INVENTORY FOR USA LCS

Location

Whinthrop Beach, Massachusetts, Atlantic Coast, USA. 1935. Constructed by the State of Massachusetts.

Main motive for building the LCS

Beach restoration and coastal protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	6
Project length:	625 m
Segment length:	100 m
Gap length	30 m
Distance offshore (preproject):	305 m
Fill placed:	No
Beach response:	Permanent tómbolos at low tide. Salient at high tide

Typical cross section (dimensioned sketch)

Water depth (at mhwl):	3.0 m
Freeboard (at mhwl):	≈ 1 m
Crest width (at mhwl):	≈ 5-10 m

Indication of water level variations

Spring Astronomical tide:	≈ 1.5 m

Existence of detailed information

US Army Corps of Engineers

Location

Colonial Beach (Central Beach), Virginia, USA, Atlantic Coast (Potomac River). 1982. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and coastal protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	4
Project length:	427 m
Segment length:	61 m
Gap length	46 m
Distance offshore (preproject):	64 m
Fill placed:	YES
Beach response:	Periodic tombolos

Typical cross section (dimensioned sketch)

Water depth:	1.2 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 1.2 m

Existence of detailed information

US Army Corps of Engineers

Location

Colonial Beach (Castlewood Park), Virginia, USA Atlantic Coast (Potomac River). 1982. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and coastal protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	335 m
Segment length:	64 m
Gap length	26 m
Distance offshore (preproject):	46 m
Fill placed:	YES
Beach response:	Permanent tombolos

Typical cross section (dimensioned sketch)

Water depth:	1.2 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 1.2 m

Existence of detailed information

US Army Corps of Engineers

Location

Elms Beach, Maryland, USA, Atlantic Coast (Chesapeake Bay). 1985. Constructed by the State of Maryland.

Main motive for building the LCS

Wetland restoration

Impacts on bio-environment

Wetland formation

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	335 m
Segment length:	47 m
Gap length	53 m
Distance offshore (preproject):	44 m
Fill placed:	YES
Beach response:	Permanent tombolos

Typical cross section (dimensioned sketch)

Water depth:	0.6 – 0.9 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 1.0 m

Existence of detailed information

US Army Corps of Engineers

Location

Elk Neck State Park, Maryland, USA, Atlantic Coast (Chesapeake Bay). 1989. Constructed by the USACE.

Main motive for building the LCS

Wetland restoration

Impacts on bio-environment

Wetland formation

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	4
Project length:	107 m
Segment length:	15 m
Gap length	15 m
Distance offshore (preproject):	N/A
Fill placed:	NO
Beach response:	Periodic tombolos or subdued salients

Typical cross section (dimensioned sketch)

Water depth:	0.6 – 0.9 m
Freeboard:	≈ 0.5 m
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 1.0 m

Existence of detailed information

US Army Corps of Engineers

Location

Terrapin Beach, Maryland, USA, Atlantic Coast (Chesapeake Bay). 1989. Constructed by the USACE.

Main motive for building the LCS

Wetland restoration

Impacts on bio-environment

Wetland formation

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	4
Project length:	161
Segment length:	23 m
Gap length	15, 31, 23 m
Distance offshore (preproject):	38 m
Fill placed:	YES
Beach response:	No sinuosity

Typical cross section (dimensioned sketch)

Water depth:	0.6 – 0.9 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 1.0 m

Existence of detailed information

US Army Corps of Engineers

Location

Eastern Neck, Maryland, USA, Atlantic Coast (Chesapeake Bay). 1992-93. Constructed by the US Fish and Wildlife Service.

