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Proposed AS2187 Appendix J Amendments – 16 September 2016

Introduction:

This simple proposal is submitted for inclusion in Round 13 of the Standards Australia Projects system and is made on behalf of all the members of the Mt Coot-tha Residents Group and the Mt Coot-tha Quarry Action Group, as defined by the 80 homes in the streets adjacent to and in the target area of the Mt Coot-tha quarry.

These residents have had a long running battle with the quarry spanning some decades and they see the need to correct some minor sections of AS2187 that pertain to the blast vibration levels and measurement. The residents, many of whom are highly qualified professional people, wish to emphasise that they are honest and decent Brisbane residents who simply want the blasting process to be conducted in accordance with the Queensland State Regulations as defined in the EHP Document ERA-16 (2015). Damage to property from strong blast vibrations is common and hence many residents live in fear that the next blast will cause further damage.

These residents know and feel the common seismic house vibration amplification problem every week, however this is totally ignored by the quarry management because it is not mentioned in the standard. Even through vibration damage to private houses is the end product of the Cause and Effect System, there has never been any blast vibration measurement done inside the homes. This Full-Process Monitoring aspect will never be achieved until the standard is updated.

The quarry blast count now exceeds 700 blasts which is justified by a very old perpetual blasting license which allows it to blast as high as it likes on every 10th blast. The current state government does not have the ability to cancel or over-rule this license. As a means to maximise their profit, the quarry uses items in the AS-2187 to justify extra strong blasting that is causing the damage to resident's property and mental health.

The quarry, which was supposed to close in 2000 and then again in 2015, is fully owned and operated by the Brisbane City Council which under the Public Sector Ethics Act, The City of Brisbane Act and the Brisbane City Council Code of Conduct requires adherence to the concepts of Zero Harm and Best Practice. However, this has never been applied to the unfortunate residents that live in the shadow of the quarry, many of whom are pensioners with almost no ability to repair blasting damage to their homes.

This proposal therefore only deals with Appendix J and attempts to improve the clarity by striking a balance between those that cause the blasting and the residents that suffer the effects.

We do not believe that the AS2187 authors ever imagined that strong blasting would continue for such an extended period, especially at a prime location only 4klm from the centre of Brisbane and in the heart of a prime tourist and residential area.

AS2187 J3.2.2 Problem Definition:

1. J3.2.2 says that vibration monitoring when attached to a building at height may be "misleading" and show an increased vibration due to structural or modal response.
   - It is a well-known fact that the building vibration is amplified with building height.
   - However, it is also true that if the building is vibrating on the upper levels in response to a blast vibration that this is the result of the original blast. This resonance factor does not eliminate the need for monitoring at all levels.
   - It is unprofessional and simply wrong to suggest that this aspect of monitoring should be avoided because the results are "misleading".

   Measuring blast vibrations in multi-level buildings:
   - Australia it is not equipped to consider seismic building resonance responses and hence the organization doing the blasting cannot blame the building because it resonates.
   - Hence, if a blast vibration hits a multi-level Australian building causing it to vibrate, this is clearly the fault of the original blast and further this must be measured and accounted for.
   - It is all about Cause and Effect and the resonance is simply another critical effect so it must be measured.
   - The general rule of thumb is that if a multi-level concrete building has vibration cracks in the slab, then it is likely to have cracked walls as well (according to our RPEQ Civil). This is a huge concern which is ignored.

   Buildings founded in the same rock seam as that being blasted.
   - There is no concept that addresses the situation where homes are founded in the same bedrock strata that is being mined.

