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Flow in vegetated compound open channels: A Computational Fluid Dynamics (CFD) study

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Context

- Project background
- Aims and Objectives
- Methodology
- Plan for PhD
- Some results

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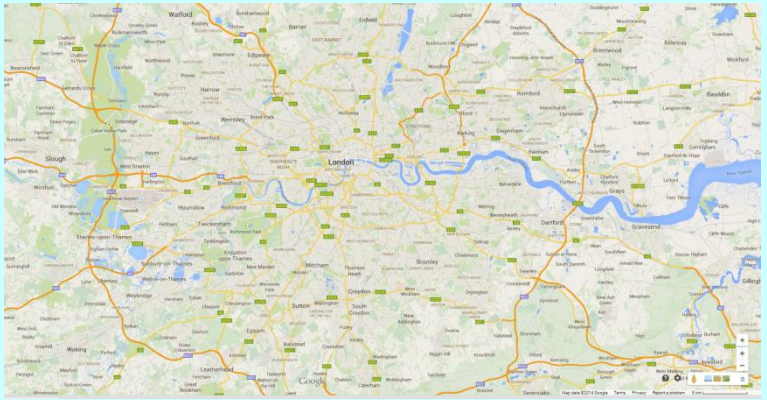
Rivers and cities

- Rivers play an integral part in the day to day functioning of our planet.
- Existence would not have been possible, at least not in the forms we know , unless there was a plentiful supply of fresh water.
- Today; great cities such as London, Paris, Berlin , New York and Prague have all centred on rivers.



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Vegetated rivers

- Naturally all the rivers will develop vegetation.
- Vegetation varies on size and shapes.
- Normally most of the vegetation are in the flood plain of rivers.

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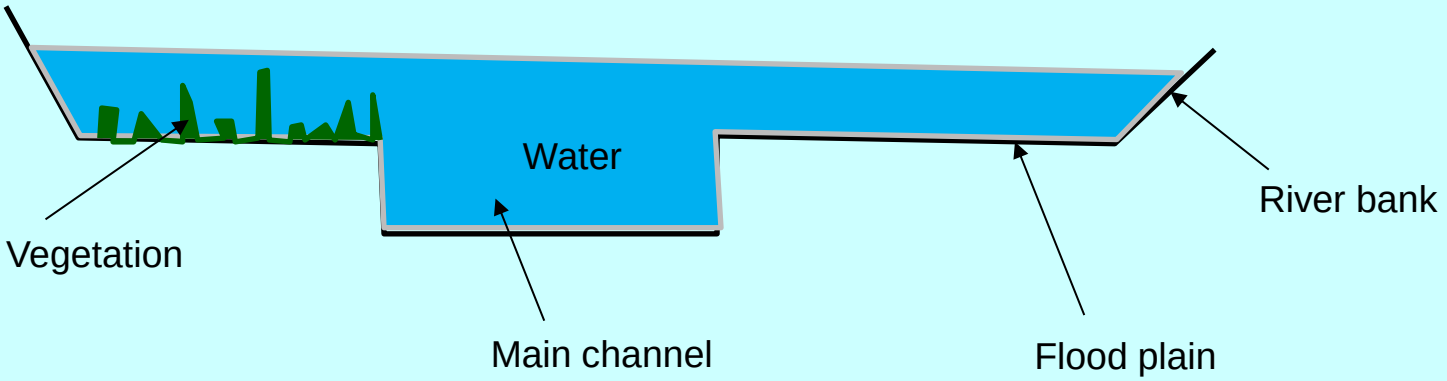
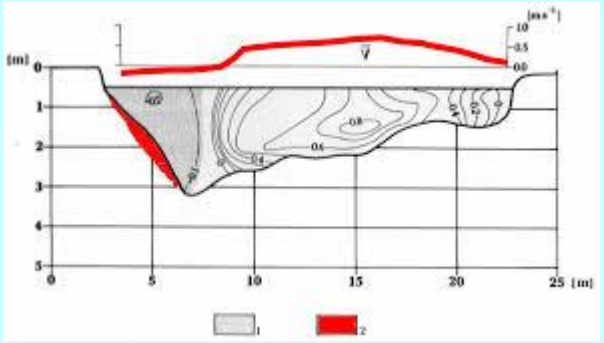
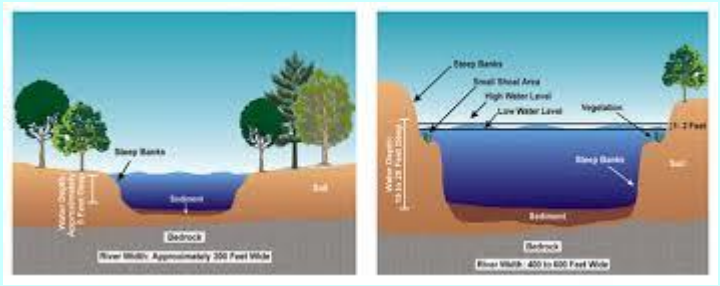
Terminologies

