Rept.Bk. No. 67/79
G.S. No. 4107

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

ENGINEERING DIVISION

REPORT ON BUILDING FAILURE AT BERRI HOSPITAL

Blk. 877 Berri Irrigation Area

Co. Hamley

by

B.M. HARRIS
GEOLOGIST
HYDROGEOLOGY SECTION

30th October, 1968

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIB 67/79

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CONTENTS

FIGURES

Rept. Bk. No. 67/69
G.S. No. 4107
D.M. 1337/58

30th October, 1968

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 67/79
G.S. 4107
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REPORT ON BUILDING FAILURE AT

BERRI HOSPITAL

Blk. 877 Berri Irrigation Area

Co. Hamley

ABSTRACT

Severe cracking of a brick building is related to settlement of footings seated on wind-blown sand of the "collapsing" type, which loses volume when saturated with water.

INTRODUCTION

An inspection of a cracked building at the Berri Hospital has been made on 30th July 1968, following a request by the Director of Mines. Foundation failure has severely damaged one half of the casualty building. Mr. R.D. Steel of this Department reported on the foundation conditions at the site in 1958 (Ref. 1).

Details of the building are as follows: single storey brick, roof supported by steel columns taken directly to the foundations. The external footings appear to be 18 inches deep by 12 inches wide. The architects are Brown and Davies of Adelaide.

According to the head groundsman, the failure was first noticed as internal cracks which progressed to the outside of the building. This movement continued for a week resulting in severe damage to half of the building. Figure 1 shows a sketch plan of the building and the positions wherephotos were taken.

Subsequent investigation by the Architects and the Insurance Company showed a leaking pipe adjacent to the foundations (Figure 1).

SOIL PROPERTIES

The soil profile consists of sand overlying a sandy marl to varying depths. Detailed descriptions of the soils at the site can be found

in the report by Steel (Reference 1). All of the soils are believed to be aeolian (wind-blown) in origin.

The soil is a collapsing type, i.e. one in which a considerable reduction in volume occurs when the soil is saturated with water. Therefore, footings seated in these soils may suddenly be without support following saturation of the underlying soil.

General notes on collapsing soils are given in Appendix A.

MECHANISM OF COLLAPSE

It is believed that the failure occurred in the following manner:-

(a) Water leaking from a pipe connection saturated the surrounding soil.

(b) A rapid reduction of the soil volume followed i.e. "collapse" occurred.

(c) At first the zone of collapsed soil was small and the footings were able to bridge this zone, although minor cracking may have occurred.

(d) After some time a large part of the footing was left without support and therefore failed.

Figures 1 and 2 indicate diagrammatically the mechanics of the building failure. It can be seen that the footing failure on the eastern side caused the eastern side of the building to settle and rotate away from the remainder of the building along crack (1). The settlement and rotation was greatest over the zone of collapsed soil, and this caused differential movements in the eastern side (cracks (3) (4) (5) and (6)). The horizontal crack (2) appears to have been formed as blocks of the eastern wall settled away from the upper part of the wall. The upper part of the wall appears to have received sufficient support from the roof to prevent its failure.

CONCLUSIONS

The report by Steel (Reference 1) described the soil as one which would lose strength on wetting but did not describe completely the consequences

of wetting up.

The phenomenon of soil collapse (Appendix A), had not been recognised in South Australia at that time and hence the recommendations given were based on insufficient knowledge of the behaviour of this soil type. It is now known that the most satisfactory ways to found buildings in areas of collapsing soils of this type are:

(a) Precompaction of the soil to a sufficient depth by flooding and rolling.

(b) Construction on piles or piers seated or or in a strong, stable horizon beneath the collapsing soil.

