ANNEX-5

CLASSROOM LESSON ON ROAD

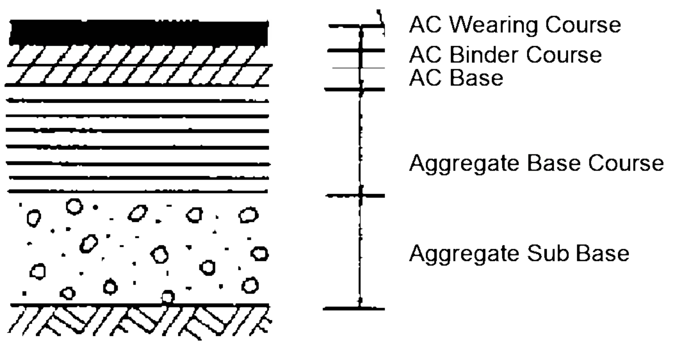
Planning of Road (1)

11th May 2013

Pavement Structure Category

Source: Pavement Design Manual 2008 in ADN Wiki Database

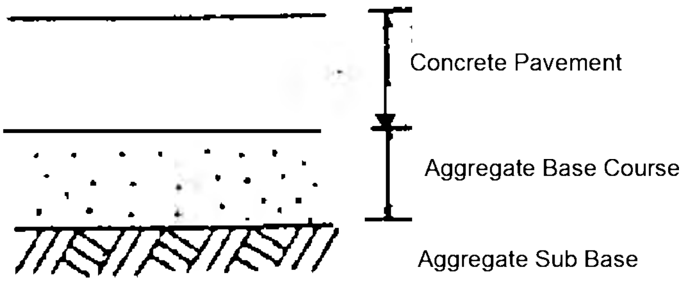
1.Flexible ; Bituminous-type of pavement



Pavement Structure Category

Source: Pavement Design Manual 2008 in ADN Wiki Database

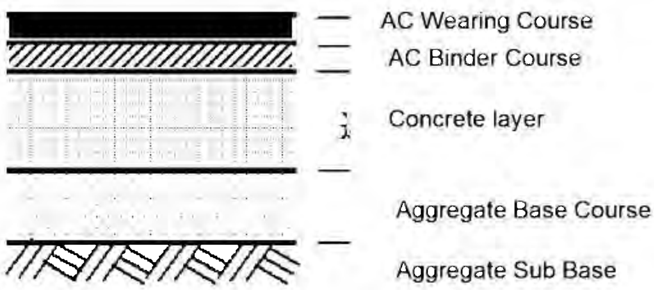
2.Rigid ; Portland Cement Concrete



Pavement Structure Category

Source: Pavement Design Manual 2008 in ADN Wiki Database

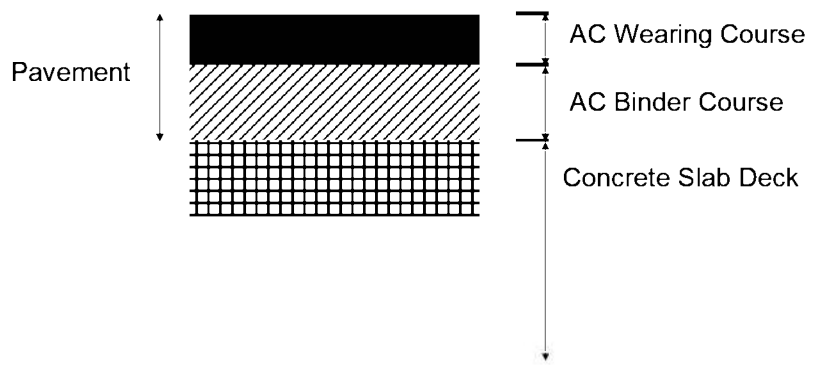
3.Composite ;



Pavement Structure Category

Source: Pavement Design Manual 2008 in ADN Wiki Database

4.Bridge ;



MOISTURE ENVIRONMENT

- The moisture regime associated with a pavement has a major influence on the performance of the pavement.
- The stiffness/strength of unbound materials and subgrades is heavily dependent on the moisture content of the materials.

TEMPERATURE ENVIRONMENT

- The temperature environment has a major influence on the performance of pavements surfaced with asphalt wearing surfaces.
- Asphalt becomes stiff and brittle at low temperatures while it is soft and elastic at higher temperature.

SUBGRADE

- The support provided by the subgrade is the most important factor in determining pavement design thickness, composition and performance.
- The subgrade strength is dependent on the conditions at construction and during service.
- Soil type, density and moisture content largely determine subgrade strength.
- The aim of subgrade evaluation is to estimate a value of subgrade support to use in design.

FIELD DETERMINATION OF SUBGRADE CBR

- Subgrade condition and design parameters should be assessed from subsurface investigations.
- As a minimum, subsurface investigations and laboratory testing of the subgrade should provide the following results:

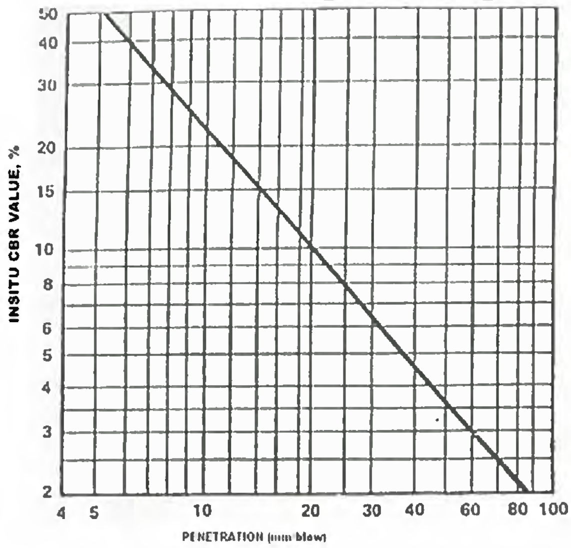
(1) 4 day soaked CBR.

(2) Particle size distribution.

(3) Plastic limits, liquid limits and plasticity index (PI), if applicable.

(3) At least one dynamic cone penetrometer (DCP) test per test pit.

CORRELATION CBR VS PENETRATION TEST



TYPICAL PRESUMPTIVE DESIGN CBR VALUES

TYPE OF SOILS	SOIL CLASSIFICATION	CBR VALUES, %	
		WELL DRAINAGE	POOR DRAINAGE
• Highly Plastic Clay	CH	5	2 – 3
• Silt			
• Silty Clay	ML	5	2 – 3
• Sandy Clay	CL		
• Sand	SC	6 – 7	4 – 5
	SW, SP	15 - 20	-

PAVEMENT MATERIALS

- The choice of materials for any particular application should be based on considerations of structural requirements, economics, durability, workability and experiences.
- According to their function, materials for flexible pavement can be classified into the following groups, such as;

 1). Soil subgrade
 2). Granular materials
 3). Bituminous material.

GRANULAR MATERIALS

- Granular materials consist of natural gravel and sand or crushed rocks which have a grading that makes them mechanically stable, workable and able to be compacted.
- Granular materials can be classified into three (3) categories, such as:

  1). Coarse aggregate

  2). Fine aggregate

  3). Filler

BITUMINOUS MATERIAL

- Bituminous materials is materials which have function as bounding agent for flexible pavement and produced from petroleum industry and/or rock asphalt produced from natural deposit.
- Bituminous materials can be classified into five categories as follows:

  (1) Petroleum asphalt

  (2) Emulsified asphalt

  (3) Cut back asphalt

  (4) Modified asphalt
- The selection of the using of each category based on the pavement type, traffic volume, construction method and construction cost considerations.

Petroleum Asphalt

- Petroleum Asphalt is a bituminous residue of crude oil after its lighter components have been removed through atmospheric and vacuum distillation.
- For some types of crude oil, other processes are necessary for obtaining all the types of petroleum asphalt.
- Air blowing to asphalt or mixing hard and soft types of asphalt is adopted for the case.
- The process varies depending on the type of crude oil production methods.

Petroleum Asphalt

REQUIREMENTS OF PETROLEUM ASPHALT

PARAMETER	TEST METHOD	ASPHALT GRADE				
		40-50	60-70	85-100	120-150	200-300
• PENETRATION	AASHTO T49	Min. 40 Max. 50	Min. 60 Max. 70	Min. 85 Max. 100	Min. 120 Max. 150	Min. 200 Max. 300
• FLASH POINT	AASHTO T48	Min. 232 Max. -	Min. 232 Max. -	Min. 232 Max. -	Min. 218 Max. -	Min. 177 Max. -

Emulsified Asphalt

- Emulsified asphalt is usually an emulsion composed of relatively soft straight asphalt, an emulsifying agent, a stabilizer and water.
- According to their particle changes, emulsified asphalt is classified as:

  (a). Cationic emulsified asphalt

  (b). Anomic emulsified asphalt

Emulsified Asphalt

Cutback Asphalt

- Cutback asphalt is liquid petroleum products, produced by fluxing an asphalt base with suitable petroleum distillates, to be used in the treatment of pavement surface.
- Combination of asphalt cement and petroleum solvent.
- Based on curing time, cutback asphalt can be classified into two types; such as;
  (a). Medium curing time type (MC)
  (b). Raid curing time type (RC)

Cutback Asphalt

Modified Asphalt

- Modified Asphalt is asphalt which materials such as rubber and resin added in attempt to improve viscosity at 60o C, toughness, teracity and temperature susceptibility.
- Modified asphalt is also semi-blown asphalt which is treated by a blowing process and Polymer modified Cationic Emulsified Asphalt.

Modified Asphalt

Thin asphalt overlays, polymer-modified mix.

LIME FOR SOILS STABILISATION

- Lime is materials such as quick lime, hydrate lime, either high calcium, dolomite or magnesium lime for use in stabilization of soils.
- Quick lime and hydrate lime act upon clay soils and may render such soils suitable for highway construction and for other load bearing applications, in most cases, lime causes finely divided clay particle which improves load bearing properties and subsequently the lime treated soil hardens by chemical reaction.

LIME FOR SOILS

DESIGN TRAFFIC

- Detailed procedures depend on the type of traffic data available, the pavement type being designed and the design method adopted.
- Features of traffic that largely determine performance are:
  - (1) The number of axles passes
  - (2) The axle loadings
  - (3) The axle configurations
- The standard axle is defined as a single axle with dual wheels that carries a load of 8, 20 ton.

CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

- Several construction and maintenance considerations must be taken into account in pavement design because they can influence the type of surfacing which adopted, the base and sub base material requirements or even fundamental choice of pavement type.

EXTENT AND TYPE OF DRAINAGE

- Special drainage provisions may be provided, including sub surface drains or porous drainage layers.
- In high rainfall regions or areas subject to high ground water levels, the use of a properly design designed drainage layer under near a granular pavement may be an effective means to remove water which has infiltrated through the surface, shoulders or from beneath the pavement.

AVAILABILITY OF EQUIPMENT

- The pavement type must be compatible with the equipment which is available for construction.
- For large projects it may be economical to import the required equipment, but in remote areas the locally available equipment will affect the choice of pavement type and composition.
- Sometimes, if a number of small jobs are to be constructed in a short period within the same region, the number of available economic alternatives can be increased.

Next Schedule

2nd Road Class Room Lesson;

Explanation of Drawings

(1) Drawing List

(2) Location Map

(3) Plan & Profile

(4) Cross Section

(5) Design Speed

3rd Road Class Room Lesson

(1) Road Structures

(2) Soil Condition

Planning of Road (2)

18th May 2013

- The road network is extensive, **road standards** are generally **poor**. **Road width** are generally **narrow (3.5 to 5.5 meters)** and require vehicles to move off the pavement to pass other vehicles. **Vertical and horizontal alignments** are poor, limiting **travel speeds** and **sight distance**. Inadequate drainage exacerbates road damage.

- **Rural Transport**
- Roads provide access to the rural parts of the country, where the majority of the poor live. They link rural communities to markets, services, and participation in the wider society.
- Connections with the southern economic zone cross a mountainous and midland area, which includes steep lands of **unstable rock** and **poor soils** that are highly susceptible to **erosion** and **landslides.**
- **Today's topics are Road Width & Landslide.**

Road Width

[Class-A Road]

- 1.0 m road shoulder + **7.0 m** travelled way + 1.0 m road shoulder = Total width **9.0** m (Funded by JICA)
- Class-A Road applies to National Road in Timor-Leste.