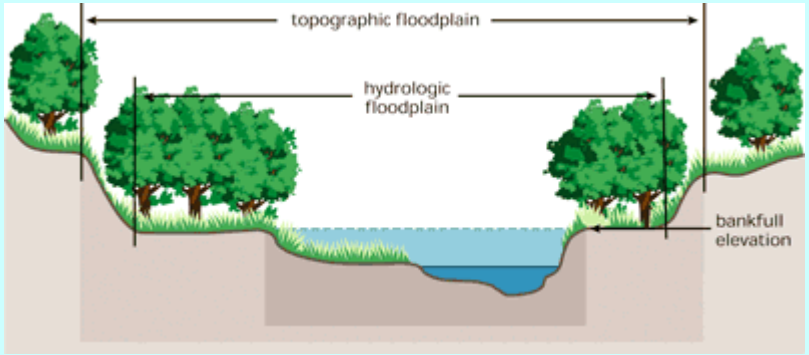


The cross-section shapes of a typical river

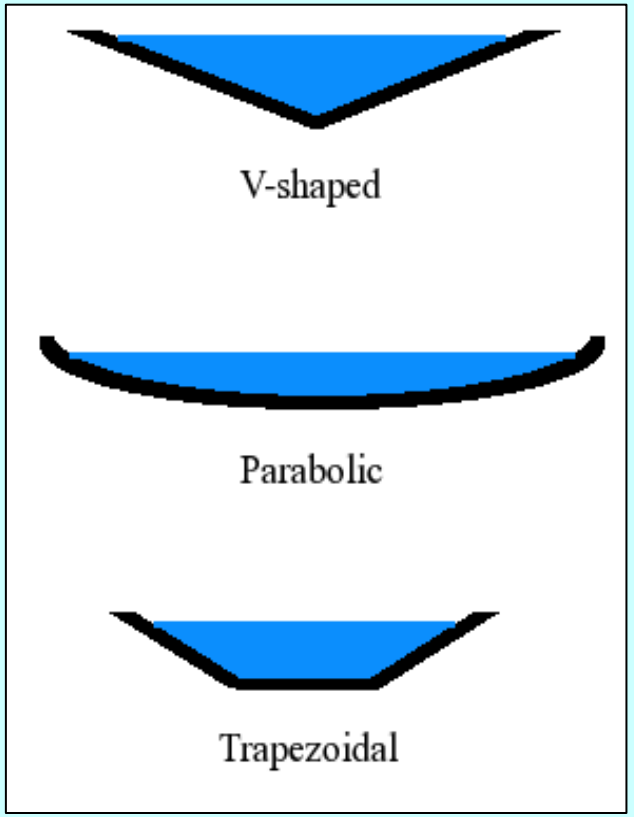
Realistic cross section







Idealized cross section



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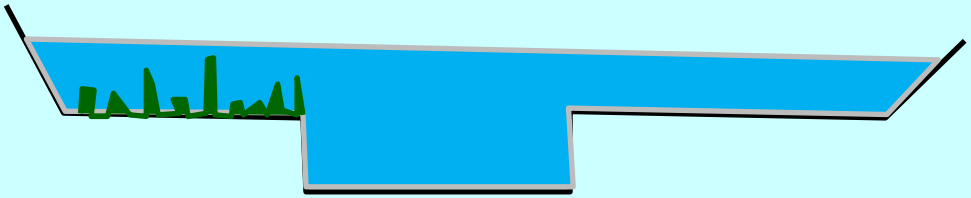
Possible effects of vegetation

- Reduction of the area of the flow.
- Increase turbulence
- Increase drag.
- Increase secondary flow.
- Increase the boundary layer thickness.
- Reduction in the flow rate.
- It increases the chance of flooding.



