Role of Public Sector and Current Technologies for Public Support in River Transportation

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1. Introduction

Four biggest cultures of the world have developed in Egypt, Mesopotamia, India and China along with big rivers, *i.e.*, *Naile*, *Tigris-Euphrates*, *Indus* and *Yellow River* respectively. It is not just a coincidence, but due to the fact that rivers play very important role for human beings. They are used originally to transport several goods, but more important point is to spread technologies and culture far from the original place to others.

Far down from the *Pre-historic Culture Age*, we still receive many benefits from rivers, but now have another big river, so-called *Internet*. It spreads culture, so-called *information*. In this presentation the author would like to encourage people who are in great concern of river transportation for new age culture creation using two big rivers, the river itself and Information Technology.

2. Current Situation of River Transportation

It is well known that the *Rhine* and *Mississippi River* are playing important roles for economic activities in Europe and in the United States respectively. However, it is not well-known Indonesia is the 5th and Vietnam is the 7th country in terms of the distance of available river transportation. Although the United States is the 4th country in this term, we cannot find any European countries before France appears in its 10th position in the top 10 countries as shown in Table 1.

Inland waterways will be of great importance for industrialization of the countries along big rivers. We can learn much from the case of the *Rhine* and *Mississippi River* and these two are quite good examples, because the former is the river thorough several countries and the latter is the case of one-country property.

Table 1 Inland waterways length available for navigation

	Country	Description
1.	China	110,000 km (1999)
2.	Russia	95,900 km (total routes in general use) (routes with navigation guides serving the Russian River Fleet - 95,900 km; routes with night navigational aids - 60,400 km; man-made navigable routes - 16,900 km (January 1994))
3.	Brazil	50,000 km
4.	United States	41,009 km (navigable inland channels, exclusive of the Great Lakes)
5.	**Indonesia**	**21,579 km total (Sumatra 5,471 km, Java and Madura 820 km, Kalimantan 10,460 km, Sulawesi (Celebes) 241 km, Irian Jaya 4,587 km)**
6.	Colombia	18,140 km (navigable by river boats) (April 1996)
7.	**Vietnam**	**17,702 km (more than 5,149 km are navigable at all times by vessels up to 1.8 m draft)**
8.	India	16,180 km (3,631 km navigable by large vessels)
9.	Congo, Democratic Republic of the	15,000 km (including the Congo and its tributaries, and unconnected lakes)
10.	France	14,932 km (6,969 km heavily traveled)

(source: http://www.nationmaster.com/graph-T/tra_wat)

3. Technical Issues Related to River Transportation

Kose[1] has described about the multi-barge system (Fig. 1) and onboard water-depth measurement system utilizing KGPS. It is not necessary to describe here again, but some additional information will be added in the presentation.

We could find the similar multi-barge system already operated in Vietnam (Figs. 2 and 3). It will be depend on the commodity, the river characteristics such as water depth and curvature and infrastructure such as port facilities and navigational aids. It will be carefully chosen the best way for the river and commodity individually.

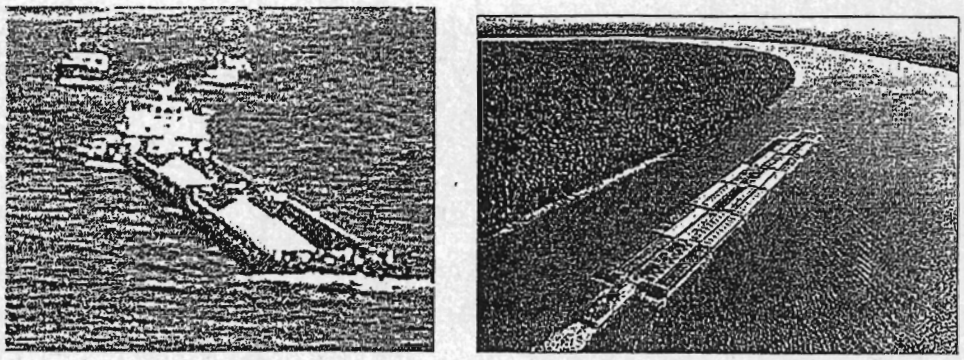


Fig. 1 Multi-barge system (left: the *Rhine*, right: *Mississippi*)