Main motive for building the LCS

Wetland restoration

Impacts on bio-environment

Wetland formation

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	26
Project length:	1676 m
Segment length:	31 m
Gap length	23 m
Distance offshore (preproject):	N/A
Fill placed:	YES
Beach response:	No beach

Typical cross section (dimensioned sketch)

Water depth:	0.3 – 0.6 m
Freeboard:	≈ 0.5 m
Crest width:	≈ 10 – 15 m

Indication of water level variations

Spring Astronomical tide:	≈ 1.0 m

Existence of detailed information

US Army Corps of Engineers

Location

Bay Ridge, Maryland, USA, Atlantic Coast (Chesapeake Bay). 1990-91. Private Project.

Main motive for building the LCS

Beach restoration and coastal protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	11
Project length:	686 m
Segment length:	31 m
Gap length	31 m
Distance offshore (preproject):	43 m
Fill placed:	YES
Beach response:	Subdued salients

Typical cross section (dimensioned sketch)

Water depth:	N/A m
Freeboard:	≈ 1.0 m
Crest width:	≈ < 5 m

Indication of water level variations

Spring Astronomical tide:	≈ 1.0 m

Existence of detailed information

US Army Corps of Engineers

Location

Redington Shores, Florida, USA, Gulf of Mexico Coast. 1985-86. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	1
Project length:	100 m
Segment length:	100 m
Gap length	No gaps
Distance offshore (preproject):	104 m
Fill placed:	YES
Beach response:	Permanent tombolos

Typical cross section (dimensioned sketch)

Water depth:	N/A
Freeboard:	≈ 0.5 m
Crest width:	≈ 5-10 m

Indication of water level variations

Spring Astronomical tide:	≈ 0.9 m

Existence of detailed information

US Army Corps of Engineers

Location

Holly Beach, Louisiana, USA, Gulf of Mexico Coast. 1985. Constructed by the State of Louisiana.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	6
Project length:	555 m
Segment length:	46, 51, 50 m
Gap length	93, 89 m
Distance offshore (preproject):	78, 61 m
Fill placed:	NO
Beach response:	Subdued salients

Typical cross section (dimensioned sketch)

Water depth:	2.5 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 0.9 m

Existence of detailed information

US Army Corps of Engineers

Location

Holly Beach, Louisiana, USA, Gulf of Mexico Coast. 1991-93. Constructed by the State of Louisiana.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	76
Project length:	N/A
Segment length:	47 m
Gap length	92 m
Distance offshore (preproject):	122 m
Fill placed:	YES
Beach response:	Well-developed salients

Typical cross section (dimensioned sketch)

Water depth:	1.4 - 1.6 m
Freeboard:	≈ 1.0 m
Crest width:	≈ 5 - 10 m

Indication of water level variations

Spring Astronomical tide:	≈ 0.9 m

Existence of detailed information

US Army Corps of Engineers

Location

Grand Isle, Louisiana, USA, Gulf of Mexico Coast. Constructed by the City of Grand Isle.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	4
Project length:	84 m
Segment length:	70 m
Gap length	21 m
Distance offshore (preproject):	107 m
Fill placed:	NO
Beach response:	Well developed salients

Typical cross section (dimensioned sketch)

Water depth:	2.0 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 0.6 m

Existence of detailed information

US Army Corps of Engineers

Location

Lakeview Park, Ohio, USA, Lake Erie Coast. 1977. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	403 m
Segment length:	76 m
Gap length	49 m
Distance offshore (preproject):	135 - 150 m
Fill placed:	YES
Beach response:	Subdued salients

Typical cross section (dimensioned sketch)

20-year design wave heigh.	3.0 m
Water depth (below LWD):	2.4 m
Freeboard (over LWD):	2.4 m
Crest width:	4.2 m
Seaward slope:	1/1.5
Shoreward slope:	1/1.5
Armour stone weight:	5 t
Underlayer stone weight:	0.5 t

Indication of water level variations

Spring Astronomical tide:	Negligible
Highest recorded monthly mean lake level:	+1.47 m over LWD
Average mean lake level:	+0.54 m over LWD
Lowest recorded monthly mean lake level:	-0.33 m over LWD
Design storm surge:	+0.45 m

Existence of detailed information

US Army Corps of Engineers
J.R. Walker et al. (1980). 17th ICCE. Pp. 1968-1987.

