however, our post-blasting inspection clearly designated these defects were pre-existing prior to HAWKEYE CONTRACTING's blasting back in the Fall and early Winter, 2011.

AFTER EXAMINATION OF THE EXTERIOR AND INTERIOR BASED ON OUR DETAILED PRE-BLASTING INSPECTION AND MEASURING OF DEFECTS, BOTH MS. HALL and HER DAUGHTER AGREED THE DEFECTS WERE PRE-EXISTING and WITHDREWW HER CLAIM AGAIN VIRGINIA DRILLING. SHE WAS VERY APPRECIATIVE THAT REPRESENTATIVES OF *Smith Adjusting, Inc.* CAME TO INSPECT THE PROPERTY AND ADVISED SHE WAS CONFIDENT HER HOUSE HAD BEEN DAMAGED DUE TO THE AMOUNT OF VIBRATION SHE HAD EXPERIENCED DURING THE PROJECT.

ACCORDINGLY, THE CLAIM WAS VERBALLY DENIED AND WITHDRAWN AGAIN VIRGINIA DRILLING BY THE CLAIMANT.

Smith Adjusting, Inc. **Pre-Blast Inspection**

Smith Adjusting, Inc. performed an exterior and interior pre-blast inspection of the claimant's residence on June 2, : The inspection provided documentation via digital camera, and handwritten sketches and notes. A copy of the pre-blast inspection report is attached to this report.

Blasting and Vibration Data

Seismographs were used to monitor ground vibrations from the blast operations. During blasting operations, structures closest to the blast location were monitored. provided vibration data for all of the blasting activities on this project.[1]

DISCUSSION/ANALYSIS

All of the information collected was reviewed and analyzed to assess whether the items of concern are a result of the blasting activities in questions.

Vibration Analysis

The claimant believes that the aforementioned issues are directly attributed to vibration caused by blasting activities. In order to discuss vibration levels related to blasting, it is important to understand some general information on vibration and damage levels.

Understanding Vibration and Damage Levels

It has become a common practice to monitor ground vibrations during most blasting activities in order to insure that nearby structures are not damaged. Seismographs are utilized in order to monitor and record the ground vibrations as the result of blasting activities. Seismographs measure the ground motion using a transducer (sometimes called a geophone). The transducer monitors the ground motion in three (3) perpendicular directions. These directions are up and down, left and right, front and back. These directions are typically referred to as Vertical, Transverse and Redial (sometimes called Longitudinal). In addition, most seismographs also record the sound pressure level in the air during the vibration event. In order for vibration monitoring to be effective, a safe limit must be determined.

Peak Particle Velocity

The most common measurement used for damage criteria during blasting is the Peak Particle Velocity (PPV). The PPV is simply a measurement of how fast the ground moves and it is commonly measured

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[1] The vibration data associated with this project is too voluminous to incorporate in this report.

in inches per second (in/sec). The PPV is the highest particle velocity recorded during the entire vibration event of any of the three (3) directions monitored by the seismograph. The PPV will also include a corresponding frequency for ground vibration which is essential for calculating the actual displacements and strains. PPV and frequency are commonly used for specifying vibration limits because cracking does not occur until the strain exceeds the failure limit of the material.

Safe Vibration Limits

Many studies have been performed to evaluate safe vibration levels. According to research, damage as the result of blasting does not typically occur until vibration levels are well over 2 inches per second.

> "On the average, only minor damage is observed for peak particle velocities of 5.4 inches per second, and major damage is observed for peak particle velocities of 7.6 inches per second." The above criterion for safe blasting is considered to hold over a wide variety of soil and rock conditions because of original data were obtained for a wide range of soil and rock conditions and on various types of residential structures."[2]

The United Stated Bureau of Mines (USBM) conducted numerous studies to determine a safe vibration level for buildings near blasting activities. Their recommendation was a vibration limit that varies according to the frequency of the vibration. The USBM recommends lower vibration levels at lower frequency and allows for higher vibration levels at higher frequencies.

> "Practical safe criteria for blasts that generate low-frequency ground vibrations are 0.75 in/sec for modern gypsum board houses and 0.50 in/sec for plaster on lath interiors. For frequencies above 40 Hz, a safe particle velocity maximum of 2.0 in/sec is recommended for all houses."[3]

Many states, counties, and cities have adopted the USBM recommendation as a safe guideline for vibration activities. In addition, USBM recommendations have been adopted as a safe limit in the National Fire Prevention Association's (NFPA) standards for local fire marshals to sue in conjunction with blasting activities, and adopted in whole or in part by the Federal Office of Surface Mining Reclamation and Enforcement (OSM), the insurance industry through the American Insurance Services Group, (ASIG, 1990), and the American National Standards Institute (ANSI A10.7, 1998).