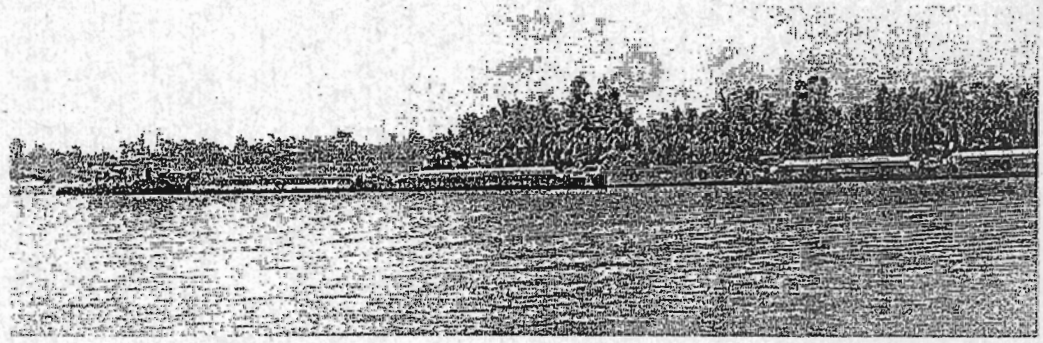


Fig. 2 Multi-barge system (*Mekon Delta*, Vietnam)

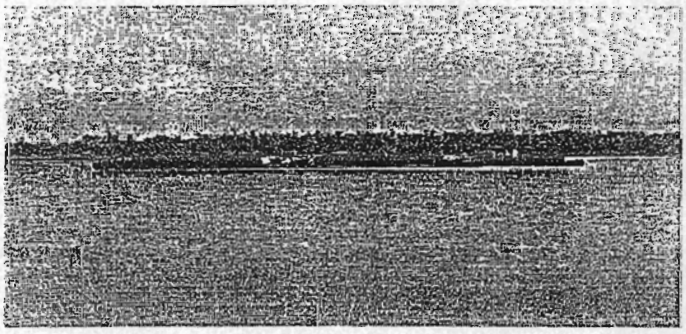


Fig. 2

Fig. 3 Multi-barge system (*Red River*, Vietnam)

Fig. 4 the *Rhine* River

4. Role of Public Sector

☐ Since a river is utilized as transportation of people and goods, control of water and area is very important. The kind of thing should be done by public sector. In the case of a river in one country, it is easier. The central government and/or local government will take an important role. If the case is on a river related to multiple countries, the situation is more complicated and sophisticated. Sometimes there occur severe political issues hard to negotiate. In the case of the *Rhine*, the river flows through Switzerland, Liechtenstein, Austria, Germany, France, and the Netherlands before emptying into the North Sea at Rotterdam as shown in Fig. 4.

☐ To discuss various things about the navigation in the *Rhine*, an international committee called the Central Commission for Navigation on the *Rhine* was founded with states members of The Netherlands, Belgium, Germany, France and Switzerland. The committee dates back to the final act of the 1815 Congress of Vienna. The Central Commission for Navigation on the *Rhine* is the oldest still-active European organization. The main tasks of the Central Commission are to ensure the freedom of navigation on the Rhine and its tributaries, and to maintain a uniform legal regime governing navigation along the full length of the river.

☐ Another committee called the International Commission for the Protection of the Rhine (ICPR) was founded in Basel on July 11, 1950 by countries bordering the *Rhine* - Switzerland, France, Luxembourg, Germany and the Netherlands. Originally it was created as a common forum, where questions relating to the pollution and management of the Rhine could be discussed and solutions sought for. The driving force behind the setting up of the commission was the Netherlands. As the final downstream riparian they were suffered from high levels of pollution and floods regularly.