2. J3.2.2 also says that the Soil Spike Mounted Transducer Reading could be Higher which is clearly biased because it could just as easily be under-reading.
   - The Instantel blast monitor manufacturers clearly state that transducer connectivity must be maximised. This is what everyone would expect: Monitor Reading Quality is Proportional to Connectivity Quality.
   - Aerated particles or sections in mediums such as mounds of topsoil and sound screen insulation are well known to cause huge sound and vibration attenuation.
   - It is difficult to imagine how any lower connectivity could ever generate increased vibration of any transducer components because the mobile components in any transducer are only ever passive.
   - If indeed there is a freak harmonic condition where the monitor reading might be higher, this would be rare and is probably transducer brand dependent.
   - Hence it is very easy for the measurement staff to fake the reading by choosing the method with the lowest connectivity. Lower vibration readings = happy quarry management, so they specify that the soil spike must be used.
   - When the vibration sensitive location is in the same rock seam that is being blasted then monitoring perspective 1 below should be used. (This is never done at Mt Coot-tha.)
   - These Blast Monitoring Situations assumes that actual rock is blasted:

Home Footing Strata	Monitor Location	Transducer Coupling	Preferred
Blasted Rock Seam	Rock Seam Near Home	Firm Epoxy in rock seam	Yes
Blasted Rock Seam	Road Embankment Topsoil	Concrete Block Method	Unlikely
Blasted Rock Seam	Any soft or re-used soil	Soil Spike	Never
Topsoil	Similar Topsoil	Concrete Block Method	Yes
Topsoil	Any soft or re-used soil	Soil Spike	Never
Field Measurements	Any soft or re-used soil	Soil Spike	Yes

- At Mt Coot-tha the residents have observed that all the monitoring is currently done by junior technicians using a soil spike which is often quickly pushed into aerated soil for each blast and often the same hole is repeatedly used. (The rule of thumb of any soil spike or tent peg is the harder it is inserted, the more difficult it is to remove.)
- The quarry staff say that the soil spike is ok because "it is mentioned in AS2187 that the reading would be higher".
- The industry standard method for permanent monitoring sites uses the concrete block or epoxy binding coupling methods, whilst the soil spike or tent peg method is only used for approximate field or casual measurements due to the high variability and the absence of standard operational and physical definitions.

<u>AS2187 Appendix J3 Project Modification Scope:</u>

1. Multi-Level Buildings:

Existing Text	Proposed New Text
however, it should be noted that the measurements taken on the structures above ground level can be misleading as they are often exaggerated by structural or modal response.	however, it should be noted that the measurements taken on structures above ground may well be higher. If the monitoring goal is to model the total blast vibration transmission process, then height monitoring inside buildings becomes essential. The height vibration amplification effect is known to be stronger in multi-level buildings.

2. Use of the soil spike:

Existing Text	Proposed New Text
Coupling with soil spikes in soft conditions may lead to exaggerated measurements and is not recommended.	Coupling with soil spikes in soft conditions is normally reserved for casual or field measurements and is not recommended in a permanent monitoring site. If the vibration sensitive buildings are founded in a rock stratum, then the monitoring location should match that same strata and the transducer mounting changed so as to maximise the energy transfer.

3. Buildings founded in the same blasted rock stratum:

   Being a rocky place, Mt Coot-tha is a special case where the rock strata that the adjacent homes are founded in is the same seam that is being blasted only 400metres away. This is different to most mines where the residential area is specifically located above or remote from the blast area and is founded in topsoil.

Existing Text	Proposed New Text
	The transducer coupling should where possible try to match the conditions of the building's foundations and structure. Hence if the building is founded in the blasted rock stratum, then the transducer should be placed in the same rock or in the building basement.
	If the building is multi-level, then monitoring should be done in the upper levels.

AS2187 J4 Problem Definition:

1. J4 publishes the British Standard BS7385-2 1993 data for cosmetic and structural damage.
   However, when you actually read this standard it states:
   There is a lack of reliable data on the threshold of vibration-induced damage in buildings, both in countries where national standards already exist and in the UK.
   And:
   It has been necessary therefore, to refer to the results of experimental investigations carried out in other countries into vibration-induced damage thresholds.
   - Publishing the extraordinarily high blast vibration limits in this very old British standard without noting the date & pre-conditions mentioned above is unprofessional and distorted.
   - Not only are these results experimental and from other countries, but the type and age of houses constructed in the UK and in this "overseas" country are entirely different to those in the majority of Australian cities today.
   - The graph is shown for 19mm drywall which is not typical in Australia.
   - The types of construction products, methods, workmanship, footings and regulations in other countries is entirely different to Australia. For example, almost all Australian building cladding is 10mm plaster or 4mm or 5mm fibro. (I personally have never seen 19mm plasterboard). Electrical voltages and current levels is often vastly different as are many of the other trades.
   - As this experimental data is clearly not relevant to Australia, the reason for its inclusion may appear as an intention to promote a viewpoint that the recommended Australian values are over-protective. Such a view is invalid, especially in the long term and also for cosmetic damage.