> "The limits in RI 8507 remain the most restrictive criteria in existence that are based upon measured structural responses and observations of cracking correlated to specific vibration events. They provide a guaranteed safe level to guide blasting practices and limits suitable for regulations. They account for the widest possible range and worse-case conditions for low-rise residential structures."[4]

BLASTING OPERATIONS & GROUND VIBRATIONS (General)

According to the Bureau of Mines publication 8507, <u>threshold (cosmetic)</u> <u>damage, the most superficial interior cracking of types that develop in all houses environmentally independent of blasting, may occur at the following minimum ground vibration value stresses</u>:

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[2] Review of Criteria for Estimating Damage to Residences from Blasting Vibrations Work on manuscript completed April 1961. Supervisory Physicist, Wilbur I. Duvall, David E. Fogelson, Geophysicist.

[3] US Bureau of Mines RI 8507 "Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting", Page 68

[4] *Vibrations from Blasting*, Chapter 1, page 3, Copyright©2000 International Society of Explosives Engineers-David E. Siskind, Ph.D.

1. Hairline cracks in old plaster may occur and old cracks in plaster may extend at 0.5 in/sec,
2. Old hairline cracks in drywall may extend at 0.75 in/sec,
3. Cracks in drywall may appear at 1.0 in/sec,
4. Cracking in mortar joints of concrete block foundations may appear at 3.0 in/sec,
5. Cracks in masonry may appear at 4.5 in/sec,
6. Cracks in solid concrete slabs or walls may appear at 10.0 in/sec.

The compliance blasting levels allowed by the issued surface mining permit, 1.0 in/sec ground vibration and 133 dB air blast, are based on the prevention of threshold cracks in typical residential structures. It should be noted that most threshold damage is not readily visible by the naked eye and likely requires special lighting and magnifying devices to be observed. These threshold cracks are typically 0.01 to 0.1 millimeters wide. For comparison, a sheet of paper is about 0.1 millimeters thick. It has been observed and determined that vibration levels below 0.5 in/sec have nearly a 0% probability of causing damage and air blast levels of 133 dB have less than a 1% chance of causing damage. It should be noted, that even if some of the estimated vibration levels may exceed minor threshold levels, it does not mean that damage must occur. Rather, it is more likely that damages have not occurred. Based on DMRE observations at numerous surface mines in Western Kentucky, the Bureau of Mines based worst-case estimate is always expected to be much greater than the actual measurement.

Expected Effects of Compliance Blasting:

Blasting within compliance levels can result in the rattling of dwelling structure components and loose household items such as items hanging on the wall or knick-knacks placed in shelves, cabinets or on tables. Many of these kinds of items are typically delicately anchored on walls or loosely placed on a horizontal surface where sudden applied force of a certain degree can result in unopposed, sudden displacement. Sometimes, that displacement is beyond the limits of what can be tolerated by the item and resulting breakage occurs with blasting vibration levels not exceeding the regulated limits. Unless the breakage occurrence is directly observed by the inspector, action cannot be taken by the inspector.

Bureau of Mines, Report of Investigations 8485 states that air blast levels exceeding 120 dB will produce some annoyance from rattling of the structure and its contents. A 133 dB air blast may produce a response similar to a 0.75 in/sec ground vibration which corresponds to essentially a zero percent chance of even superficial damage. As a point of comparison, a 20 mile per hour wind produces a pressure similar to a 133.7 dB air blast. Any damage becomes improbable below 140 dB. It is the consensus of the report that if window breakage due to air blast did not occur, then damage at the smallest threshold limit is not probable.

Ground vibrations can be felt within a structure as low as 0.04 in/sec vibration and a 100 dB air blast can cause knick-knacks to rattle. This is obviously far below the level of possible threshold damage occurrence. The perception of hard blasts is tied to the level of one or both of these vibrations. Persons inside a house generally do not hear or notice the sound of an air blast as it is generally not within the audible range of vibration. As the house responds to the air blast energy, a considerable amount of audible noise, including possible floor vibration, is produced. Since the air blast is not heard, many times this noise is erroneously attributed to ground vibration.

To some, these intrusive and disturbing vibrations are an annoyance and cause many to fear that they must be causing changes to the structure. The research indicates that this is not the case unless certain levels, as described above, are exceeded. The research also indicated that subjection to repeated blasting does not cause damage due to fatigue of the construction material. Repeated subjection to blasting vibration may be intrusive and disturbing; however, the regulations do not give the Department (DMRE) control over the annoyance aspects of blasting.

To most people, it is a natural response to fear that damage is occurring during any blasting event that is noticeable within their home. In an attempt to allay this fear of damage, people begin checking their homes for signs of the damage. Often natural and normal changes within the structure are really noticed for the first time and are erroneously attributed to the effects of blasting. Settlement of concrete foundations causing cracks in masonry is an example of this. The research that was performed did not identify blasting, at the regulated levels, as a cause of settlement. This condition can be attributed to a number of non-mining related factors, including uncontrolled surface and groundwater conditions.