[Class-B Road]

- 1.0 m road shoulder + **6.0** m travelled way + 1.0 m road shoulder = Total width **8.0** m
- Class-B Road applies to National Road (Mountainous) in Timor-Leste. (Funded by World Bank, ADB, JICA)

[Class-C Road]

- 1.0 m road shoulder + **4.5** m travelled way + 1.0 m road shoulder = Total width **6.5** m
- Class-C Road applies to Local Road at narrow existing road in Timor-Leste.

Maubisse-Turiscai Road Rehabilitation Project

- Maubisse-Turiscai Road applies to Class-C Road standard due to existing narrow road width and widening about 2.0 m for existing road, 1.0 m road shoulder + 2.5 m travelled way + 1.0 m road shoulder = Total width 4.5 m.

- Existing road has many small curve lines, and new horizontal alignment has short-cut at small curve lines

Coarse Aggregate in Maubisse-Turiscai

- Issue of coarse aggregate is whether aggregate is easy to be soil, which is more than 30 % of Method for rock slaking test and more than 50 % of Method for rock crushed test.

White stone seems to be hard and no problem for coarse aggregate. It is better to do test.

Landslide in Maubisse-Turiscai

- There is a land slide area in Maubisse-Turiscai, which slope is protected by gabion. We propose to pay attention low-angle cut and cut speed.
- Source of Landslide explanation is "Slope Protection Guideline 2008", saved in ADN Wiki Server, as following next sheets.

Type of Landslide

- Three general types of land slides are most commonly encountered in highways:

(1) Movement involving **surface** material

(2) Movement involving **deep seated soft soils**

(3) Movement involving **rock strata**

Survey on Landslide

- Desk Study
- Reconnaissance Survey
- Detailed Survey
- Topography Survey
- Geotechnical Survey
- **Drain Survey**
- Environmental Survey
- **Slope Failure Survey**

Drainage Survey

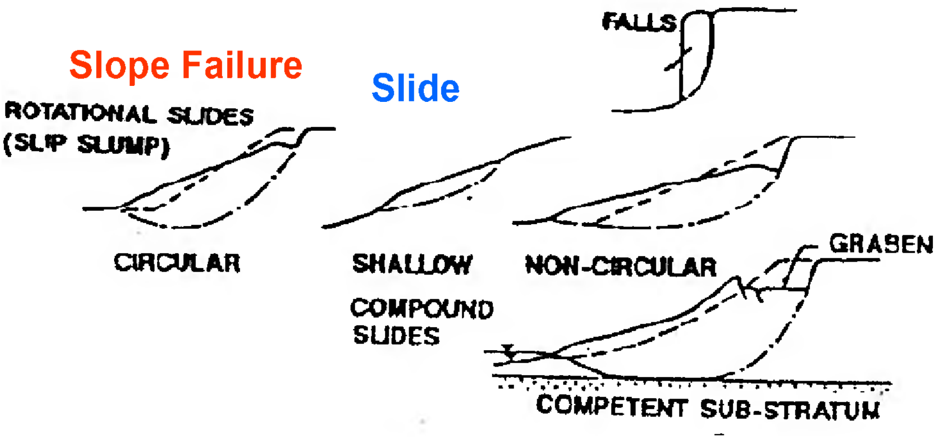
(1) Design concept of the drainage system within problems area
(2) Rainfall intensity
(3) Estimation of catchment area
(4) Type of land use and environment condition

Type of Landslide

(1) Landslide --- **Slower** Movement
(2) Mass Movement --- Take place **suddenly**
(2)-1. Slope Failure --- at Slope
(2)-2. Mudflow or Debris Flow (Sabo) --- at Sabo area

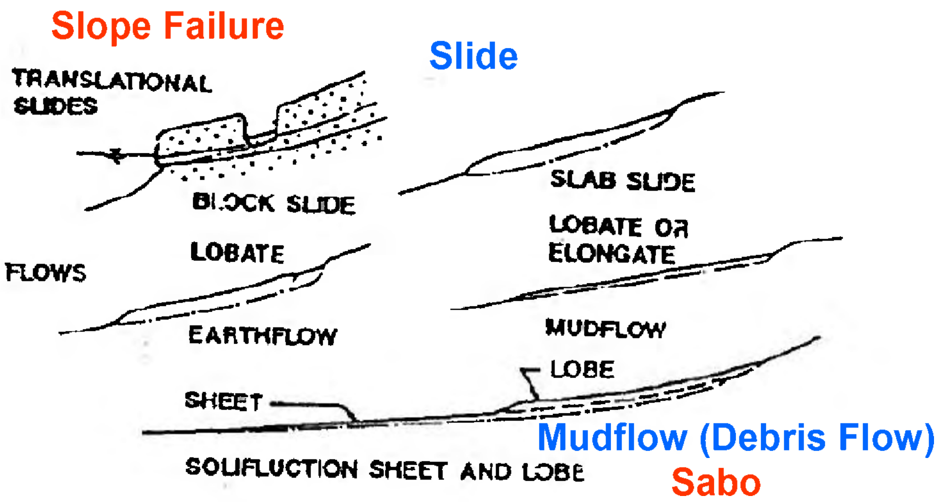
In Japan, Landslide are distinguished between 1) Landslide, 2) Slope Failure and 3) Debris Flow.

Basic Type of **Mass Movement** on Clay Slope



(For Slope Failure Survey)

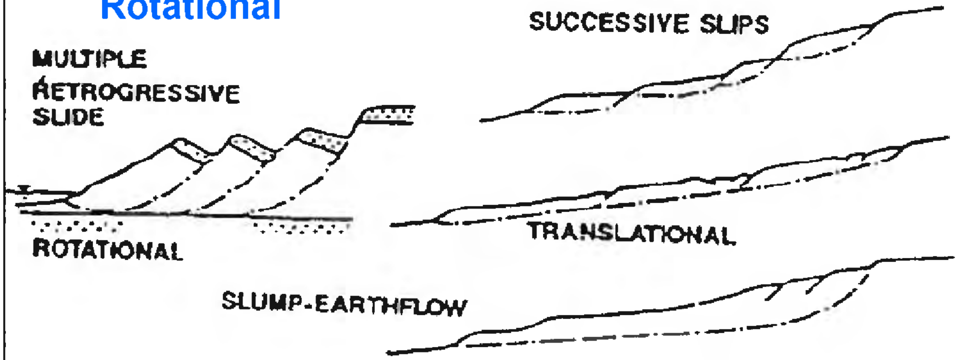
Basic Type of **Mass Movement** on Clay Slope (Contin.)



Typical **Landslide**

Slip & translational

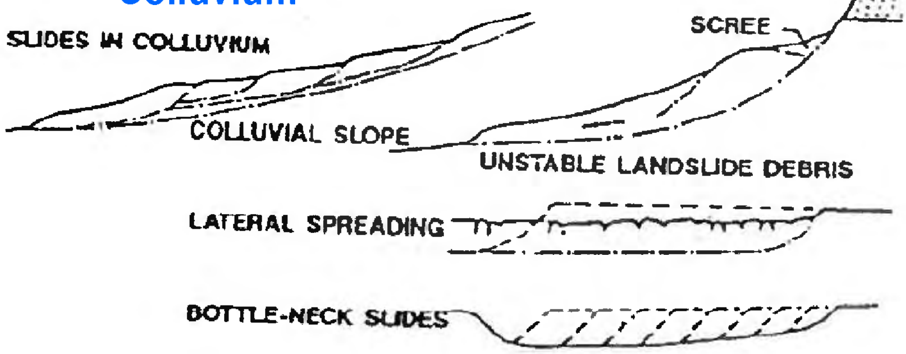
Rotational



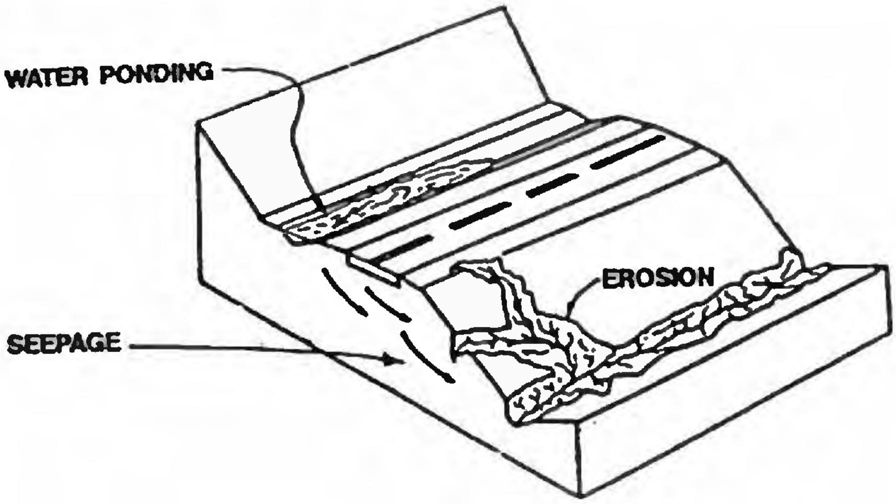
Landslide

Typical **Landslide** (contin.)

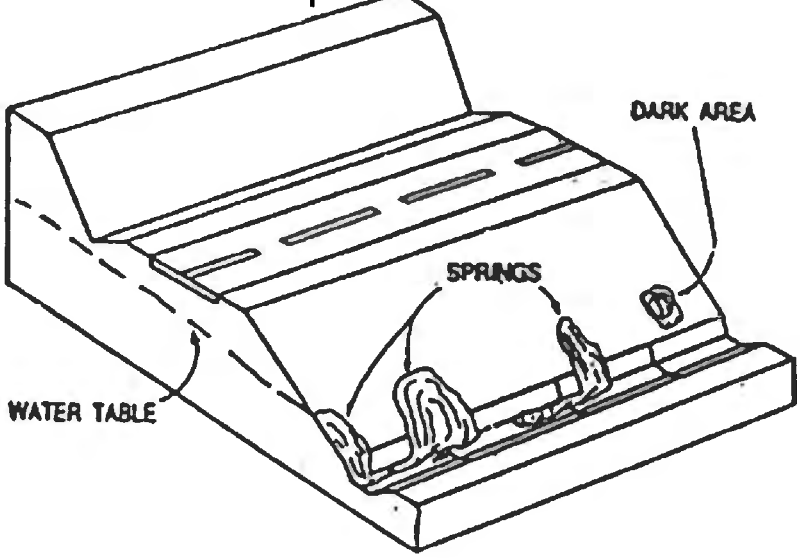
Colluvium



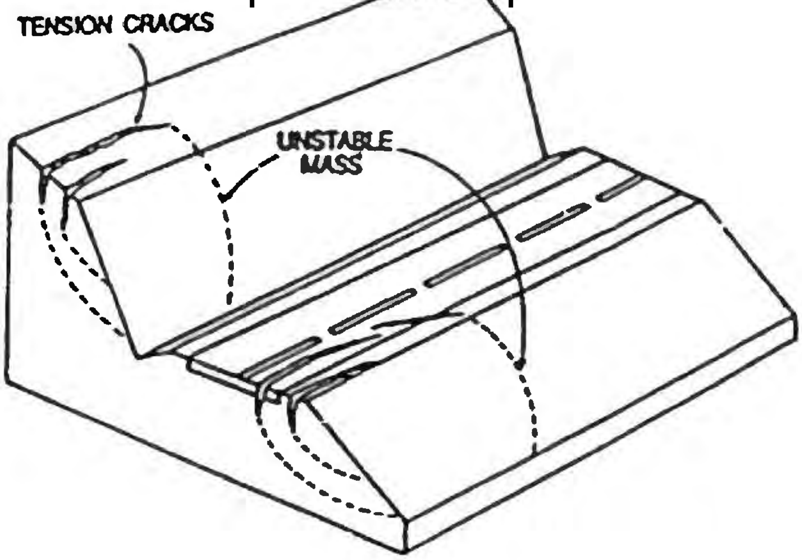
Typical Landslide due to poor drainage



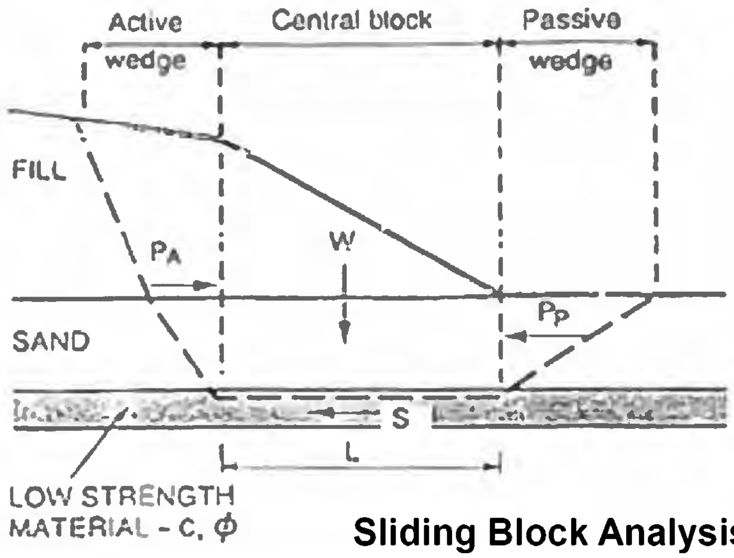
Typical Slope Failure due to spring problem



