UR1975_40

Seismic survey for a proposed cutting at East Risdon Road, west of Sugarloaf Hill.

W.R. Moore

At the request of the Public Works Department Materials and Research Section a seismic survey was undertaken on the crest of the saddle that separates Geilston Bay and Risdon Vale at the junction of Sugarloaf Road and East Risdon Road. The Public Works Department propose to reconstruct the East Risdon Road across this saddle on a new alignment. There will be a 12 m deep cutting immediately west of the existing road, at the crest of the saddle. The proposed cutting will be in hard Permian sediments for its entire length.

GEOLOGY

A down-faulted block of Triassic sandstone and mudstone occupies the western part of the saddle and lies between two uplifted blocks of Permian sediments which form Government Hills and Sugarloaf Hill. The Triassic block is bounded by two major faults N-S faults.

The Triassic sediments are poorly exposed in the saddle but sandstone crops out on the E-W track that follows the crest of the saddle and climbs to Government Hills from the East Risdon Road. Some blocks of Triassic sandstone and mudstone are exposed on the northern slope of the saddle; on the southern slope Triassic outcrops are few and poor, although the presence of Triassic sediments is indicated by sandy soil and sandstone boulders.

The Permian sediments are well exposed on Government Hills and along East Risdon Road and the Government Hills track. These sediments are hard poorly bedded silty sandstone, and sandy siltstone in beds 1-2 m thick separated by minor mudstone and silty mudstone beds. The dips are low and vertical joints are conspicious at outcrops. These sediments belong to the Permian Ferntree Formation.

The two N-S faults are not well exposed in the saddle area. The eastern fault is exposed on the East Risdon Road on the southern side of the saddle near Geilston Bay Road. Here, the crush zone is narrow and has been covered by a cement gutter since it was observed in 1964.

The Permian sediments are not crushed by the fault and no noticeable increase in jointing occurs close to it. Sediments near the fault are therefore not likely to be any easier to excavate. The western fault is exposed in a small quarry near the Risdon Tavern (pers. comm., D.E. Leaman); a dolerite dyke penetrates the fault zone.

GEOPHYSICAL WORK

Both the old and new routes cross the lowest part of the saddle which is underlain by Permian sediments. Along the Government Hills track an interval of about 50 m where there are no exposures separates the Permian siltstone from Triassic sandstone further west.

Using a Bison 170B signal enchancement seismograph with stations every 1.5 m the eastern boundary fault was located 18-21 m west of the last Permian siltstone outcrop. A sharp seismic velocity contrast existed between the Permian and Triassic sediments at this locality. In the Permian sediments three velocity layers were present: a surface layer of soil (V_0 = 700 m/s) and an intermediate layer (V_1 = 1650-1800 m/s) and third layer (V_2 = 3000 m/s) of rock. In contrast seismic velocities in the Triassic sediments were markedly lower: surface soil layer (V_0 = 900 m/s); second layer (V_1 = 1500 m/s). The fault area was then exposed using a back-hoe and showed the fault plane dipping 80° W.

Because of the velocity contrast of the Permian and Triassic sediments reflecting the difference in hardness between the two types of sediments further seismic investigation appeared warranted. Greater depth of penetration was required to determine if this difference in hardness detected by the shallow seismic traverse persisted to the proposed depth of the cutting.

Using the Geospace 124 refraction seismograph two E-W spreads of 128 m were fired using twelve geophones spaced at intervals of 6.1 m. Spread 1 was located entirely within the Permian sediments, the twelve geophones straddling the width of the proposed cutting at its deepest point. Spread 2 was located entirely within the Triassic sediments, west of the fault.

Table 1. RESULTS OF SEISMIC SPREADS 1 AND 2.

Spread	*Velocity layers (m/s)*	*Depth to interfaces (m)*	*Slope of interface*	*Geological interpretation*
1	V_0 = 915			Soil and weathered surface layer.
		V_0/V_1 1.8-2.7		
Permian sediments	V_1 = 3050-3675			White and grey mottled sediments with open joints
		V_1/V_2 44.5-45.1	No slope	
	V_2 = 4267-4570			Dark grey sediments with closed joints which are filled by calcite and pyrite.
2	V_0 = 915			Soft soil and deeply weathered sandstone
		V_0/V_1 25-35	Slight slope down to W.	
Triassic sediments	V_1 = 1980-2438			Weathered sandstone still brown stained and mudstone deeply weathered for some depth.

The results shown in Table 1 indicate that the seismic contrast between the Permian and Triassic sediments detected by the shallow seismic traverse persists well below the likely depth of any cutting.

Only the top 2-3 m of Permian sediments are likely to be rippable, whereas the Triassic sediments should be rippable down to at least 28 m.

CONCLUSIONS

At Sugarloaf Hill saddle the depth of weathering in the Permian sediments is very shallow compared with that of the Triassic sediments. The Permian sediments have very high seismic velocities equivalent to those found for granite and for much of the dolerite in Tasmania. This indicates that below a depth of about 2-3 m excavation will require drilling and the use of explosives and the rock will not be rippable. The hardness of these sediments will be equivalent to, or even harden than, those found on the Eastern

Outlet Road at the base of the Tunnel Hill cutting and in the cutting at the Cambridge deviation where Permian Ferntree sediments of equivalent stratigraphic position occur. Most of the Triassic material will be rippable. The Triassic sequence is normally one of sandstone with interbedded mudstone. The percentage of mudstone and thickness of the mudstone beds will be most important in the excavation of these sediments and in the design of the slope of the walls of the cutting.

Intelligent use of benching of the walls of the cutting by following the top of the sandstone bedding and following the natural angle of repose for the sandstones protecting the mudstone should overcome most of the problems due to weathering and fretting. Such a method of terrace benching would allow a higher overall angle of repose (up to 50°) for the batter walls in a Triassic cutting.

RECOMMENDATIONS

(1) At least two holes should be drilled in the Permian sediments and two in the Triassic sediments.

When drilling the Permian sediments the depth at which the unweathered white and grey rock is encountered should be noted; rock below this depth is not likely to be rippable. The openness of the joints and the degree of iron staining due to groundwater circulation should also be recorded.

In the Triassic sediments the thickness of the sandstone and mudstone beds and the percentage of each present in the core is important in estimating their rippability.

(2) An alternative route within the Triassic sediments west of the proposed alignment should be investigated. If it is feasible further seismic surveys and drilling should be carried out.

[16 May 1975]