EVALUATING THE IMPORTANCE OF FLOOD LOADINGS ON STRUCTURAL PERFORMANCE OF A FLOODWAY

Buddhi Wahalathantri, Weena Lokuge, Warna Karunasena

School of Civil Engineering and Surveying, University of Southern Queensland, QLD

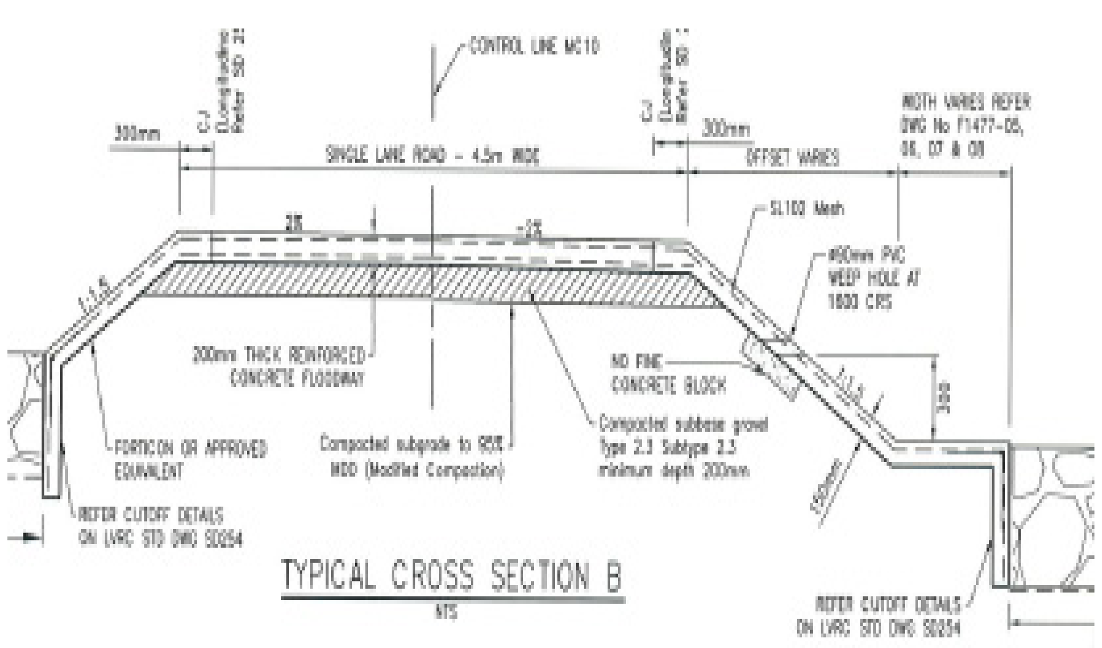
IT IS IMPORTANT TO INVESTIGATE THE VULNERABILITY OF FLOODWAYS IN AN EXTREME FLOOD EVENT AS THESE CRITICAL INFRASTRUCTURES CONTRIBUTE TO THE RESILIENCE OF THE RURAL COMMUNITY THAT THEY SERVE DURING AND IN THE RECOVERY STAGE OF THE EVENT. THIS STUDY AIMS TO ANALYSE THE BEHAVIOUR OF FLOODWAYS UNDER FLOOD LOADINGS USING A FINITE ELEMENT MODELLING APPROACH.

Floodways are critical infrastructures mainly in rural areas whose resilience in extreme flood events is contributing towards the resilience of the community being served. Therefore it is important to understand the impact that flooding has on floodways so that they can be made less vulnerable to damage from these extreme events. This study aims to find out:

- The importance of flood loadings such as debris load, impact load and hydrostatic load in the analysis of floodways.
- Structural behaviour of floodways under extreme flood loadings.