't may be possible for blasting vibrations to cause loose molding and trim or other structural members to drop or separate further. However, it is also possible for these already loose or detached members to drop or separate due to their own weight or other environmental conditions. Because of the uncertainties of the contribution of blasting to the movement, this investigation cannot consider these kinds of problems as being caused by blasting.

Bureau of Mines, Report of Investigations 8896 notes that common origins of cracks in wood frame structures include differential thermal expansion, structural loading and overloading, chemical changes in bricks, mortar, plaster and stucco. Strains induced by changes within humidity, temperature and wind also contribute to the cracking sources. Shrinkage and swelling of wood members and wood-paper products, differential settling of the structures, aging (naturally occurring fatigue and creep) of wall coverings and everyday household activity can also contribute to cracking.

The following are examples of observed strains exerted by household activities. The slamming of a patio door induced strains near the door similar to those caused by a 0.5 in/sec blasting-induced ground vibration. Driving nails for pictures produced strains at various locations similar to 0.38 to 0.92 in/sec vibrations and low jumps on the floor induced mid-wall strains similar to 0.26 in/sec vibrations. One must keep in mind that the environment exerts many everyday stresses and strains that result in cracks and aging of a structure. Nothing in nature remains unaffected by it. No structure that is in use remains unaffected by that use.

We measure ground vibration in terms of the Peak Particle Velocity (PPV), in units of inches per second IPS). Decades of research have established criteria that relate the occurrence of cosmetic or more serious damage to certain levels of ground motion. Equally as important, like all wave phenomena, blast vibration waves decrease in intensity as distance increases. The Peak Particle Velocity *cannot* remain the same as the distance increases. In other words, the energy level of the vibration waves *must* decrease as they travel through soil and rock.

In order to estimate the magnitude or damage potential of the vibrations at any particular location or structure we use research and data published by the U.S. Bureau of Mines, scientific studies of ground vibration attenuation, studies by other organization, institutions or consultants, seismograph readings from the site or calculated from site blasting records, as well as the investigator's observations and experience.

The limit for PPV is 2.0 IPS. The 2.0 IPS limit was established at a level to effectively eliminate damage *potential*, because both experience and decades of research show damage is unlikely, even at significantly higher levels. Higher PPV merely indicates increasing potential for damage. Even at low frequencies, damage from vibration does not typically occur until vibration levels are well over the 2.0 in/sec. limit:

> "On the average, only minor damage is observed for peak particle velocities of 5.4 inches per second, and major damage is observed for peak particle velocities of 7.6 inches per second."[5]

For blast effects it is important to realize that studies reveal a large difference between human perception and potential damage in structures. Human physiology is very sensitive in vibration and people can typically detect vibration levels below 0.02 in/sec. this is only 1% of the recommended limit by the US Bureau of Mines to exclude *structure* damage. Some persons express concern at levels as low as 0.10 IPS. This means that even when vibrations may be very noticeable to *people*, they are usually still quite safe for *buildings*.

It is also important to recognize that peak particle velocity is a measure of how *fast* the vibration occurs, and not how much movement occurs. When we speak about "2.0 inches" the Peak Particle Velocity, actual movement will be in the range of a few on-thousandths of an inch (0.001"). It is further important to realize this vibration is an elastic movement, and that there is no permanent or cumulative displacement (movement).

It is a common idea or concern that blasting vibration causes or accelerates soil settlement. Despite this common misperception, blast-induced settlement is NOT a measurable phenomenon in stable soils. Usually there will be some excavation work before any blasting, so frequently there are mounds of freshly-dug soils adjacent to, or in the immediate vicinity of many blast sites. Settlement is not observed to occur, even in these loose, freshly-dug unconsolidated soils, very close to blast sites (though loose clods may roll down the slope). Consequently, settlement cannot occur in more stable naturally consolidated soils at much greater distances and much lower vibration levels.

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[5] Review of Criteria for Estimating Damage To Residences From Blasting Vibrations, USBM Report of Investigations #5968, Wilbur I. Duvall, David E. ogelson, Geophysicist.

AIRBLAST

Air-blast is a pressure in the air. It *can* be (and usually does include) some audible "noise" but for blasting, generally also includes a low frequency wave(s) that we cannot hear (but that can be *felt*, by persons inside homes and buildings). Air-blast damage is easily recognized, and more serious structure damage does not and *cannot* occur without a great deal of characteristic "threshold" type air-blast damage:

> "Blasting vibration experts, governmental regulatory agencies, and consultants generally agree that, if air-blast causes any damage, it will first manifest itself in the form of broken window glass. Damage such as plaster cracking is very rate, but when it occurs it is always accompanied by window breakage and occurs almost simultaneously. Large plate-glass and store front type windows are more prone to damage than are smaller window panes. Poorly set pre-stressed, or loose panes are more prone to fracture than well set, firm plates that have no stress raisers such as glazier's brads. It should be noted that air-blast may not be audible and that the "loudness" of an event is not a real indicator of whether or not it could have caused the damage."[6]