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River flooding

- Flooding situation in river is a complex phenomenon and affects the livelihood and economic condition of the region.

Flood sees half of London wiped out after the Thames Barrier fails

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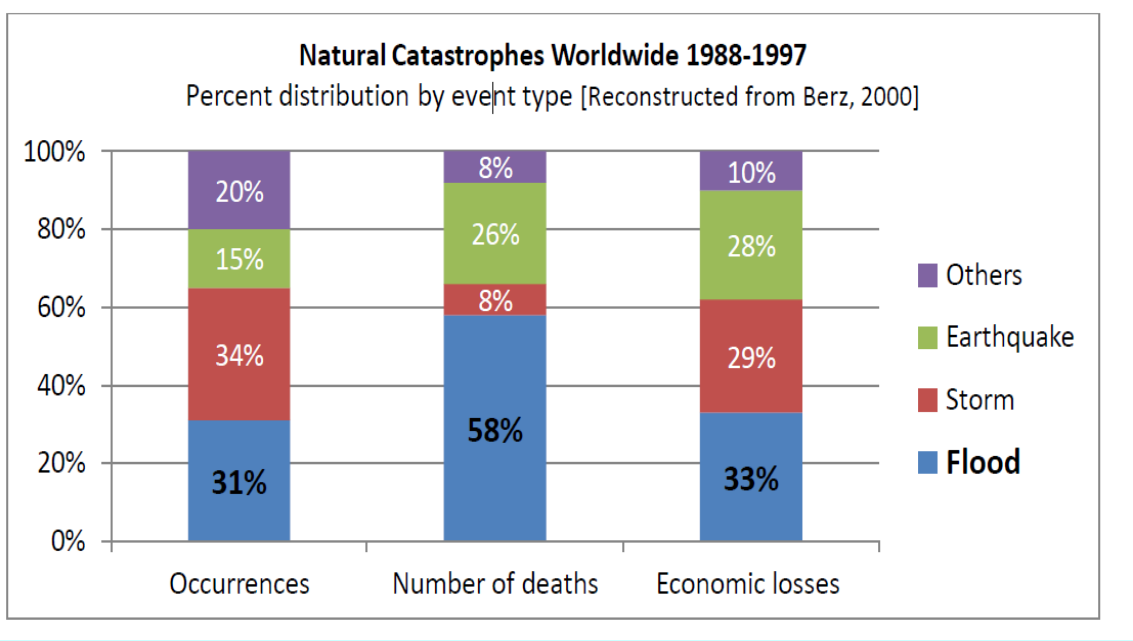
Statistic Related to the natural catastrophes



World wide flood disaster occurrence account for third of the natural disaster during 1988-1997 but is responsible for half of the number of death and leading in economy lose

