Tasmania Department of Resources and Energy

Division of Mines and Mineral Resources — Report 1991/39

Investigation of a proposed house site near Bradys Lookout

by W. L. Matthews

An inspection was made of a proposed house site on a lot fronting Masons Road, Rosevears (fig. 1). The land is undulating and comprises a narrow section of low slope angle land near Masons Road, a steeper portion (sloping at 10–12°) downslope and a further area of land with a low slope angle (about 5°) near the West Tamar Highway. Basalt boulders occur on the surface but it is likely that Tertiary-age sedimentary materials, consisting of clay and sandy clay, underlie most of the lot at depth. Basalt crops out strongly on the uphill side of Masons Road and some 40 m from the road.

The undulating nature of the land is due to old landslide movements and although no recent movements are visible on the lot it was thought advisable to obtain a better idea of the underlying material before development proceeds. The land with the lower slope angle near the West Tamar Highway appears to have a lower risk of being affected by landslides in the future but the proposed house and shed are either on the steeper sloping land or marginal to it. Test pits up to about three metres deep would allow an examination of the underlying material as well as groundwater conditions and from this a more informed opinion of the likely future stability of the land could be given. These pits should be located in the vicinity of the proposed house and shed on or near some of the steeper sloping land where landslide risk may be greater.

Test pits

Four test pits were dug on the lot. Brief descriptions of the material are given in Appendix 1 with the approximate locations of the pits shown on Figure 2.

The material encountered in the test pits comprises clay layers and zones with basalt boulders. The clayey layers under the zones with basalt boulders are likely to be Tertiary in age. Some of the near-surface material is relatively soft but the deeper material is stiff to hard. Slip surfaces on the clay may represent signs of old landslides (which almost certainly occurred in the area) or may have formed as a result of compaction of the sediments.

Material from test pits 2 and 3 was tested with the following results:

Pit	*LL*	*PL*	*LS*	*'$_r$*	*c'$_r$*	*Emerson No.*
2	127	32	24			
3	113	30	22	15°	2	5

(LL = liquid limit, PL = plastic limit, LS = linear shrinkage, = friction angle, c = cohesion)

X-ray diffraction on material from pit 3 resulted in the following results (all values in %):

	Kaol	*Mont*	*Goeth*	*Gibbs*	*Quartz*	*Mica*
Clay fraction	65	20	10	5		
Whole sample	50	15	10	5	20	2

Minerals are kaolinite, montmorillonite, goethite, gibbsite, quartz and mica. Determinations by R. N. Woolley.

These determinations indicate that the material has a high plasticity. The strength test on the sample from pit 3 gives values of 15° and 2 kPa for residual friction angle ('$_r$) and cohesion. These are in the moderate strength range for values obtained around the Tamar Valley. Friction angles as low as 8° have occasionally been obtained.

Stability calculations were undertaken by B. Weldon using these strength tests (Appendix 2). A safety factor of 1.3 is usually regarded as the lowest value indicating long term stability. It can be seen that when saturation of the theoretical slide is complete (i.e. approaching 0.5 for Ru) the factor of safety drops below 1.3. Drainage measures need to be undertaken to ensure that saturation of the soil to the surface does not occur.

Conclusions

The results of the test pits show that reasonably safe development of the lot should be possible. This assumes that material with a significantly lower strength does not occur at deeper levels than the pits.

A number of precautions should be undertaken. The whole area around the house should be free draining and water should not be allowed to accumulate at any point so that seepage underground is possible. A swimming pool (which may leak) is not advised. At depth the material is in a relatively dry (and high strength) condition but its strength would decrease if it became more moist. A drain to about 1 m+ around the top side of the house will aid in keeping the land on which the house is situated in a dry condition. It must be ensured that such a drain works efficiently and continuously as any blockage could cause problems.

Any excavations should be supported by strong, designed retaining structures with drainage. Excavation around the house site should be avoided as far as possible, particularly around the contour on the steeper land. Tree planting on the lot will aid in maintaining stability. The clay has expansive properties and foundations should be designed to account for this.