All modern blasting seismographs also records air blast. Air-blast is widely recognized as an annoyance factor in blasting, even when ground vibrations are low. In fact, blast effects felt at long distances may not involve any measurable ground vibration; people cannot distinguish any difference in the structure response they feel. They have been comprehensive studies of air-blast effects by the US Bureau of Mines. They concluded:

> "The human response and annoyance problems from air-blast, is probably caused primarily by wall rattling and the resulting secondary noises. Although these will not be entirely precluded by the recommended levels, they are low enough to preclude damage to residential structures and any possible human injury over the long term."[7]

Air-blast can cause structure response that is not damaging (but can cause window and dishes rattle, pictures tilting), and some people may find annoying:

> "These mid-wall motions are not necessarily dangerous to the structure since walls can vibrate in the mode without producing high levels of stress. Mid-wall motions are mostly annoying. Floor motions present a problem similar to mid-walls."[8]

It is typical for surface mine blasting (and/or with relatively long distance) that the frequency of the air-blast is relatively low, and the peak air-blast readings will be in the single-digit range, below 10 Hz. This means those peak air-blasts will not be audible, even if the air-blast wave includes frequencies in the audible rate, which nearby residents do hear. The low frequency peaks also mean that window rattling and similar interior noise effects will be more noticeable, than at higher peak air-blast frequencies.

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[6] American Insurance Association, "Blasting Damage: A guide For Adjusters And Engineers" 3rd Edition, 1990, p8.

[7] US Bureau of Mines RI 8485, "Structure Response and Damage Produced by Airblast From Surface Mining" p.1 (Abstract)

US Bureau of Mines RI 8485, "Structure Response and Damage Produced by Airblast From Surface Mining" p.25

Converting Sound Level dB to Psi

It should be noted a 133 dB limit in some areas for coalmine air-blast is an annoyance limit, and well below the minimum damage level for large plate glass windows. Damage thresholds for smaller residential-size panes are about 164 dB. Since the decibel scale is an *experimental* scale that measures air pressure waves related to the human ear, the force (in pounds per square inch or psi) is better understood when considering damage potential. A 133 dB noise level is about 0.015 psi. An approximate damage threshold of 164 dB is about 0.5 psi, or more than *30 times* the 133 dB limit.

DISCUSSION: Footings, Basement, Block, Exterior Brick Walls & Slabs

Many people who feel blast effects become concerned about building foundations, and we understand why. However, foundations (including footers, slabs, etc.) are the least likely part of any building to be damaged by extraneous vibrations, particularly a slab-on-grade. As on comparison, an internationally recognized expert on blasting and vibration damage notes that after a severe earthquake, it is common that the rubble of a structure may be cleared away, with the foundation undamaged and ready for rebuilding:

> "One way of getting additional demonstrations of the relative durability of concrete slabs, driveways, footings, swimming pools, as well as engineered structures, in comparison to the much weaker [above-ground] houses is by studying the effects generated by destructive earthquakes. As one example of this comparison, the City of Coalinga, CA suffered extensive damage. Among the many useful comparisons to be found, I watched a front-end-loader remove the debris that once had been a house. After the house/debris had been hauled away in dump trucks, I carefully examined the slap and found it to be undamaged and ready for a new house if desired. I found similar comparisons when I toured a large area in the epicentral region of the Northridge, CA earthquake*. For example, there were many abandoned houses which had partially or completely collapsed, along with collapsed boundary walls. There was then a clear view and access to back patios and swimming pools, which remained completely free of vibration damage. This was also true of sidewalks and driveways on those properties."[9]

In other words, earthquake vibration on a relatively severe and massive scale, as compared to blast effects, will literally shake a building to pieces, but leave the foundation intact, such that the structure can be rebuilt.

All homes and buildings have some cracking that is typical of minor differential settlement and natural, dynamic, cyclic soil mechanics processes. Soils shrink and swell and variation in moisture content; changes can exceed 30%. Seasonal fluctuations change soil volumes and stresses in slabs, footings and foundations. Years after normal initiation settlement (and cracking), structures continue to be stressed (and cracked) by natural processes in the active" layers of soils:

> "The earth at the near the surface moves up and down by as much as ¼ inch, more or less on a yearly cycle. Except for structures founded 15 to 20 feet below the surface, many buildings have

[9] Journal of Explosives Engineering, Vol.15#4, July/Aug 1998, "Blasting Specifications for Concrete" Oriard, Pages 40-45

*The Jan 17, 1994 Northridge quake, at magnitude 6.7 with an epicenter in Los Angeles' San Fernando Valley, was the costliest temblor in U.S. history and killed 72 people. (www.livescience.com/environment/070425_shake_simulation.html)

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> similar fluctuation in elevations. In residential areas therefore, truly stationary buildings are rare, and establishing absolute, uniform settlements may be impractical."[10]