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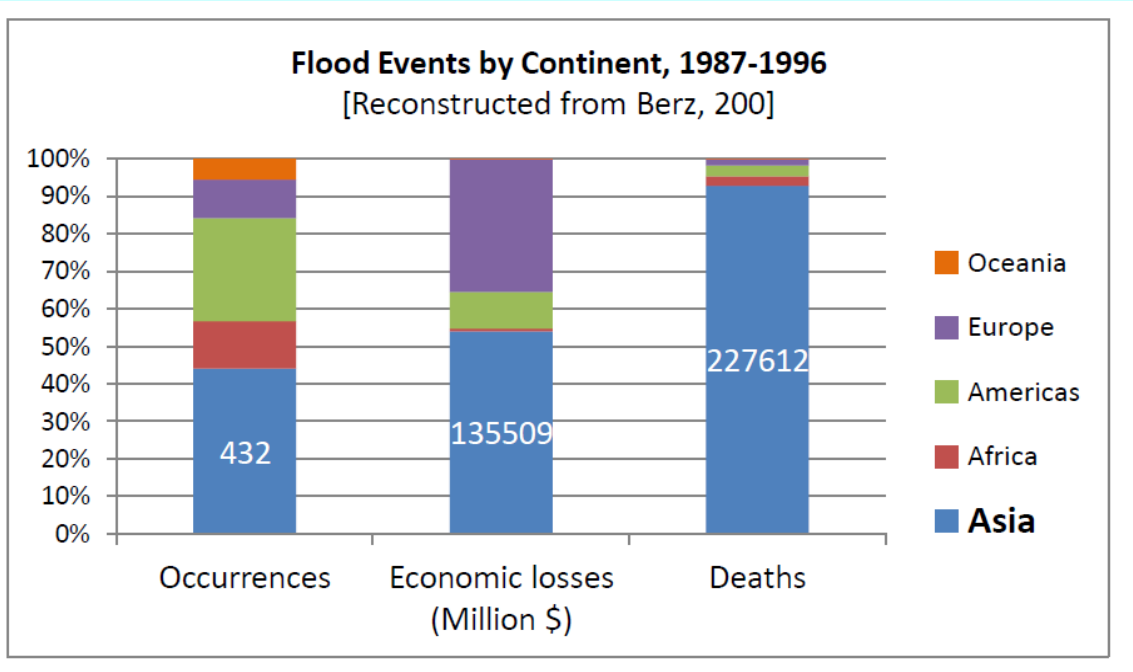
Impact of flooding in each continent



The number of occurrence and the effects of these flood event are more announced in Asia due to climatology geographical location .

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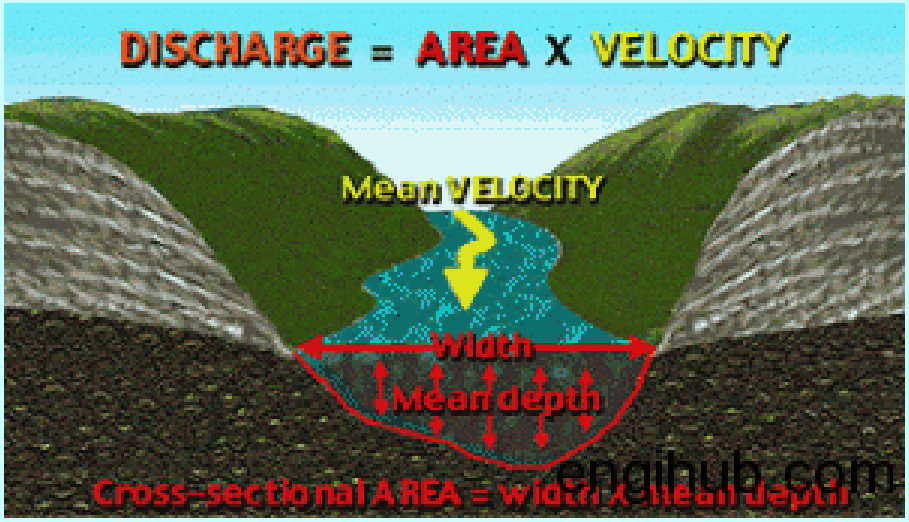
River Engineering

- The modelling of such flow is primary importance for a river engineers and scientists working in this field.



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Aims

- To investigate the effect of both emergent and submerged vegetated floodplain on the flow characteristics.
- To investigate the effect of cross section on the mean flow velocity, the depth average velocity, boundary shear stress and turbulence characteristics of the flow in smooth and rough compound channels.

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Objectives

- Review the literature of the flow in channels and in particular with vegetation.
- To find the knowledge gap in the literature.
- Develop a numerical modelling using the Volume of fluid (VOF) method and Large-eddy simulation (LES) to study the flow in a river with and without vegetation.
- To use the developed models to investigate the flow in rivers with different types of vegetation and cross sections.
- To analyse the results to quantify the effect of vegetation and cross section on
  - Surface shear stress
  - Mean flow velocity
  - Secondary flow
  - Drag force
- To validate available published analytical models.