Development of Tension Crack at top of cut slope

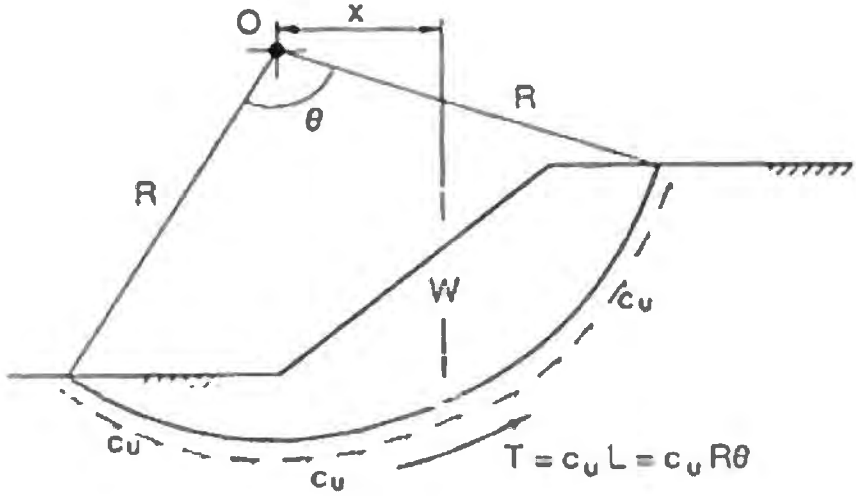


Slope Stability Analysis (1)



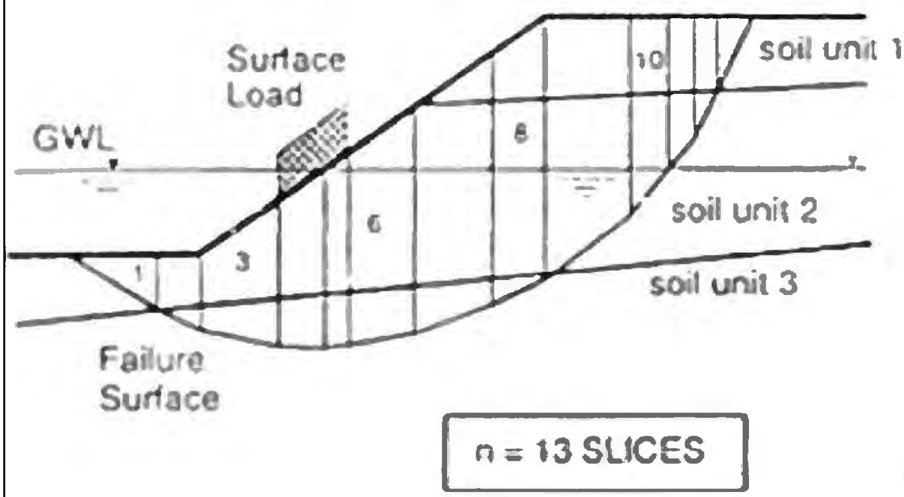
Sliding Block Analysis

Slope Stability Analysis (2)



Circular Surface Analysis

Slope Stability Analysis (3)

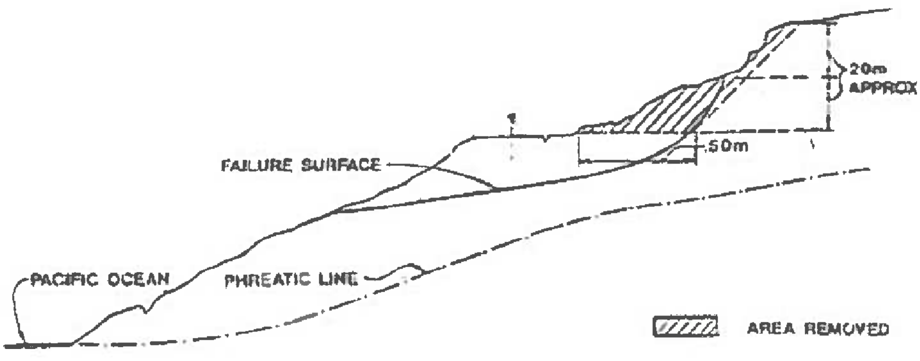


Slice Method

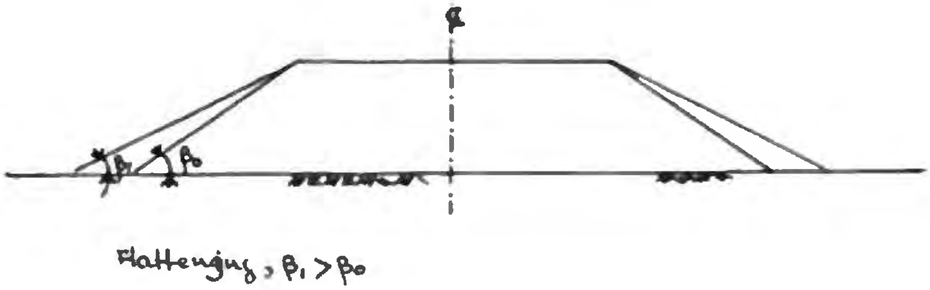
Slope Protection Method

(1) Unloading
(2) Construction of Drainage System
(3) Construction of Retaining Structures
(4) Other Methods

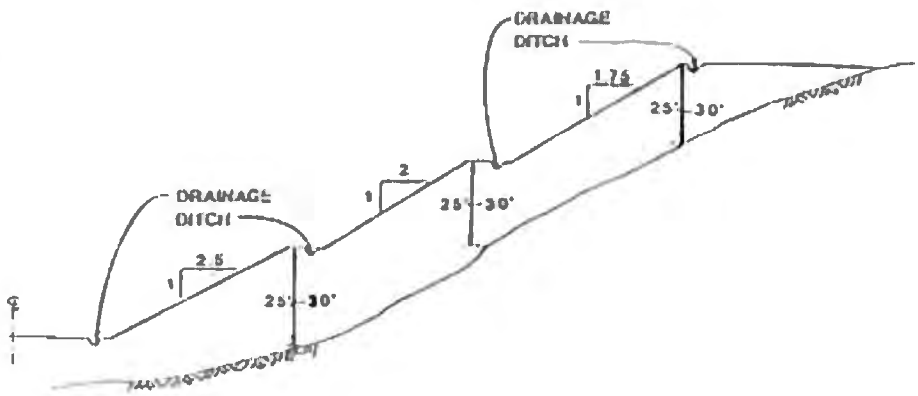
Removing Material from Slope Head



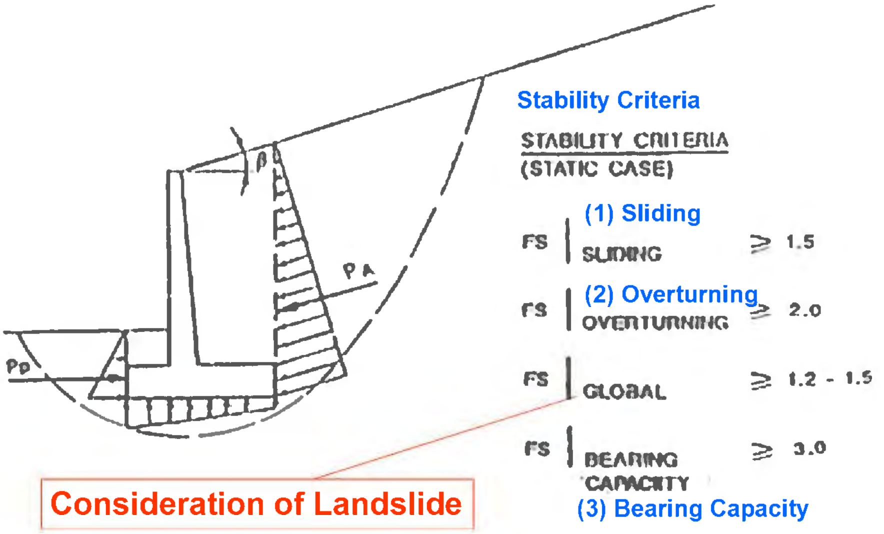
Slope Flattening in Embankment Slope



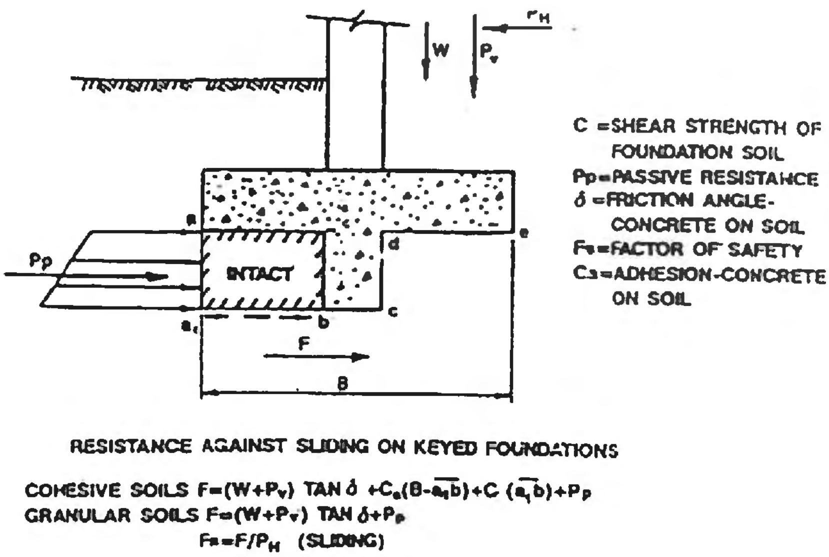
Terracing in Slopping Ground



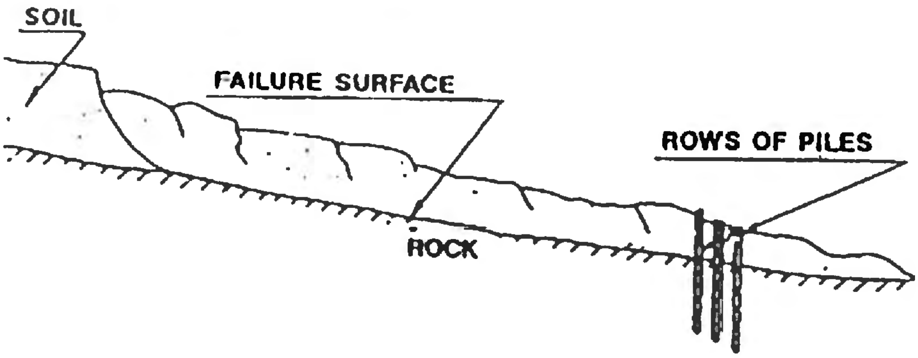
Requirement for Safety Factor on Retaining Wall