In summary although there are signs of old landslide movements on or near the property, if precautions are taken in developing the land it should be possible for this to take place with reasonable safety. These precautions include good drainage and excavation practices and the planting of trees. Expansive clay conditions should be considered in designing foundations.

[6 December 1991]

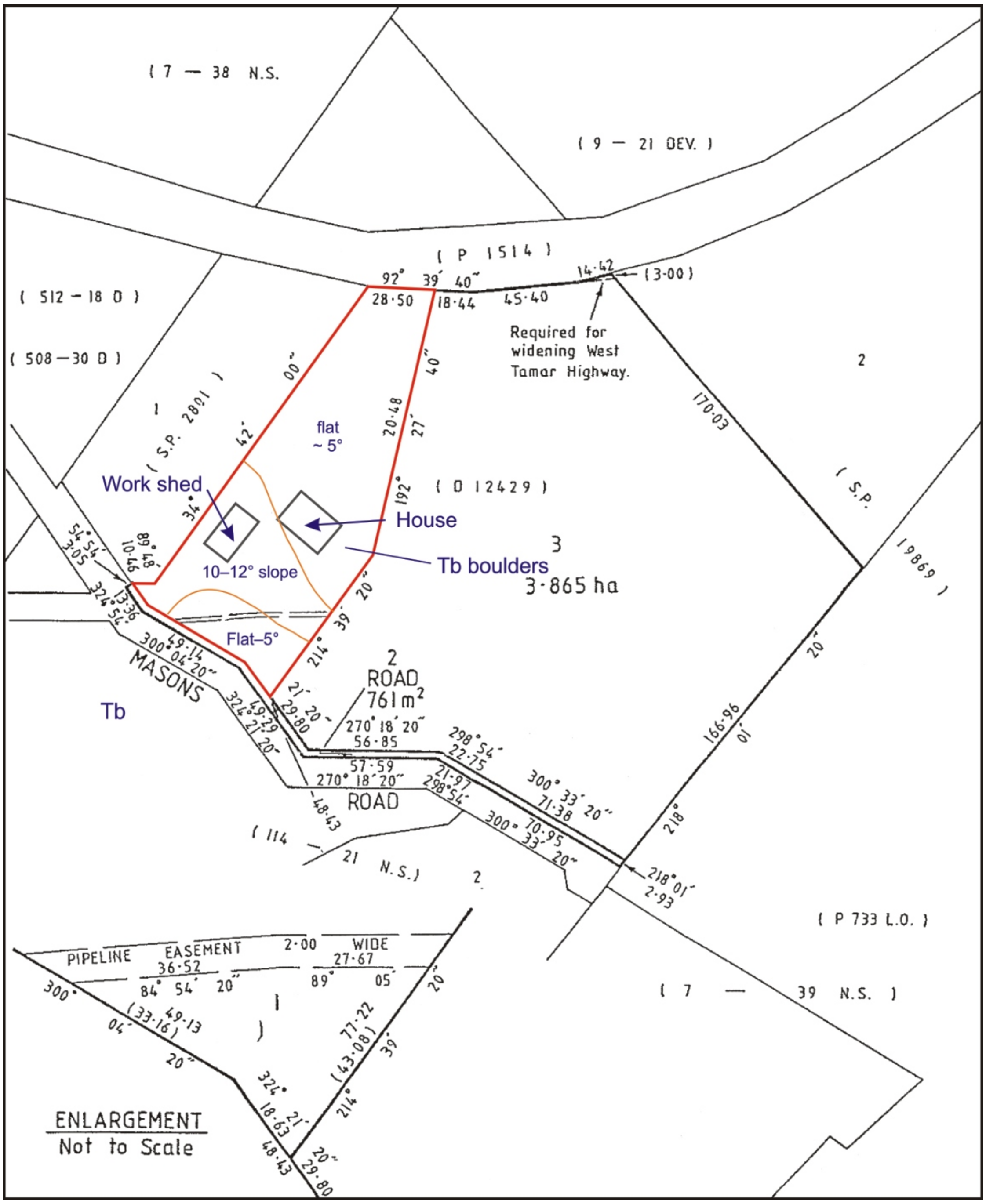


Figure 1. *Location of investigation area.*

APPENDIX 1
Logs of test pits

Pit 1

0 – 0.2 m	Dark brown silty clay soil, roots, moist.
0.2 – 0.9 m	Mid brown plastic to fragmented clay, moist and fairly soft.
0.9 – 3.1 m	Light brown grey clay, fairly stiff large massive zones of brownish clay, a little calcite (weathered rock?), some large slip surfaces.

Pit 2

0 – 0.2 m	Dark brown silty clay soil, moist.
0.2 – 1.1 m	Mid brown plastic to fragmented clay, soft, some fracturing visible, basalt boulders up to 150 mm across, some slip surfaces, layer slopes to north.
1.1 – 2.9 m	Light brown and grey clay, fairly hard (difficult to indent with thumb). Some centres with calcite nodules.

Pit 3

0 – 0.2 m	Dark brown silty clay soil, roots, moist, some basalt boulders.
0.2 – 1.2 m	Mid brown loose clay, fissured but plastic when worked.
1.2 – 3.05 m	Light brown and grey plastic clay, hard and fractured, calcite rich nodules, 30 mm iron oxide seam on south end of trench.

Small seepage at 0.6 m

Pit 4

0 – 0.2 m	Dark brown clay soil, some basalt boulders, wet, roots.
0.2 – 0.8 m	Light brown clay, fissured and soft, plastic when worked.
0.8 – 2.3 m	Light brown mid grey mottled clay, hard, some fracturing. Basalt boulders in this zone to within 0.3 m of base.

Seepage water coming in through soil layer at a few points.

