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Experimental Study on the Skewed Integral Bridge by Using Crushed Concrete Geobags as Scour Protection

(ICSE6-276)

Engineering applications

Bridge Scour

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Experimental Study on the Skewed Integral Bridge by Using Crushed Concrete Geobags as Scour Protection

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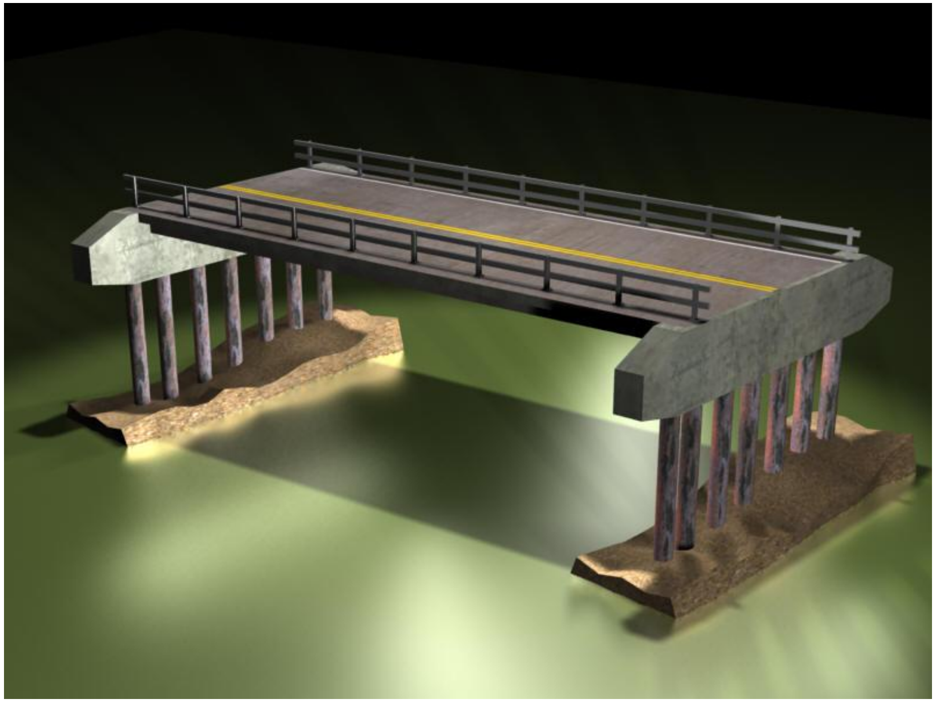
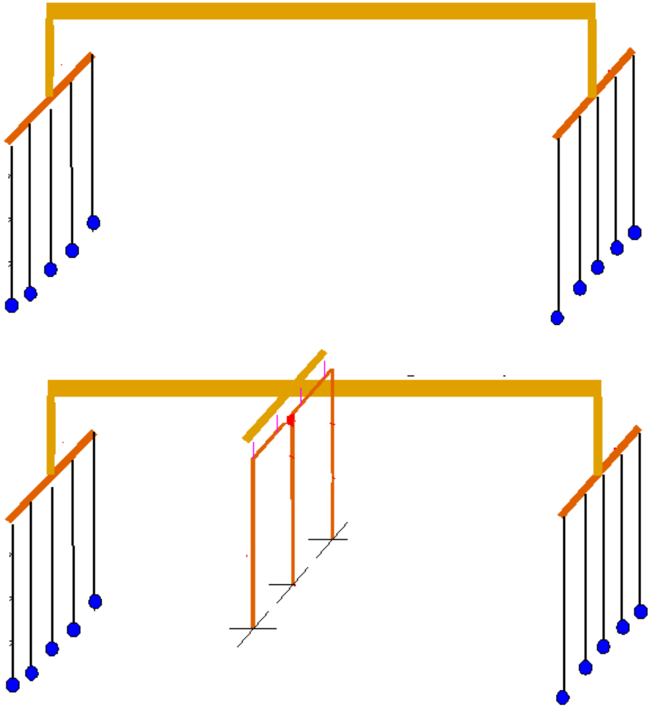
INTRODUCTION

The use of **integral and semi-integral bridge** has also dramatically increased for the recent years.