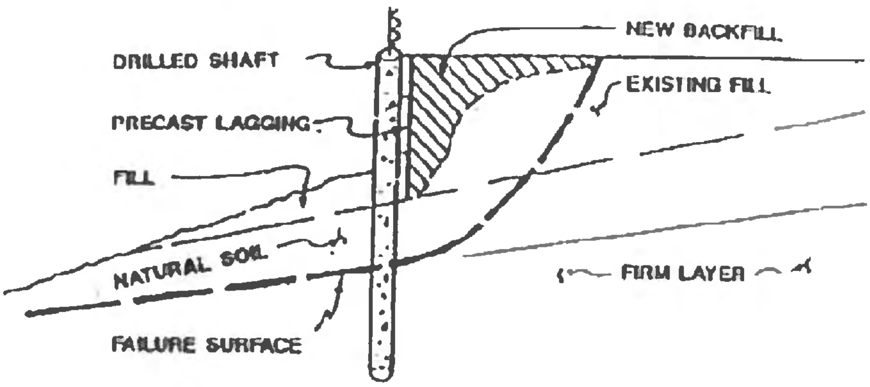
Gravity and Cantilever Retaining Wall



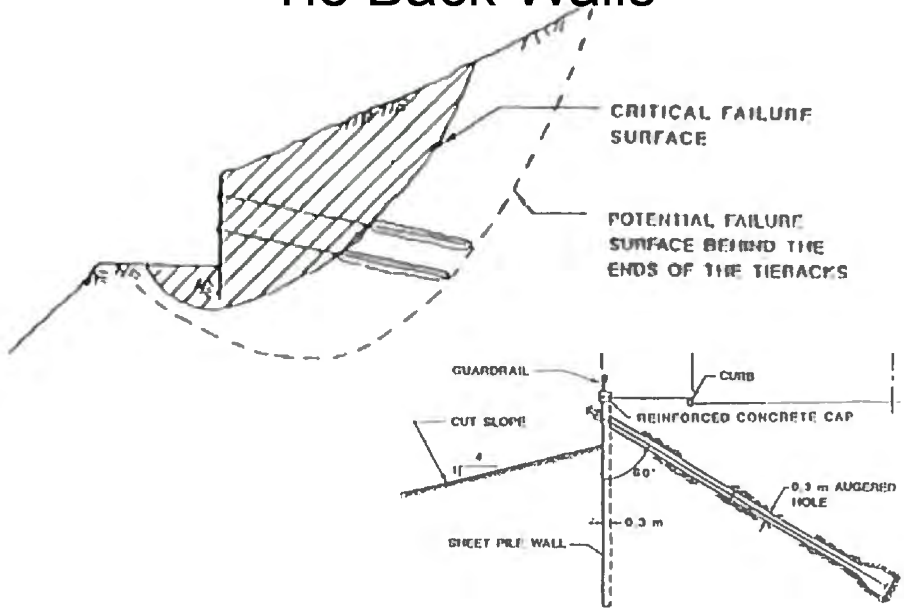
Driven Piles to Stabilize Slope



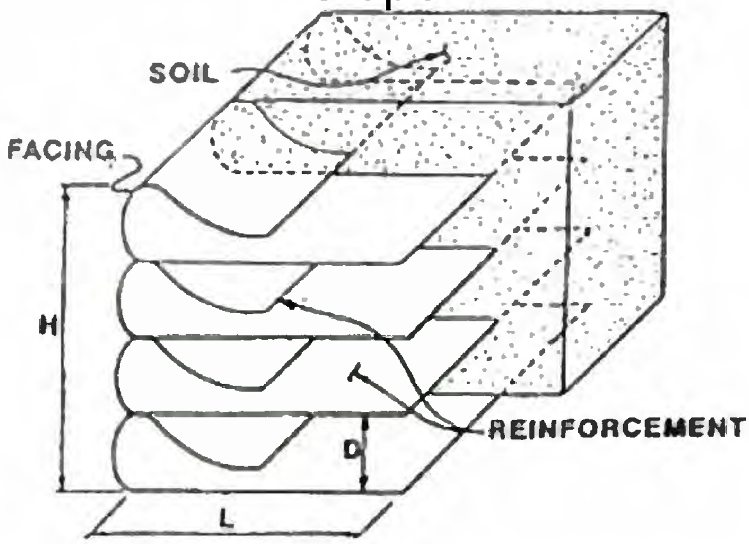
Drilled Shaft Wall



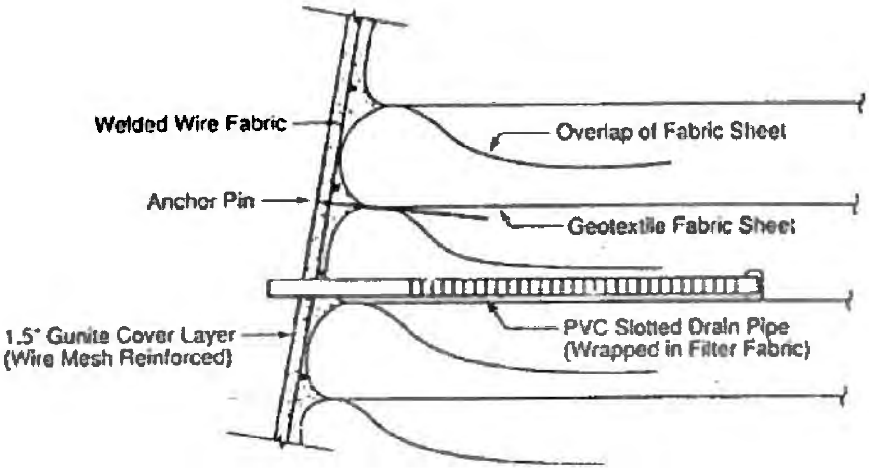
Tie Back Walls



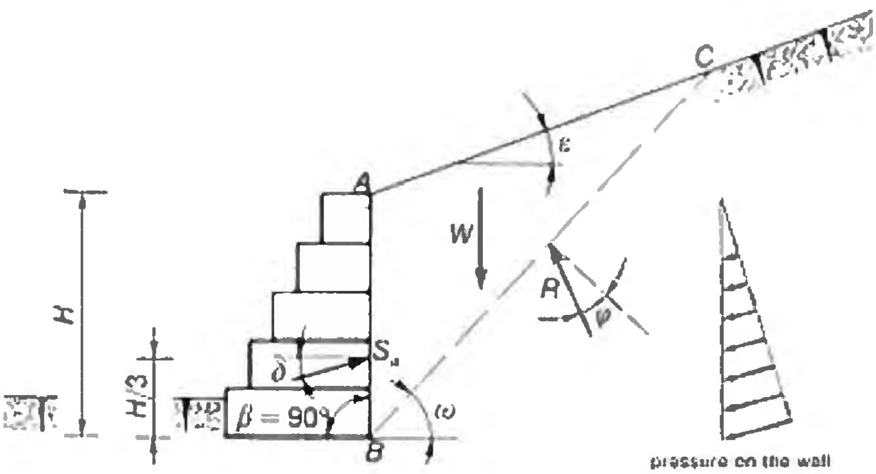
Geo-Synthetic Fiber Reinforced Slope



Geotextile Wall Detail

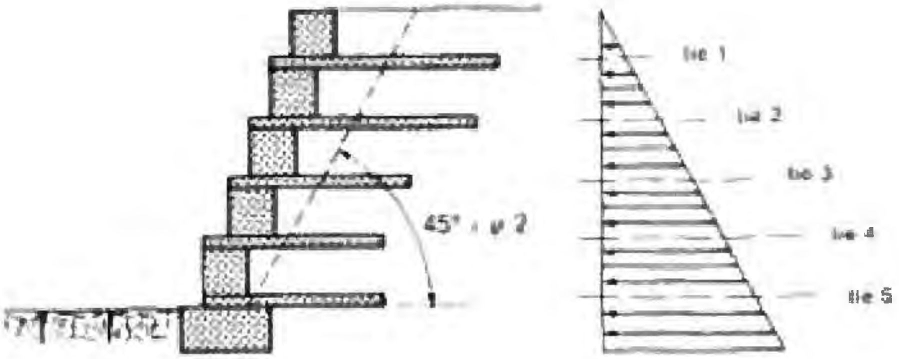


Gabion Retaining Structure



Flexibility Type

Soil Reinforcement Gabion



Flexibility Type

Next Schedule

3rd Road Class Room Lesson

Explanation of Drawings

(1) Drawing List, (2) Location Map, (3) Plan & Profile, (4) Cross Section, (5) Design Speed,

4th Road Class Room Lesson

(1) Road Structures (Culvert)

(2) Road Structures (Pipe)

Planning of Road (3)

1st Jun 2013

Verification of Drawings

ADN staffs must verify tender drawings through view point of following items, using ADN manual checklist page 9, (8) Drawings, P59, Checklist A, and Checklist C2.

Today's Lesson:
(1) Design Speed
(2) Drawing List,
(3) Location Map,
(4) Plan & Profile,
(5) Cross Section,

(1) Design Speed

- Design speed is a selected speed used to determine the various geometric features of the roadway. The assumed design speed should be a logical one with respect to the **topography**, anticipated **operating speed**, the adjacent **land use**, and the **functional classification** of the highway.

Design Speed in Japan

Type of Roadway	Classification	Grade	Design Speed		Traffic Volume (vehicles/day)			
					> 30,000	30,000–20,000	20,000–10,000	< 10,000
Highway / Express Way	1	1	120	100	Flat			
		2	100	80	Mountainous	Flat		
		3	80	60		Mountainous		Flat
		4	60	50				Mountainous
	2	1	80	60	Exclusive National Road			
		2	60	40	Urban			

(Source: Express Highway Design Standard of NEXCO, Japan)

(2) Drawing List

- Check the drawing list requiring the coincident of BoQ.
- Usually drawings of road have these contents as below:

1) Location Map
2) Plan & Profile
3) Cross Section
4) Structure of Road

Suai – Beaco Highway Road Project Drawings List

A. General
B. Typical Cross Section
C. Alignment Layout and Curve Data
D. Plan & Profile
E. Structure (includes Bridge)
F. Drainage
G. Standard (Traffic Sign, Lighting, etc.)

(3) Location Map

Consider below, seeing Location Map

(1) Detail Design require the coincidence of Feasibility study or Master Plan.

(2) Check the land use, environmental & social impact, interference obstacles, note on construction and flood at site survey.

(3) Check the land acquisition and Right of Way (ROW).

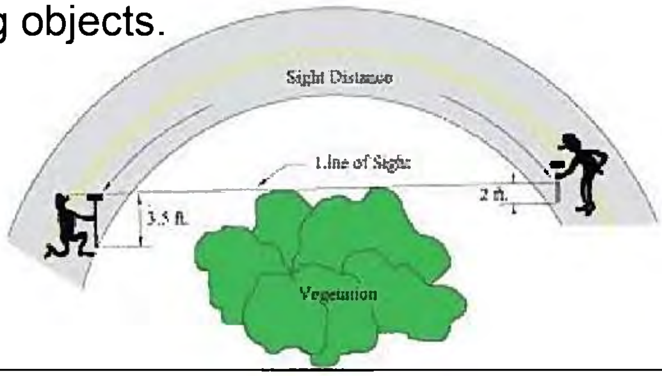
(4) Check the area of landslide or another issue of soil condition.

(4) Plan & Profile

A. Sight Distance
B. Super-elevation
C. Radius of Horizontal Curve
D. Clothoid Curve
E. Vertical Slope
F. Radius of Vertical Curve
G. Note of bad profile design
H. Note of bad combination of vertical Curve and Horizontal Curve

A. Sight Distance

Sight distance available from a point is the actual distance along the road surface, over which a driver from a specified height above the carriage way has visibility of stationary or moving objects.



Sight Distance in Japan

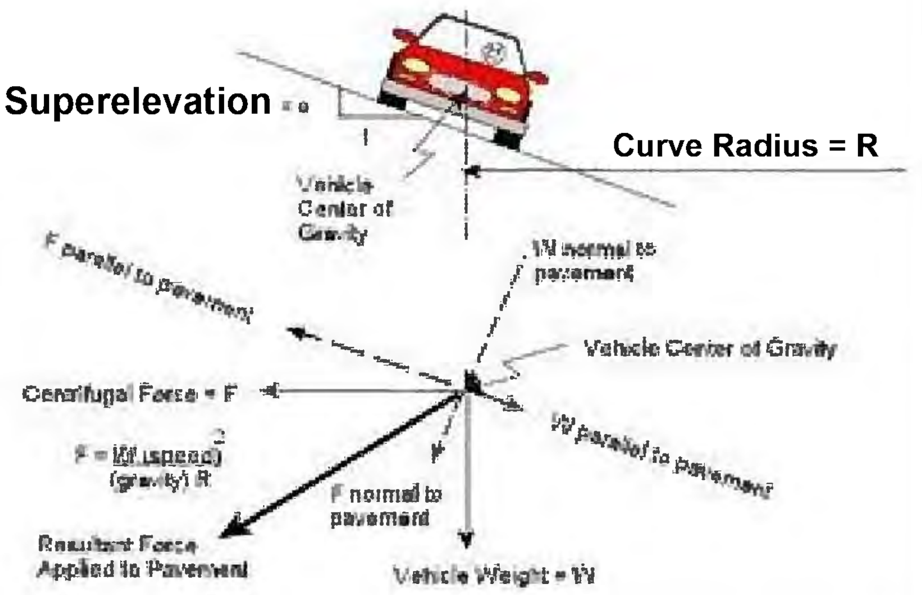
Design Speed (km/h)	Traffic Speed (km/h)	Idle running time (sec)	Friction coefficient	Stopping sight distance (m)	Sight Distance (m)
120	102	2.5	0.29	212	210
100	85	2.5	0.3	154	160
80	68	2.5	0.31	100	110
60	54	2.5	0.33	72	75
50	45	2.5	0.35	54	55

(source: Express Highway Design Standard of NEXCO, Japan)

B. Superelevation

(1) Superelevation is the rotation of the pavement on the approach to and through a horizontal curve.