2. J4 has some useful damage definitions but it lacks a common all-inclusive clear definition of the 4 commonly used Levels of Damage: Human Comfort, Cosmetic Damage, Minor & Major Structural Damage.
   - The important concept of Building Damage is not clearly defined whilst the USBM table is helpful by defining Threshold, Minor and Major definitions, but it leaves the reader to assume that these should somehow be applied to the Australian classifications.
   - There is no definition or even a concept of continued cumulative blasting effects beyond 2 years, only the less than or more than 12 months is considered.
     - I am advised by the Mt Coot-tha quarry management that it has been blasting for several decades.
     - We do know from their published blast monitor results that the blast count exceeds 700 blasts, plus we know that this is proceeding at a rate of once or twice per year.
     - If the difference between <20 blasts and > 20 blasts is 5mm/second then the acceptable level after 400 or 800 blasts should be almost Zero vibration.
   - The Cosmetic Damage concept appears to be acknowledged and then ignored.
   - There is no mention of any safe blasting levels for prevention of damage to Historic Buildings.
   - There is no mention of any safe blasting levels for prevention of damage to Electronic Equipment commonly found inside private homes.
   - There is no concept that takes into account the massive decline in construction quality since the year 2000.
   - Human Comfort and Human Health are undefined.
     - These days with facilities such as "Beyond Blue" there is an increased focus on Human Mental Health and particularly the helpless sensation of Depression.
     - Mental Sickness and Helpless feelings are likely when twice per week your house is shaken, sometimes quite violently, by people who you know have absolutely zero interest in your building survival or repair costs. This is made much worse when you

are never advised how strong the blast will be and if the next one will damage your home further.
- This blast anticipatory tension can be very strong when the blast vibration upper limit is undefined. It is made much worse when the occupant is aged and even more worse when the occupant has almost zero ability or funds to repair the damage caused.
- We have called this pre-blast tension "Quarry Blast Sickness" because it is very real, plus it can never be cured.
- Pre-blast Tension is clearly unhealthy and not at all Simple Human Discomfort.

3. The Recommended Australian Maximums table:
- The lack of a recommendation for Preventing Cosmetic Building Damage implies that this kind of damage is an unavoidable effect of any blast vibration. This is indeed the culture in the Australian Mining Industry.
    - They believe that if they blast at just under the maximum, the worst that can happen is that local residents will be minimally uncomfortable for a few seconds.
    - This untrue assumption is totally unjust, unfair and hurtful to the residents.
    - Especially for the aged ones and those with restricted repair capability.
    - The so called cosmetic cracking of plaster joints, concrete slabs and tiles is a major issue for many residents and AS2187 should acknowledge this.
- There is no concept that comes anywhere near defining the compounding effects of the 700 blasts that the Mt Coot-tha quarry has done.
    - Yes, the standard has acknowledged that different limits exist according to the blast count.
    - To define a limit that simply ends with 20 blasts is like saying that anything over 40 is totally undefined or indescribable.
    - If you shake a house for just 100 blasts at 9mm/second, it is absolutely implausible that Minor Damage would not occur.
    - If you shake a home with 700 blasts, then Major Damage is virtually impossible to prevent.
    - If the allowed vibration difference between less-than 20 and more-than 20 is 5mm/second, then what should it be for 700 blasts.
    - The cumulative compounding blast vibration effects need to be mentioned and clarified.
- There is no mention of possible damage to the electronic equipment that all Australian homes now contain.
    - Hard Disk Storage systems are now common place items in every home. They are commonly used in both Computers and HDD TV recorders.
    - The storage sizes now hold more than 10 Terabytes and are impossible to back up to anything other than another hard drive.
    - The magnetic read/write heads fly above the disk platters riding only on the layer or air that adheres to the disk as it spins.
    - If a blast vibration of more than 5mm/second happens when the disk heads are doing a write operation, then data corruption is almost inevitable and actual platter damage is likely.
- The Multi-Level Building Amplification Effects need to be clarified and noted in this standard. There are numerous seismic studies and data available to draw information from.