BMH:JB:CC
30.10.1968

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REFERENCES

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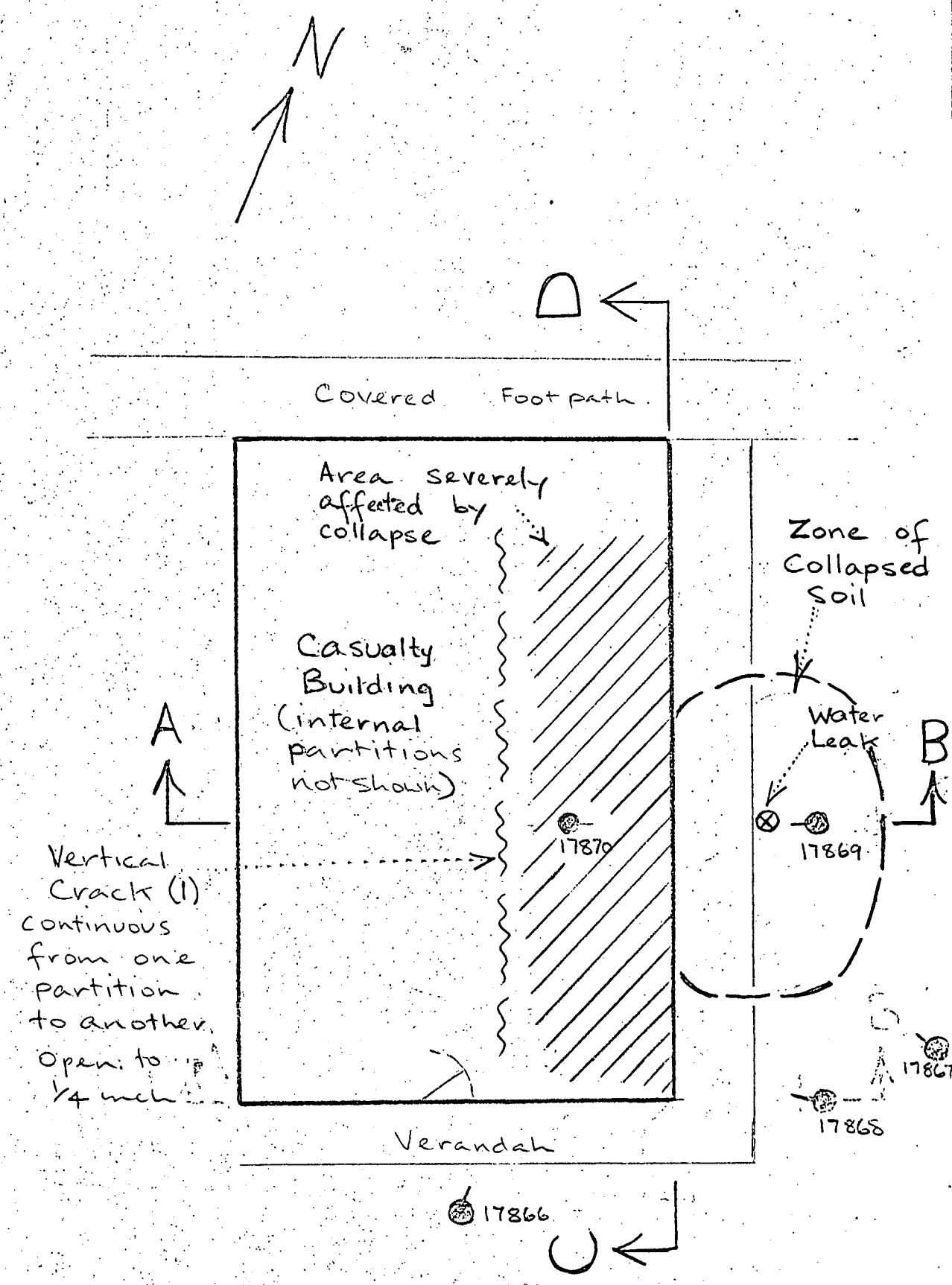
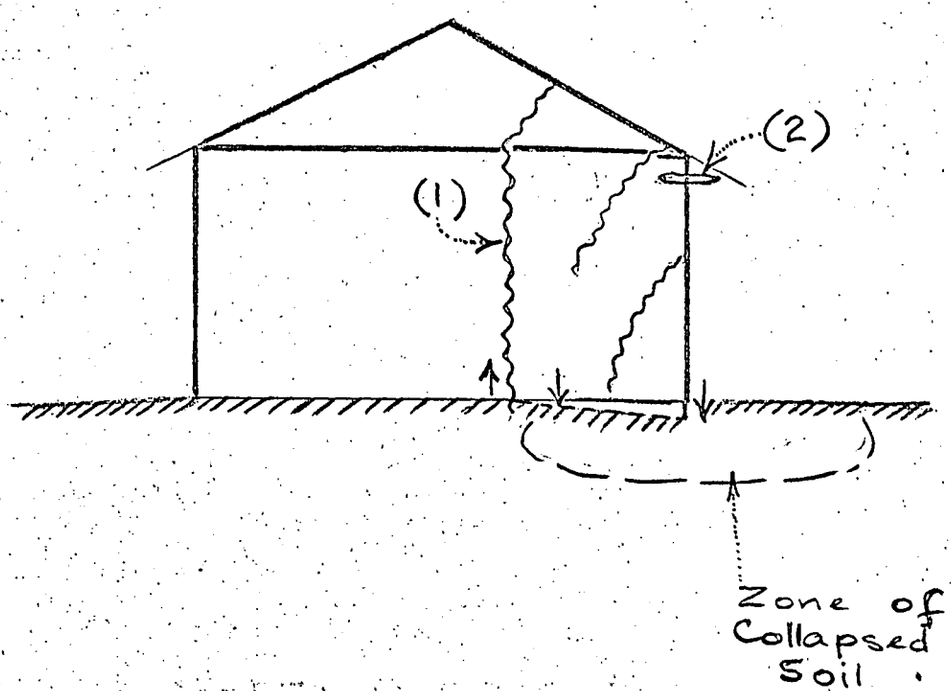