They have thus established the system to discuss on the common things related to the river transportation and the environmental issues for long time. Coming back to the Asian case, the international organization or committee should be established as for the big rivers flows through several countries such as the *Mekong* River.

As Kose[1] has pointed out, regulations and infrastructure necessary for the river transportation should be provided by public sector for private usage. The issues to be provided by public sector are controlling water level and width, navigational aids etc. However, keeping the water depth and width is rather difficult, because of the soils delivered from upstream. The RGPS-based measuring system proposed by Kose[1] can be time-saving and cost-saving method than setting conventional navigational aid such as buoys and lighthouses.

5. Some special examples

The Netherlands is a small country, but well-known as its inland waterway. As shown in Table 2, it has about 5,000km waterways, but 3/5 of them are canals and Rotterdam is the very end of the *Rhine* River. It utilized this benefit maximumly. Another example is Belgium. Belgium is also a small country and even the length of its inland waterway is 1,570km. It also suffers from the small hills covering the country. Figs. 5 and 6 emphases the importance of the infrastructure provided by public sector. Fig. 5 is the largest incline waterway and Fig. 6 is the largest ship lift respectively in the world.

Table 2 Waterways in Some Countries

24.	Netherlands	5,046 km (of which 3,745 km are canals) (47% of total route length is usable by craft of 1,000-metric-ton capacity or larger)
54.	Belgium	1,570 km (route length in regular commercial use) (2001)
72..	Panama	882 km (800 km navigable by shallow draft vessels; 82 km Panama Canal)

Fig. 5 World largest incline (Ronquieres ,Belgium)

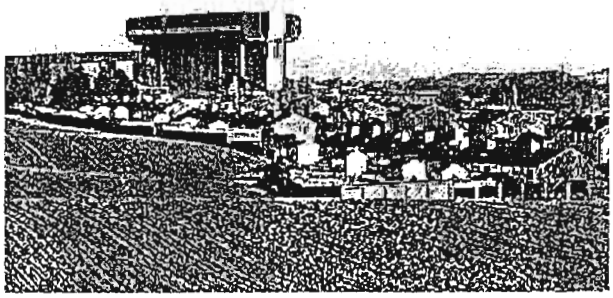


Fig. 6 World largest ship lift (Strepy Thieu, Belgium)

6. Concluding Remarks

The importance of public sector necessary for development of river transportation is described with some examples of the *Rhine* River. The importance of international cooperation is also stressed.

The author didn't described about the current situation of technological development concerning to the river navigation, but the progress in this direction is
Just dog-year. We need to watch the update progress in IT and other technology fields.

New age culture based on big rivers is promising. We have many big rivers in Asia, not yet developed. Your contribution towards this direction is strongly appreciated.

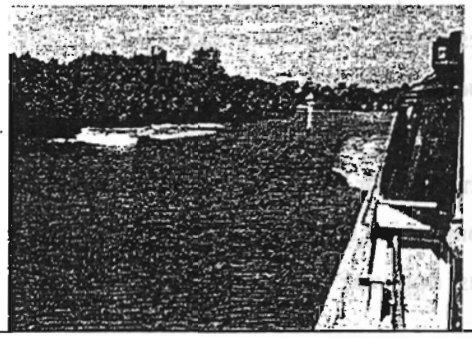
References

[1] Kuniji Kose: General Scope for Development of River Transportation, Seminar on River Transportation, Jakarta, Aug. 23, 2004.