4. Additionally, the massive decline in construction quality since the year 2000 should be acknowledged because this means that any vibration tests done on Australian homes 20 years ago are not relevant now.

- The project home industry is intensely competitive and the price has been cut to the bone.
- In the Mt Coot-tha quarry target area there are several multi-level project home houses that were built using 0.6 and 0.4mm steel framing. In fact it is now almost impossible to buy a new steel framed house that is not built using 0.6mm steel. (Steel framing is chosen because it is low cost and termite proof.)
- Typical buildings 20 years ago used the frames used to support the plasterboard cladding, now the cladding supports the frames.
- Buildability is at rock bottom, common Tek-screws spin in their hole and cannot hold in 0.6mm steel frames. The entire system relies on the internal wallboard cladding glue which comes from the cheapest possible place overseas and has no specified lifetime.
- A similar situation exists with other building materials such as patio and pool balustrade glass. Australian glass was always strong because it floated on molten zinc which fully melted all the crystal "seeds". However, all glass is now imported from China where they use the cheaper and weaker "drawn glass process" which is not as strong and can easily explode during a quarry blast.
- The occasional 15mm/second blast rule may have applied to the brick or hardwood framed houses 20 years ago. In 2016 construction quality is at rock bottom whilst mine blasting intensity is much higher more often.

<u>AS2187 Appendix J4 Project Modification Scope:</u>

1. British Standard BS 7385-2:

Existing Text	Proposed New Text
BS 7385 blast vibration graphs and tables. USBM Graphs and definitions.	Delete all of BS7385 and USBN text. Some of the classifications definitions may be useful.

2. Define a 4 Level Blast Vibration Damage Classification (change Human Comfort to Human Health).

Human Health *(Visitors to the area when a blast hits never hear any warning siren. They assume that a strong blast is in fact an earthquake, so they always urgently react accordingly.* *A 10mm/second blast vibration removes most gravity friction for approximately 2 seconds and can easily dislodge an unclamped plank or long ladder which is leaning against a wall or gutter.)*	Workmen on roofs, ladders and other elevated platforms such as planks and trestles becoming dislodged. High residential anxiety preceding and/or during a blast vibration. Unaccompanied young children not understanding the threat posed by their house vibration. Shift workers woken abruptly by strong vibrations. Perceived and/or measured but unprovable damage effects to personal property and structures. Secure wall-hung objects such as paintings falling onto the floor and breaking. Other objects such as glass or china falling off benches or tables and shattering.
Cosmetic Building Damage *(when no other damage causes can be attributed or when these are a common theme between multiple different buildings in the same vibration zone).*	The formation and growth of hairline cracks in internal concrete slabs that exceeds typical maximum shrinkage rates of 0.5mm between 3 metre footing beams. The formation and growth of hairline cracks in floor tiles and all plasterboard joins. The formation and growth of cracks in masonry and brick structures including mortar joins. Cracks up to 1mm width in concrete driveways or other outdoor concrete slabs.

Minor Building Damage *(When no other damage causes can be attributed or when these are a common theme between multiple different buildings in the same vibration zone.)*	The formation and growth of cosmetic internal concrete cracks to a width of 1mm or 2mm in outdoor slabs. Chips in concrete slabs or pieces falling from walls and ceilings.
Major Building Damage *(When no other damage causes can be attributed or when these are a common theme between multiple different buildings in the same vibration zone.).*	Damage to building structural elements such as cracks in concrete support columns. Apparent failure of loadbearing walls. Loosening of timber, steel or masonry joints, opening up of internal concrete cracks wider than 2mm.
Asbestos Sheet Damage *(Very old Asbestos Cement "fibro" sheets are known to release naked fibres when the sheets are vibrated. If this sheeting is located in the ceiling, then asbestos fibres could fall into the living space.)*	Buildings containing Asbestos Cement wall or ceiling cladding should be inspected every 200 blasts and checked for Asbestos fibres in the home. The occurrence of these forms of cladding is still significant in some cities, as soon as it is touched or moved in any way strict government rules apply to its handling and disposal.
Un-Cured Concrete Damage *(Whilst concrete continues to gain strength with age, an approximate new concrete 7-day rule applies where for each day it gets 1/7th stronger.)*	Blast vibration to a partially cured slab which is two or three days old is known to cause damage, because it has passed the plastic stage and only partial chemical bonds have formed. There is usually insufficient strength to withstand the strong vibration, so the temporary bonds get broken and probably never heal.