(2) Superelevation is intended to assist the driver by counteracting the lateral acceleration produced by tracking the curve.

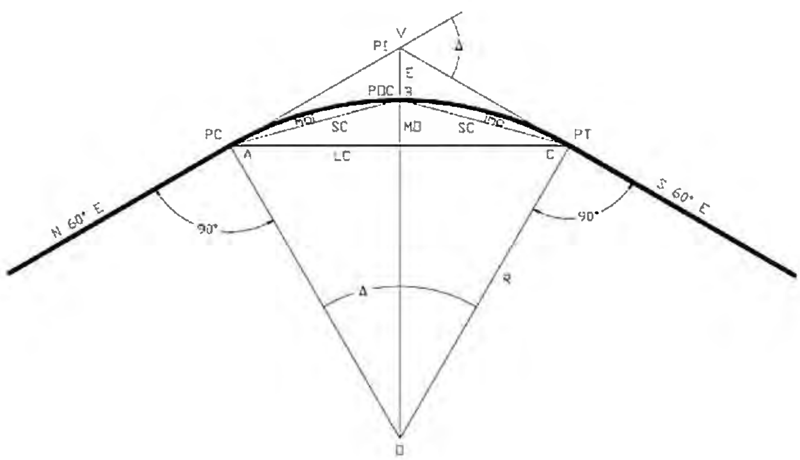


Superelevation in Japan

Design Speed	120 km/h	100 km/h	80 km/h	60 km/h	50 km/h	Superelevation (%)
Radius of Curve (m)	1,140 ＞ ＞ 1,040	870 ＞ ＞ 960	630 ＞ ＞ 710	350 ＞ ＞ 390	240 ＞ ＞ 270	6.00%
	1,380 ＞ ＞ 1,540	1,060 ＞ ＞ 1,200	790 ＞ ＞ 900	440 ＞ ＞ 500	300 ＞ ＞ 350	5.00%
	1,740 ＞ ＞ 1,980	1,360 ＞ ＞ 1,560	1,030 ＞ ＞ 1,190	570 ＞ ＞ 660	400 ＞ ＞ 460	4.00%
	2,310 ＞ ＞ 2,750	1,820 ＞ ＞ 2,180	1,400 ＞ ＞ 1,680	780 ＞ ＞ 940	540 ＞ ＞ 650	3.00%
	＞ 3,390	＞ 2,700	＞ 2,090	＞ 1,170	＞ 810	2.00%

(source: Express Highway Design Standard of NEXCO, Japan)

C. Radius of Horizontal Curve

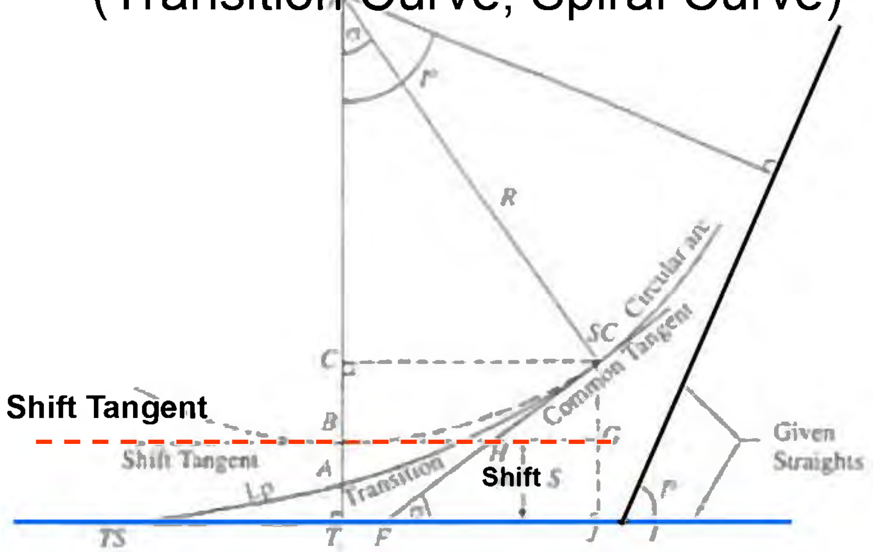


Radius of Horizontal Curve in Japan

Design Speed	Desirable Minimum Radius of Curve	Minimum Radius of Curve	
		Superelevation = 8 %	Superelevation = 6 %
120	1,000	630	710
100	700	410	460
80	400	250	280
60	200	140	150
50	150	90	100

(source: Express Highway Design Standard of NEXCO, Japan)

D. Clothoid Curve (Transition Curve, Spiral Curve)



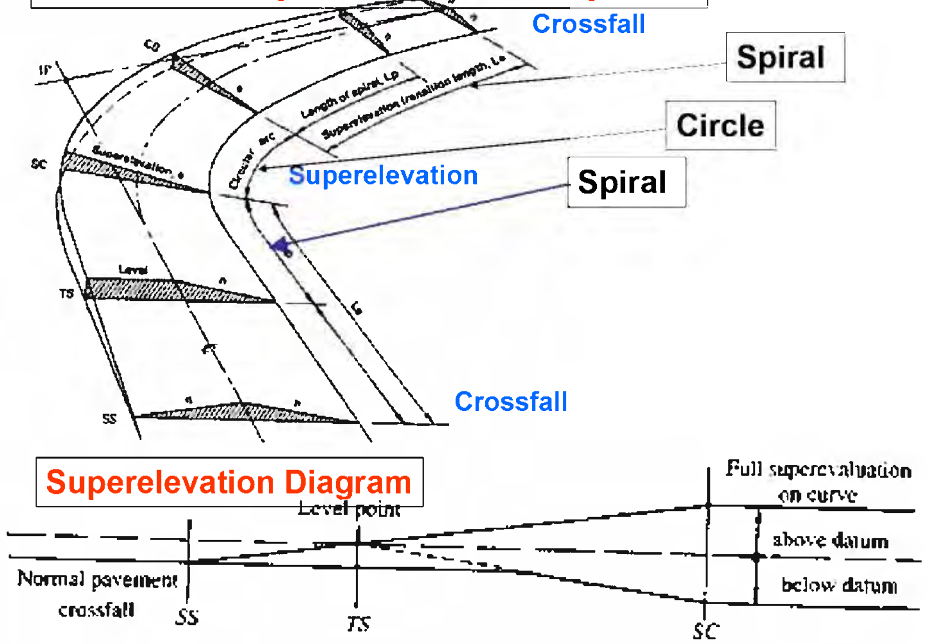
Purpose of Clothoid Curve (Transition Curve, Spiral Curve)

(1) Provides path for vehicle to move from straight to a circular curve

(2) Improved appearance of curve to driver due to smooth steering

(3) Allows introduction of superelevation and pavement widening

Curve of "Spiral – Circle- Spiral"

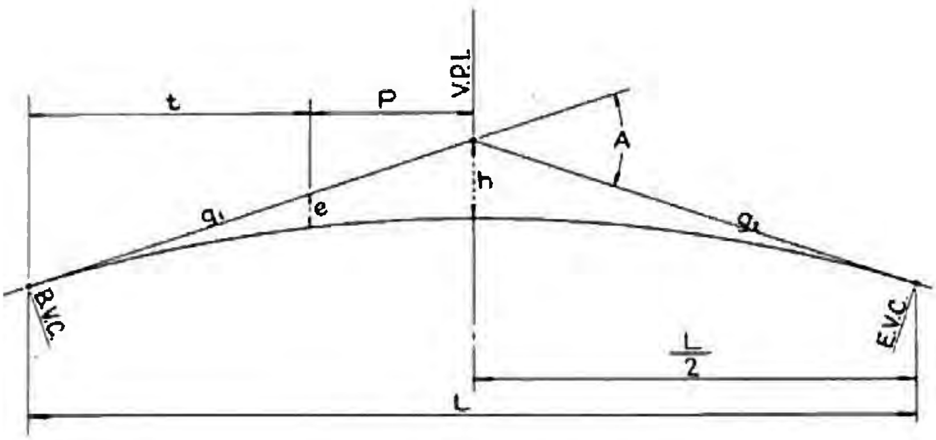


E. Vertical Slope

Design Speed (km/h)	Maximum Grade (Vertical Slope) (%)
120	2
100	3
80	4
60	5
50	6

(source: Express Highway Design Standard of NEXCO, Japan)

F. Radius of Vertical Curve



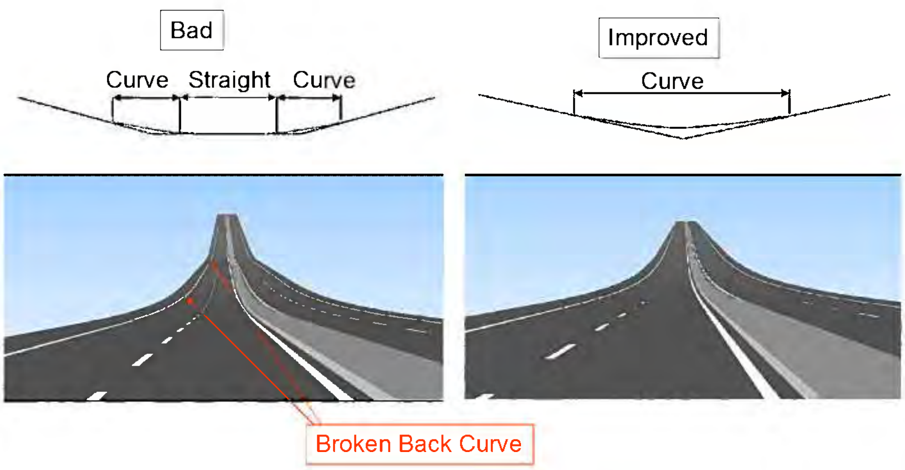
h = Vertical distance from point of intersection to the curve.
L = Vertical curve length.

