

Ground Vibration Monitoring Ensures Underground Petrol Tank Integrity

The location of a Shell petrol station and particularly the close proximity of its underground holding tanks and associated pipe work to the boundary wall of a building site in central London, posed an environmental problem for the developers Gleeds.

The Brownfield site at Steedman St, in the Elephant & Castle area of London had already been cleared but now required areas of concrete to be broken up and piling operations close to the boundary to commence. The petrol holding tanks are 15 years old and excessive vibration could cause a rupture with environmental pollution consequences.

Gleeds contacted AVT to provide a ground vibration measurement system connected to an alarm unit to indicate when peak acceleration limits had been exceeded.

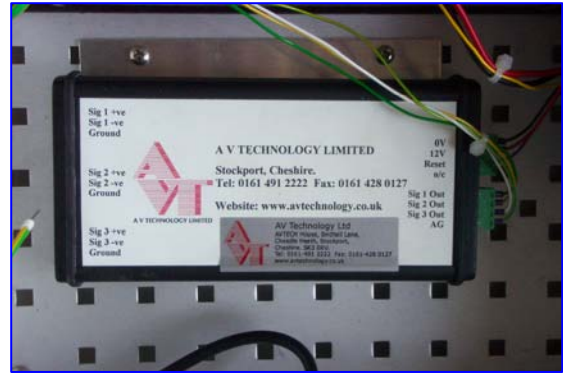
AVT installed a system which would measure vibration in 3 planes between +/- 1'g' within the frequency range 4 – 250 Hz with a minimum measurement resolution of 5 thousands of a 'g' (mg).

The system consisted of 3No. Monitran MTN 1100 accelerometers arranged to measure in 3 planes (X, Y & Z) housed in an IP64 rated enclosure (200mm x 200mm) mounted to a spike that had been driven into the ground such that the enclosure would be at least 600mm below ground level (to comply with ISO 4866:1990(E) sect 7.2.2.) and 1m from the boundary wall.



A 6 core screened twisted pair cable connected the Monitran accelerometers to a 3 channel peak hold device built in house at AVT which holds the maximum reading which was sampled and re-set at 1 sec intervals by a Campbell CR10X data logger housed within the second IP64

enclosure mounted on the boundary wall. The data logger then applies integration and scaling to produce a velocity value, which is then stored and used to produce trend data graphs.



The data logger would detect an 'alarm' condition if any of the 3 peak velocity signals exceed the pre-set threshold (adjustable between zero and full scale), produce a remote alarm activation signal to the remote visual/audible alarm unit also mounted on the boundary wall. The visual alarm was a flashing strobe beacon and the audible alarm was a single tone siren rated at 116db!



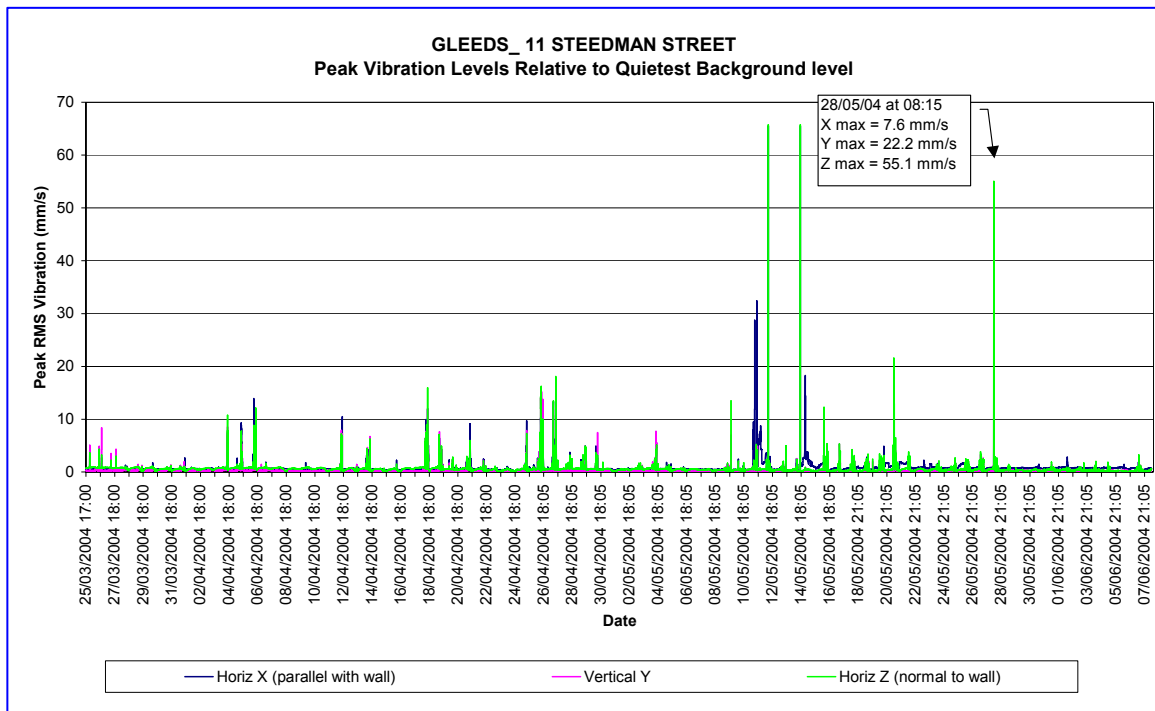
Whenever triggered, the audible alarm will operate for 30 seconds or until manually re-set (undue noise pollution). The visual alarm will continue until manually re-set by pressing the Manual alarm accept button on the alarm unit. A test button was also provided on the alarm unit to check the function of both the visual and audible alarms.