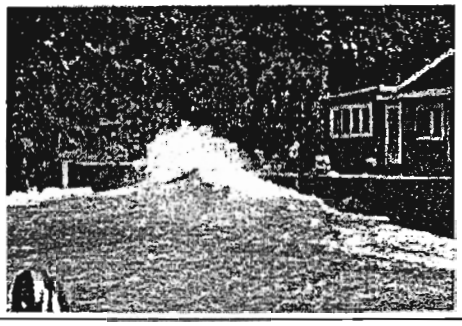
Beach Erosion by Wash Wake

Y. Doi, H. Minamimoto, J. Hara and T. Ito
Hiroshima University

Back Ground Large and High-Speed Vehicle
Impact by Wash Wake



Back Ground Large and High-Speed Vehicle
Impact by Wash Wake



Back Ground Large and High-Speed Vehicle
Impact by Wash Wake

Back Ground Large and High-Speed Vehicle
Impact by Wash Wake

Beach Erosion at Rich Passage
(Seattle USA)

Erosion of reed field
(Arakawa Japan)

Investigate Mechanism of Beach Erosion

Previous Study

- Soliton in restricted water way (Ertekin,1984)
- Simulation of ship wave in shallow water (Henn, et al.2001)
- Measurement of wave height by ship near sea shore (Stumb, et al.,1999)

Previous Study

•Wash criteria is given by wave height.

•Is it enough?

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in shallow water (Henn, et al.2001)
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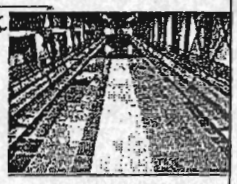
near sea shore (Stumb, et al.,1999)

Few studies on the beach erosion by wash wake

Experiments at Towing Tank

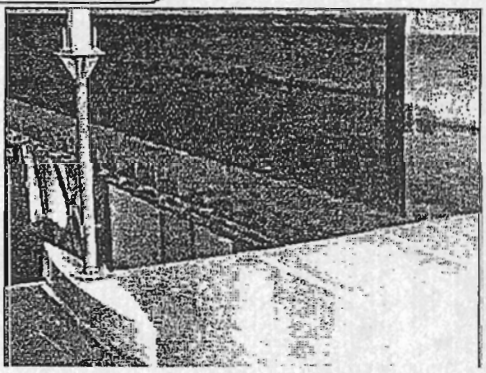
water way model
Rich Passage
Seattle UAS



wave height | velocity | shape of beach | flow visualization

Investigate the mechanism of beach erosion by wash wake

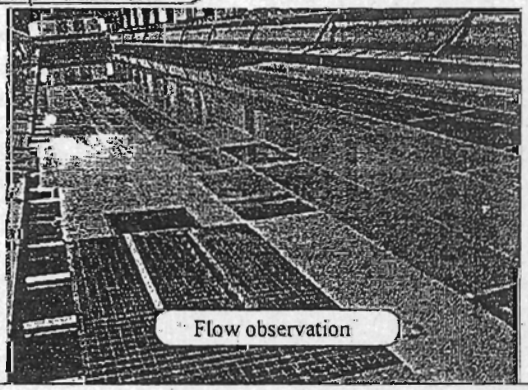
Experiments



Experiments

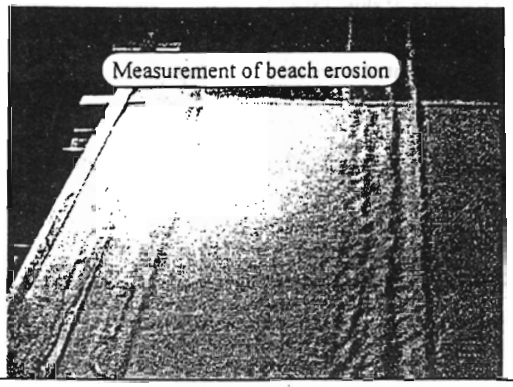
Measurement of wave height & flow velocity