Minimum Vertical Curve Length (VC)

Design Speed (km/h)	Minimum Vertical Curve Length (m)
120	100
100	85
80	70
60	50
50	40

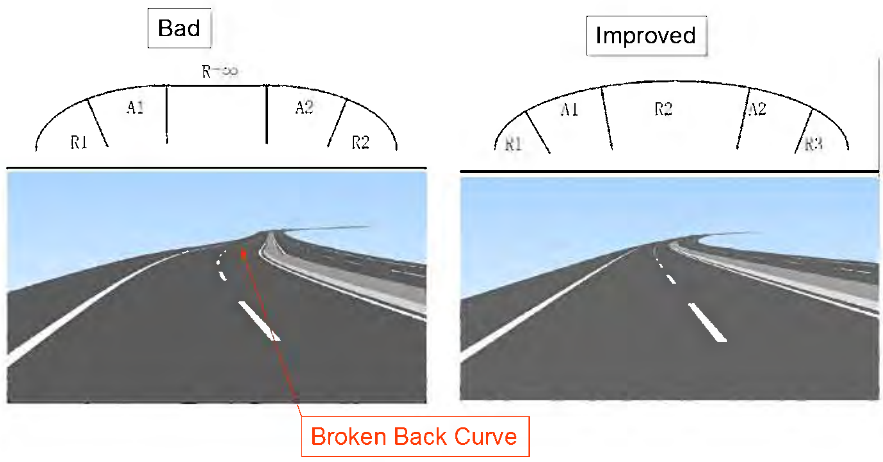
(source: Express Highway Design Standard of NEXCO, Japan)

G. Note of bad profile design



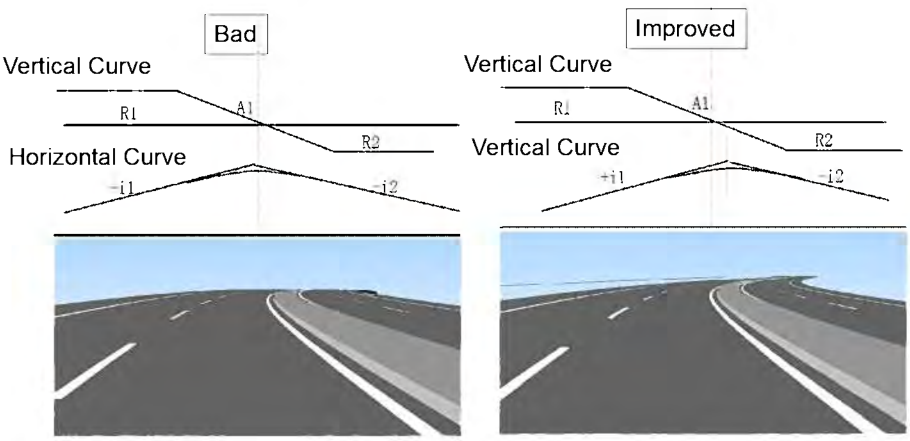
(source: Express Highway Design Standard of NEXCO, Japan)

H. Note of bad Alignment Layout design



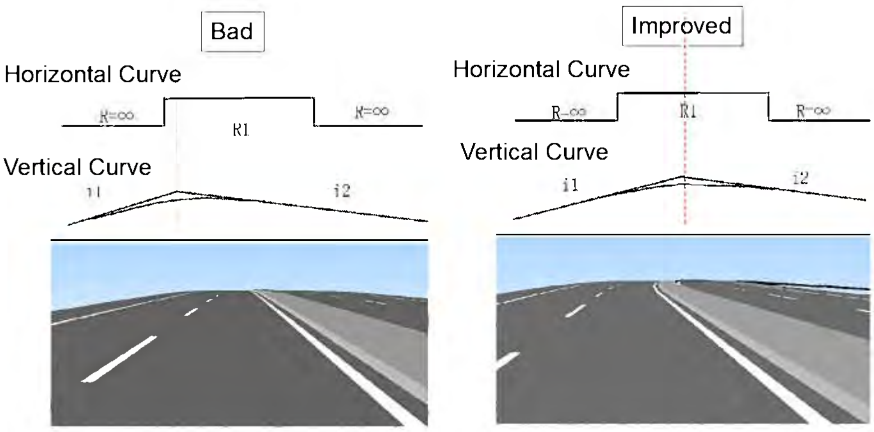
(source: Express Highway Design Standard of NEXCO, Japan)

I. Note of bad combination of vertical Curve and Horizontal Curve



(source: Express Highway Design Standard of NEXCO, Japan)

J. Note of bad combination of vertical Curve and Horizontal Curve



(source: Express Highway Design Standard of NEXCO, Japan)

(5) Cross Section

1) Road width
2) Pavement type (AC / DBST)
 AC: Asphalt Concrete
 DBST: Double Bituminus
3) Slope Angle on Cut Area / Fill Area / Embankment Area
4) ROW (Right of Way)
5) Drainage
6) Guardrail

(6) Structure of Road

1) Proposed Bridge / Existing Bridge
2) Proposed Box Culvert / Existing Box Culvert
3) Proposed RCP / Existing RCP (Pipe)
4) Proposed Drainage / Existing Drainage
5) Electric Pole / Telephone Pole
6) Water Supply Pipe
7) Traffic Light
8) Guardrail / Concrete Barrier

Next Schedule

4th Road Class Room Lesson
Analysis, Design, Re-bar, Dimension on
(1) Road Structures (Culvert)
(2) Road Structures (Retaining Wall)

5th Road Class Room Lesson
Construction of Road, Pavement

Planning of Road (4)

8th Jun 2013

Verification of Drawings

ADN staffs must verify tender drawings through view point of following items, using ADN manual checklist page 9, (8) Drawings, P59, Checklist A, and Checklist C2.

Today's Lesson:
(1) Soil Condition
(2) Design of Retaining Wall & Re-bar
(3) Design of Box Culvert
(4) Landslide

(1) Soil Condition

1) Drained Strength of **Cohesive Soils (Clay)**

Long-term effective stress strength parameters, c' and φ', of clays should be evaluated by slow consolidated drained direct shear box tests, consolidated drained (CD) trialxial tests, or consolidated undrained (CU) triaxial tests with pore pressure measurements.

Where;

c' : Cohesion of soil

φ': Angle of internal friction of drained soil (degrees)

(1) Soil Condition (contin.)

2) Drained Strength of **Granular Soils (Sand)**

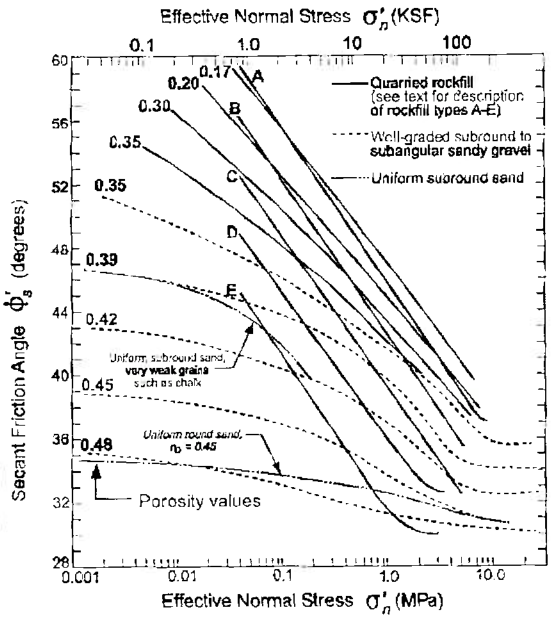
The drained friction angle of granular deposits should be evaluated by correlation to the results of SPT (Standard Penetration Test: N-value) testing, CPT (Cone Penetration Test) testing, or other relevant in-situ tests.

N = SPT blow count corrected for hammer efficiency (blows/ft, or blows/30 cm)

[foot = 30.48 cm]

- For **gravels** and **rock** fill materials where SPT testing is not reliable.
- This figure should be used.

Rock Fill Grade	Particle Unconfined Compressive Strength (ksf)
A	>4610
B	3460–4610
C	2590–3460
D	1730–2590
E	≤1730



(source: AASHTO LRFD BRIDGE DESIGN SPECIFICATION 10.18, 2010)

(2) Design of Retaining Wall

Foundation of Retaining Wall

- Spread Footings

Spread footings shall be proportioned and designed such that the supporting soil or rock provides adequate nominal resistance, considering both the potential for adequate bearing strength and the potential for settlement.

1. Overturning (Eccentricity)
2. Sliding
3. Uplift
4. Overall stability (Bearing strength & settlement)
5. loss of lateral support (Landslide)

Bearing Depth

- Where the potential for scour, erosion or undermining exists, spread footings shall be located to bear below the maximum anticipated depth of scour, erosion, or underminings.

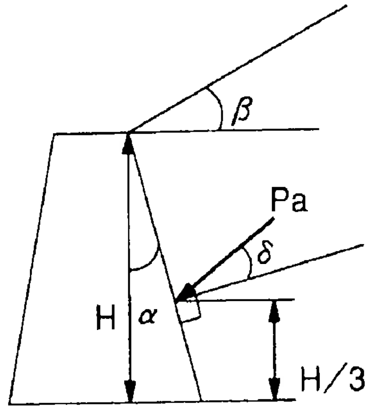
Bearing Layer

- **Sandy soil and gravel layers** may be regarded as good-quality **bearing layers** if their N value (SPT) is approximately equal to or larger than **30.**
- Regarding small retaining wall, Bearing layers of **Sandy soil and gravel layers** may be **20** of STP.
- **Cohesive soil layers** may be supposed to be good-quality bearing layers, if the N value is approximately equal to or larger than **20**. Unconfined compression strength Qu is more than about 0.4 N/mm2.

(source: Specifications for Highway Bridges Part IV Substructures, Japan)

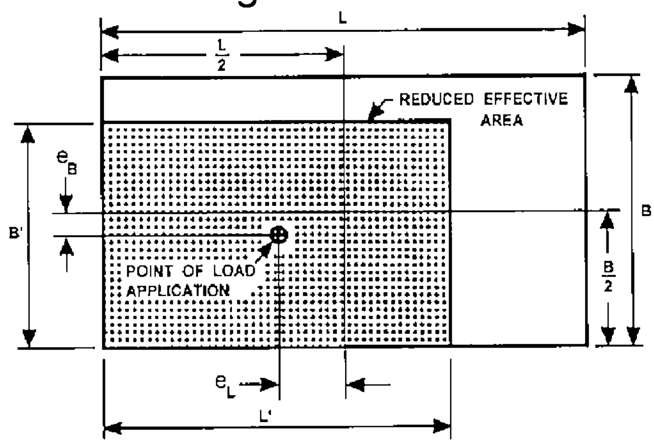
Stability Analysis of Retaining Wall

- Earth Pressure of Coulomb Theory



Effective Footing Dimensions

- The reduced dimensions for an eccentrically loaded rectangular footing are shown in figure.



Settlement of Spread Footing

Foundation settlements should be estimated using computational methods based on the results of laboratory or in-situ testing, or both.

Total settlement includes elastic, consolidation, and secondary components.

Elastic settlement is instantaneous deformation as the soil is loaded.

Consolidation settlement is the most important deformation consideration in cohesive soil deposits.

Secondary settlement is of principal concern in highly plastic or organic soil deposits

Bearing Resistance of Spread Footings

- The position of the **groundwater** table can significantly influence the bearing resistance of soils.
- In general, the **submergence** of soils will reduce the effective shear strength of cohesionless (or granular) materials, as well as the long-term shear strength of cohesive (clay) soils.

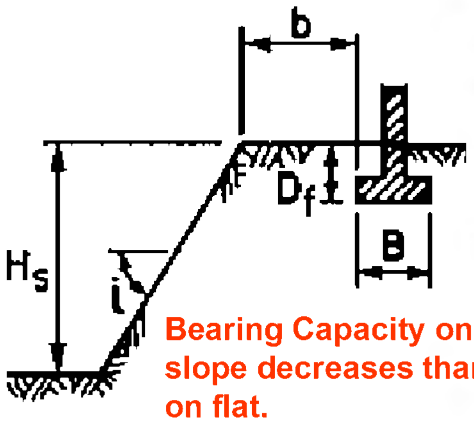
Bearing Resistance of Spread Footings (contin.)

- The bearing resistance formulation provided in bellow equations is the complete formulation.

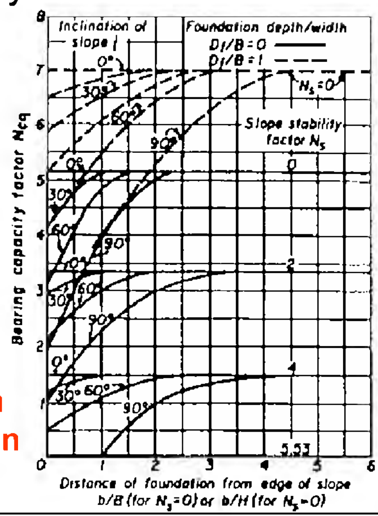
$$q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + 0.5\gamma \quad BN_{\gamma m} C_{w\gamma}$$

Considerations for Footings on Slopes

Modified Bearing Capacity Factors should be used at near slope.



Bearing Capacity on slope decreases than on flat.



