



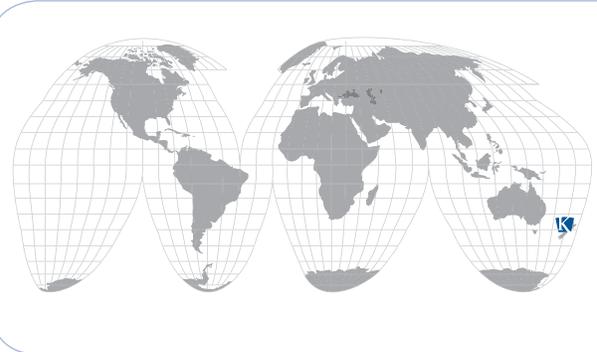
Drury Quarry

Auckland, New Zealand

The W. Stevenson & Sons Ltd. Drury Quarry is one of the largest aggregate suppliers in New Zealand. With four loaders dedicated to loading up to 500 trucks daily, the quarry supplies greywacke rock, which is used as base material in roads, concrete aggregate, paving and construction.

But it came time to grow even bigger. After four years of research and development by Steve Ellis, Stevenson Quarries Divisional Manager and his team, the updated Drury Quarry was designed. This quarry would improve productivity and increase the range of products they could manufacture.

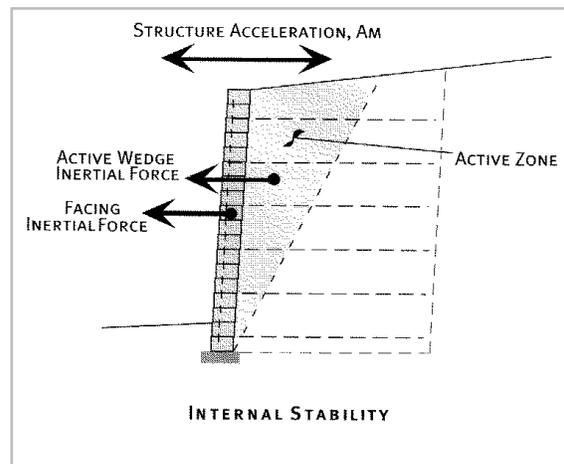
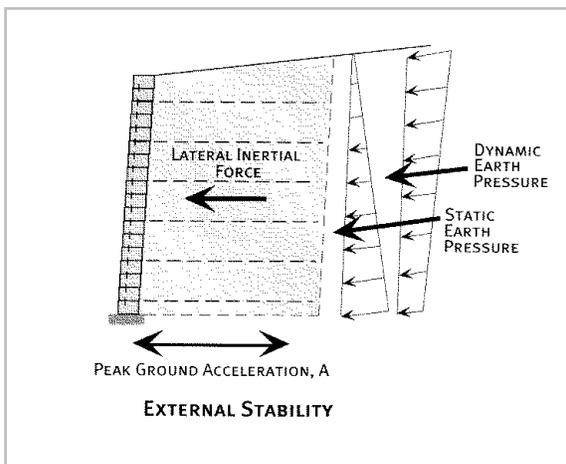
“We looked at what people were doing in Europe, the United States and Australia over a three year period and made our conclusions and decisions based on what we learned,” said Ellis. *“We were able to combine innovation and best-practices gathered from our research into various quarry operations worldwide.”* Ellis and his team discovered that there were massive gains to be made in productivity and quality – up to three times the previous levels. *“This project brought together the latest technology in construction and in quarrying performance and we certainly feel we came up with the right combination,”* Ellis said.



Project:	Drury Quarry
Location:	Auckland, New Zealand
Keystone Product:	Keystone Standard
Licensed Manufacturer:	W. Stevenson & Sons Ltd. Auckland, New Zealand
Total Wall Area:	1,522 m ²
Main Contractor:	Premier Construction Ltd. Auckland, New Zealand
Wall Sub Contractor:	ICB Retaining Walls Auckland, New Zealand
Consulting Engineers:	Peters & Cheung Ltd. Auckland, New Zealand



CASE STUDY



Keystone walls are proven to be earthquake-resistant due to their inherent flexibility, permitting minor yielding during seismic activity. Schematics of pseudo-static analysis considerations are shown as they pertain to reinforced soil structures.

Peters and Cheung were the consulting engineers charged with designing and developing the multi-level site, as well as providing geotechnical assistance.

The first part of the development was substantial earthworks and retaining at the site. Premier Construction was the main contractor on the project, assisted by ICB Retaining Walls who constructed the massive Keystone retaining wall system.

There were a number of design considerations that made this expansion project no simple task. Aesthetically, an existing wall needed to be considered while trying to tame the 35 degree back slope. Because the existing site was to be upgraded and not built from scratch, space issues led to some complex geometry in the tight radii of internal and external curves needed to wrap around existing quarry equipment. Furthermore, the wall would reach 11 meters in some areas, so key aspects of the design included determining safe cut slope angles and carrying out slope stability analysis.

Additionally, the wall was required to resist static loads of up to 200 tons from the primary crusher, where huge boulders are transported and pass in the first phase of the rock crushing process. From the primary crusher, manageable-sized rock is then able to be processed through a secondary crusher and graded into usable aggregates for road ways, drainage and concrete manufacture. It was also required that the wall bear the static and live loads of the heavy trucks.

Another challenge for designers Peters & Cheung was New Zealand's seismic activity. New Zealand is situated at the juncture of two tectonic plates, the Australian Plate and the Pacific Plate, whose collision is responsible for New Zealand's beautiful and mountainous landscape. It is also the reason that the Alpine Fault runs the length of New Zealand's south island, marking a prime area for earthquake activity.

The huge scope of the project called for a construction solution that was strong, stable and cost-effective. Since W. Stevenson & Sons Ltd. is a producer of Keystone retaining wall products, it would seem that the use of Keystone was a foregone conclusion for this project, but engineering/design consultants, Peters & Cheung, were most interested in providing the optimum solution for the Quarry. "The key properties of Keystone – strength, design flexibility, easy installation and cost effectiveness – were further enhanced by the aesthetic and environmentally-friendly solution it provided for this application," said Ka-Ching Cheung, of Peters & Cheung Ltd. "And an extra benefit was the great welcome, support and collaboration we received from the Keystone team." According to Cheung, the wall was able to be built vertically without the need for setback, resulting in smooth curves.

The Keystone system was able to provide specific requirements calling for a construction system that could work with the existing structures as well as the geographical characteristics of the site.

"Our new facility certainly secures our future as one of the leading quarrying organizations in the world," said Steve Ellis.

For more information on Keystone Standard units or other innovative Keystone products, please visit www.keystonewalls.com or call 800-747-8971. Further information on W. Stevenson & Son Ltd. and their Drury Quarry can be found on the web site at www.stevensonresources.co.nz.