CASE STUDY

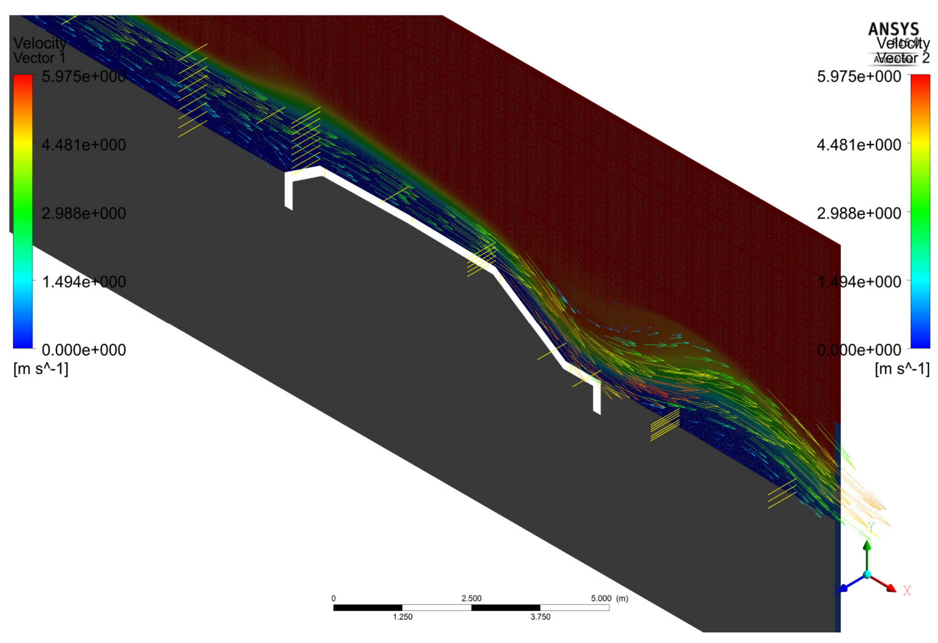
A floodway located at Left Hand Branch Road in the Lockyer Valley Regional Council (LVRC) area was selected as the case study. This floodway consists of three 1200 mm x 600 mm (width x height) reinforced concrete box culverts at the deepest section and three typical cross section layouts named as A, B and C adjacent to the culvert section. The cross section type B is selected for the analysis as it is under the most critical flow condition.



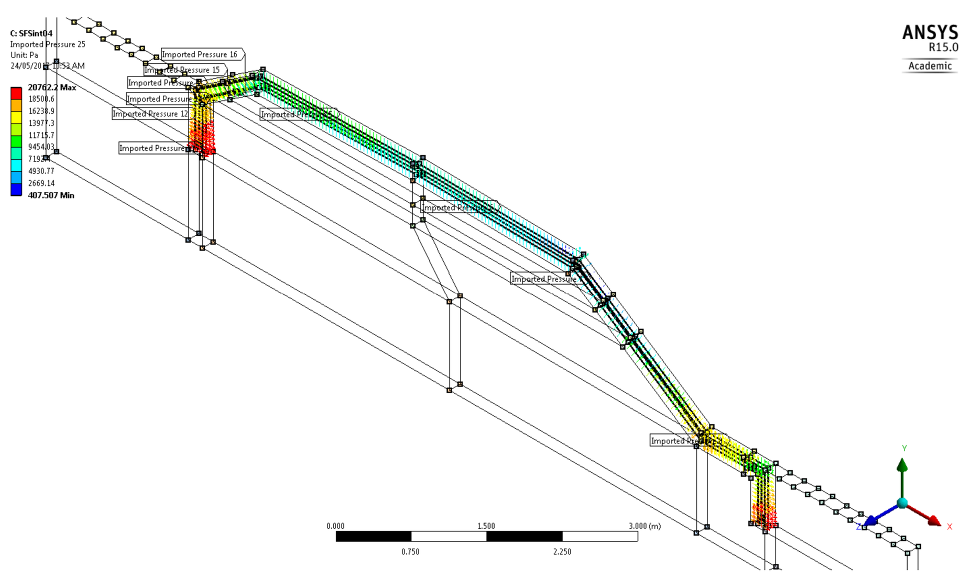
NUMERICAL MODELLING OF FLOODWAYS UNDER FLOOD LOADING

Three dimensional analytical models are developed using ANSYS software. Compressive strength of concrete was taken as 30 MPa.