Driven Piles

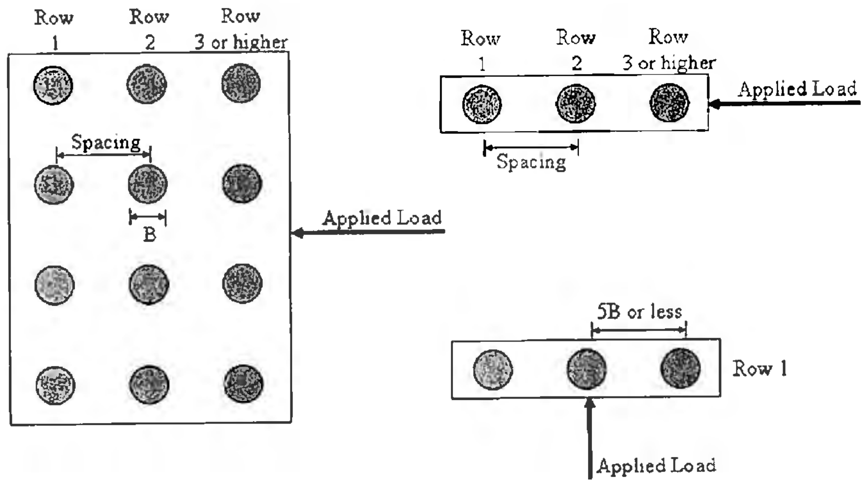
Driven piling should be considered in the following situations:

1) When spread footings **cannot be founded on rock, or on competent soils** at a reasonable cost,
2) At locations where soil conditions would normally permit the use of spread footings but the potential exists for **scour**, liquefaction or lateral spreading, in which case driven piles bearing on suitable materials below susceptible soils should be considered for use **as a protection** against these problems,
3) Where right-of-way or other **space limitations** would not allow the use spread footings, or
4) Where an unacceptable amount of **settlement** of spread footings may occur.

Minimum Pile Spacing, Clearance, and Embedment into Cap

- Center-to-center pile spacing should not be less than 30.0 in. or 2.5 pile diameters.
- The distance from the side any pile to the nearest edge of the pile cap shall not be less than 9.0 in.
- The tops of piles shall project at least 12.0 in. into the pile cap after all damaged material has been removed.

Definition of Loading Direction and Spacing for Group Effects of Piles



Determination of Nominal Bearing Resistance for Piles

1) Static Load Test
2) Dynamic Testing
3) Wave Equation Analysis
4) Dynamic Formula
5) **Static Analysis** **---Design Report**

(Bearing Resistance of Piles) = (Resistance Factor) x ((Pile Tip Resistance) + (Pile Side Resistance))

Using SPT or CPT data **---Design Report**

Drilled Shafts

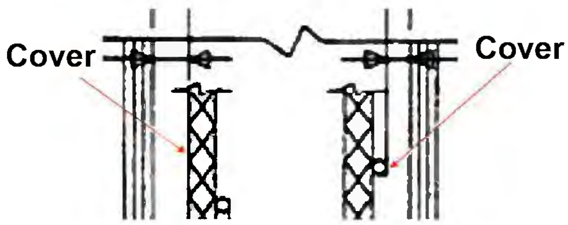
Drilled shafts may be an economical alternative to spread footing or pile foundations, particularly when spread footings can not be founded suitable soul or rock strata **within a reasonable depth** or when driven piles are **not viable**.

Drilled shafts may be an economical alternative to spread footings where **scour depth** is large. Drill shafts may also be considered to **resist high lateral or axial loads**, or when deformation tolerances are small.

Re-Bar (Reinforcement Bar)

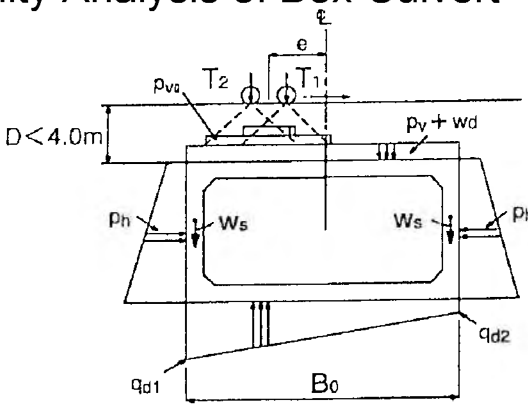
Cover : The least distance between the surface of the reinforcement and the outer surface of the concrete. Check Drawings.

Spacer (Cover Block) : Device that maintains reinforcement in proper position, also a device for keeping wall forms apart at a given distance before and during concreting.



(3) Design of Box Culvert

- Stability Analysis of Box Culvert



Box Culvert is more stable than retaining wall on earth pressure.

Failure Mode of Box Culvert

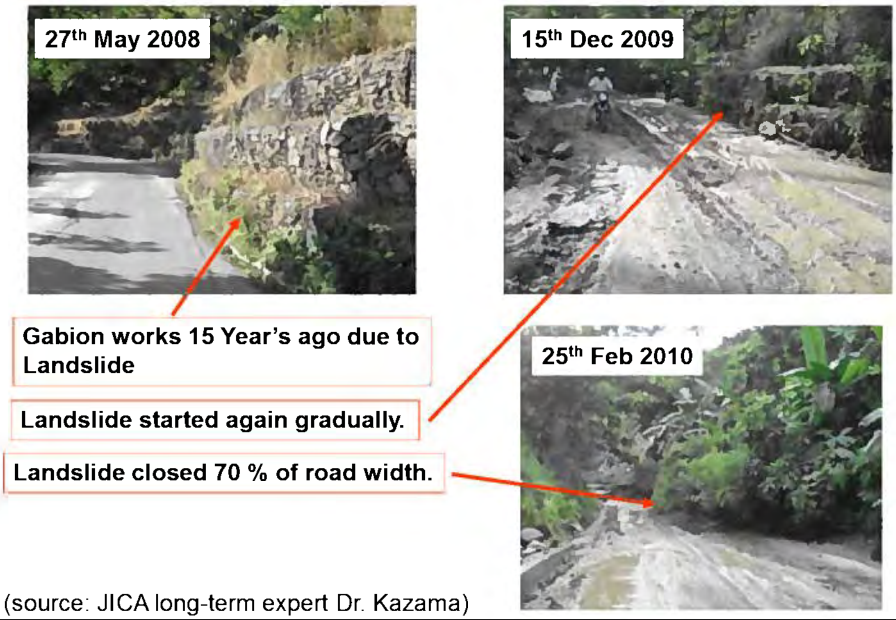
Existing Box Culvert was washed out during flood.

The reason is small cross section of Box Culvert against debris during flood.
Width of new box culvert needs minimum 3.00 m because existing tributary width is 3.00 m.

(4) Landslide

Landslide is in Maubisse on National Road A02.

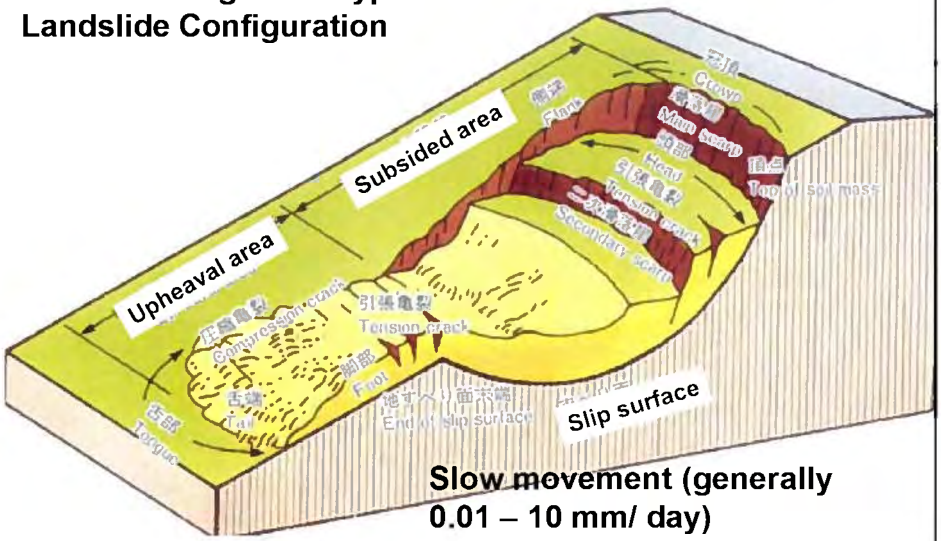
Landslide is in Dili on National Road A01.



(source: JICA long-term expert Dr. Kazama)

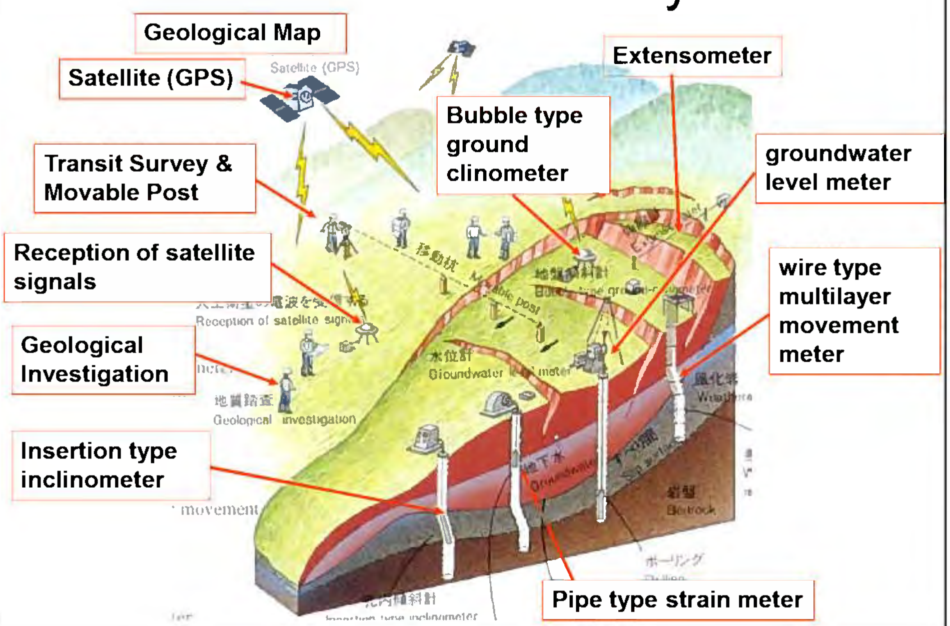
Mechanism of Landslides

Schematic Figure of Typical Landslide Configuration

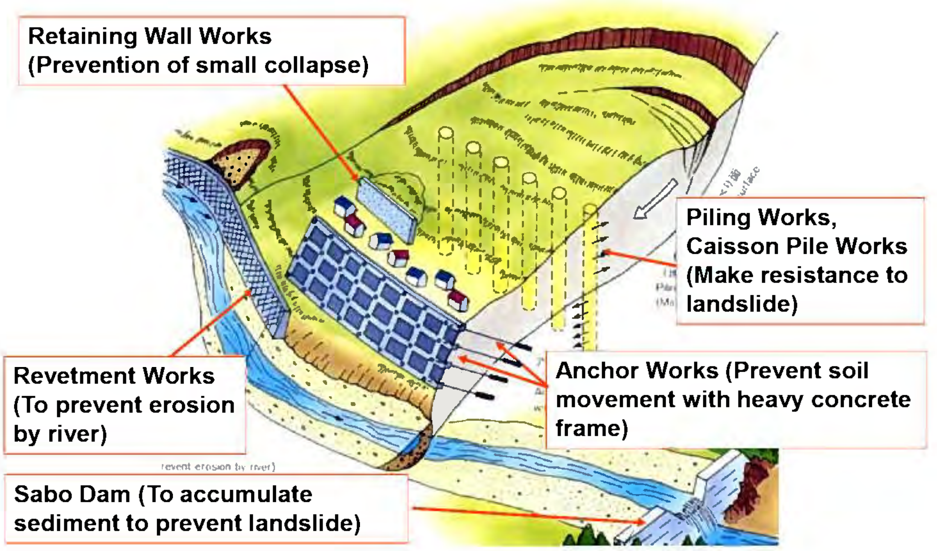


Slow movement (generally 0.01 – 10 mm/ day)