Experiments



Flow observation

Experiments



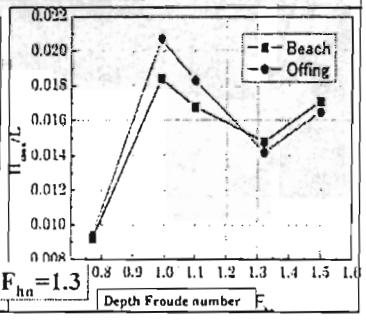
Investigation on beach erosion

- Erosion vs. F_{hn} — Erosion height
- Erosion vs. Wave breaking — Erosion height; Flow observation
- Level of erosion — Flow velocity; Wave height; Erosion height
- Erosion vs. Wash wake — Flow velocity

Condition for experiment

$$F_{hn} = \frac{V}{\sqrt{gh}}$$

V=ship speed
g=gravity acceleration
h=depth



Design speed F_{hn}=1.3

Condition for experiment

- Wash criteria is given by wave height.
- Is it enough?

Design speed F_{hn}=1.3

Mechanism of beach erosion

Investigation on beach erosion

- Erosion vs. F_{hn} — Erosion height
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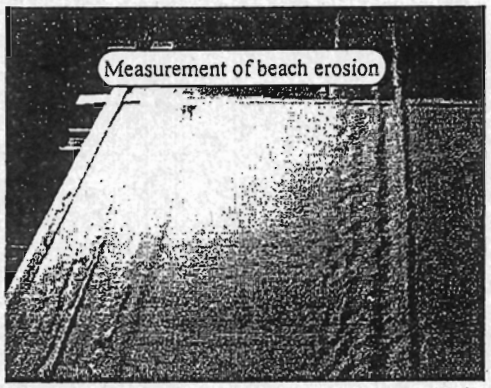
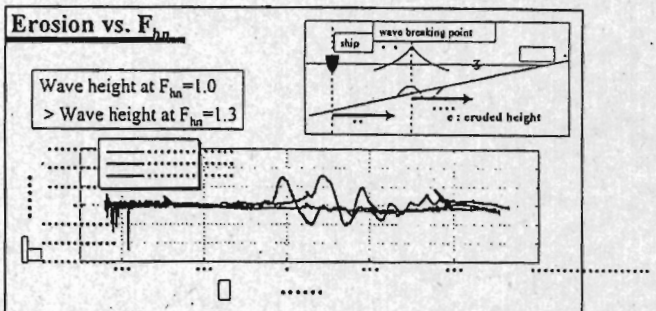
- Level of erosion — Flow velocity; Wave height; Erosion height
- Erosion vs. Wash wake — Flow velocity

Erosion vs. F_{hn}



Erosion vs. F_{hn}

Wave height at F_{hn}=1.0
> Wave height at F_{hn}=1.3



Erosion is observed at $F_{hn} \geqq 1.0$

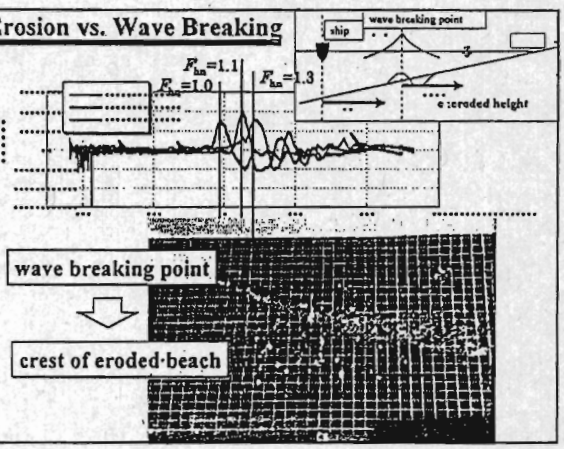
Wave breaking is observed at $F_{hn} \geqq 1.0$

Wave breaking and Erosion

Investigation on beach erosion

- Erosion vs. F_{hn} — Erosion height
- Erosion vs. Wave breaking — Erosion height, Flow observation
- Level of erosion — Flow velocity, Wave height, Erosion height
- Erosion vs. Wash wake — Flow velocity