Location

Presque Isle, Pennsylvania, USA, Lake Erie Coast. 1978. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	440 m
Segment length:	38 m
Gap length	62 m
Distance offshore (preproject):	60 m
Fill placed:	YES
Beach response:	Periodic tombolos

Typical cross section (dimensioned sketch)

Water depth:	0.9 – 1.2 m
Freeboard:	≈1 m
Crest width:	≈ <5 m

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

Presque Isle, Pennsylvania, USA, Lake Erie Coast. 1989-92. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	55
Project length:	8300 m
Segment length:	46 m
Gap length	107 m
Distance offshore (preproject):	76 - 107 m
Fill placed:	YES
Beach response:	Well developed salients or subdued salients

Typical cross section (dimensioned sketch)

Water depth (LWD):	1.5 – 2.4 m
Freeboard:	≈1 m
Crest width:	≈ <5 m

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

Lakeshore Park, Ohio, USA, Lake Erie Coast. 1982. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	244 m
Segment length:	38 m
Gap length	61 m
Distance offshore (preproject):	120 m
Fill placed:	YES
Beach response:	No sinuosity

Typical cross section (dimensioned sketch)

Water depth:	2.1 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

East Harbor, Ohio, USA, Lake Erie Coast. 1983. Constructed by the USACE.

Main motive for building the LCS

Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	4
Project length:	550 m
Segment length:	46 m
Gap length	90, 105, 120 m
Distance offshore (preproject):	170 m
Fill placed:	NO
Beach response:	No sinuosity

Typical cross section (dimensioned sketch)

Water depth:	2.3 m
Freeboard:	≈1 m
Crest width:	≈ <5 m

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

Maumee Bay, Ohio, USA, Lake Erie Coast. 1990. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	5
Project length:	823 m
Segment length:	61 m
Gap length	76 m
Distance offshore (preproject):	N/A m
Fill placed:	YES
Beach response:	Permanent tombolos

Typical cross section (dimensioned sketch)

Water depth:	1.3 m
Freeboard:	≈1.5 m
Crest width:	≈ 5 - 10 m

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

Sims Park, Ohio, USA, Lake Erie Coast. 1992. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	975 m
Segment length:	38 m
Gap length	49 m
Distance offshore (preproject):	N/A m
Fill placed:	YES
Beach response:	Permanent tombolos

Typical cross section (dimensioned sketch)

Water depth:	2.5 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	N/A

Existence of detailed information

US Army Corps of Engineers

Location

Forest Park, Illinois, USA, Lake Michigan West Coast. 1988.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number detached of segments:	3 detached (shore connected by a central sheet pile jetty)
Number of attached segments:	2 (in the limits of the project)
Project length:	1067 m
Segment length (detached):	69, 69, 51 m
Gap length	60, 69, 86, 86 m
Distance offshore (preproject):	86 - 107 m
Fill placed:	YES
D_{50} of placed sand	2.6 mm
Beach response:	Well developed salients.

Typical cross section (dimensioned sketch)

20-year design wave heigh.	Depth limited
Water depth (below LWD):	3 m
Freeboard (over LWD):	2.1 m
Crest width:	4.0 m

Indication of water level variations

Spring Astronomical tide:	Negligible
Design lake levels:	+1.4 to +2.5 over LWD

Existence of detailed information

K.J. McIntosh et al. (1988). 21st ICCE. Pp 2840 - 2854

Location

Klode Park, Whitefish Bay, Wisconsin, USA, Lake Michigan West Coast.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3 (shore connected by a central sheet pile jetty)
Project length:	200 m
Segment length (detached):	13, 30, 28 m
Gap length	38 m
Distance offshore (preproject):	38 - 60 m
Fill placed:	YES
D_{50} of placed fill	2.6 mm
Beach response:	Well developed salients.