FIG. 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA

ENGINEERING GEOLOGY SECTION	Drn. MH	BUILDING FAILURE	SCALE: Not to Scale
	Tcd.		
	Ckd. WRPS	BERRI HOSPITAL	S 6970 Fig. 1
DIRECTOR OF MINES	Exd. DK	PLAN	DATE: 27 Sept 68

SECTION A-B



SECTION C-D

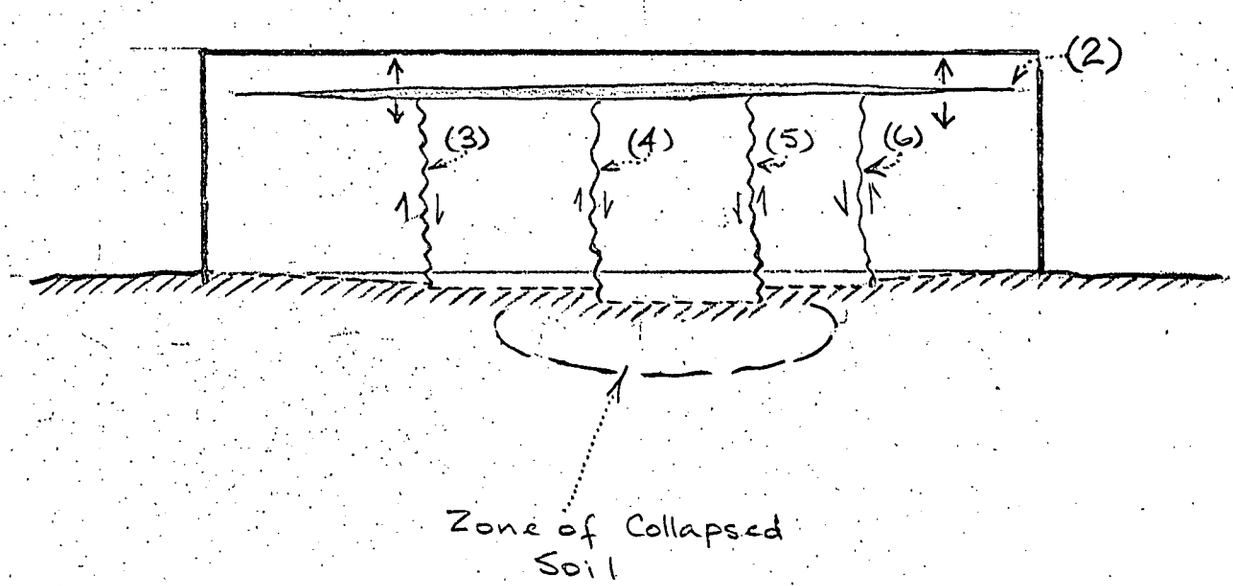


FIG. 2

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
ENGINEERING GEOLOGY SECTION	Drn. MH	BUILDING FAILURE BERRI HOSPITAL DIAGRAMMATIC SECTIONS	SCALE: Not to Scale
	Tcd.		S6971 Fig 1
DIRECTOR OF MINES	Ckd. JKPC		DATE: 27 Sept 68
	Exd. DM		

RIM - LINE

APPENDIX A

COLLAPSING SOILS

CONTENTS

FIGURES

Fig. No.		Dwg. No.
1	Engineering Geology - Collapsing Dune Sand - Effects of Saturation on Behaviour.	S6022 MG

APPENDIX

COLLAPSING SOILS

Characteristics of collapsing soils

Soils which show a decrease in volume when their moisture content is increased, are classified as "collapsing" types. (Ref. 1, 2 and 3). They are sands and silts, characterized by the following:

.... Formation in arid environment

.... Low in-situ densities; commonly 1000 to 1400 kg/cu.m. (62 to 87 lbs/cu.ft.)

.... Low in-situ moisture content

.... Some cohesion at low moisture contents, due either to calcareous cement or clay or silt binder.

.... Remarkably consistent particle-size distributions within each type.

Types of collapsing soils

Each known type of collapsing soil owes its behaviour to a mode of formation in which an initial, very loose, open structure is retained. This may happen in either of two ways:

.... The soil is never reworked or thoroughly wetted since deposition in a very loose state.

.... Sufficient cementing material or clay binder is deposited between the grains, to give the soil appreciable dry strength; enough to resist compaction as the depth of overburden increases.

Collapsing soils known to occur in Australia include the following:

.... "Mallee Soils" of South Australia, which are calcareous silts and sandy silts of loessal origin.

.... Dune sands, including those composed of grains of quartz or calcium carbonate.

Fig. 1 shows the "collapse" phenomenon which occurs on saturation of these sands.

In addition to these known collapsing soils, some mudflow and talus type deposits below escarpments in arid areas are suspected to be of the collapsing type. Mudflow soils in a similar environment in California show collapse behaviour (Ref. 2 and 3).

Significance of collapsing soils

If a structure is built on collapsing soil, without precompaction or adequate provision for keeping the soil dry, serious failure may result at any time during the life of the structure, if the foundation soil becomes wet. Failures of domestic homes and larger buildings and structures have occurred due to the following:

.... Dripping taps

.... Leakage water and sewerage pipes

.... Watering of lawns and gardens

.... Overflow of water storage tanks

.... Concentration of roof runoff water adjacent to footings.

Particular care is also necessary during construction, to prevent accidental wetting of the foundation area.

Collapsing soils present special problems when such structures as water storage tanks, dams, canals, or pipelines are to be constructed on or through them. Ref. 2 gives details of precompaction of collapsing soils carried out prior to canal construction.

