

COMPUTATIONAL INVESTIGATION OF BRIDGES VULNERABILITY UNDER HEAVY FLOOD



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THE RESEARCH IS FOCUSED ON THE ASSESSMENT OF THE VULNERABILITY OF A CONCRETE U-SLAB BRIDGE AS A BRIDGE TYPE WIDELY USED IN AUSTRALIA AND SIMULATION OF THE STRUCTURE EXPOSED TO THE DIFFERENT FLOOD INTENSITIES AND ITS CONSEQUENT LOG IMPACT. THE STRUCTURAL STATISTIC AND DYNAMIC ANALYSIS OF THE BRIDGE WILL BE DONE AND A GUIDELINE FOR RESILIENT DESIGN OF BRIDGES UNDER FLOOD WILL BE DEVELOPED

INTRODUCTION

Australia has suffered from loss of life and extreme damage to infrastructure and bridges from natural hazards. Literatures indicates that the current Australian standards don't cover extreme flood loads. Bridges are vital components of transportation systems. Therefore, safety and serviceability of bridges have always been great concern to the practice and profession of civil engineering.

Based on the preliminary literature reviews and the analysis of case studies, investigation of the vulnerability and the hydrodynamic instability behaviour of U-slab Bridges under flood and the dynamic effect of subject impact during exposure to extreme flood events on the piers and the deck has been considered as significant and is one of the main research scopes of this research. Therefore, a numerical model has been Developed for the piers and deck to cater for application of dynamic and static forces on the main bridge components.

Based on a preliminary literature reviews and analysis of case studies, following research questions have been formulated.

- What are the failure modes of a U-Slab Bridge structure exposed to flood?
- How can we create a numerical model to analyse the effect of flood loading on U-Slab bridges?
- How can we derive vulnerability models for bridge under flood and log impact loading?
- How can we enhance resilience of bridges to flood loading, by optimizing the shape of the object?

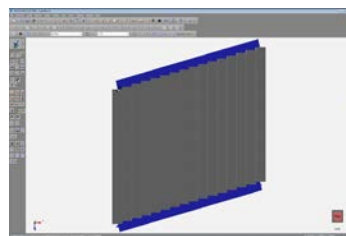
ANALYSIS FRAMEWORK



Only the CFD method of the pier modelling and deck damage behaviour will be discussed in the following.

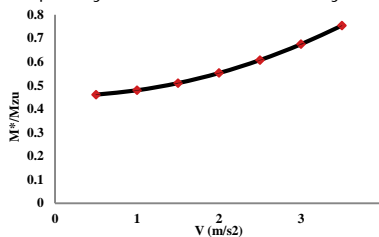
SIMULATING OF THE U-SLAB BRIDGE DECK UNDER FLOOD LATERAL FORCES

In order to predict the vulnerability of the u-slab bridge deck under extreme flood a very simple grillage analysis has been done to configure the effect of lateral flood loads on the deck behavior.



Grillage analysis of the deck (Space Gass)

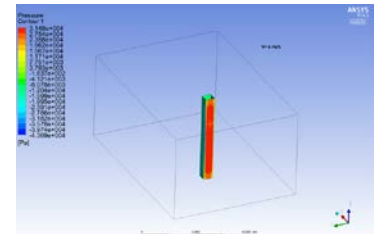
Damage curve for the deck has been defined by the (M^*/ M_{zu}) moment generated by flood over moment capacity of a beam individually.



Vulnerability of the U-Slab bridges' deck

SIMULATION OF A PIER AND CALCULATION OF THE HYDRODYNAMIC PRESSURE

In order to determine the fluid pressure and its distribution on the pier component, it needs to determine the critical fluid pressure on the structure to couple with. A square pier have been analysed using Fluent ANSYS, and the Pressure-velocity coupling method is used by the programme to model and analysis.



Maximum Pressure generated by flood V=6 m/s

The maximum pressure location on the pier is not a specific location and it changes by the increasing velocity. The result shows, by increasing the velocity of the flow, the maximum position of the maximum pressure on the pier rises. Therefore, determining the location of the maximum pressure is crucial to identify critical velocity to measure the vulnerability of the pier.

END-USERS STATEMENT

The major outcome of the project will be developed of vulnerability models for U slab bridges under exposure to extreme flood events. These will allow road authorities to develop strategies to harden vulnerable structures, enhancing resilience of the road network under extreme flood loading. therefore the outcomes will be valuable to Vic roads and other road authorities.

