Paradise Dam

Fact Sheet: Roller Compacted Concrete Shear Strength Testing Results

May 2021

Background

When Paradise Dam was built, the Roller Compacted Concrete (RCC) that makes up the body of Paradise Dam, was placed in horizontal layers approximately 310mm thick. The joints between each layer of RCC are referred to as "lift joints" (refer to Figure 1 below). The lift joints were intended to bond the layers of concrete to form a secure structure, however at Paradise Dam, they are weak points that could lead to failure of the dam during flooding.

Sunwater has undertaken additional sampling and testing of the RCC in Paradise Dam to gain further data on the condition of the lift joints to determine suitable remediation measures. Information about the sampling and testing conducted is available in the following Fact Sheet: Roller Compacted Concrete Sampling and Testing September 2020

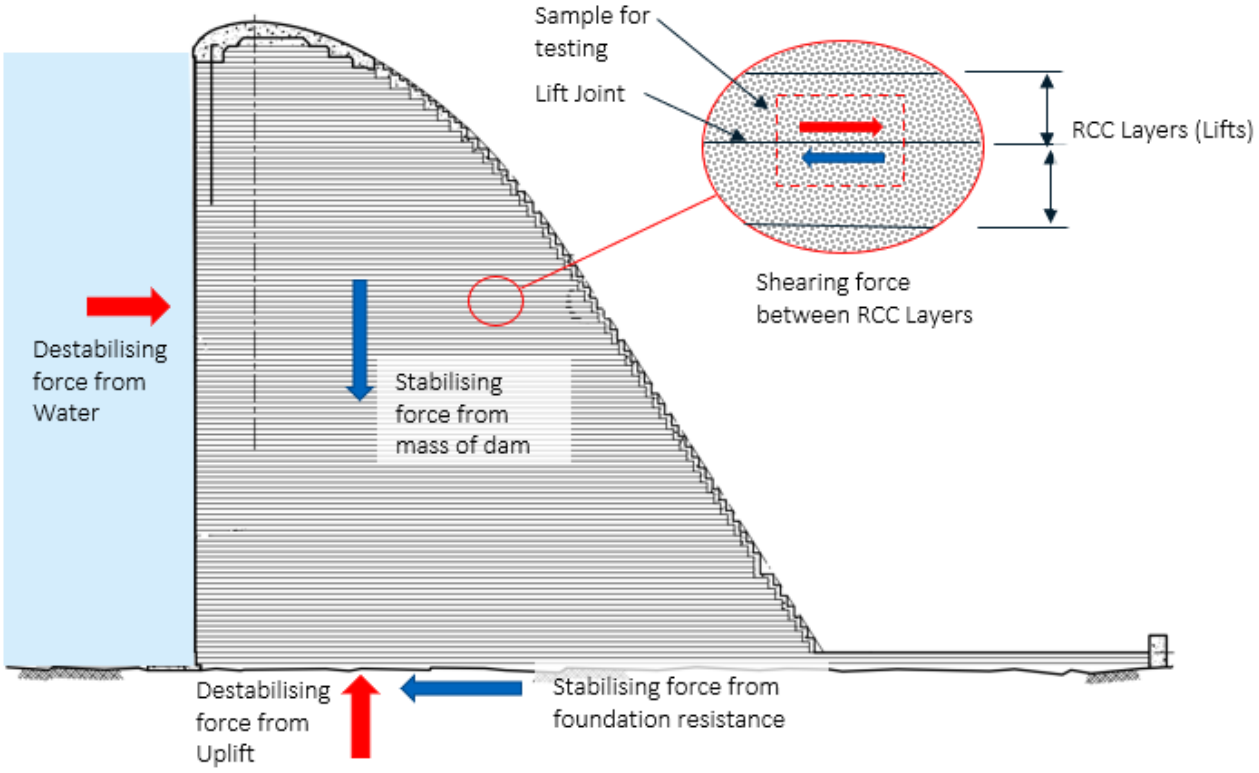

Figure 1 – Paradise Dam Spillway Section – demonstration of how forces relate to shear strength of lift joints

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Introduction

The results of RCC shear strength testing conducted in 2020 have been analysed and reviewed with the Paradise Dam Technical Review Panel and additional independent experts.

Sample size

This latest RCC testing used a comprehensive 63 samples sourced by collecting nine individual blocks of concrete at seven different locations across the primary and secondary spillway of Paradise Dam.

Shear angle results

The recent and earlier results (for comparison) are presented the table below. Shear strength is a measure of the residual unbonded strength of the layers of RCC (i.e. the ability to resist sliding or horizontal shear force of one RCC layer over another across the lift joint). The results are calculated as an 80 per cent exceedance value as per the Australian National Committee on Large Dams (ANCOLD) Guideline requirements.

The final reviewed results are consistent with the analysis that initiated the Essential Works back in September 2019.

Timeframe	Shear strength results
Sampling and testing conducted in 2020	shear angle of 38.7 degrees
2020 report based on 2019 testing only	shear angle of 38.2 degrees
2019 report based on 2015-2019 testing	shear angle of 39.3 degrees

A higher number is a better, or stronger result. For comparison, a typical result or design basis for RCC dams (using the Guideline recommendation as an example, if no test results or data is available) would be for a shear angle of 45 degrees.

Cohesion results

An equally important component of the shear strength, in addition to the shear angle, is the cohesion. This is a measure of the chemical bond between the RCC layers and ability to resist the initial sliding or shear force (as opposed to the ongoing sliding resistance which is measured by the shear angle).

Work undertaken in 2019 concluded that, given the clear evidence of unbonded lift joints present within Paradise Dam, cohesion can't be relied upon when determining how the dam will perform during flood loading.

The results from the recent tests and peer reviews reinforce that conclusion. This was further supported by the observed condition of the lift joints during construction activities to lower the Paradise Dam spillway. Sunwater found clear evidence of extensive unbonded lift joints which has confirmed that the lift joints cannot be relied upon as bonded (a requirement to allow cohesive strength to be considered).

This is a significant difference from the high cohesion values adopted by the Burnett Dam Alliance design when the dam was built (which assumed the lift joints would be bonded).

The next stage of remediation works at Paradise Dam will be designed assuming no cohesion, as did the revised dam stability assessment in 2019 that initiated the Essential Works project.

Independent reviews

The Paradise Dam Project Technical Review Panel has overseen the RCC testing process.

Dam experts Tatro Hinds and Rizzo International, both based in the United States of America, have also been engaged by Sunwater as additional engineering peer reviewers. They have reviewed the RCC sampling methodology and test results and have provided feedback that the sampling and testing program has been thorough and of a high standard. Tatro Hinds and

Rizzo International are also reviewing the concept design options for the long-term remediation of Paradise Dam.

Next steps

The latest RCC results are being incorporated into revised dam stability assessments as Sunwater plans for the long-term remediation of Paradise Dam.

The results will not lead to any significant change to the design of, or need for, further strengthening and stabilisation works at Paradise Dam, which is increasingly likely to include mass concrete buttressing. Post-tensioned anchors are still being considered but are a higher risk solution for Paradise Dam.

Stakeholder engagement

Sunwater is committed to ongoing engagement with the community to ensure transparency during the works at Paradise Dam. We will continue to share updates as the work progresses with a dedicated Community Reference Group and Paradise Dam Industry Forum that include representatives from local government, peak bodies, customers, and downstream residents. Information is also regularly shared on Sunwater's Paradise Dam Facebook page and the project webpages on the Sunwater website.

Questions?

Please contact us on 3120 0270 or paradise.dam@sunwater.com.au with any questions.