

# Reducing ground vibration using rubble zones

Boral Peppertree, NSW

### Site Profile

Peppertree Quarry is Boral's newest and largest hard rock quarry development in Australia. The quarry has been constructed at Marulan South, in the NSW Southern Tablelands region. Commissioning of the plant has been completed and the site is now increasing production in preparation for the upcoming closure of the Emu Plains Quarry at Penrith Lakes.

### The Situation

During the infrastructure development stage, the completion of the construction of the new quarry office coincided with the timing of firing the closest blast to the office.

Boral had applied an internal vibration limit of 50mm/s PPV at the quarry office. The next three scheduled blasts (shots 12, 13 and 14) were located within 80m of the office monitor. Due to the proximity of these three blasts to the office, a technical solution was required to avoid exceeding the vibration limit.



Peppertree Quarrying Area and Office (square grey building)

### Technical Solutions

The initial idea for shot 12 was to load all blastholes with multiple charged decks using charge weights that were calculated to stay under the vibration limit if fired individually.

To achieve this, electronic detonators and a novel initiation design, including firing a rubble zone (a smaller shot between the main production shot and the

sensitive receiver to dampen the vibration travelling through it) would be required. This technique had successfully been employed at other Orica sites.

Shot 12 was a large shot with more than 400 blast holes. Whilst single deck firing (in order to control vibration more accurately) was achievable, other blast prediction measurement tools in Orica's SHOTPlus™ 5 software indicated considerable potential for blast hole dislocation and poor burden relief. This could lead to explosive desensitisation as well.

Orica and Boral decided to fire a separate rubble shot in the strip of remaining rock parallel to the edge of the pit below the new quarry office. This would be a "trench" style shot about 100m long and 20m wide. The closest blast hole would be only 52m away from the quarry office. This shot essentially became the "new" shot 12.

Vibration predictions and a series of Maximum Instantaneous Charge (MIC) contour lines were determined using Orica's SHOTPlus™ 5 software. These contour lines assisted the designer to load a greater quantity of explosive charge as distance from the quarry office increased, whilst still maintaining control over the vibration to keep it under the vibration limit.

### The Result

The rubble shot was successfully fired on 17<sup>th</sup> December 2013 with a vibration result at the office of 30.91mm/s PPV, well below the 50mm/s limit. Fragmentation and heave results were also good.

Shot 13 had the closest blast holes, just 67m away from the new quarry office. This shot was loaded and fired on 19<sup>th</sup> December 2013, two days after the rubble shot. With a rubble zone now in place, it was decided to use Exel™ detonators instead of electronic detonators and to utilise full columns of charges rather than deck charging.

The price difference with decked blastholes was significantly less using Exel™ compared to uni-tronic™ detonators. Furthermore, by fully loading all blastholes

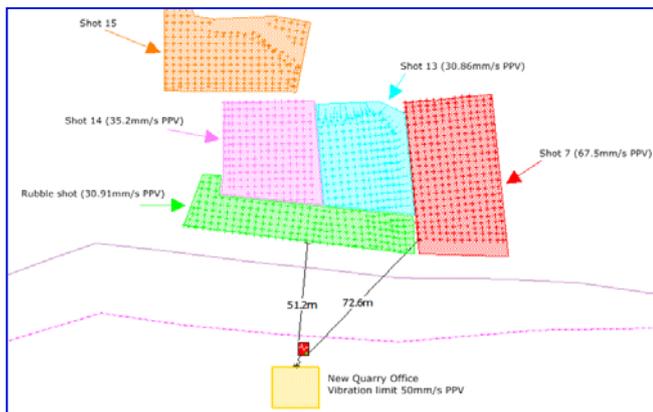
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instead of deck loading, the time taken for loading was also reduced, achieving more cost savings as well.

The vibration result at the quarry office was 30.86mm/s PPV. Fragmentation and heave results were quite good as well.

Shot 14 had blastholes 68m away from the quarry office monitor, again Exel™ initiation was used and all blastholes fully loaded. Shot 14's initiation sequence utilised the free face which would typically send high vibration toward the quarry office, however with the rubble zone in place a vibration of 35.20mm/s PPV was recorded at the quarry office, and further improved fragmentation and heave results accompanied.



Shot locations, sequence and vibration results

In summary, the rubble zone successfully reduced vibration at the quarry office. In addition, blasting costs were significantly reduced, future blast size was unaffected, more standard Exel™ initiation designs could be retained, and there was no further need to deck charge blast holes.

### Testimonial

“Blast modelling and monitoring carried out at Peppertree identified the potential for high vibrations as blasting moved closer to the main plant structures. With over 200 contractors on site Boral were keen to minimise disruption to the site and as a result favoured larger, less frequent blasting.

A number of discussions were held between Boral and Orica and several options were considered. The technical and blast modelling capabilities of Orica allowed a clear evaluation of the options to be made.

The above proximity blasts, in conjunction with the rubble zone, worked very well, with vibration readings well under the limits and good rock fragmentation.”

Mr Angus Shedden, Quarry Manager

### Acknowledgements

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