Experimental Study on the Skewed Integral Bridge by Using Crushed Concrete Geobags as Scour Protection

INTRODUCTION

2nd Penang Bridge, Malaysia

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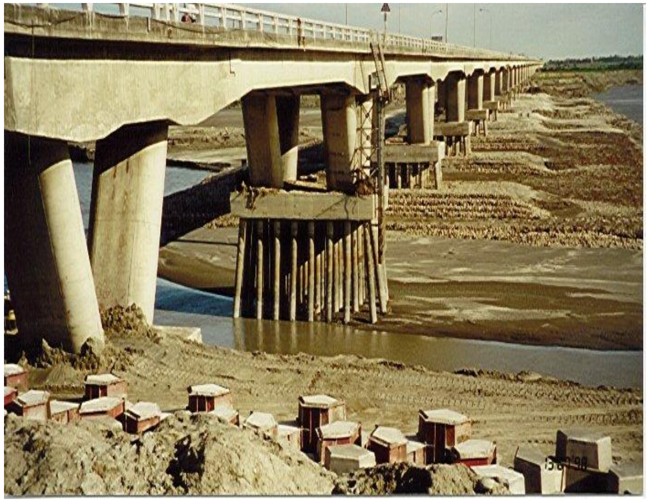
INTRODUCTION

Scouring is a lowering level of the riverbed by water erosion to expose the foundation of the bridge.



In such way, the piers and the abutment will lose their load carrying capacity which incorporates the skin friction capacity between the soil and also the structure. Thus, the expose of the structure will lead to the **failure** of the structure.

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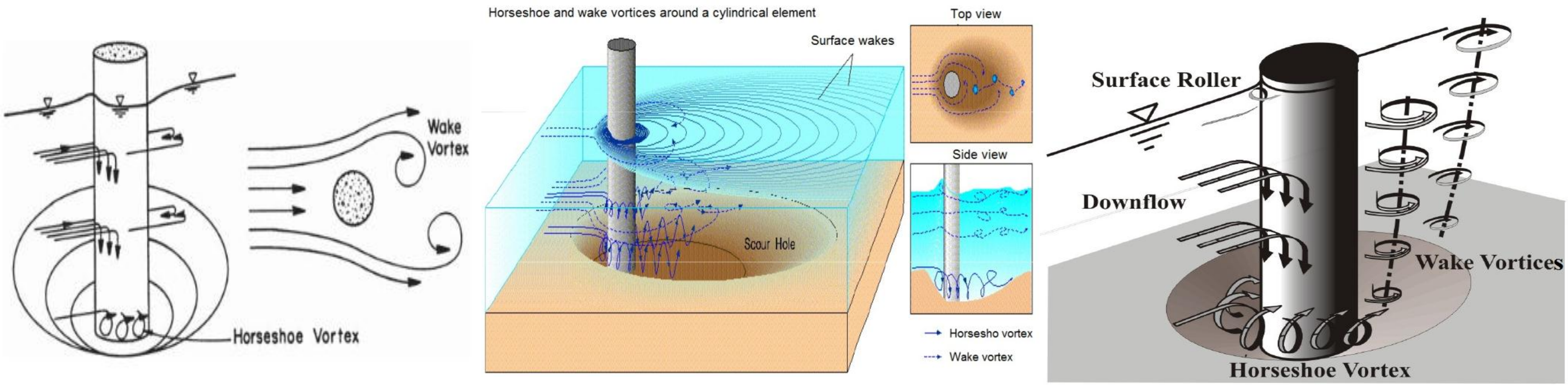
LOCAL SCOUR MECHANISM

The local scour is caused by the formation of vortices:

1) **Horseshoe vortex**

2) **Wake vortex**



Schematics of previous researchers

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SCOUR COUNTERMEASURES

Classification of scour countermeasures:

1) Armoring countermeasures (riprap stones, mats, bags)

2) Flow altering countermeasures (collars, slots, plates)

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GEOBAG COUNTERMEASURES

Geobags are commonly used in coastal erosion prevention, **but not in the river scour protection.**

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CRUSHED CONCRETE GEOBAG

Recycled aggregate can be generated from demolished construction structures.

There is a possibility of incorporating the **recycled concrete** into a **geo-textile bag** to stimulate a similar function, as a countermeasure as opposed to the conventional sand filled container.