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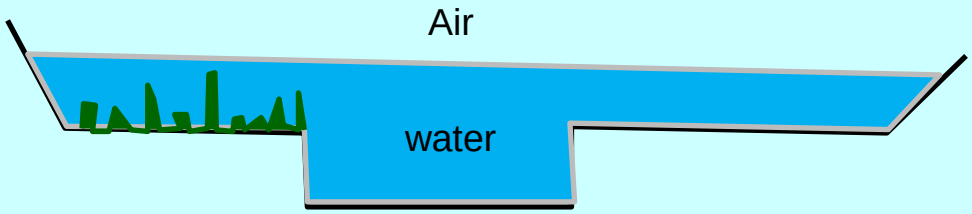
Solution Method

- **Computational Fluid Dynamics (CFD)**, in which the governing equations are solved numerically
  - Volume of fluid (VOF)
  - Large-eddy simulations



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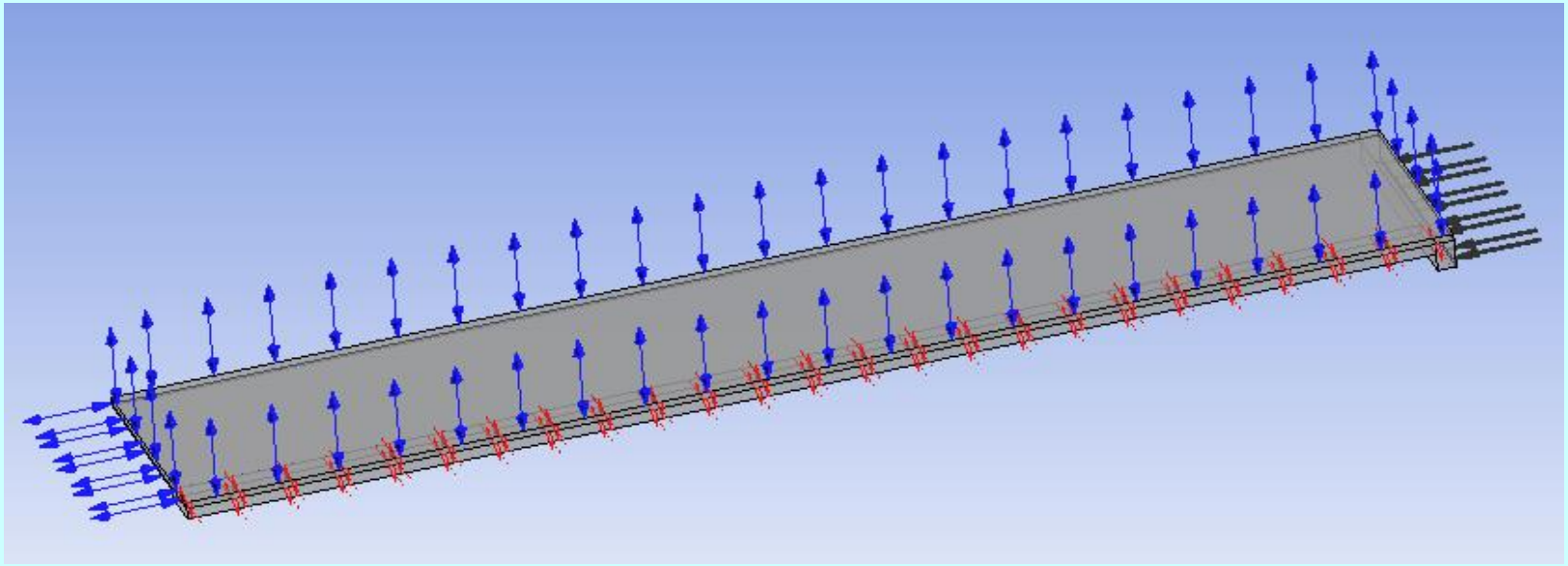