CONCRETE, FACTS & QUOTES

Concrete, an artificial building construction material made from a mixture of Portland cement, water, fine and coarse particles, and a small amount of air.[11]

Shrinkage cracks occur when the concrete slab dries out and shrinks slightly. The cracks are normal, and concrete typically shrinks about 1/16 in for each 10-ft. section.[12]

> "Oriard also lists Tennessee Valley Authority (TVA) criteria for mass concrete, which specify a level of 12 in/s for concrete over 10 days old at a distance beyond 250 ft. Closer distance allows higher vibrations (e.g. up to 20 in/s within 50 ft.)"[13]

> "Concrete is far more resistant to blast damage than has generally been believed, although this fact has been noted may times by observers of concrete demolition work. Except for certain special cases it seems inappropriate to limit vibrations in concrete to particle velocities of only several inches per second. It is not rare to find conditions on construction sites such that concrete could not be damaged by blasting unless the rock supporting the concrete was to be ruptured."[14]

ON THE 2.0 IPS STANDARD: It is actually referencing "threshold" damage to weaker materials such as plaster or sheetrock, rather than tougher building materials like concrete. Concerning USBM & OSM coalmine blast vibration standards, Oriard writes:

> "These criteria are very conservative. Under typical circumstances we would expect that vibration intensities would have to exceed these criteria by a considerable amount before even threshold damage would be likely to occur. They were intended to prevent threshold damage even to low-quality residences."[15]

There has been considerable research and field experience in blasting near concrete structures, demolition blasting of concrete and even partial demolition – as in projects to recondition deteriorated surface concrete in massive lock and dam structures. In those cases, 8-12 inches or more of weathered concrete is typically blasted away, without cracking or damage to the concrete behind the line of blast holes. Particle velocities in the adjacent concrete may be found to measure over 300 inches per second.

Concrete is generally a stronger, tougher, more isotropic material than any natural rock being blasted nearby. This is true even for unreinforced concrete, but especially so for commercial concrete structures (which usually have a great deal of reinforcing steel). Some significant research on blasting near fresh

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[10] Diagnosing and Repairing House Structure Problems", 1980, Edgar O. Seaquist, page 18

[11] *Encarta® 98 Desk Encyclopedia©* & 1996-97 Microsoft Corporation. All rights reserved.

[12] BOB SHULDES, director of technical services for the Portland Cement Association in Skokie, Illinois

[13] Siskind, et al., US Bureau of Mines RI 9455, Page 4

[14] OBSERVATIONS ON THE PERFORMANCE OF CONCRETE AT HIGH STRESS LEVELS FROM BLASTING - Copyright© 1997 International Society of Explosives Engineers – L.L. Oriard

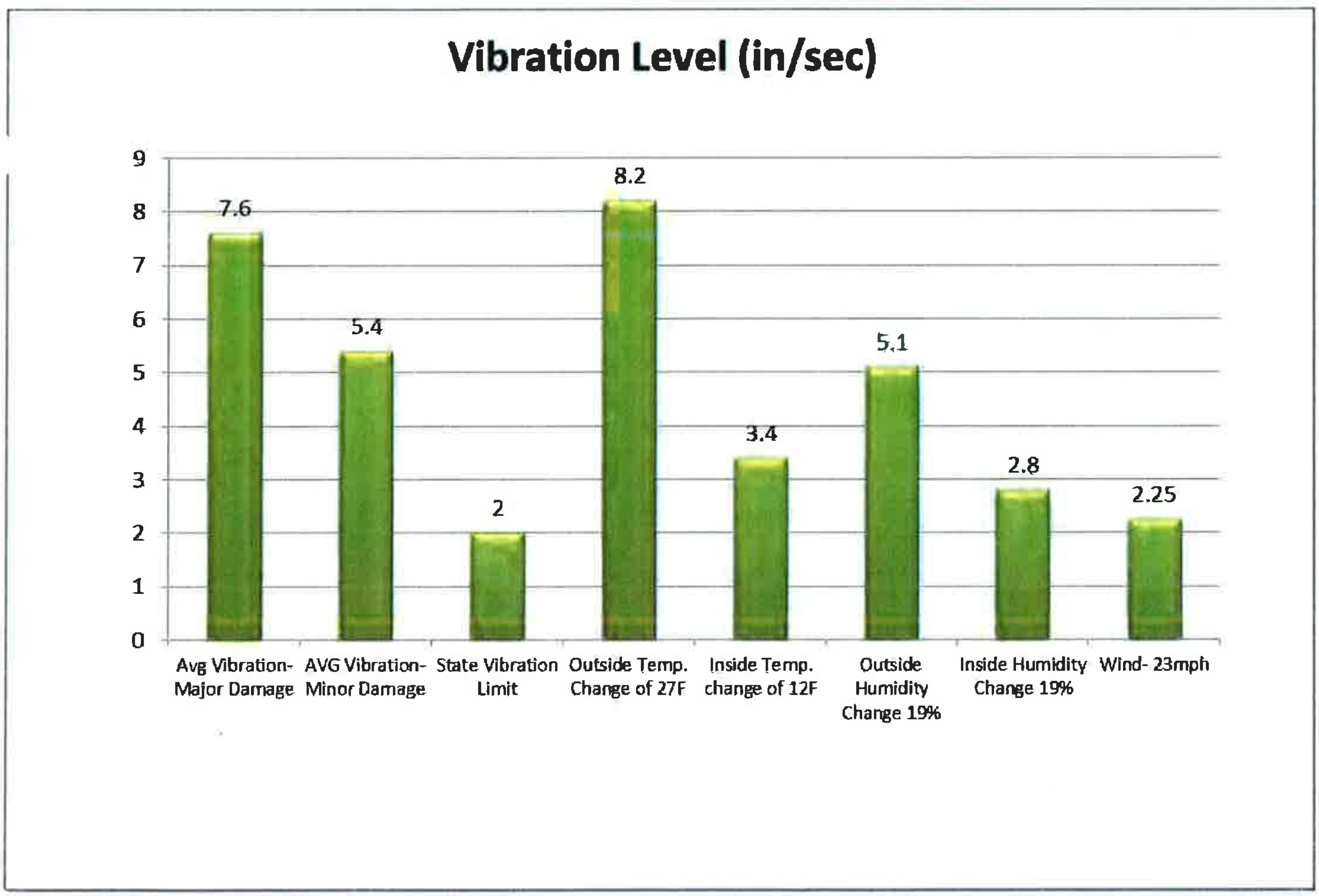
[15] Oriard, 1999, The Effects of Vibrations and Environmental Forces, p.27