In addition to this there is also damage to Historic Buildings, Multi-level buildings and Data storage systems.

Australian Historic Buildings (pre-WW2)	Sandstone Block Buildings such as Brisbane Town Hall and Stuartholme Convent and School. Other sandstone block buildings that have non-concrete footings and aged culturally significant timber buildings.
Multi-Level Buildings	Buildings that are 3 or more levels are renowned for having amplified vibration with height. This is just another effect of the blast.
Residential Data Storage Devices. Business Data Storage Devices. Internet On-line Data Storage Devices	Magnetic based read/write hard drives. Optical and DVD hard drives. Magnetic tape backup systems.

3. Define maximum blast vibration levels allowed to prevent the 4 damage categories.

Damage Classification	Blast Counts and Vibration (mm/second ppv) & Frequency 4Hz to 15Hz					
	10	25	50	200	400	800
Human Health	5mm	5mm	5mm	4mm/s	3mm/s	2mm/s
Cosmetic	9mm	8mm	7mm	6mm	5mm	4mm
Minor	11mm	10mm	9mm	8mm	7mm	6mm
Major	15mm	14mm	13mm	12mm	11mm	10mm

4. Also for Historic Buildings and Data Storage Systems:

Damage Classification	Blast Counts and Vibration (mm/second ppv) & Frequency 4Hz to 15Hz		
	10	25	50+
Australian Historic Buildings	4mm	3mm	2mm
Multi-Level Buildings	5mm	5mm	4mm
Data storage Systems	5mm/s		

<u>AS2187 Appendix J – Amendment Project Benefit:</u>

1. J4 has some good useful information, however it suffers badly from a lack of currency, clarity and detail that is common with many document appendix references. This is often due to time management pressures or deadlines, plus simply a lack of priority.
2. By definition, an appendix is always an afterthought. It is something that does not always apply and often can be removed without significant effect.
3. For this reason and also because it is present is every single blast, a “Vibration Specification and Measurement” section should be created containing the rewritten Appendix J. It should be elevated in the AS2187 document to an actual Section Level so that it receives the focus and priority that this critical area deserves.
4. These details may not be highly important to the people doing the actual blast, however Improved Balanced and Clarity will ultimately provide an improved outcome for everyone, eliminating legal disputes and building damage by providing correctly structured standards data.
5. Ultimately in a democratic urban blasting environment, the blasting project survival will depend on compliance with the resident’s needs and the elimination of undefined problems.
6. In urban areas the buildings are getting ever higher. In Brisbane approval for 9.5metre high (ONG) ordinary single-dwelling buildings is now assured plus 10.5metre heights can be approved through the Council DA process. The town plan allows unit blocks with increasing levels to be built. Hence the blast vibration effects on multi-level buildings plus the correctly categorised height amplification factors must be taken into account. These are currently totally ignored and should be measured.
7. Thus restoring the balance by removing out-dated vibration monitoring definitions should eliminate the “anything goes” monitoring and promote a professional Best Practice, Zero Harm perspective which will benefit Australians much more in the longer term.
8. Realistic and clear monitoring definitions that eliminate undefined areas will allow the state EHP departments to better monitor and customise their own conditions. It is important to put the power back in the hands of the state EHP departments for the benefit of all Australians as they rapidly move beyond 2020.
9. The current situation where the standard is saying 15mm/second and the state EHP departments are asking for 5mm/second simply destroys the harmony that this section of Australian business badly needs.

10. It is also important to remember that the state EHP department Blasting Licenses always refer to measurement of a noise or vibration sensitive location, so those miners who have the big projects in the sparse places are unaffected. It is all about balance in the increasingly populated urban places such as Mt Coot-tha, Toowong and Bardon.

