# Damage Assessment of U-Slab Bridges under Flood Loading

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Resistance to flood loading are critical parameter affecting the design of bridges under flood loading. Since the flood intensity is raising due to global warming, it is recommended to review the design of the bridges under flood loading. Historical data show that flood as a natural hazard is a costly disaster in Australia. Resilience of society depends on the resilience of the road infrastructures.

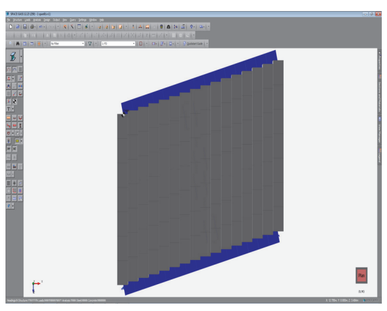
## INTRODUCTION

Australia has suffered from loss of life and extreme damage to infrastructure and bridges from natural hazards. Literature 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 of great concern to the practice and profession of civil engineering.

Preliminary literature reviews, case studies, investigation of the vulnerability and the hydrodynamic instability behaviour of U-slab Bridges under Flood and the dynamic effect of log 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. To achieve the main aim of the research we are determining the most vulnerable element in the structure and then generating fragility curves.

## EVALUATION OF THE MOST VULNERABLE ELEMENT

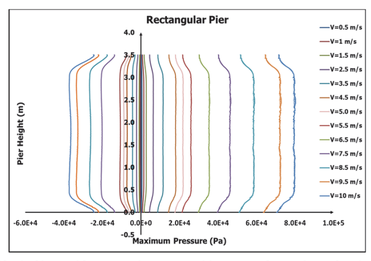
In order to predict the vulnerability of the u-slab bridge deck under extreme flood a very simple grillage analysis has been done to configure the  effect of lateral flood loads on the deck behavior, using Space-Gass software. The results show that piers are the most vulnerable element in the U-Slab bridge structures.



Grillage analysis of the deck (Space Gass)

## CALCULATION OF PRESSURE DISTRIBUTION ALONG THE PIER HEIGHT

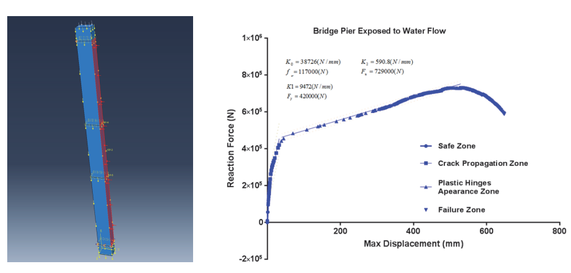
In order to determine the fluid pressure and its distribution on the pier component, we need to determine the critical fluid pressure on the structure. A square pier has been analysed using Fluent ANSYS, and the Pressure-velocity coupling method is used by the programme to model and analyse the data. The results show that the pressure distribution is a uniform distribution along the pier height. We also evaluated the pier shape effect on the pressure distribution.




pressure distributions long the pier height in different water flow velocities

## DAMAGE LEVELS CONFIGURATION AND THE STRUCTURAL RESPONSE TO THE WATER FLOW PRESSURE

The single pier is modeled using the ABAQUS package and a pushover nonlinear analysis has been applied to the pier under water flow pressure. The bridge response to incremental increases in pressure on the pier can help us to determine different damage levels.

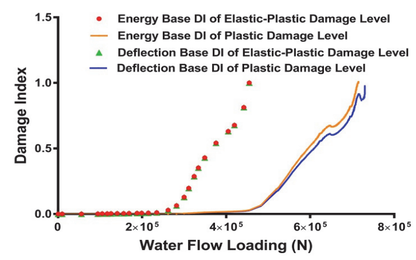



Configuration of different damage level based on load-deflection curve

This study categorizes damage into 3 different levels. Undamaged, moderate damage and fully damaged. Bridge failure, the last phase, is not included in our study.

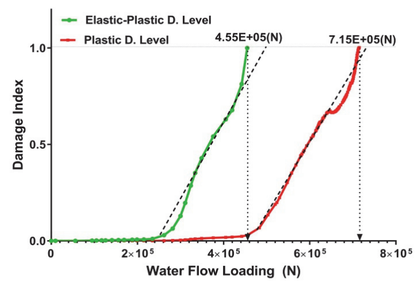
## DAMAGE INDEX (DI) DEFINITION

Based on the research objectives, defining a proper damage index is essential to allowing us to understand the potential damage and to make a vulnerability assessment. The damage index is defined based on the Damage Energy Dissipation (ALLDMD) concept for a whole structure.




Damage Index for different damage levels and comparing the displacement and energy concept

Deterministic damage was evaluated using the previous approaches for different damage levels




Damage evaluation for the whole system for different damage levels.

## FUTURE WORK

The project approach to determining the damage level and damage index will be to conduct nonlinear structural analysis. Based on this approach the pier will be analyzed under log impact using explicit dynamic analysis to develop the structural fragility curves. In this analysis the log mass and the velocity are uncertainties which can be used for determination of probability of damage to the structure.

## CONCLUSION

In this study the damage level and damage index is defined and will be used to generate fragility curves. The novelty of this method is the damage index definition using damage dissipated energy .

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