concrete of varying ages was conducted by and for the TVA. That study included guidelines that allow blast vibrations up to 200.0 IPS at mass concrete structures, provided the concrete was over 10 days old.

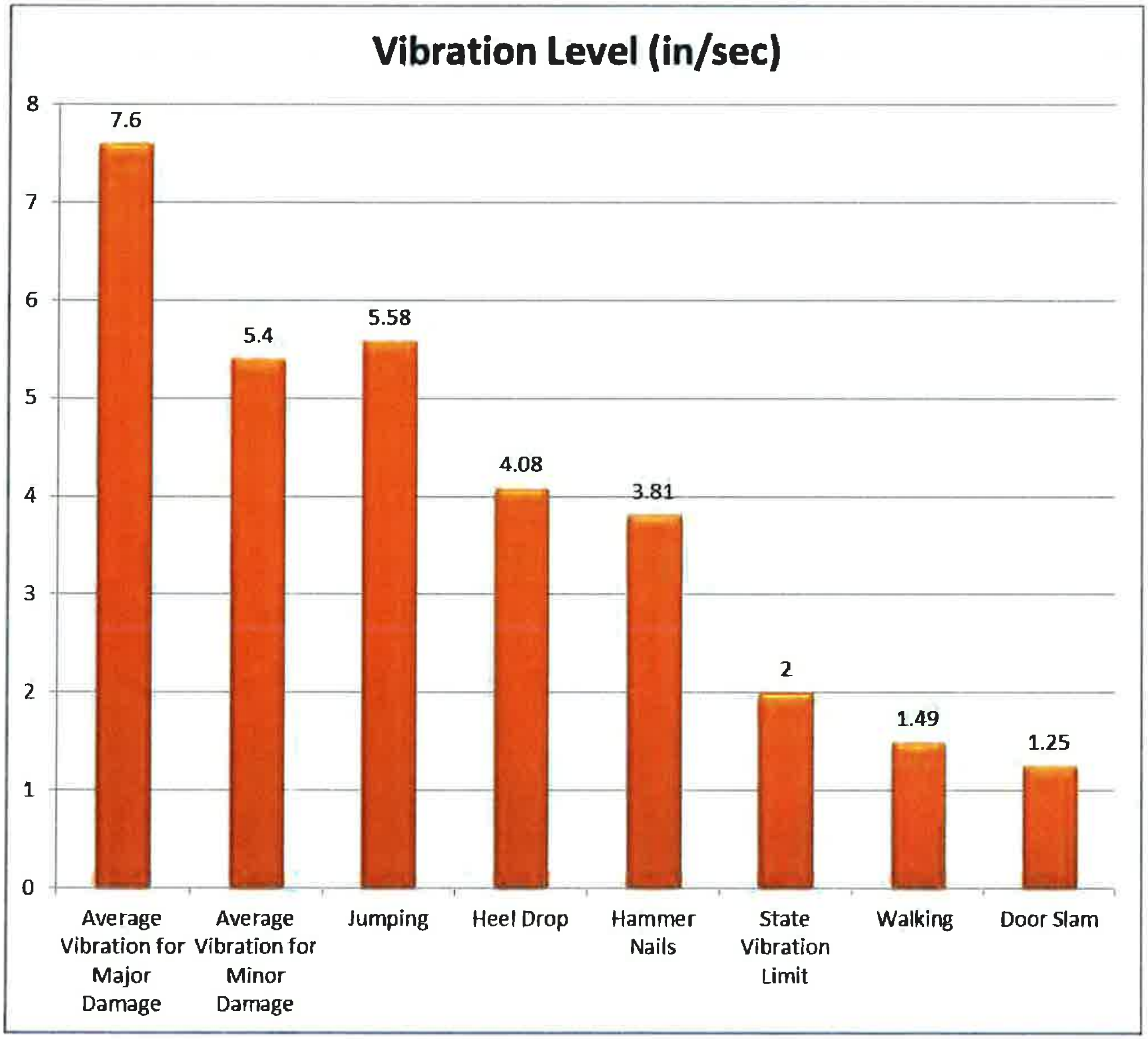
DISCUSSION: Environmental Stresses & Equivalent Blast Effects Stresses