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EXPERIMENTAL WORK

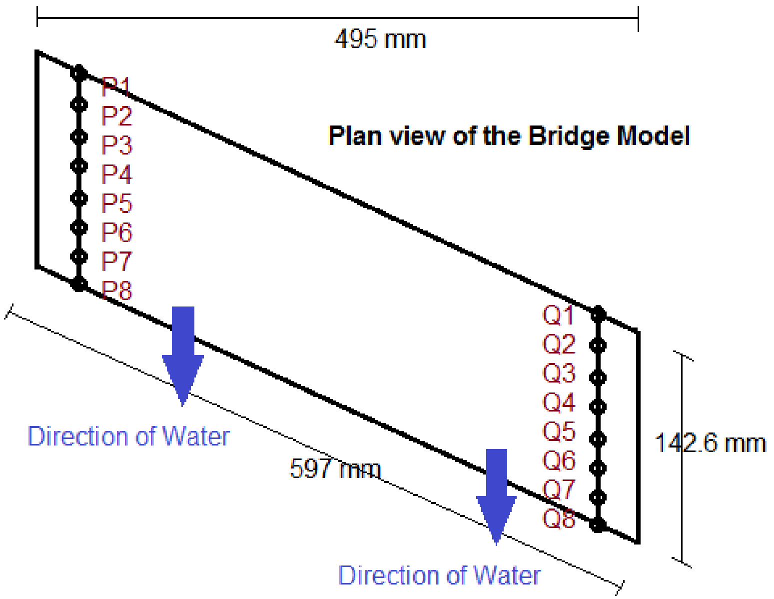
The test **flume** is 16m long, 0.60m wide and 0.57m deep, and located at Hydraulic Laboratory in Department of Civil Engineering, University Malaya.

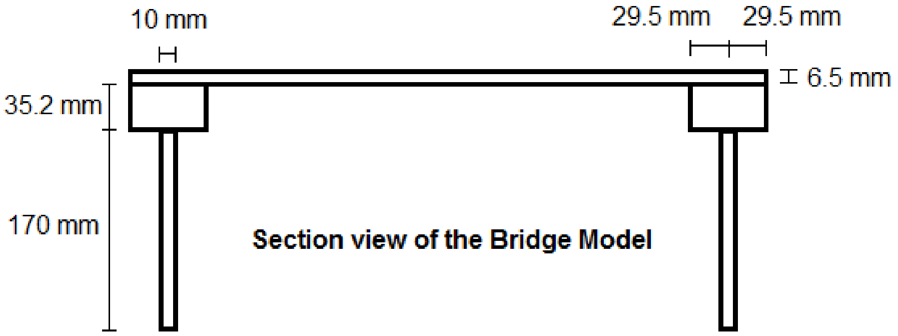
EXPERIMENTAL WORK (BRIDGE MODEL)

The details of the skewed **integral bridge** model.

a) Skew angle: 34 degree

b) Material: Perspex





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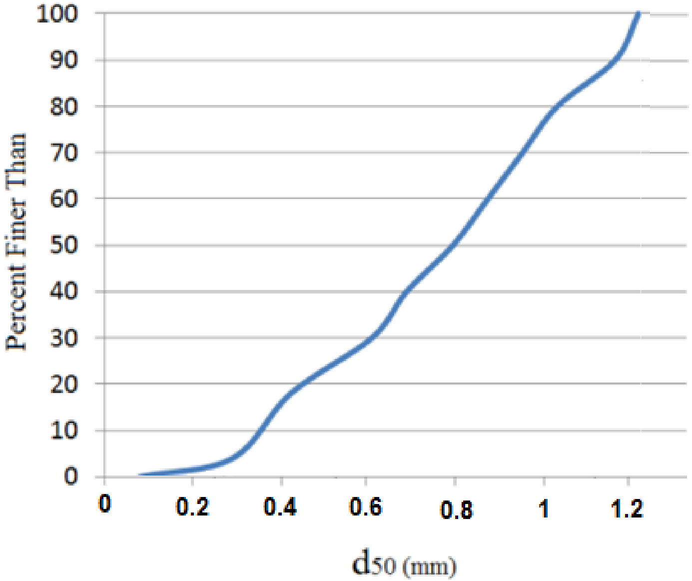
EXPERIMENTAL WORK (BED SEDIMENT)

The details of sand bed sediment:

Specific gravity = 2.65

d_{50} = 0.8mm

Geometric std deviation, σ_g= 1.29 (uniform bed)



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EXPERIMENTAL WORK (EQUIPMENTS)

To measure the scour depth:
digital point gauge

To measure the water velocity:
current velocity meter

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EXPERIMENTAL WORK (GEO BAG & CRUSHED CONCRETE)

The crushed concrete:
had been sieved according to **BS1377: Part 2: 1975** with sieve range in **20mm to 75µm.**

The material of bags:
woven polypropylene
Size: 20 mm X 80mm X 50 mm (Pilarczyk, 2000)

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RESULT AND DISCUSSION (APPROACH VELOCITY)