Typical cross section (dimensioned sketch)

20-year design wave heigh.	Depth limited
Water depth (below LWD):	≈2 m
Freeboard (over LWD):	≈2 m
Crest width:	≈4.0 m

Indication of water level variations

Spring Astronomical tide:	Negligible
Design lake levels:	+1.4 to +2.5 over LWD

Existence of detailed information

K.J. McIntosh et al. (1988). 21st ICCE. Pp 2840 - 2854

Location

Venice, California, USA, Pacific Coast. 1905. Private Project.

Main motive for building the LCS

Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	1
Project length:	180 m
Segment length:	180 m
Gap length	---
Distance offshore (preproject):	370 m
Fill placed:	NO
Beach response:	No sinuosity

Typical cross section (dimensioned sketch)

Water depth:	N/A
Freeboard:	≈1.5 m
Crest width:	≈ 5 - 10 m

Indication of water level variations

Spring Astronomical tide:	≈ 2.5 m

Existence of detailed information

US Army Corps of Engineers

Location

Haleiwa Beach, Hawaii, USA, Pacific Coast. 1965. Constructed by the USACE and State of Hawaii.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	1
Project length:	49 m
Segment length:	49 m
Gap length	---
Distance offshore (preproject):	90 m
Fill placed:	YES
Beach response:	Well developed salient

Typical cross section (dimensioned sketch)

Water depth (MSL):	2.1 m
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 0.9 m

Existence of detailed information

US Army Corps of Engineers

Location

Sand Island, Hawaii, USA, California Coast. 1991. Constructed by the USACE.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	3
Project length:	110 m
Segment length:	21 m
Gap length	23 m
Distance offshore (preproject):	N/A
Fill placed:	N/A
Beach response:	N/A

Typical cross section (dimensioned sketch)

Water depth:	N/A
Freeboard:	Positive (N/A)
Crest width:	N/A

Indication of water level variations

Spring Astronomical tide:	≈ 0.8 m

Existence of detailed information

US Army Corps of Engineers

JAPAN INVENTORY

Location

Kaike coast, near Yonago, Honshu Island, Japan, Sea of Japan Coast. 1971-1981.

Main motive for building the LCS

Beach restoration and Coastal Protection.

Impacts on bio-environment

N/A

Socio-economic impact

N/A

System Layout (dimensioned sketch)

Number of segments:	11
Project length:	2150 m
Segment length:	150 m
Gap length	50 m
Distance offshore (preproject):	80 -130 m
Fill placed:	NO
Beach response:	Well developed salient and periodic tombolos

Typical cross section (dimensioned sketch)

Water depth (below LWD):	5 m
Freeboard (over LWD):	2.5 m
Crest width:	8.5 m
Armour tetrapod weight:	16 t
Underlayer stone weight:	0.02 – 0.8 t

Indication of water level variations

Spring Astronomical tide:	0.38 m

Existence of detailed information

O. Toyoshima (1982). 18th ICCE. Pp. 1873-1892

T. Uda. Statistical analysis of detached breakwaters in Japan (1988). 21st ICCE. Pp. 2028-2042

QUESTIONNARIE

General matters:

Name of the prefecture
Name of the coast
Type of coast (A-D)*
Number of the detached breakwater
Construction date

Design conditions:

Design wave height
Design wave period
Tidal range
Bottom slope at the site
Water depth (reference HWL)
Offshore distance (reference HWL)

Dimensions of detached breakwater:

Type (permeable or impermeable)
Placing (pell-mell of uniform)
Crown height
Crown width
Length
Elevation above the HWL
Foundation

Kind of concrete units:

Kind
Weight
Kd value in Hudson formula

Effect and stability:

Subsidence of the blocks
Scattering of concrete blocks
Method of placing
Tombolo formation (yes or no)
Foundation (yes or no)

