

An Indian-Australian research partnership

**Project Title:** Design load estimation due to debris flow during tsunami

**Project Number** IMURA0656

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## Research Academy Themes:

**Highlight which of the Academy's Theme(s) this project will address?**

*(Feel free to nominate more than one. For more information, see [www.iitbmonash.org](http://www.iitbmonash.org))*

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. Clean Energy
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

## The research problem

Tsunami after landfall flows over land and gathers huge amount of debris; the tsunami-debris flow will impact structures, which can lead to overloading of structural elements. This research problem deals with estimation of loads exerted on coastal structures due to the impact of tsunami along with debris. The loads on coastal structures due to tsunami are not only due to moving fluid mass but also due the debris carried by the tsunami. To estimate the realistic loads on structures, the combined loads due to fluid and structure interaction need to be considered. The study requires experimental as well as numerical investigation of the complex flow. Efforts should be made to understand the physics of the tsunami uprush and down flow along with the typical debris. Furthermore, the impact of the coupled complex flow on the structures needs to be investigated. A load estimation guideline should be developed based on the study on this extreme event.

## Project aims

The present study aims to develop a numerical modelling technique to estimate the loads on coastal

structures due to the tsunami inundation along with debris.

The objectives of research are:

1. To develop a numerical model to simulate the tsunami flow and debris considering various debris characteristics.
2. To estimate the flow-debris load on typical elements of structures.
3. To carry out experiments in the laboratory for validation of the numerical model.
4. To review the present guidelines for tsunami load estimation for design of structures.
5. To conduct parametric study to prepare the load estimation guideline.

### **Expected outcomes**

There are various provisions prescribed by codes of practice to calculate the loads on structures due to waves and winds, etc. There are also efforts to estimate the tsunami loads considering the hydrodynamic loading only. However, tsunami being a devastating event always carries huge amount of debris within a short span of time. Thus, the further impacts are no longer due to water mass alone. Instead, the loads are due to the high velocity moving water mass along with full load of debris. Thus, the mass of the combined flow with debris could be much higher than the debris only. This will lead to higher loading on the existing structures. Proper quantitative estimation of this load is necessary and the proposed study should finally provide a modelling framework for tsunami-debris load calculation and empirical formulations for computation of its effect on the structures.

### **How will the project address the Goals of the above Themes?**

The proposed study involves numerical solution of tsunami-debris flow and its loading on coastal structures using fluid-structure interaction approach. The proposed study is computationally extensive and will assist in the load calculation for coastal infrastructure due to extreme events such as tsunami. Hence, the present project will address the goals of the themes highlighted above.

### **Capabilities and Degrees Required**

Persons with the following qualification should be considered eligible:  
B.Tech/M.Tech degree in Civil and Mechanical Engineering.

Capabilities: An ideal candidate will have a strong interest in computational studies. The candidate with some experience and interest in basic computer programming languages (Fortran/C/C++/MATLAB) will be preferred.

Candidates who have experience on Numerical methods particularly FEM, Advanced Fluid Mechanics, Fluid-Structure Interaction are highly preferable.

### **Potential Collaborators**

Port and Harbour Authorities, Coastal Regulatory Zone Authority, Bureau of Indian Standards.

Please provide a few key words relating to this project to make it easier for the students to apply.

Debris flow, Tsunami-Debris loading; Extreme event; Fluid-structure interaction.

