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# 18. FOUNDATION CONDITIONS AT FLAGSTAFF GULLY DAM

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In response to a request from Gutteridge, Haskins and Davey, consulting engineers, the excavations at the Flagstaff Gully dam were inspected on 29th August, 1963. These excavations consist of a shaft sunk in the core wall of the dam from above the outlet pipe to the base of the clay wall. From near the bottom of this shaft a drive has been put in to the west for some 30 feet and has intersected the zone of failure. At this point crosscuts have been made to the north and south along the leakage path.

This report deals only with the condition of the rock as exposed at present in these excavations. No precise information is available as to the conditions prevailing along the interface of the clay and foundation rocks at the time of failure. Some of the clay core, bedrock and filter material have been removed by excavation or by erosion during the dam failure. Indeed at this time it is difficult to judge exactly where the base of the clay wall was sited at many points along the leakage path.

The foundation rocks are mudstone and pebbly mudstone of Permian age as described by Jack (1963). Some of the mudstone beds are dense and massive whilst others, notably along the floor

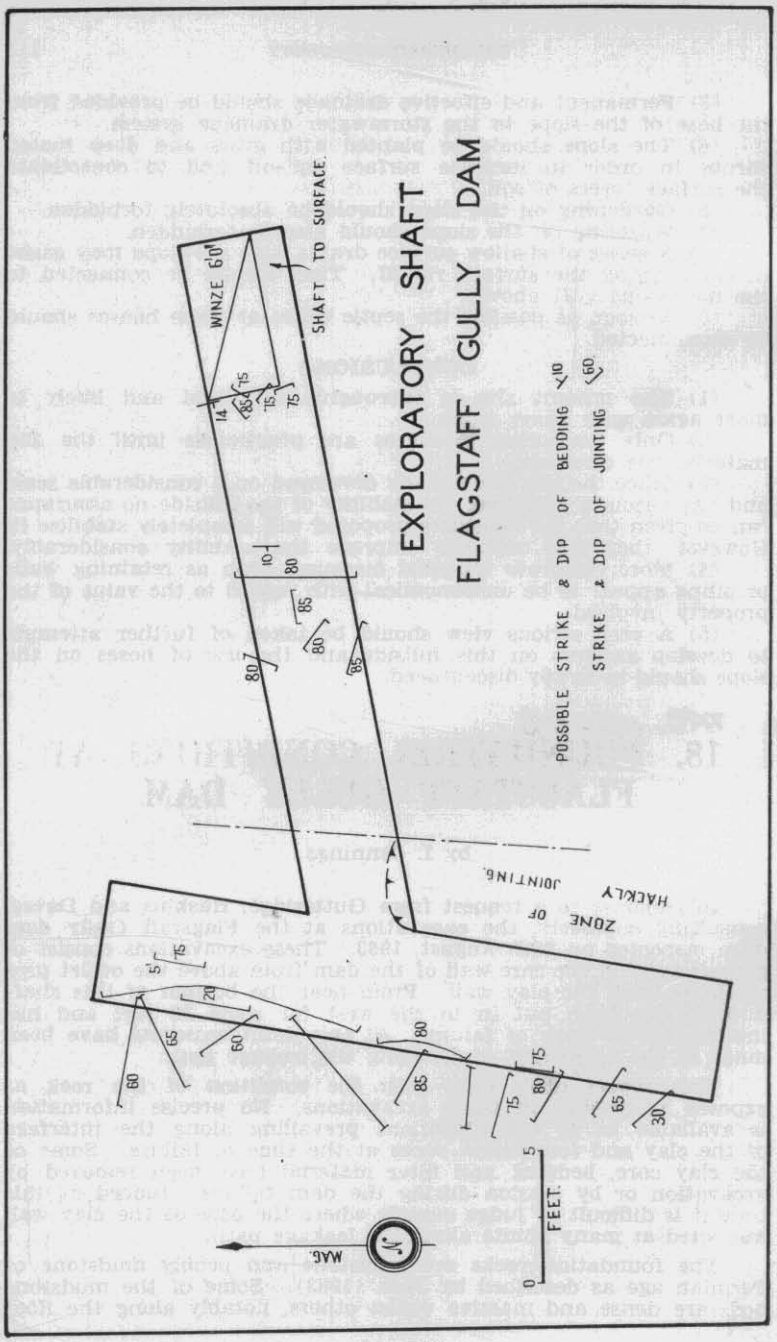


FIGURE 33.