*** Type of coast:**

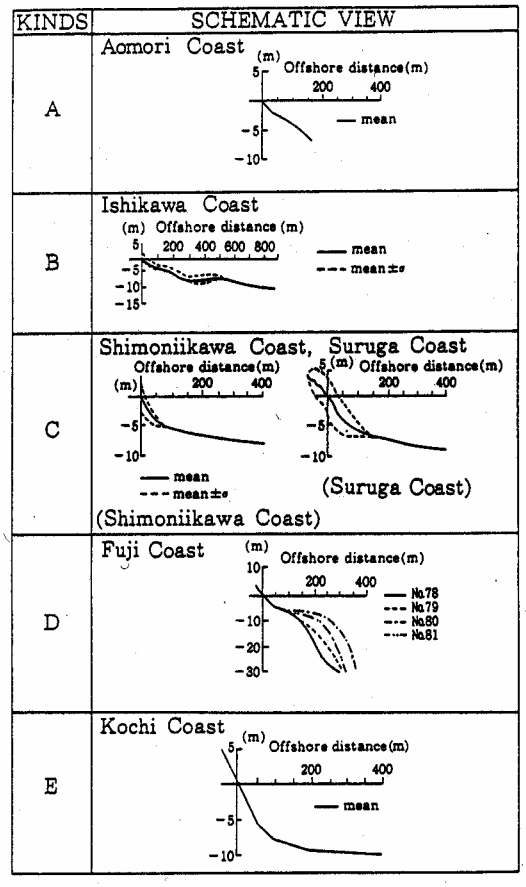
A: Coast facing a bay or an inland sea, such as the Aomori Coast and the Toban Coast. The wave heights are low on these coasts compared with those on the coasts facing the open sea, and the critical depth for sand movement is small.

B: Coasts with a fairly developed bar-through topography, such as the Niigata Coast. The bottom slope in a region shallow enough for sand movement is mild, and the direction of mean incident waves is almost normal to the coastline.

C: Coasts where the bottom slope in the shallow region is relatively steep without the formation of bar-through topography, e.g., the Shimoniikawa Coast and the Suruga Coast.

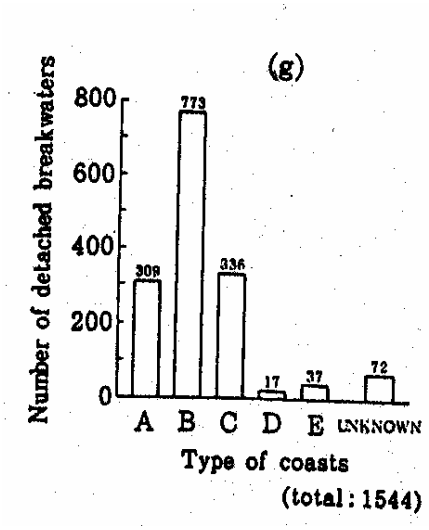
D: Coasts with an extremely steep slope ranging from 1/3 to 1/10, e.g., the Fuji Coast in Suruga Bay.

Statistics over 1552 detached breakwaters built by the Ministery of Construction until 1982.

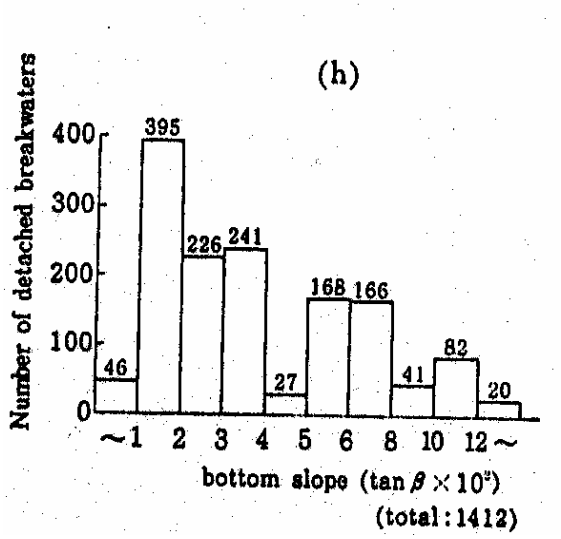


RESULTS.