REFERENCES

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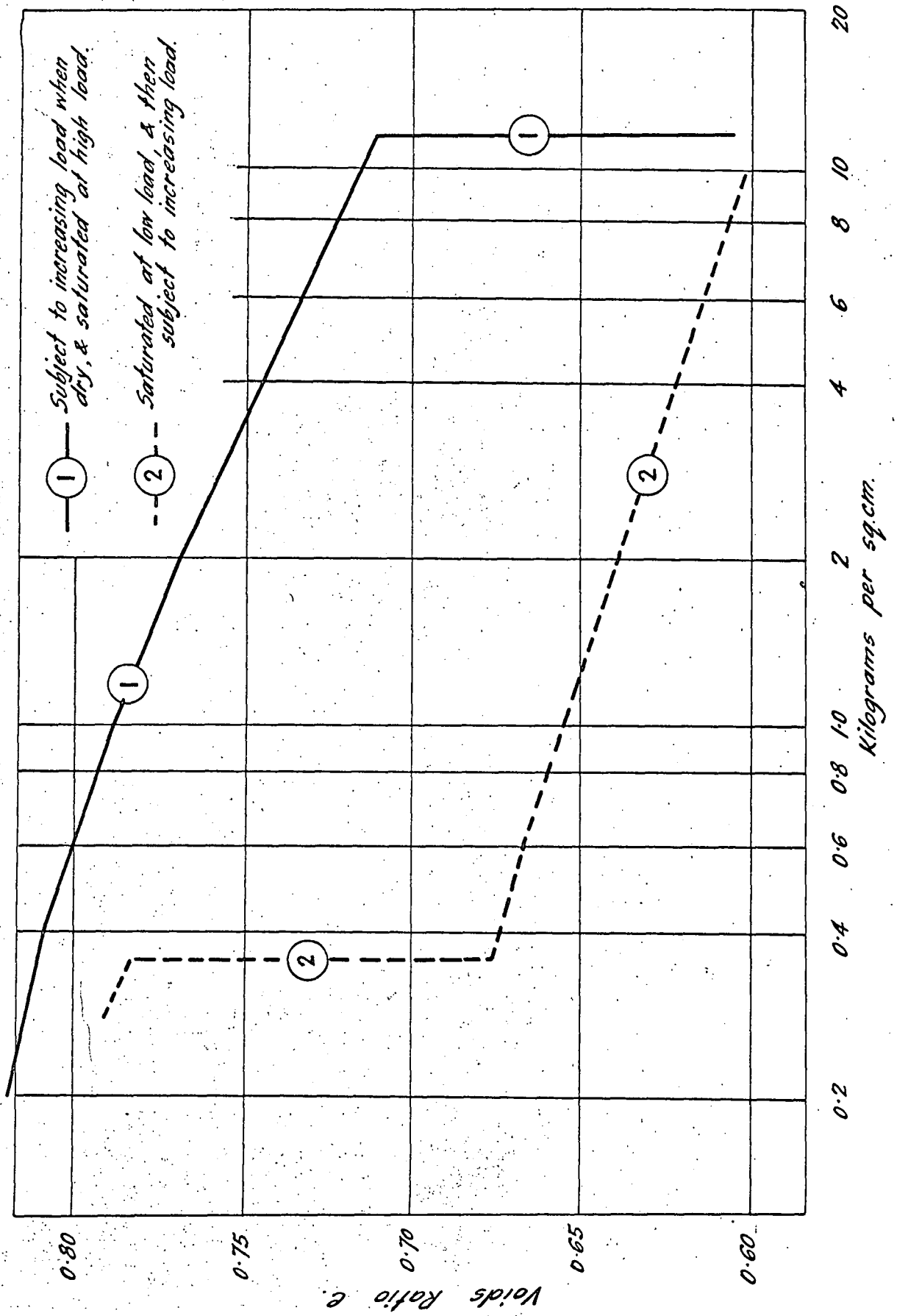

APPENDIX A FIG 1

DEPARTMENT OF MINES — SOUTH AUSTRALIA

ENGINEERING GEOLOGY SECTION	Drn.	ENGINEERING GEOLOGY "COLLAPSING" DUNE SAND EFFECTS OF SATURATION ON BEHAVIOUR	SCALE: -
	Tcd.		S 6022 MG
Director of Mines.	Ckd.		DATE: 24th August '67.
	Exd.		