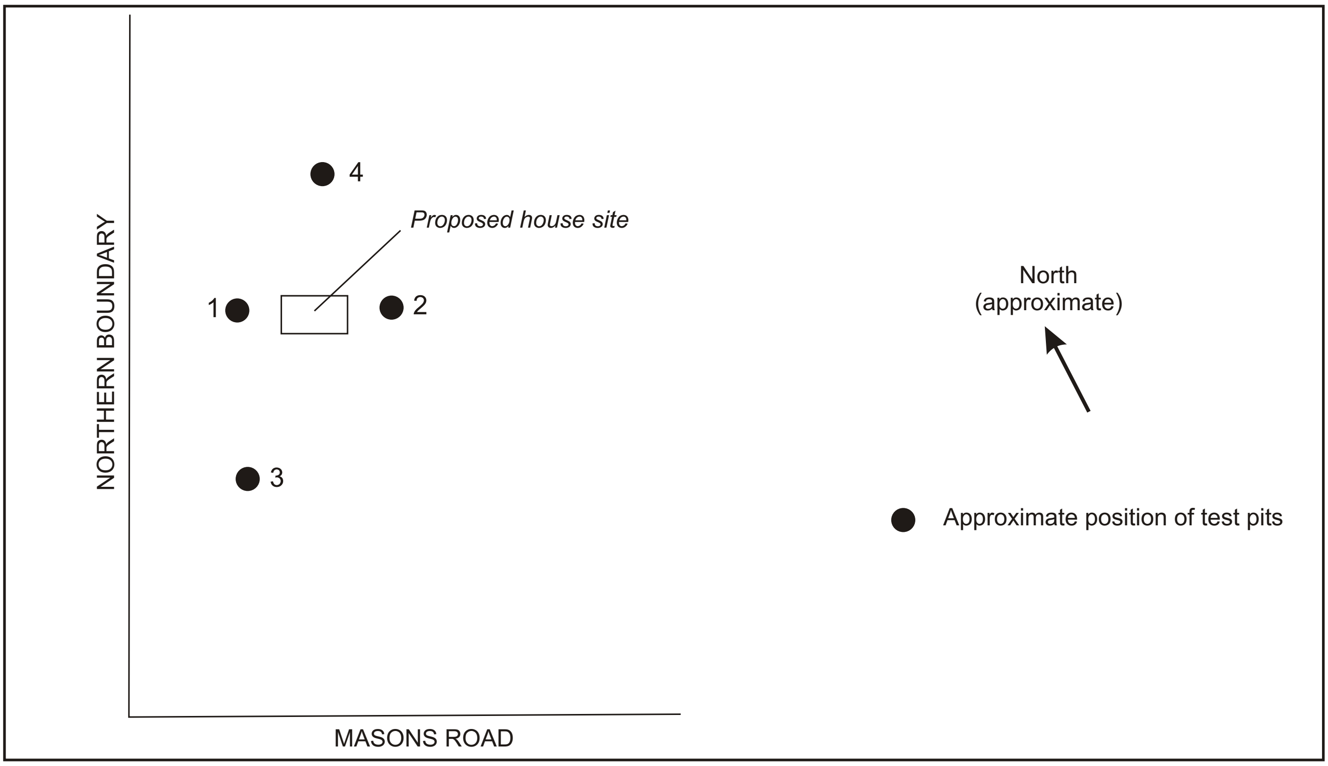


Figure 2. *Approximate locations of test pits.*

APPENDIX 2

Stability analyses

SLOPE STABILITY ANALYSIS - COMPUTATIONS SHEET 1 OF ..1..

NAME OF SLIP .... MAP REF ....

ANALYSIS BY ....
DATE ....
CHECKED BY ....

INITIAL INPUT		
STORE	ITEM	
00	X L.H.S.	0 m
01	Y L.H.S.	0 m
02	X R.H.S.	60 m
03	Y R.H.S.	10 m
04	SLICES	6
06	GAMMA	19.00 kN/m³
07	C	2 kPa
08	PHI	15 degrees
09	ru	
10	Y CIRCLE	140 m
11	F1	