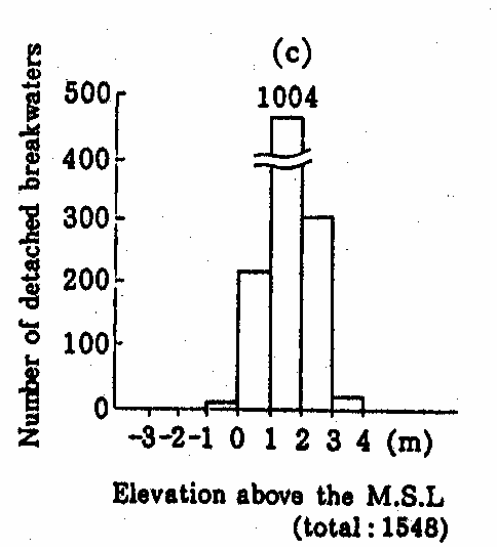
1. Type of coast.



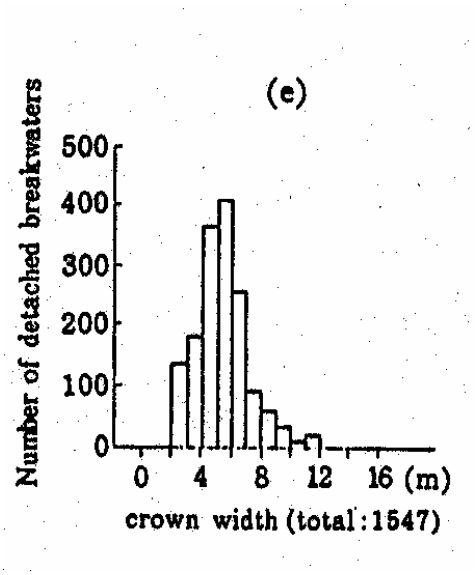
2. Bottom slope at the site.



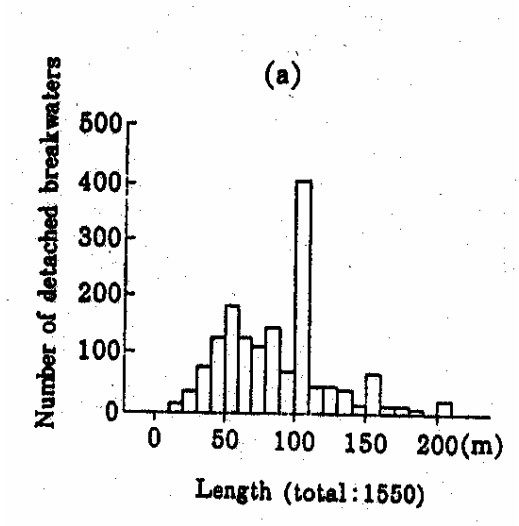
3. Crown height (above MSL).



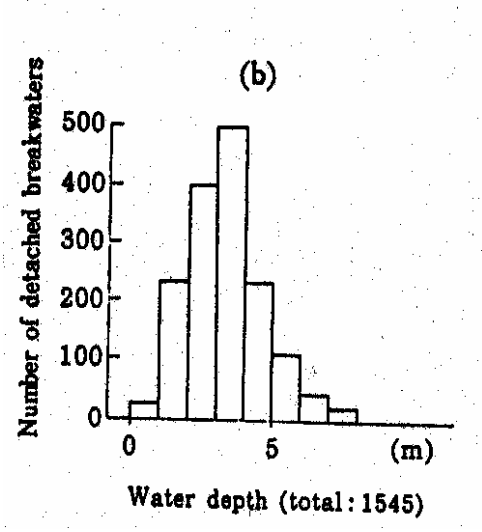
4. Crown width.