The monitoring system included a GSM modem to enable data to be retrieved remotely by AVT at their offices in Stockport. This also allowed the alarm limits to be altered as the client required.



The whole system was installed on Fri 26th March 2004 and it was powered from a single solar panel (500mm x 300mm) charging a 12V lead acid battery housed within the wall-mounted enclosure. The battery voltage was monitored and remained between 12.5V and 14V for the duration of the 5-month (Apr-Aug) hire period.

Initial vibration limits were set at 50mm/sec², however Shell UK Oil Products were consulted and their Petroleum Officer requested that the vibration limits be set at 25mm/sec². The alarm limit was reduced over the modem link on 26th April 2004.

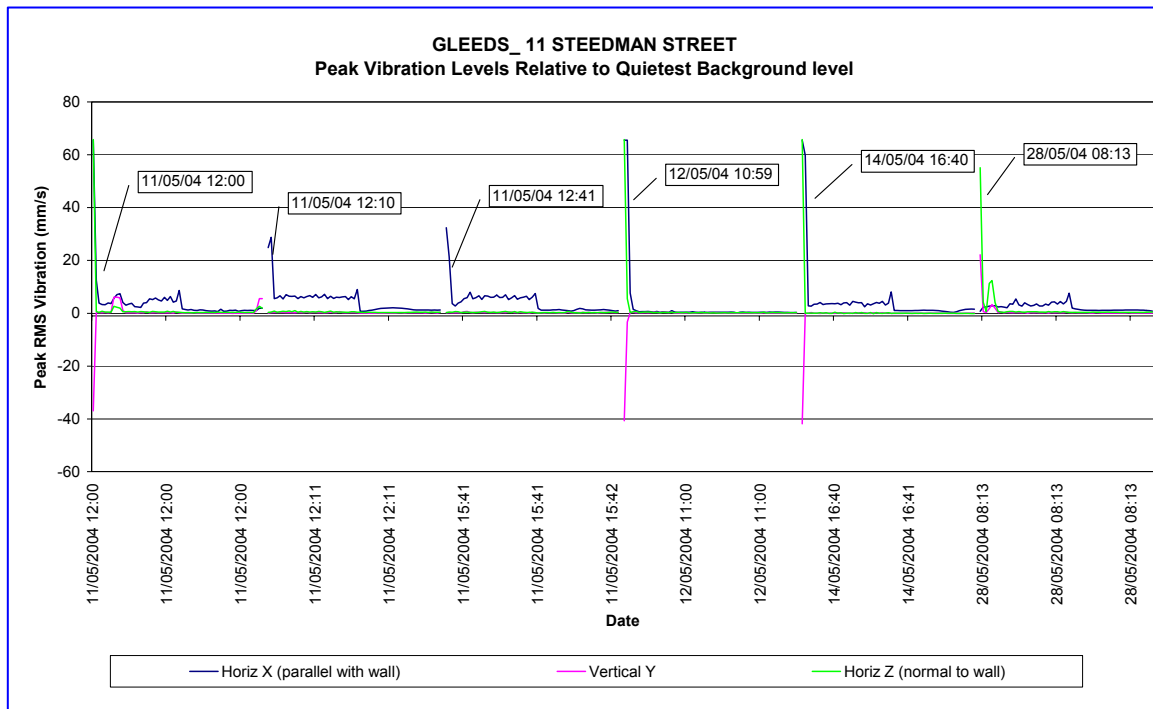


During the hire period the vibration data was routinely monitored by AVT engineers, and periodically supplied to Gleeds as an excel graph.

The alarm level was exceeded 6 times:

- 1) Tues 11/05/04 12:00
- 2) Tues 11/05/04 12:10
- 3) Tues 11/05/04 15:41
- 4) Wed 12/05/04 10:59
- 5) Fri 14/05/04 16:40
- 6) Fri 28/05/04 08:13

In all cases, the alarm level was exceeded only once and for a duration of 2 seconds maximum. In 5 of the 6 cases, the alarm initiation is followed by a slightly elevated and constant vibration level of typically 6mm/sec^2 for a subsequent period of virtually exactly 30 seconds, before returning to the normal background levels of typically $0-2\text{mm/sec}^2$.



The operations being undertaken at the time of the alarms were:

- 1) Tues 11/05/04 Removal of Fondedile Piling Platform
- 2) Wed 12/05/04 Removal of Fondedile Piling Platform
- 3) Fri 14/05/04 Breaking out oversite slab GL 1 C to 2
- 4) Fri 28/05/04 Removing earthwork beam from in front of Fondedile piles

The Ground Vibration Monitoring System was removed from the site on Tuesday 7th September 2004.



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