Various factors affected scouring:

1) Time
2) Velocity
3) Side of the integral bridge
4) Countermeasure imposed

Approach velocity at P and Q sides:

Average velocity, V (cm/s)	Approach velocity (cm/s)	
	P side (Vp)	Q side (Vq)
25	15.1	14.2
35	26.8	24.9
45	37.6	36.2

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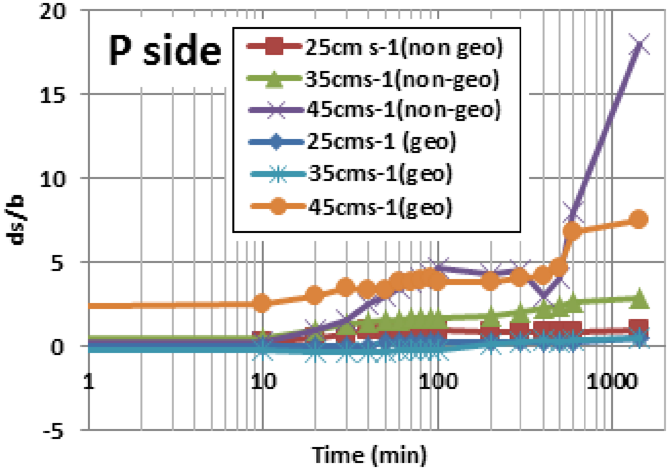
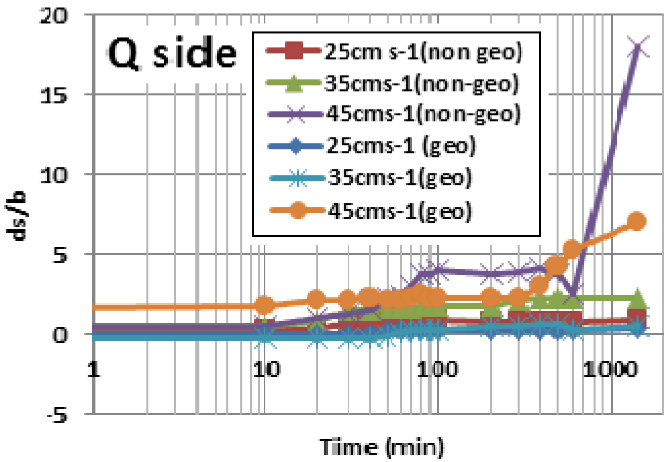
RESULT AND DISCUSSION (SCOUR DEPTH)

The maximum scouring depth for **25cm/s:**
P side = Q side

The maximum scouring depth for **35cm/s:**
P side > Q side

The maximum scouring depth for **45cm/s:**
P side > Q side





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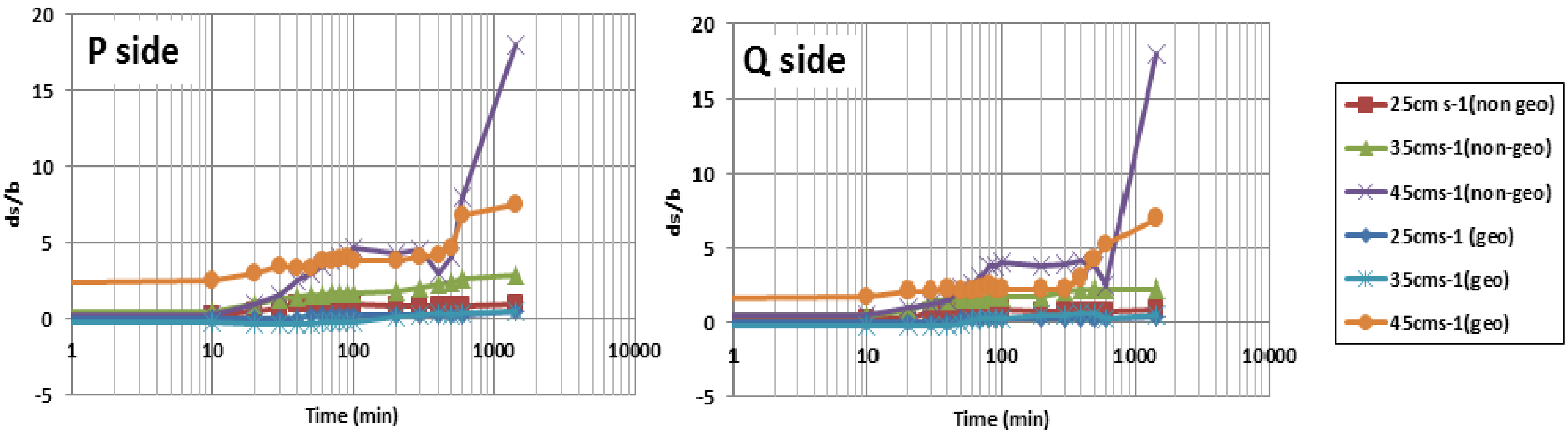
RESULT AND DISCUSSION (SCOUR DEPTH)

Scouring depth was decreased at **400 minutes for P side** and around **600 minutes for Q side** for 45cm/s velocity.