AS2187 Project Support:

1. In compiling this report, it is important to understand that whilst I am not qualified in mining or blasting, I have lived with and (because I work from home) have witnessed the effects of quarry blasting above the state ERA-16 maximum for more than 10 years. This was demonstrated recently at a site meeting with the Qld EHP Minister and Department Heads where I correctly estimated the blast strength within 0.2mm/second.
2. Hence I do claim to be an expert on the effects of urban blast vibrations on private homes and it is with this knowledge that I have written this report.
3. In making recommendations I obtained data from several areas and one of these was the Australian Tunnelling Society. The ATS is similar because they mostly dig tunnels by blasting in urban and historic areas and hence their vibration tables had the most accurate information.
4. The Qld EHP Department ERA-16 document plus their staff was also extremely helpful.
5. However much of what I have written is just basic common sense – it is just that nobody has ever had the time and experience to define the concepts before now.
    - After reading all available sources, the sensitive areas become obvious.
    - The actual vibration levels themselves are based on the ATS and ERA-16 numbers plus what I know from observations. They had to be allocated either below 10mm/second or 15mm/second so once the category structure was defined, the vibration value assignments became obvious.
6. Attached are also the measured audio levels inside our 4-level home on the 3rd August this year which has astounded everyone.
    - It showed that the building continued to vibrate (make noise) for around one minute after the actual blast vibration had ceased.
    - This is an absolutely amazing factor for everybody except our RPEQ Civil Engineer who said:
        i. As defined in current seismic theory, multi-level buildings are famous for vibrating and resonating long after the initial vibration has ceased.
        ii. It is this factor which destroys most buildings during an earthquake (not so much the initial shock wave).
7. The modification initiatives that we have proposed are inexpensive to actuate as they only require a few basic common sense changes. These can be engaged by all industry and the common-sense content should not lead to adversity.
8. In an urban environment which is only 4klm from a major state capital city centre, there will obviously be differences between an engineering standard written by persons who have a vested interest in the blasting or mining process and the residents who suffer the effects of the mining process.
9. However, in Queensland the days when miners can walk away from real environmental responsibilities are over and the Australian Standard must now consider a balanced approach.
10. AS2187 should be able to cater for the special circumstances like Mt Coot-tha and hence we submit that our specific case should be considered as an example.
    The lack of clear AS2187 definitions allows operators to make their own decision which will undoubtedly favour their profit margins and disfavour all other critical stakeholder values such as the resident's retirement mental health and their property equity values.

11. Various relevant documents are not attached but are available if required:

ATS Drill & Blast Table.	Contains realistic maximum vibration definitions.
ERA-16 relevant extract.	The QLD State Maximum Vibration and Sound Levels.
ANZEC relevant extract.	Australian Maximum Vibrations Levels.
QG business screen shot.	Defines QLD Monitoring Methods.
Comparison between Mt Coot-tha Quarry Actual and Typical ERA-16 Compliant Blast Vibrations.	Shows what the quarry should be doing.
Measured Blasting Sound Levels in a home 3rd August 2016.	Clearly shows how a multi-level building continues to resonate long after the initial blast.
Example Mt Coot-tha Blast Vibration Graphs	Typical amplitude and duration of a 5mm/second vibration measurement.
Comparison Timeline between vibration graph and Home Resonance Period.	Indicates how the blast vibration duration is much shorter than the building vibration effects.
Quarry Caused Slab Crack measurement using a Feeler Gauge.	Typical low tech method for measuring slab crack widths.
Example Mt Coot-tha house steel frame.	Shows how the thin steel framing is easily cut using common snips.

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About The Author:
My relevant qualifications and professional experience can be found on the Linked-In Page.
http://au.linkedin.com/pub/phil-best/3/8b4/3a4
In addition to this I have built four houses, all with a focus on quality work & products. I have thus gained a huge knowledge of current day construction products & methods plus respect from my peers. I have, as a professional person, studied and witnessed the effects of well over 100 blasts in Mt Coot-tha area and liaised with more than 50 vibration affected residents.

AS2187.2 2006 version was used as our reference.