Erosion vs. Wave Breaking



Investigation on beach erosion

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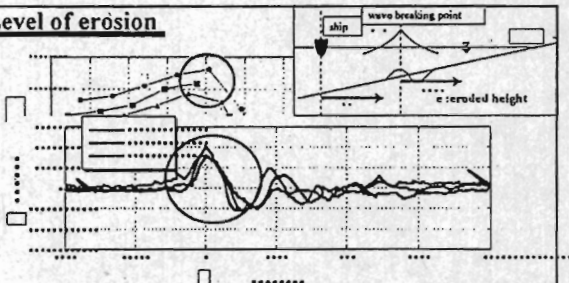
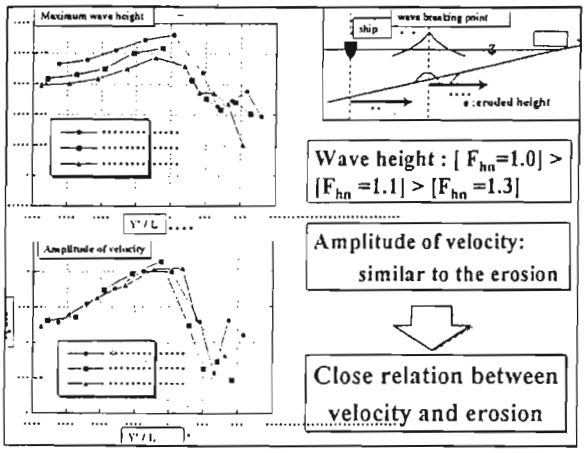
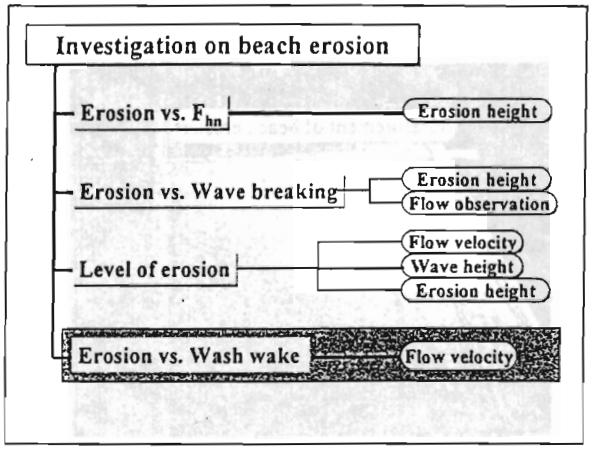
Level of erosion

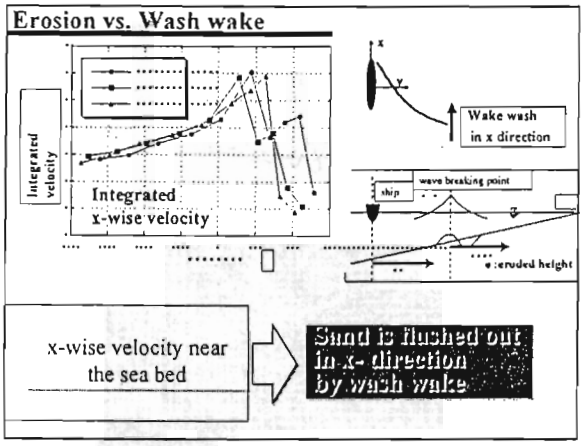


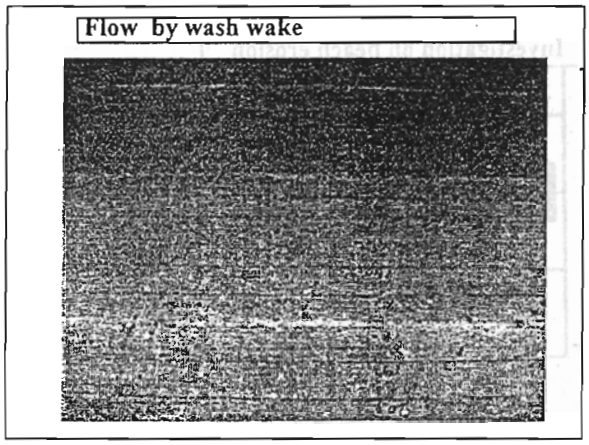
Wave height : [F_{hn}=1.0] > [F_{hn} =1.1] > [F_{hn} =1.3]