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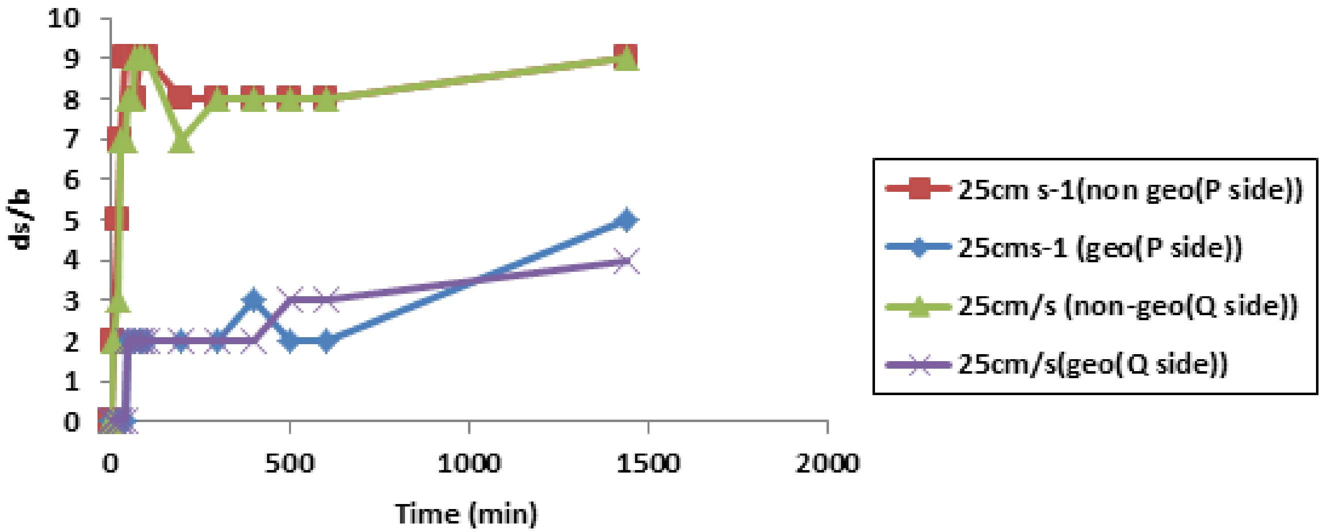
RESULT AND DISCUSSION (SCOUR DEPTH WITH GEOBAG)

In **25cm/s** velocity:

Maximum scouring depth had been decreased from average 9 mm to 4.5mm (both sides). The Geobag had successfully decreased the scour depth around **50%**.