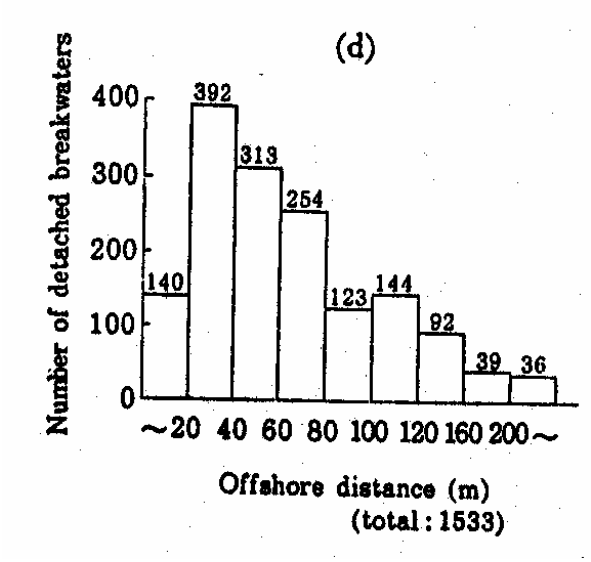
5. Breakwater length.



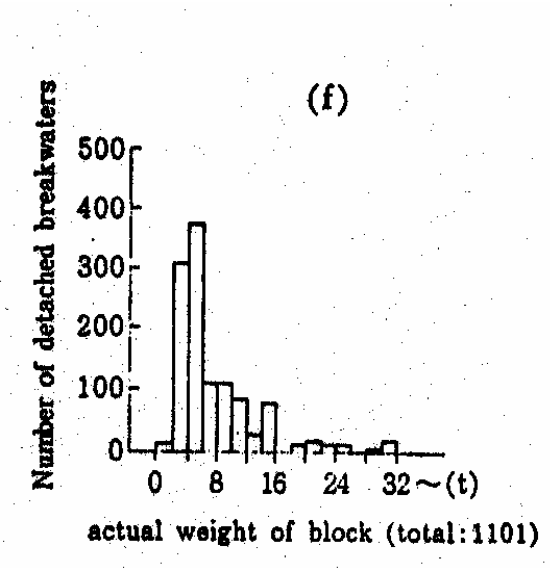
6. Water depth.



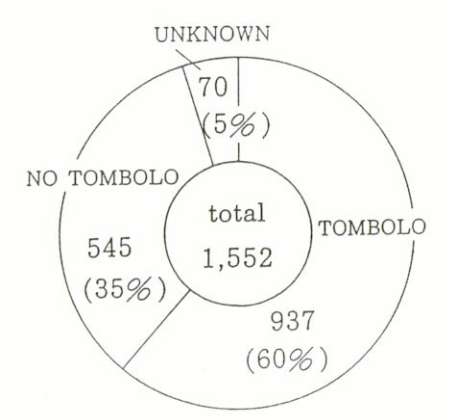
7. Offshore distance.



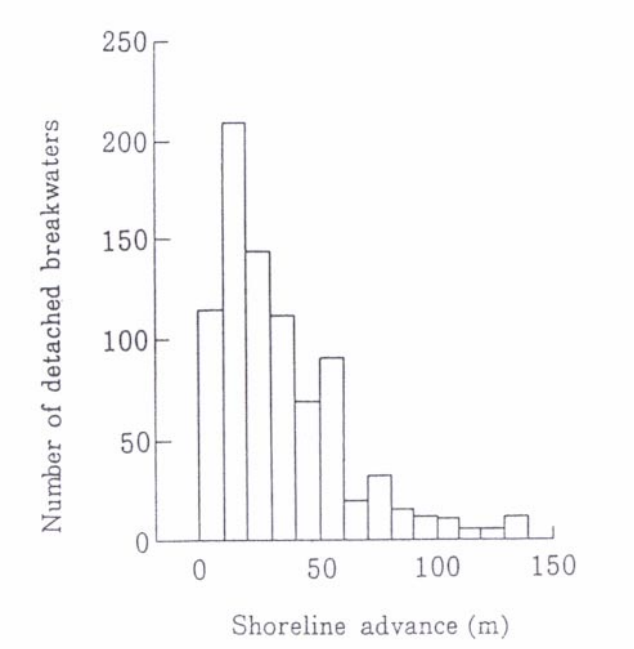
8. Armour block weight.



