CHAPTER 18
THROUGH AND OVERFLOW ROCKFILL DAMS
A. K. PARKIN

1. INTRODUCTION

The origins of through and overflow rockfill dams can be traced, in Australia at least, to the Cascade Dam (Fig. 1), built to supply sluicing water to the Briseis alluvial tin mine at Derby in north-east Tasmania (Anon, 1989). It was to enter the annals of history as the only large dam in Australia to fail causing loss of life. However, despite this disastrous beginning, the ensuing sixty years have seen the techniques of mesh protection develop to the stage where flood flows can now be passed over rockfills with confidence, and where such provision is almost a normal feature in the construction of rockfill dams. These techniques now permit substantial economies to be made in the scale of river diversion works, and even the total elimination of such works in some cases.

Cascade Dam was, in principle, a concrete-faced rockfill (CFR) dam, constructed to dimensions as in Fig. 2, but with a 70 m central gap in the 0.5 m high parapet wall to serve as a spillway. This discharged directly onto the downstream face, with an estimated capacity of 200 cusecs, generated from a catchment of some 30 km². In order to accept these overflows, the main body of the dam was constructed of granitic rockfill, containing boulders up to 2 or 3 m³ in size, placed to a void ratio of about 0.46. Evidently this was largely hand-placed in order to achieve the steep side slopes.

On 4th April 1929, the dam was overtopped and failed during an extreme rainfall event, causing the loss of 14 lives, at which time the spillway flow was estimated to be 600 cusecs. Apart from the inadequately estimated design flood, the steep unprotected downstream slope ensured that the structure would have a bleak future. Subsequently in 1934 the dam was reconstructed, with the downstream face flattened to 1.75 : 1 and additional spillway capacity (McKeown, 1938). It continues to function, and is again noteworthy in being one of the few failed dams of such size ever to be rebuilt.

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1. At the design flow, it was evidently intended that the parapet wall would be totally submerged by 0.5 m or so. The estimated peak flood flow may not be reliable, or may have been a transient surge as discussed by Barnett (1989).

E. Maranha das Neves (ed.), Advances in Rockfill Structures, 571–592.
2. Early Developments in Flood-protected Rockfills

Experience gained in the 1930's with wire gabions in river training works inspired the first reported use of bar-reinforced rockfills during the construction of three embankment dams in Mexico\(^2\), as reported by Weiss (1951). Of these, San Ildefonso Dam (1939), a CFR dam protected by a rather open grid of 19mm bars, was overtopped at a height of 11m by a flow of some 200 cumecs with insignificant effect, but after the bars were recovered for use in the facing a further flood washed out 7000 m\(^3\) of rock. El Azucar Dam (1941) was also overtopped, suffering some damage due to an inadequate height of protection, while Palmito Dam (1941) withstood a massive 1400 cumec flood.

A fourth dam (Valsequillo, 1943) falls into a rather different category, being a central core rockfill in an exceptionally narrow canyon, where a perforated concrete slab was judged to be the best means of protection against the concentrated flow and flood debris. Of three overtoppings, the last was the most severe because of the bank then standing at 39m. Internal pore-pressure lifted and cracked the slab, but caused no failure because of its anchorage into the canyon walls. This form of protection, however, has not been used again and is unlikely to be appropriate elsewhere.

These successes in the passage of flood flows over rockfill during construction aroused immediate interest in the USA where such techniques had been beyond contemplation since the Johnstown (Pa) disaster of 1889 (Mattes, 1951). However, it would appear that mesh

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2. A recent report indicates that the first use of reinforced rockfill was on two dams in South Africa incorporating wire gabions (Prins River 1918, and Bellair 1920), both of which were overtopped several times (ICOLD, 1986).