Research on blast effects has also measured the effects of normal environmental stresses, as they compare to blast effects. Environmental stresses that cause expansion/contraction cycles in building materials act slowly and silently, and so are less noticeable than blast effects. However, even low levels of natural environmental stress can far exceed the maximum allowable limits for blast effects. A daily exterior temperature range of 20-30 degrees F is fairly typical. Note that a change of 27 degrees F can cause stresses in excess of 8.0IPS, on a daily basis. *Annual* exterior temperature stress will typically be in a range of 100°F. Some other results from several different sources are summarized in the following graphs:

Equivalent Vibration Levels for Environmental Forces (after USBOM, SME, ISEE, Oricard)



Equivalent Vibration Levels for Household Activities (after Siskind, Duvall)



DISCUSSION: Interior Furnishings Rattle, Tilt, Or Fall

Items that sway, rattle, or even fall, are a common complaint from blasting operations, and is due to a non-structurally-damaging response to air-blast and/or ground vibration. In cases where a picture or item falls, or objects "walk" or fall from shelves or tabletops, we usually find these items to be insecurely mounted. The fact that they fall does not indicate a structurally damaging force. The [non-structurally damaging] structure vibrations can overcome the slight frictional forces holding such items in place. These loose or unstable items tend to be act as very sensitive seismometers.

Early seismic instruments worked on the same principle. "Cascading Cylinders" all of the same height but different diameters were set on end; the largest-diameter cylinder that fell was a measure of the vibration level. There are usually certain items in every home or building that may act similarly, as a crude but sensitive seismometer. This is not any indication of structure damage potential.

Vibration and the Human Response

It is understandable that people in homes near blasting activities express concern about the vibration felt in their home. People inside a structure often report impressions of more significant vibrations than people report outside a structure.[16]

> "[t]he average person forms a judgment based largely on [her] response to sounds, and is usually unaware of the important distinction between the characteristics of the motion alone and the sound effects that might accompany that motion. One type of sound effect is produced by a blast which generates a very loud noise of the explosion. Such a blast is often regarded as severe and damaging even when damage did not occur and when the motion was not perceptible. To the average person, the loud noise itself is sufficient to provide severity. Similarly, a blast may be accompanied by an air wave that is itself inaudible, but has sufficient energy to cause loose windows and doors to rattle. Motion may be imperceptible, but the building occupant can be expected to judge the intensity of the blast by what was heard. Simply stated, [she] thinks the building was subjected to strong vibrations because [she] heard the sounds of the vibrating parts of the structure. [She] may be completely unaware that [she] actually felt no motion, and may conclude that the motion was severe. When the listener judges that the house was shaking, [she] often concludes that damage may have been done, and proceeds to examine the house carefully for some sign of the expected damage." [17]

Distance Effects on Vibration

It is scientific maxim that energy dissipates within increased distance from the source. The further energy travels the further it spreads out in all directions, and thus, the more it dissipates. Under typical conditions, blast vibration intensity lessens to about 1/3 of its previous measurement each time the distance is doubled.

> "Propagation effects and geology change the amplitude and frequency character of ground vibrations as they travel from the blast area to measurement locations. The most important influence is dissipation, or "geometric spreading," where the finite amount of energy fills an increasingly larger volume of earth as it travels outward in all directions away from the blast. The consequence is generally an exponential decrease in vibration amplitude with increasing distance from the source."[18]

Under typical conditions, blast vibration intensity lessens to about 1/3 of its previous measurement each time the distance is doubled.[19]

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[16] Harris-Miller-Miller & Hanson, Inc., [*Federal Transportation Administration-FTA Guidance Manual-Transit Noise & Vibration Impact Assessment 2006/Chapter 07*].

[17] *Explosives-Engineering, Construction Vibrations and Geotechnology,* Chapter 6: Ground Vibrations and Air Waves from Blasting, pg223 - Copyright©2002 International Society of Explosives Engineers-Lewis L. Oriard

[18] *Vibrations from Blasting*, Chapter 2, page 5, Copyright©2002 International Society of Explosives Engineers – David E. Siskind, Ph.D.