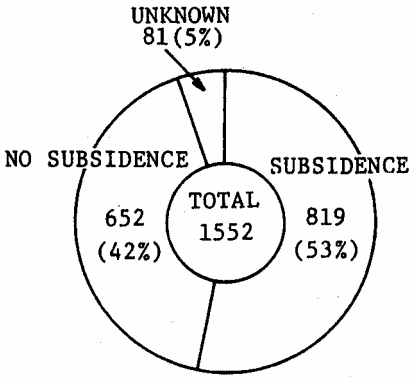
9. Percentage of tómbolo formation.



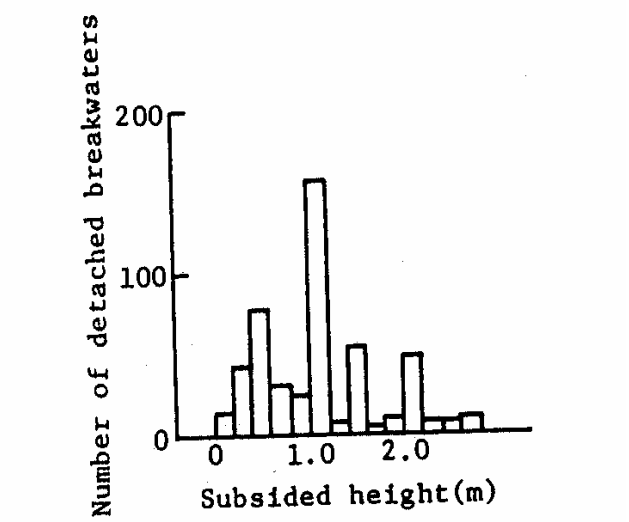
10. Frequency distribution of the maximum shoreline advance due to tómbolo formation.



11. Percentage of the number of detached breakwater with or without subsidence of blocks.



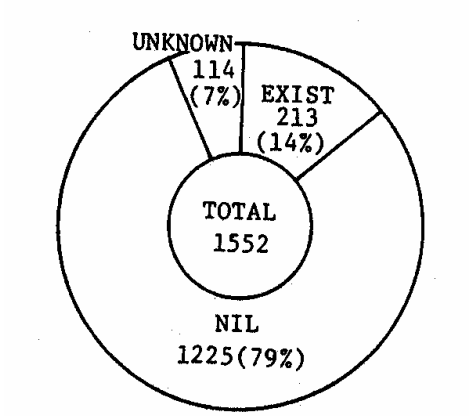
12. Frequency distribution of the subsided height of detached breakwater.



13. Percentage of the number of the subsided detached breakwater corresponding to kinds of the bed materials.

Subsidence / Bottom Materials	Exist subsidence	No subsidence	Unknown	Total
Rock	(10 %) 19	(73%) 141	(17 %) 34	(100 %) 194
Gravel	(43 %) 139	(56%) 183	(1 %) 5	(100 %) 327
Sand	(64 %) 678	(33%) 347	(3 %) 42	(100 %) 1067
Silt	(100 %) 1	(0 %) 0	(0 %) 0	(100 %) 1
Total	(53 %) 837	(42 %) 671	(5 %) 81	(100 %) 1589

14. Percentage of the number of detached breakwater with scattering of blocks.



15. Frequency distribution of the scattered distance of the blocks.