5 cm

of the crosscut, are somewhat softer and exhibit closely spaced hackly jointing. All of these rocks have a soft crust due to surface weathering an inch or two thick but in the more closely jointed rocks the weathering has proceeded to a greater depth. However, from a visual inspection, the rocks appear to be relatively impermeable and quite competent to carry the loadings imposed by a dam of this size.

The mudstone beds are broken into a series of irregular blocks by several sets of joints most of which are steeply dipping. Bedding if present is difficult to identify in the available exposures. The main joint systems present are indicated on Figure 33. The systems identified are:—

(1) A strong set striking slightly east of north and dipping very steeply to the east.
(2) A set striking roughly parallel to (1) but dipping flatly to the east and west. These may be incipient partings sub-parallel to the bedding.
(3) A set striking at about 320° and steeply dipping.
(4) A near vertical set striking about 230°.
(5) An irregular, steeply dipping set roughly bisecting the acute angle between (3) and (4).

Sets (3) (4) and (5) are tightly closed and strike toward the dam abutment so that they do not appear to be important from an engineering viewpoint. Set (2) are poorly developed and frequently conform roughly to the surface of excavation. Little information is available concerning them.

A strong joint conforming to set (1) above is well exposed in the crosscut and appears to follow the zone of failure. In plan this joint is curved and cut by a number of cross fractures. In the northern end of the crosscut the joint appears to be slightly open but some clay filling can be observed a few inches below the present surface. Since the joint has been carefully cleaned out with a high pressure air hose several times it is not possible to indicate whether or not this joint was open at the time the clay wall was placed upon it.

## SUMMARY

(1) From a visual inspection the rocks exposed appear to be competent and relatively impermeable. Two specimens from the vicinity of the main joint have been examined microscopically and proved to be fine grained, impermeable mudstone.

(2) Several sets of joints are present which may affect the permeability of the rocks in mass. Most of these are tightly closed but a member of the strongest joint set exposed in the crosscut striking roughly at right angles to the dam axis is slightly open at its northern end at present.

(3) The present exposures do not provide any useful information as to the possibility of leakage along bedding planes or in beds not exposed. However, on general grounds this is expected to be slight.

(4) Wherever the clay-rock interface, outside of the zone of failure, could be examined the clay appeared to have been carefully placed and well compacted.

(5) No evidence of recent movements along the joint planes could be detected.

## REMEDIAL MEASURES

Since most of the joint planes are nearly vertical it would be unsatisfactory to attempt to seal them by grouting from vertical drill holes. However, grouting and water pressure testing from such holes would give an indication of any permeable zones parallel to the bedding.

It should be noted that the spacing and direction of many of the joints in rocks of this kind are functions of the physical properties of the rocks. Thus the joint system may vary in direction from bed to bed and joints may not penetrate more than a single bed in some instances. To effectively grout the near vertical joints it will therefore be necessary to drill sub-horizontal holes parallel to the bedding along any beds which may contain suspicious joints.

The following comments are offered on points raised during the recent discussion.

(1) The effect of unloading due to excavation is expected to have a negligible effect on the joints.

(2) If the joints were opened up slightly by any mechanism they would never close again completely due to irregularities on the joint planes and to reorientation of material within the joints. However, joints containing an appreciable filling of plastic clay could conceivably close tightly.

(3) If the dam could be partially filled again whilst still retaining the present excavation this would certainly allow a better assessment of the problems. This is a decision which must be based upon engineering consideration.

(4) Consideration might be given to cleaning off the present excavations carefully and sealing all joints off carefully with gunnite or perhaps a bituminous compound before replacing the clay. Such a programme could possibly obviate the necessity for an expensive grouting programme.

## REFERENCE

JACK, R., 1963.—Dam Site, Flagstaff Gully. *Tech. Rep. Dep. Min. Tas.*, 7, 81-82.