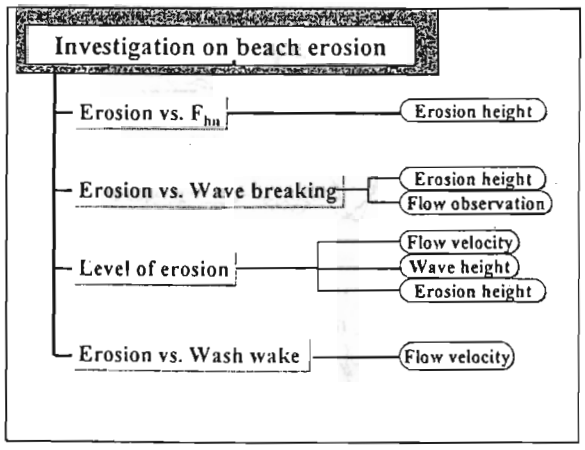
Wave height≠Level of erosion

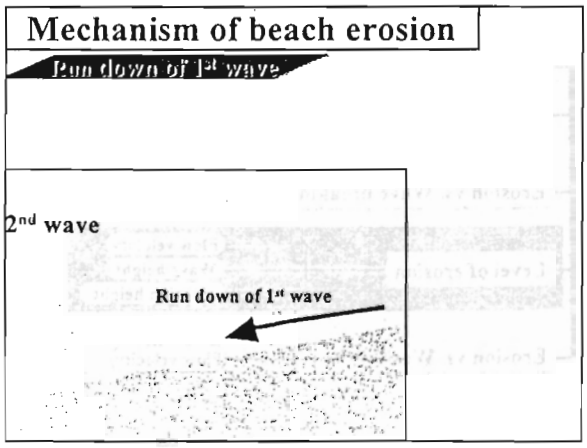

Maximum wave height
ship
wave breaking point
: eroded height
Wave height : [F_{hn}=1.0] > [F_{hn} =1.1] > [F_{hn} =1.3]
Amplitude of velocity
Amplitude of velocity: similar to the erosion
Close relation between velocity and erosion


Investigation on beach erosion
Erosion vs. F_{hn}
Erosion height
Erosion vs. Wave breaking
Erosion height
Flow observation
Level of erosion
Flow velocity
Wave height
Erosion height
Erosion vs. Wash wake
Flow velocity

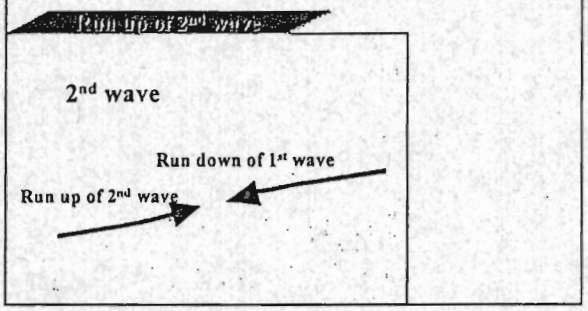

Erosion vs. Wash wake
Integrated velocity
Integrated x-wise velocity
Wake wash in x direction
ship
wave breaking point
: eroded height
x-wise velocity near the sea bed
Sand is flushed out in x- direction by wash wake