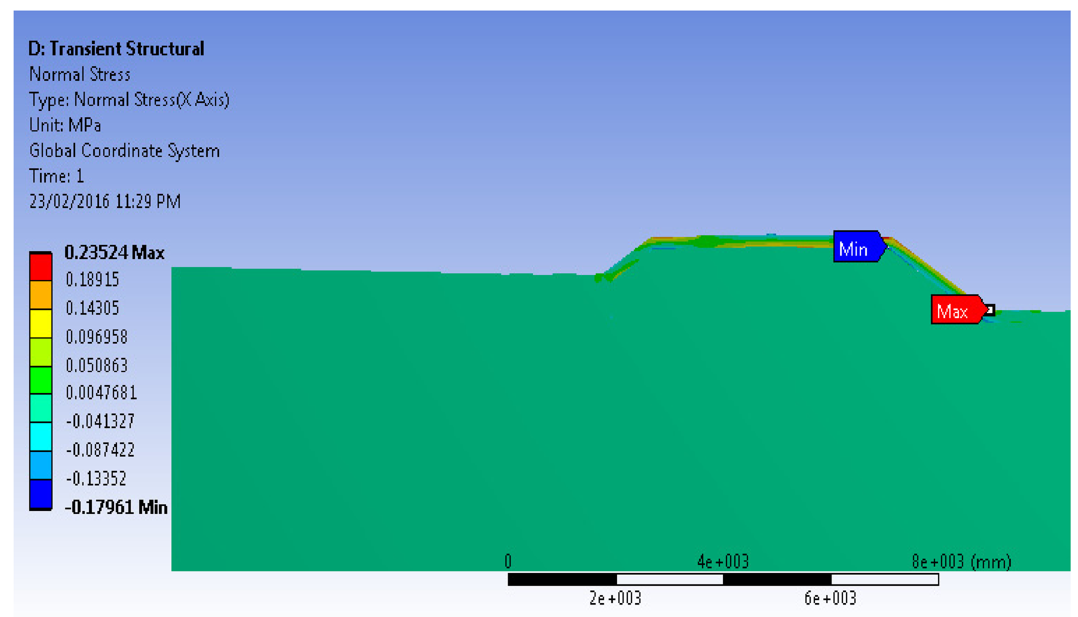
- ANSYS Fluent is used to obtain the flow profile and associated hydraulic forces acting on the structure.
- Drag, lift and hydrostatic forces are imported to the structural model at two different velocities along with the self-weight.
- Y-axis represents the direction parallel to the direction of gravitational acceleration (positive direction is opposite to the direction of gravitational acceleration). X-direction is perpendicular direction to Y-axis with positive X is set in the direction of flow.



Flow profile and velocity contours



Imported fluid forces



Stress contours

FINDINGS

Numerical results from the finite element modelling were analysed using compressive stress, tensile stress and displacements.

EFFECT OF DRAG AND LIFT

Velocity	4 m/s	8m/s
Von-Misses Stresses (MPa)	0.359	0.253
Tensile Stress in X (MPa)	0.193	0.235
Compressive Stress in X (MPa)	0.327	0.180
Tensile Stress in Y (MPa)	0.144	0.128
Compressive Stress in Y (MPa)	0.347	0.136
Total displacement (mm)	1.49	1.42
Displacement in X (mm)	0.04	0.08
Displacement in Y (mm)	-1.49	-1.42

As shown in the table, it can be concluded that drag and lift forces are negligible in the analysis of low level floodways.

Other key outcomes

Log-impact loads has a greater influence on concrete stresses than the debris forces. However, stresses due to flood loading alone does not provide sufficient evidence to claim for major failures. There is a high potential that the river bed and rock protection may scour prior to exceeding the structural capacity. This will damage structural integrity which will eventually lead for major failures.