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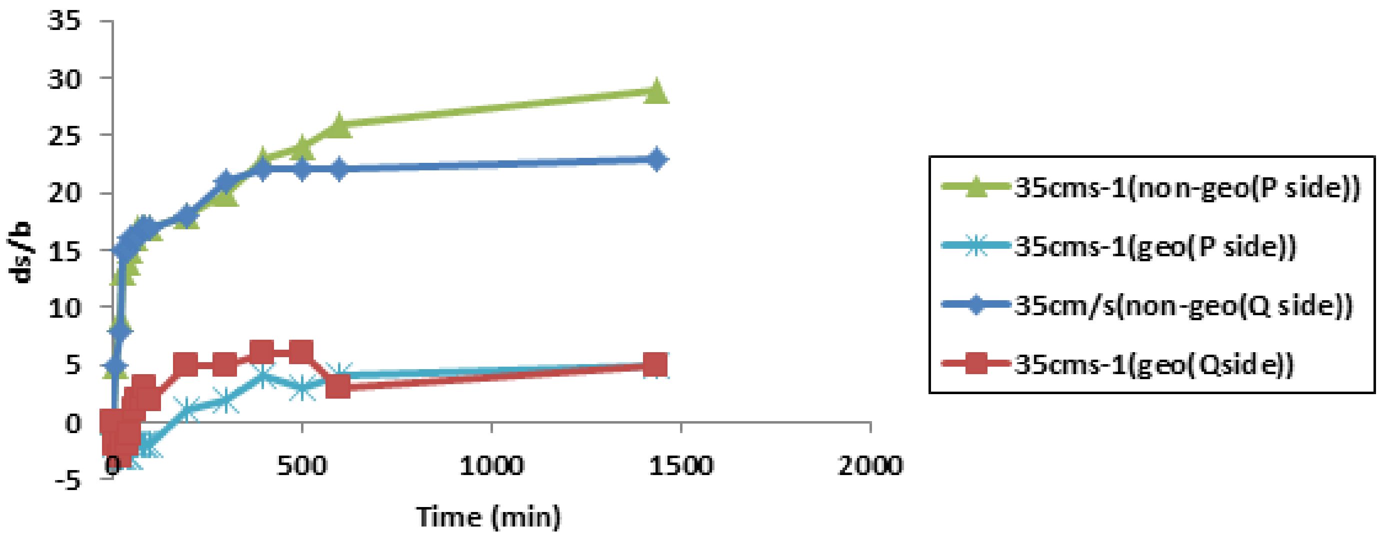
RESULT AND DISCUSSION (SCOUR DEPTH WITH GEOBAG)

In **35cm/s** velocity:

Maximum scouring depth had been decreased from average 26 mm to 5mm (both sides). The Geobag had successfully decreased the scour depth around **81%**.



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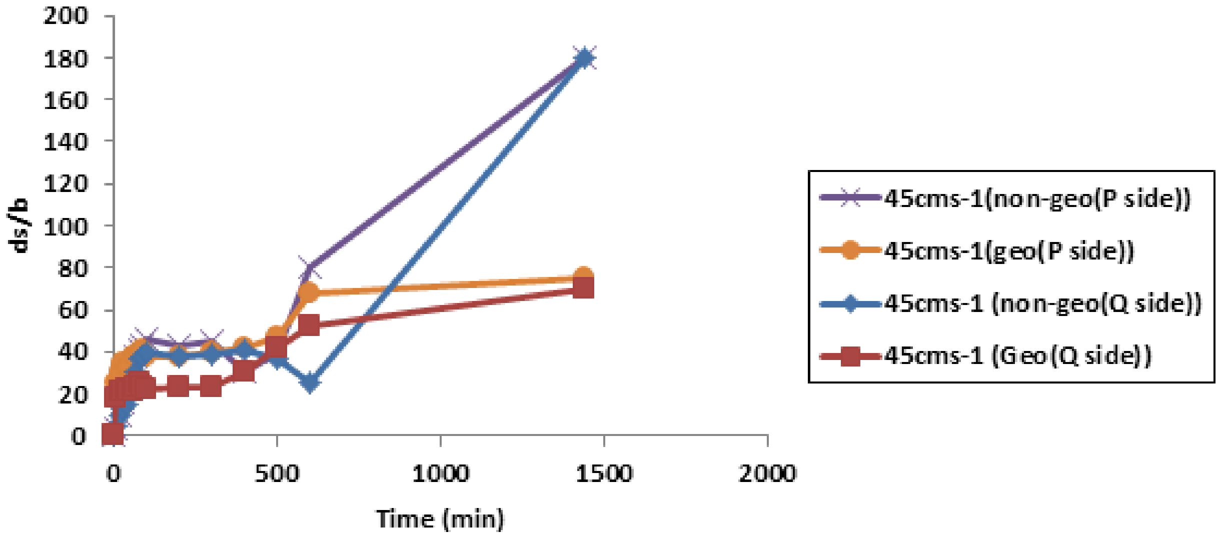
RESULT AND DISCUSSION (SCOUR DEPTH WITH GEOBAG)

In **45cm/s** velocity:

Maximum scouring depth had been decreased from average 180 mm to 72.5mm (both sides). The Geobag had successfully decreased the scour depth around **60%**.



CONCLUSION

Crushed concrete Geobag:

- **Decreased the scour** rates for each velocity
- No **restriction in designing** dimension
- Promote **environmentally friendly, economical & effective solution** to design scour protection
- **Benefit economic** sectors because the wastes are turned into something useful

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FUTURE STUDY

The scope of this study was limited to the experimental investigation on the skewed integral bridge by using crushed concrete Geobags as scour protection only. Further research on the **life time durability** and **materials of Geobag** as a bridge countermeasure could be undertaken.

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THANK YOU