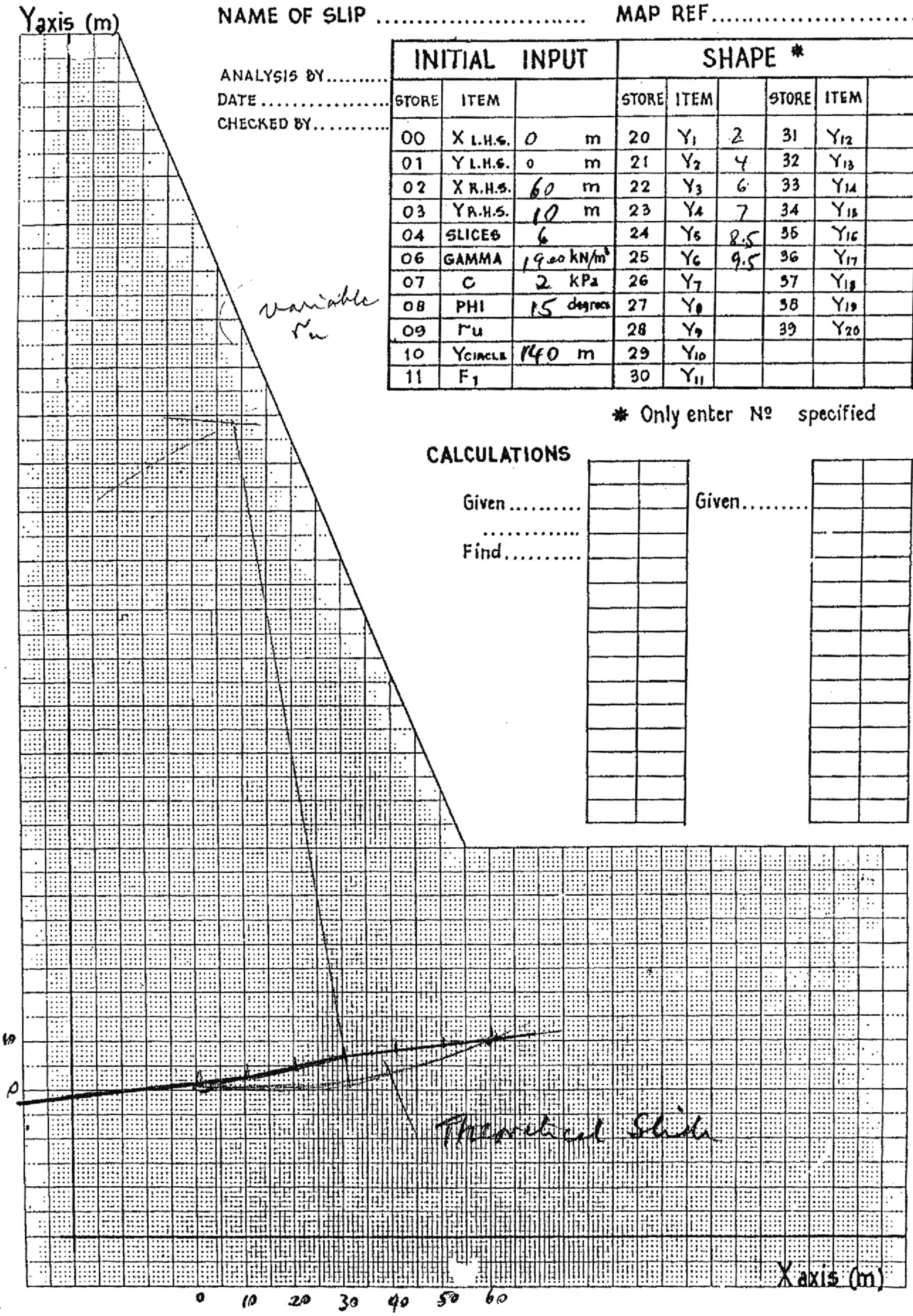
SHAPE *				
STORE	ITEM		STORE	ITEM
20	Y1	2	31	Y12
21	Y2	4	32	Y13
22	Y3	6	33	Y14
23	Y4	7	34	Y15
24	Y5	8.5	35	Y16
25	Y6	9.5	36	Y17
26	Y7		37	Y18
27	Y8		38	Y19
28	Y9		39	Y20
29	Y10			
30	Y11			

* Only enter Nº specified

CALCULATIONS

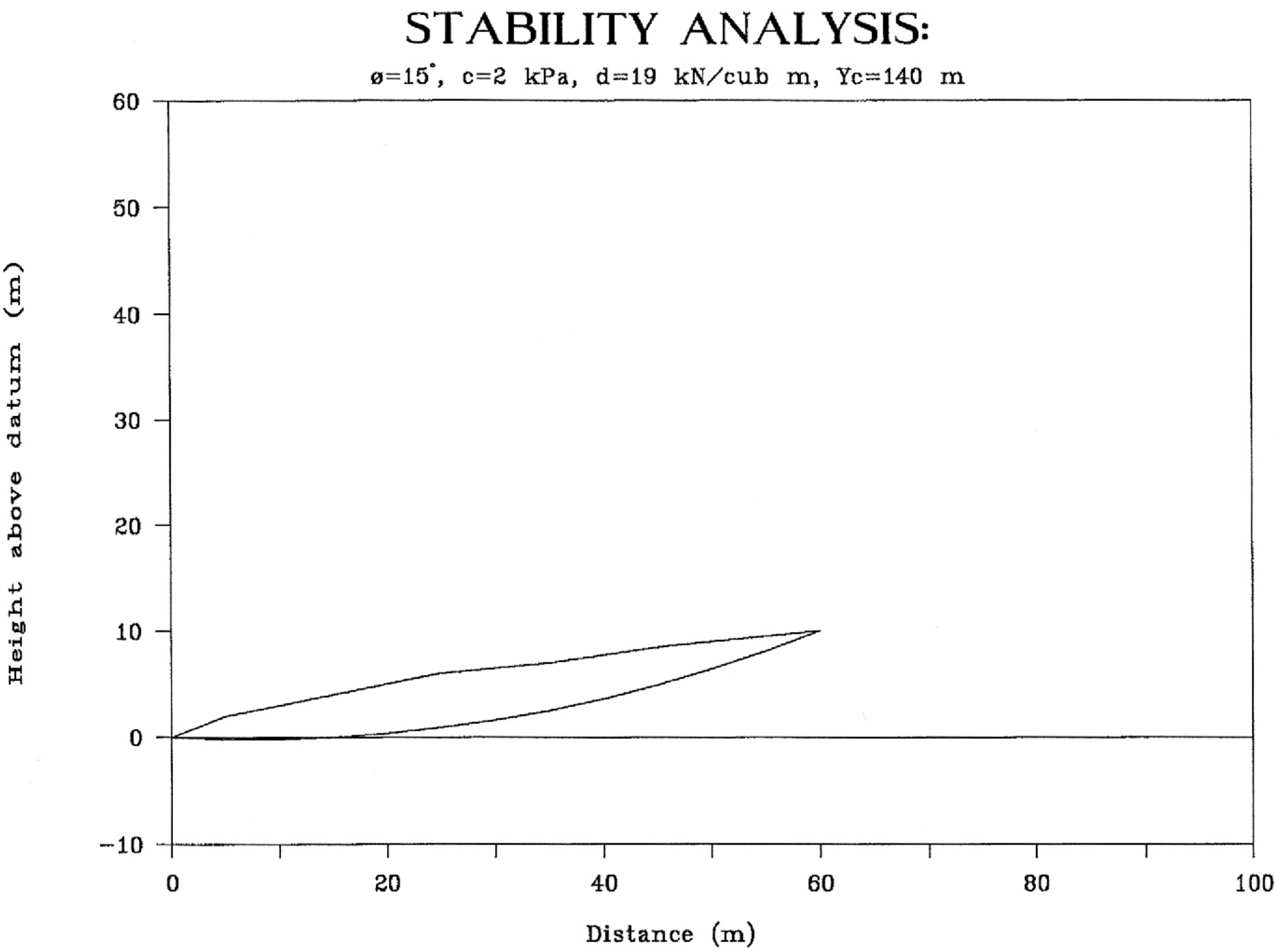
Given ....
....
Find ....