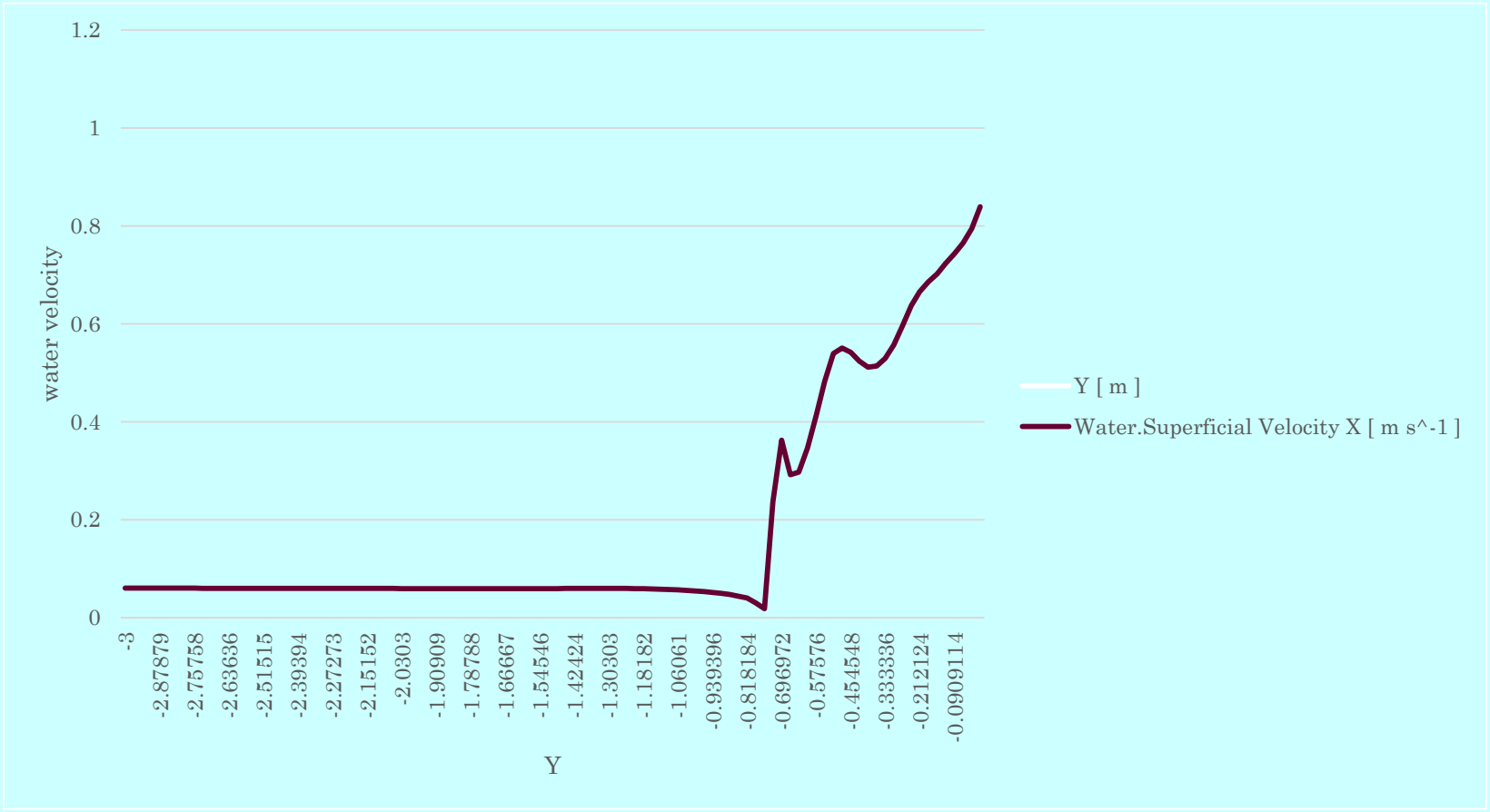
Geometry



The geometry of trapezoidal compound channel

Result



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End

Question ?

THANK YOU ALL FOR YOUR ATTENDING

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