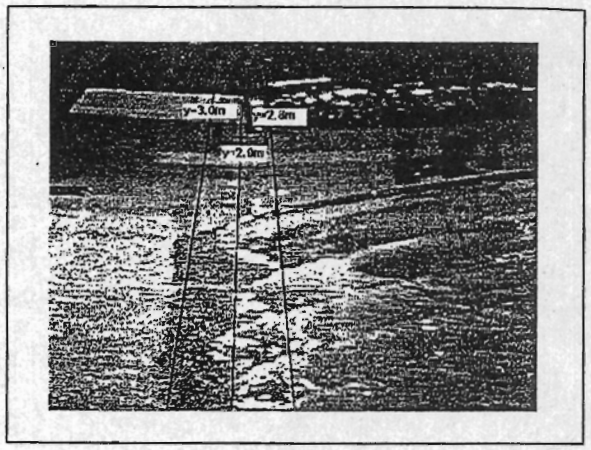

Flow by wash wake

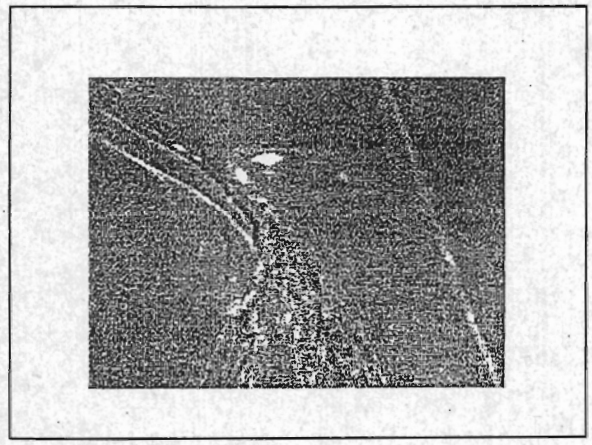

Investigation on beach erosion
Erosion vs. F_{hn}
Erosion height
Erosion vs. Wave breaking
Erosion height
Flow observation
Level of erosion
Flow velocity
Wave height
Erosion height
Erosion vs. Wash wake
Flow velocity


Mechanism of beach erosion
Run down of 1st wave
2nd wave
Run down of 1st wave

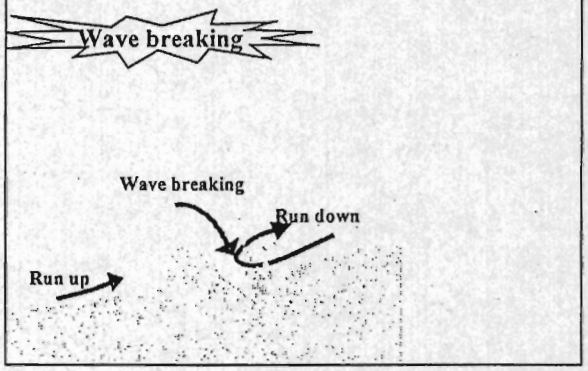
Mechanism of beach erosion







Mechanism of beach erosion



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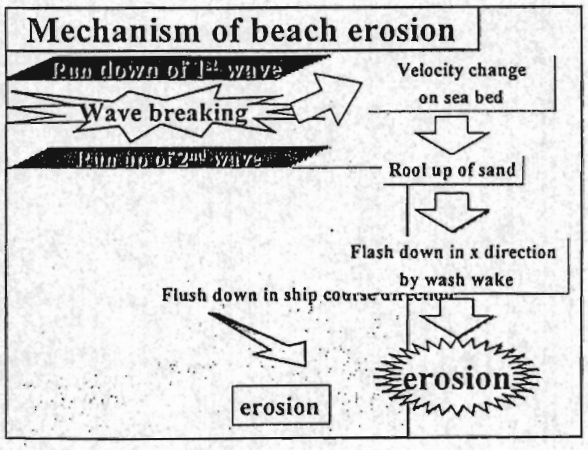

Conclusions

- Is the wave height the most dominant parameter of beach erosion by wash wake?

  NO

- The velocity is dominant parameter of beach erosion by wash wake

- Breaking wave due to run up and run down rolls up the sand of sea bed.
- Rolled up sand is flushed out in the way of ship by wash wake.