The Effects of Vibrations and Environmental Forces: A Guide for the Investigation of Structures, Chapter 2: Procedure for Evaluating Claims of Damage to Structures, pg 24, Lewis L. Oriard, Published by the International Society of Explosives Engineers.

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Vibration Data from this Project

According to maps, the claimant's residence is located approximately 800 feet from the nearest blast zone. Vibration data provided to ***Smith Adjusting, Inc.*** were clearly in compliance levels for contraction under 2 in/sec. and 133 air dB. for the State of Kentucky. Consequently, the PPV levels and air dB. were well below threshold causing damage levels.

Blasting Vibrations and their Effects

When explosives are used to fragment rock, most of their energy is consumed in breaking and moving the rock mass. However, since this fragmented rock is part of, and in contact with, the surrounding geology, some energy escapes as transient stress waves in the form of seismic or "ground" vibrations. These vibrations travel throughout the rock mass and along the surface of the ground, decreasing in intensity as they move away from the blast site. While the geology surrounding the blast site effects some of the vibration's characteristics, the primary factors that determine the intensity of the vibrations are the amount of explosive detonated at one time and the distance from the blast.

While the seismic energy in the form of vibration travels through the ground, the particles of the ground and any structure attached to the ground were moved in three (3) dimensions with the vibrations. However, this movement is exceedingly small, typically on the order of a few thousandths of an inch. Also, when these vibration energies die out, which typically takes no more than a couple of second, the particles return to their original position and become still. Such vibration can cause damage to a structure, only if their intensity is high enough to cause strain which exceeds the strength of the materials making up the structure. Obviously, stronger material, such as masonry is much more resistant to vibration damage than weaker components such as plaster or sheet rock.

Seismographs are used to measure the energy from a blast at a specific location and the seismograph will record the intensity of the ground vibrations in terms of particle velocity in units of inches/second. Peak Particle Velocity is the maximum speed that the ground moves while it is temporarily shaken as the vibration passes through. It is the quantity most closely related to the energy of the vibration. Extensive engineering research and 40 years of studies show that Peak Particle Velocity is also the best measure of damage potential from blasting vibrations.

For this reason, the potential effects of blasting vibrations on a structure are determined by the Peak Particle Velocity at the structure in question. Safe levels of ground vibrations have been established to prevent "threshold damage" to residential structures. Threshold damage is defined as the type of cosmetic damage that is most superficial to the structure as the creation or extension of cracks in interior plaster or sheetrock walls. Actual structural damage, that is damage which affects the stability or integrity of the house or building, requires much higher ground vibration levels than those that may cause such "threshold damage."

When the vibration's Peak Particle Velocity exceeds 0.75 in/sec. at a structure, it may begin to produce some cosmetic damage in weak material such as sheet rock. However, the vibration levels of 2 in/sec. or greater must be exceeded before any minor structural damage is even possible.

When evaluating structural damage to masonry elements, the Peak Particle Velocities must be in excess of 3.0 to 4/0 in/sec for brick and mortar and 10.0 in/sec or more for concrete slabs.

Items of Concern Analysis

While we tend to think of a building as a "solid" structure, all structures and all materials are flexible, dynamic materials, and constantly shift and respond to loads in the structure, human activity, and natural forces (wind, gravity, etc.).

Building materials inherently shrink or swell due to changes in ambient moisture and/or temperature; seasonal and even daily cycles can occur. Cyclic widening and narrowing of existing cracks is often observed, and new cracking occurs in all structures, over time, due to natural stresses. Even a newly completed home or renovated home will be found to have interior cracks and gaps, especially at seams, headers, or where dissimilar building materials are joined.

Environmental Changes and Blast Vibrations

Scientific research on blast effects has measured the effects of normal environmental stresses, as they compare to blast effects. Even low levels of environmental stress are found to exceed stress levels from the maximum allowable limits for blast effects. Seasonal and cyclic changes in temperature and humidity combined with changes in the moisture content of the soils supporting an above ground structure are generally expected to cause some level of movement within a structure. Such environmental changes often cause more stress to a structure than typical blasting operations.

CONCLUSIONS

After a review of the conditions claimed, site conditions and vibration data it is my professional opinion that the claimant's condition of concern are not the result of blasting operations. This opinion is based on the following:

- The conditions claimed are not consistent with blast vibration induced damage.
- Vibration data collected during blasting activities on this project clearly indicates that vibration levels remained below damage causing levels at the claimant's structures.

These conclusions are based upon the information available to ***Smith Adjusting, Inc***. and the opinion of an experienced blasting vibration claim investigator.

RECOMMENDATIONS

As indicated, the claim was **VERBALLY DENIED** and **AGREED TO** by the CLAIMANT to be **WITHDRAWN against**

ATTACHMENTS

cc: