UR1989_13

1/7

Tasmania Department of Mines—Report 1989/13

Unidata installation at Ambroses's house, Droughty Point Road, Rokeby

by R. J. Sedgman

Abstract

Cracking of a house at Rokeby indicates land movement in the area. A strain gauge and water probe were installed on the house to monitor the land movement. Details of the installation, support hardware, and software needed to service the installation are discussed.

INTRODUCTION

The Department of Mines, in a letter of 30 November 1984 from Mrs M. W. Ambrose, was requested to undertake an investigation of a cracked home at 39 Droughty Point Road, Rokeby. Preliminary investigations were carried out by W. R. Moore, and subsequent long-term automatic monitoring was requested (see fig. 1).

The house is situated on a block of land which is thought to be affected by landslip. The monitoring is to determine whether the slip extends back onto Droughty Point Road, and if the slip is influenced by activity on the block of land or external to it.

To monitor the cause and effect of cracking it was decided to use a strain gauge mounted between the south wall of the house and an anchored point on the foundations of the house. The water probe would be used to monitor the changing water table and the effect of movement of the house. Data would be recorded on a Unidata logger.

INSTALLATION

The Unidata recorder is situated on the south-facing wall, inside a grey enclosure with 'Unidata' printed in red on the cover (a detailed description of the Unidata recorder is given in Sedgman and Weldon, 1988). Next to this is another enclosure which houses the strain gauge amplifier and power supply (see fig. 2). Power is supplied to this unit via a power point in the laundry inside the house.

To monitor movement of the house an anchor was attached to the concrete steps leading into the laundry, these steps being a part of the foundation structure. A strain gauge was then attached to the anchor on the steps, with a threaded rod connecting this to an anchor attached to the brickwork on the south foundation wall of the house (Appendix 2).

To obtain a qualitative result the foundations of the house should be securely anchored into the bedrock below so that any surface movement will not affect the position of the anchor (foundations) position. This is virtually impossible in low-cost investigations, so the results have to be treated as one movement relative to the other. However the anchor point was surveyed in and is checked at regular intervals to ascertain if the anchor point is actually moving as well. The movement observed by the surveyor can be used as a correction factor by the data processor if the need should arise.

The strain gauge measures movement in terms of the distance between the house and the foundations, so if the movement of the house is up or down this can be also interpreted as a downslope movement. Care must be taken when interpreting the results, and it is suggested that the interpreter consult the surveyor when processing the data.

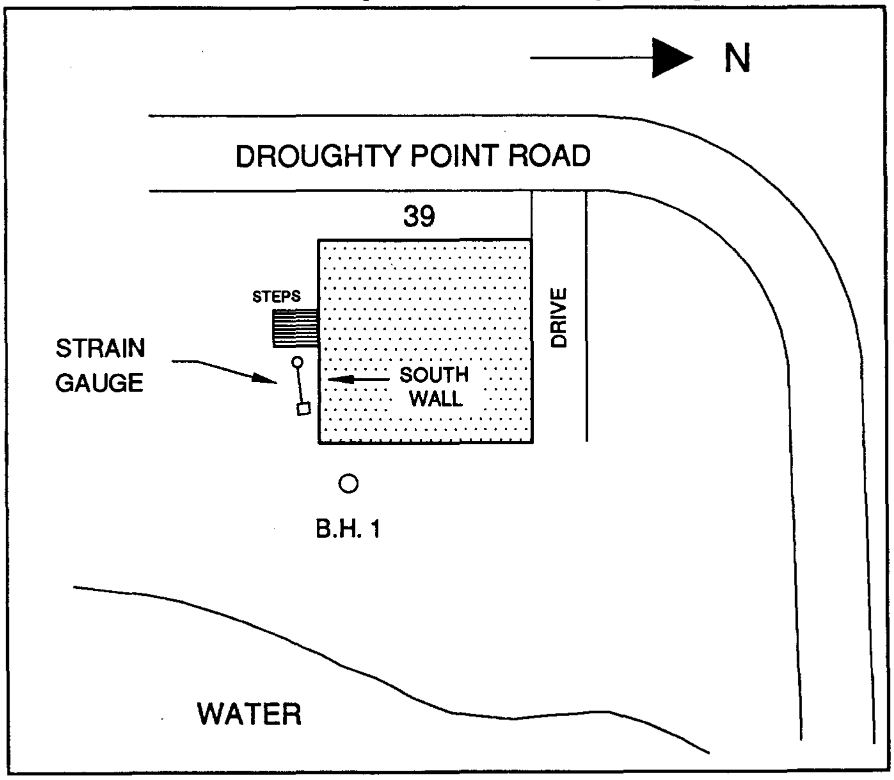


Figure 1. *Location of Unidata installation, Ambrose's house.*

To monitor the movement of the water table, a water probe which measures water table variations of up to ten metres was placed in an existing observation hole (borehole 1 on fig. 1) at a depth of ten metres (Appendix 1).

Data from the strain gauge and water probe are recorded as an average over a three-hour interval. This gives a smoothing effect to the data, so as to take out any sudden un-natural variations. The control program is given in Appendix 4.

MAINTENANCE

This installation should be serviced by the Toshiba laptop computer at least once every six weeks or so, as the memory within the data logger can be filled very shortly after this period of time (Sedgman and Weldon, 1988).

Any electrical or mechanical adjustments will require the use of a multimeter, screw drivers, a pair of shifting spanners, and special triangular-headed key to open the Unidata enclosure. Remove the lid of the Unidata enclosure and connect the negative lead of the multimeter to pin 41. To measure the output of the transducers the following pins are used (see Appendix 3 for circuit connections):

a:	pin 39	water depth probe
b:	pin 36	strain gauge

Maintenance requirements are as follows:

1: *Effect*—Strain gauge readings go off scale .

Remedy—Loosen the nut on the threaded rod that is attached to the anchor point on the south wall. Now lengthen or shorten the length of this piece of rod until a reading of about 1.25 volts on the multimeter appears when it is connected to pin 39 (see fig. 3).

2: *Effect*—erratic readings on the water probe.

Remedy—replace probe.

REFERENCES

SEDGMAN, R. J.; WELDON, B. D. 1988. Field manual for the Toshiba laptop computer. *Unpubl. Rep. Dep. Mines Tasm. 1988/22.*

[26 June 1989]

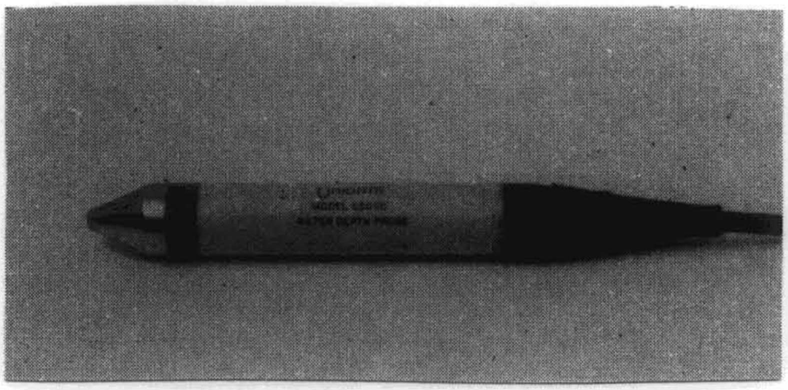
Figure 2. *The Unidata recorder, and the strain gauge amplifier and power supply installations.*

Figure 3. *Detail of anchor and threaded rod.*

APPENDIX 1

Water probe 10 m

The water probe is a low-cost, solid-state probe designed to measure the hydrostatic pressure of water. In conjunction with the data logger it has a resolution of ±40 millimetres.



Model 6508A/B/C/D – Water Depth Probes

Low cost, solid state probe designed to measure the hydrostatic pressure of water. Ideal for drainage, bore hole and river height recording projects. Sealed and factory calibrated to standard ranges, these probes are interchangeable. As many as eight Water Depth Probes may be connected to the Data Logger.

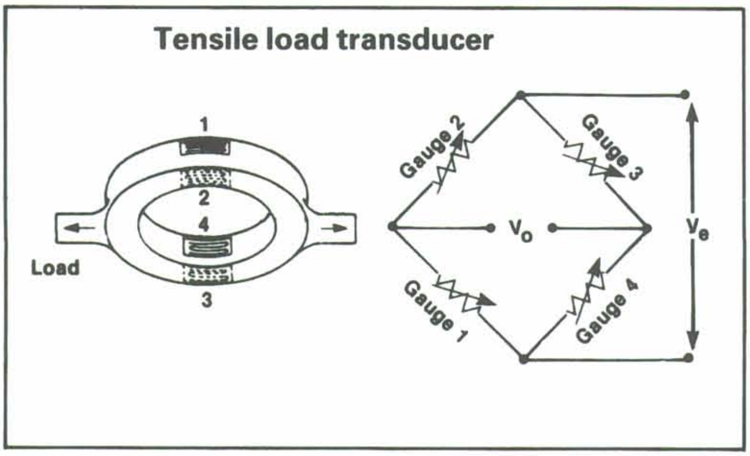
Sensor:	Semi-conductor strain gauge element
Electronics:	Integrated amplifier and correction circuitry
Power:	5 VDC, 4ma (4% of battery life)
Construction:	Sealed PVC (UV resistant)
Cable:	3 core vented cable with shield. 50m maximum
Resolution:	0.5% of range (-1 to 40 deg C)
Size:	25mm diameter, 180mm long
Weight:	200 grams (excl cable).
Range:	**Model 6508A** 0 to 1 metre of water
	Model 6508C 0 to 5 metres of water
	Model 6508D 0 to 10 metres of water
	Model 6508E 0 to 20 metres of water

APPENDIX 2

Strain gauge

To measure strain it was decided to use what is called a proving ring. This consists of four strain gauges mounted on an aluminium ring (two on opposite external sides and two on opposite internal sides) (see fig. 4). An amplifier is required to give an output which is suitable for measuring with the data loggers, which have an output of 0 to 2.55 volts. The amplifier chosen was the Radio Spares type 308-815 (see fig. 5 for construction details).

Figure 4. *Detail of proving ring.*



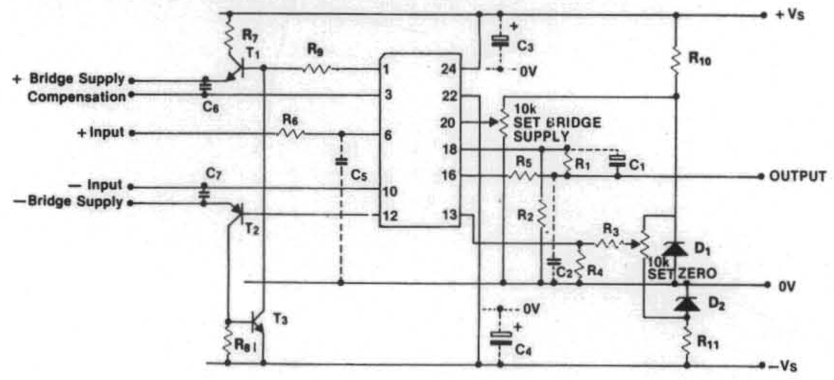
6604

Specification

(At 25°C ambient and ±12V supply unless otherwise stated.)

Supply voltage	±2 to ±20V dc
Input offset voltage	1 mV max
Input offset voltage/temperature	1 μV/°C max
Input offset voltage/supply	5μV/V max
Input offset voltage/time	1μV/month max
Input impedance	>2.5 MΩ min
Input noise voltage	1μV p.p max
Band width (unity gain)	400 kHz
Output current	5 mA
Output voltage span	$\pm(V_s\text{-}3)$V
Closed loop gain (adjustable)	5 to 10,000
Open loop gain	>100 dB
Common mode rejection ratio	>100 dB
Bridge supply voltage/temperature	20μV/°C
Maximum bridge supply current	12 mA
Power dissipation	0.5W
Warm up time	5 mins
Operating temperature range	–25°C to +85°C

Basic circuit for printed circuit board 435-692 (gain approx. 1000).



Component values

R_1 100k	R_7 47R	C_2, C_5 10n (typ.)
R_2 100R	R_8 10R	C_3, C_4 10μ(tant.)
R_3 100k*	R_9 1k0	T_1 BD 135
R_4 68R*	R_{10} 680R	T_2 BD 136
R_5 10R	R_{11} 680R	T_3 BC 108
R_6 100R(typ.)	C_1, C_6, C_7 100n (typ.)	D_1, D_2 1N827

A glass fibre printed circuit board, stock number 435-692, is available for the basic circuit as given in Figure 7.

The board is 46 x 98mm in size and is complete with screen printed component identification and a solder mask.

Only typical values are given for certain components, as adjustment of these values may be necessary in specific applications to obtain optimum noise reduction (see Minimisation of Noise, page 5).

*R_3 and R_4 values may be adjusted to alter the zero adjustment range when compensating for bridge imbalance.

Notes:

Gain is defined as $1 + \frac{R_1}{R_2}$

Zero adjustment range $\pm 6.2 \times \frac{R_4}{R_3 + R_4}$ Volts

Total bridge supply = 2 × bridge ref input (pin 20)

C_5 may be omitted for input lead lengths of less than 10 metres.

T_1 and T_2 provide bridge currents up to 60 mA and should be kept away from the amplifier.

T_3 and R_5 provide current limit of approx 60 mA.

Where high stability power supplies are being used zero and bridge supply reference may be taken direct from the power rails.

Figure 5.

APPENDIX 3

Circuit connections

Transducer	*Termination strip number*			
Strain gauge	signal	36	power external	37
water probe	signal	39	power internal	15
all grounds are 41, 38				

APPENDIX 4

Scheme definition

Scheme AMBROS, Title: Ambrose strain and water level. RJS.

Communication port 1

Access form: Direct

Logger size 8k

Logger cycle rate 5 seconds

Log interval 180 minutes

Log a1 as AV Depth, being depth 10m

Instrument 6508d measuring water depth 10m

Log a2 as AV Strain, being strain

Total 2 entries, 2 bytes logged, 3327 log entries giving a maximum logging time of 138 days, 15 hours

Lotus file generated

Detailed print-out to scrn:

Plot 2

Plot 3

Plot 2 and 3