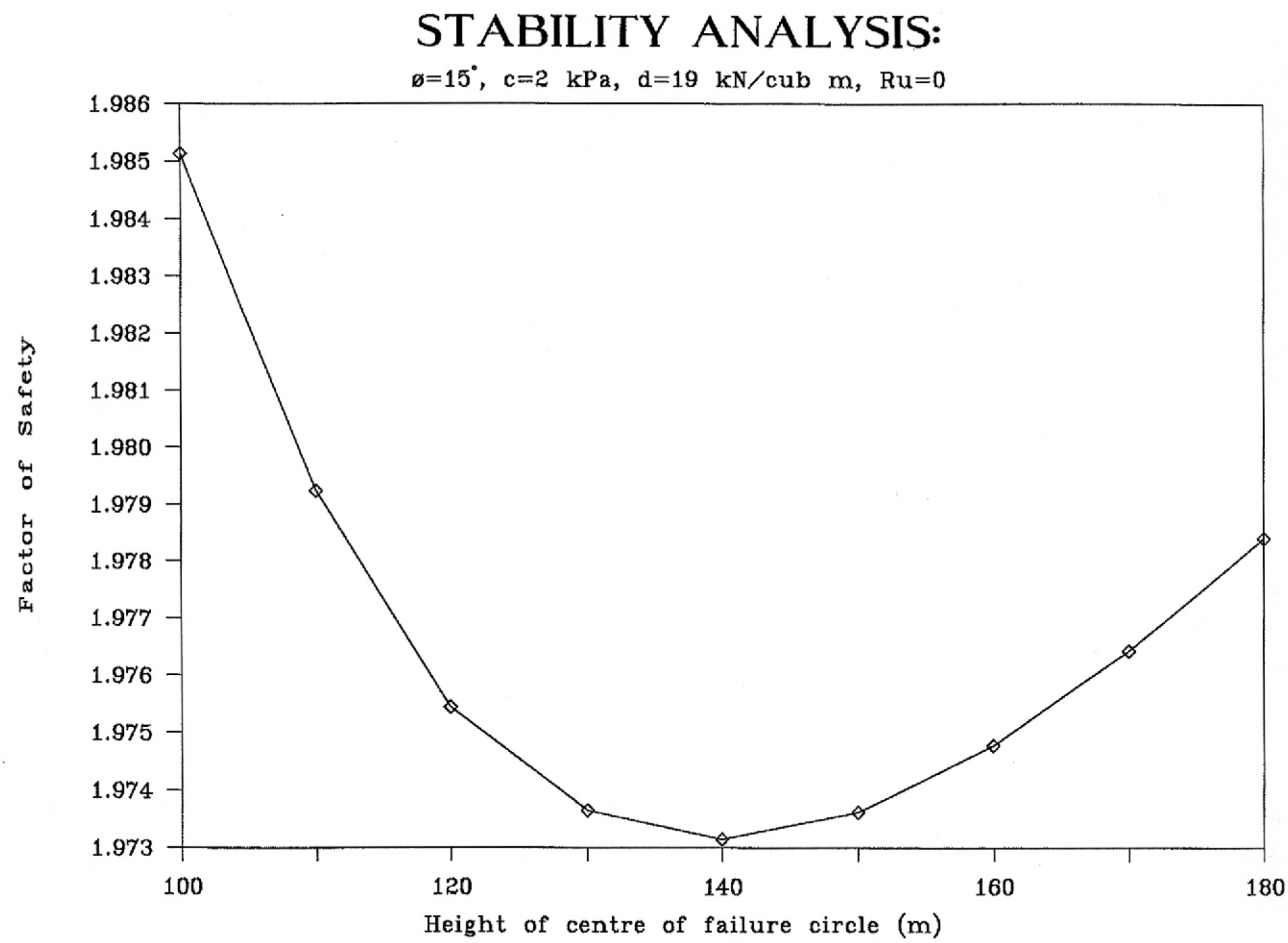
Given ....

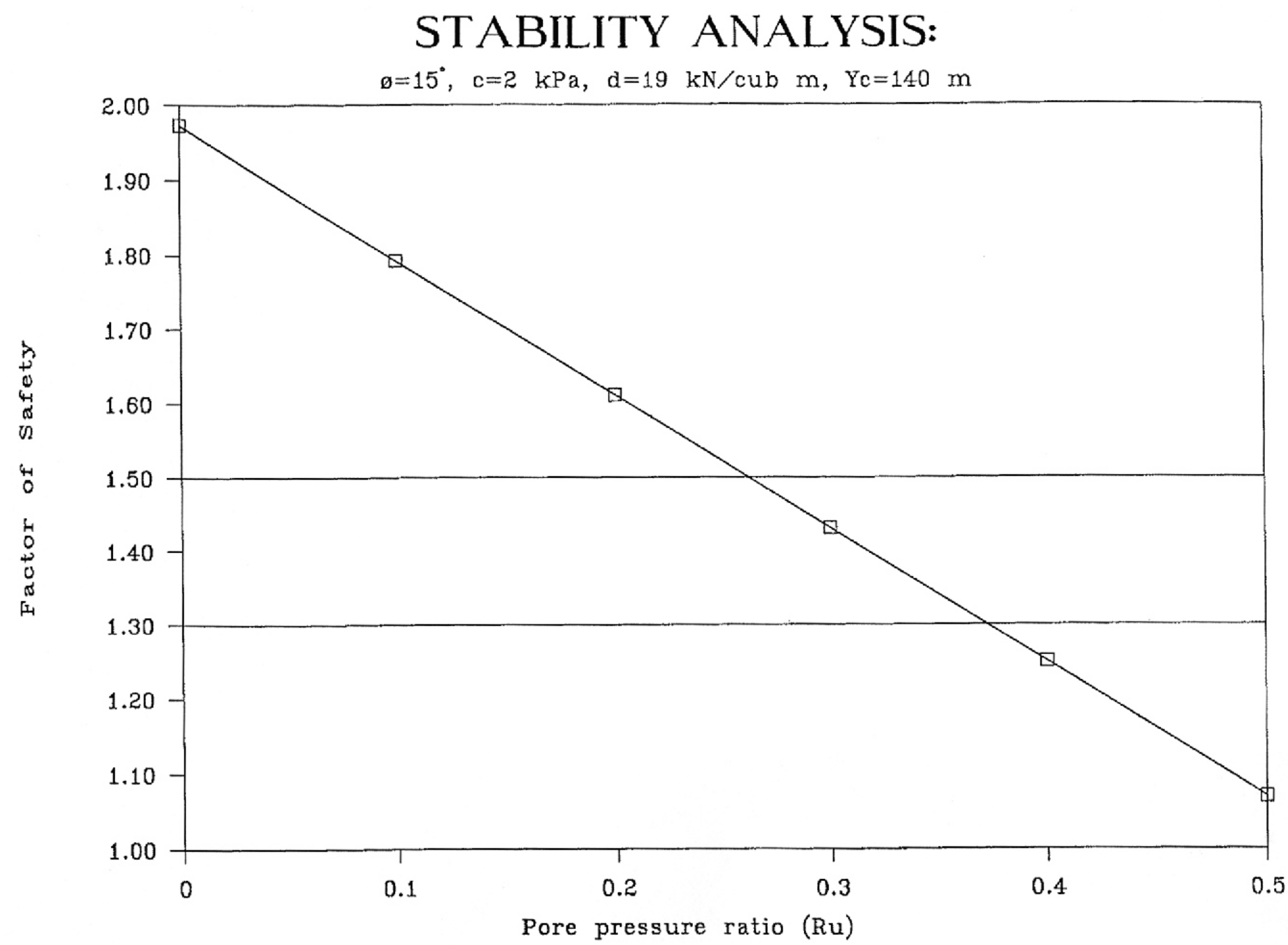


Values used in stability analyses

Density (kN/m^3)	*Cohesion (kPa)*	*Friction (degrees)*	*Ru*	*YC (m)*	*FS*
19	2	15	0	100	1.985
19	2	15	0	110	1.979
19	2	15	0	120	1.975
19	2	15	0	130	1.974
19	2	15.	0	140	1.973
19	2	15	0	150	1.974
19	2	15	0	160	1.975
19	2	15	0	170	1.976
19	2	15	0	180	1.978
19	2	15	0	140	1.973
19	2	15	0.1	140	1.792
19	2	15	0.2	140	1.611
19	2	15	0.3	140	1.431
19	2	15	0.4	140	1.250
19	2	15	0.5	140	1.069




STABILITY ANALYSIS:
ø=15°, c=2 kPa, d=19 kN/cub m, Ru=0
1.986
1.985
1.984
1.983
1.982
1.981
1.980
1.979
1.978
1.977
1.976
1.975
1.974
1.973
Factor of Safety
100
120
140
160
180
Height of centre of failure circle (m)


STABILITY ANALYSIS:
ø=15°, c=2 kPa, d=19 kN/cub m, Yc=140 m
2.00
1.90
1.80
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
Factor of Safety
0
0.1
0.2
0.3
0.4
0.5
Pore pressure ratio (Ru)