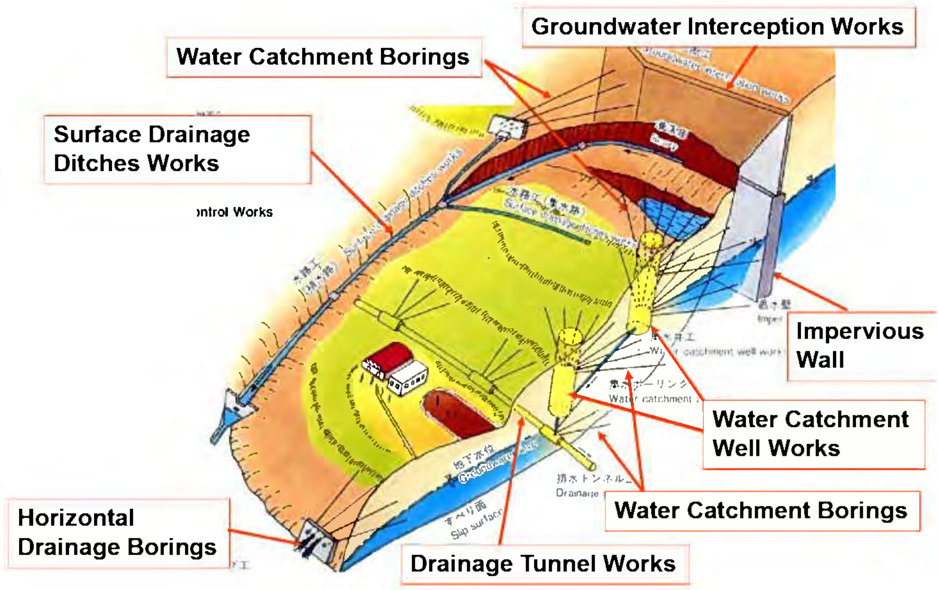
Landslide Survey



Restraint Works to Mechanically Stop Landslide



Control Works Mainly Aiming at Water Control

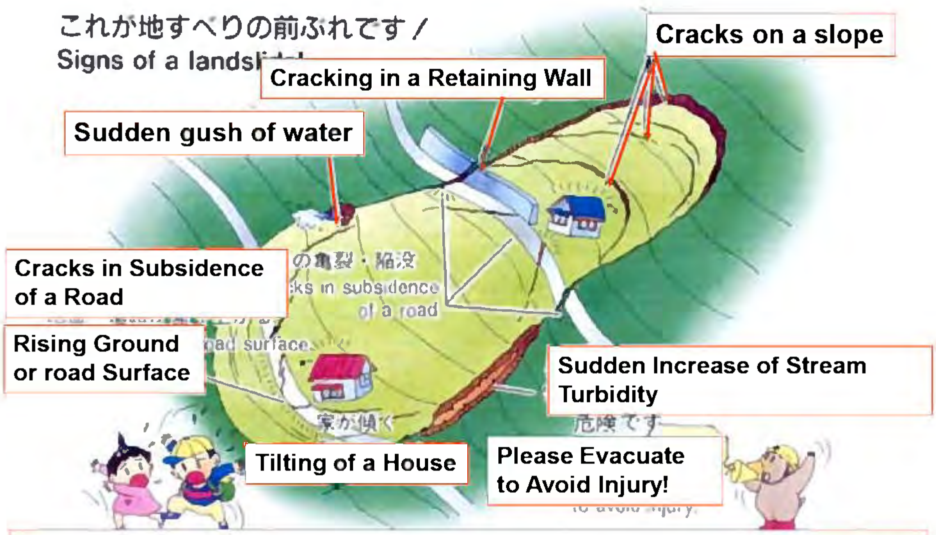


Jizukiyama Landslide in Japan, 1990

Landslide Disaster 1990

After Completion of Prevention Works

Signs of a Landslide



Activities which may cause or aggravate a landslide are restricted within landslide-threatened areas

Next Schedule

5th Road Class Room Lesson
Construction of Road, Pavement

6th Road Class Room Lesson
Construction of Road Structure (Retaining Wall, Gabion, Box Culvert)

Planning of Road (5)

22nd Jun 2013

Verification of Drawings

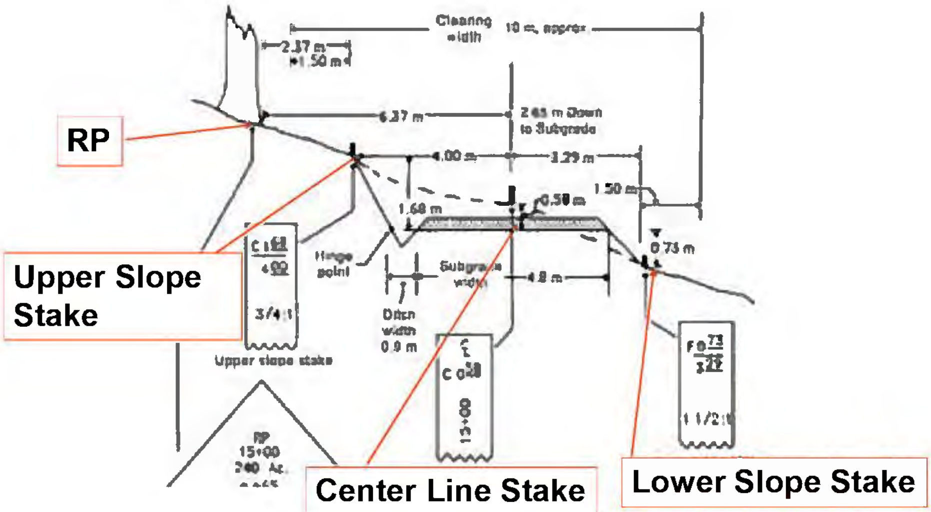
ADN staffs must verify tender drawings through view point of following items, using ADN manual checklist.

Today's Lesson:
(1) Construction & Payment of Road
(2) Construction & Payment of Pavement

Construction Staking

- Prior to the construction activity, the design information has to be moved from plan to the ground. This is accomplished by staking.
- **Stakes** is wooden pile, about 50 cm length.
- Stakes are used by the equipment operator in locating where to begin cutting.
- In order to relocate the stakes (centerline, slope stakes), it is helpful to establish **reference points (RP)** outside the clearing limits. Reference points should be set at least 3 to 5 meters behind the uphill clearing limits.

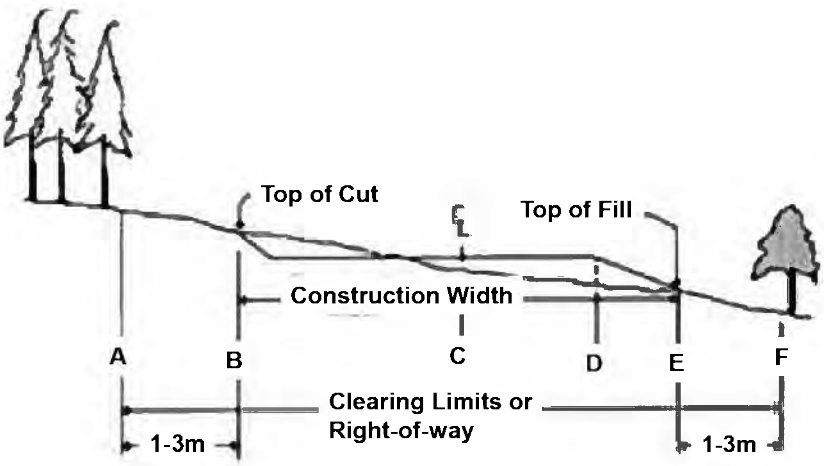
- The use of RP's (Reference Points) or slope stakes for proper excavation is shown in bellow figure.



Clearing and Grubbing of the Road Construction Area

- Preparing the road **right-of-way** or **construction area** is referred to as clearing and grubbing.
- During the clearing phase, tree are felled. Grubbing refers to the clearing and removal of stumps and organic debris.
- **Trees** should be felled and cleared a minimum of **1 to 3 m** from the top of the cut or toe of fill.
- The logs can be decked outside the construction area or skidded away.

- Clearing limits in relation to road bed widths, significant quantities of organic materials are removed between B and E.



Payment of Clearing and Grubbing

Pay Item number	Description	Unit of Measurement
201(1)	Clearing and Grubbing	Hectare
201(2)	Clearing and Grubbing	Lump Sum
201(3)	Individual Removal of Trees, Small	Each
201(4)	Individual Removal of Trees, Large	Each

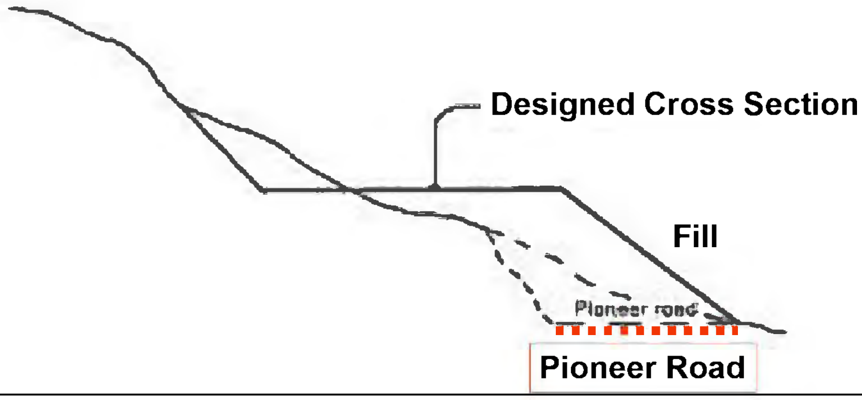
(source: MTCPW Standard Specifications, 2005)

Pioneer Road

- During the grubbing phase, or preparation phase, a pioneer road is often constructed to facilitate equipment access, logging equipment movement, and delivery of construction materials, such as culverts.
- This is often the case when construction activities are under way at several locations. If pioneer roads are constructed, they are often built at the top of the construction width and are usually nothing more than a bull dozer trail.

- When considerable side hill fill construction is planned, the dozer trail should be located at the **toe** or **base** of the proposed fill.

  Pioneer road at bottom of proposed fill provides a bench for holding fill material of completed road.



Break Up & Reclaim

- Road Reclaimer: Breaking up, reclaiming, recycling or milling

Payment of Removal of Structures and Obstructions

Pay Item number	Description	Unit of Measurement
202(1)	Removal of Structures and Obstructions	Lump Sum
202(2)	Removal of Structures and Obstructions (specific)	Each
202(3)	Removal of pavement, side walks, curbs, etc.	Square meter
202(4)	Removal of	Linear meter

(source: MTCPW Standard Specifications, 2005)

Bulldozer in Road Construction

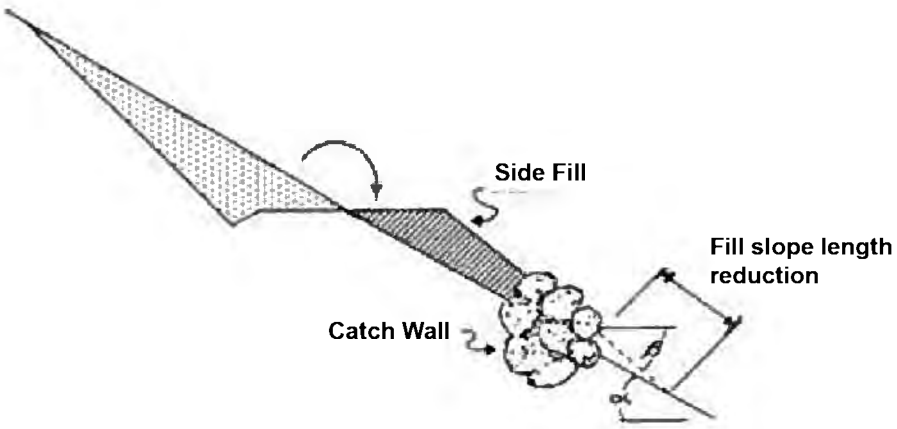
- Probably the most common piece of equipment in forest road construction is the bulldozer equipped with straight or U-type blades.
- These are probably the **most economical** pieces of equipment when material has to be moved a **short distance**.
- The economic haul or push distance for a bulldozer with a straight blade is from **17 to 90 meters** depending on grade.

Earthmoving Equipment

Hydraulic Excavator (Power Shovel) in Road Construction

- The hydraulic excavator is a relatively new technology in forest road construction.
- This machine basically operates by digging, swinging and depositing material.
- Mass balance along the centerline is limited to the reach of the excavator, typically about 15 to 20 meters.

- Fill slope length is reduced by means of catch wall at toe of fill.



Payment of Excavation

Pay Item number	Description	Unit of Measurement
203(1)	Unsuitable excavation	Cubic meter
203(2)	Surplus Common Excavation	Cubic meter
203(3)	Surplus Rock Excavation	Cubic meter
203(4)	Surplus unclassified Excavation	Cubic meter

(source: MTCPW Standard Specifications, 2005)

Payment of Structure Excavation

Pay Item number	Description	Unit of Measurement
204(1)	Structure Excavation	Cubic meter
204(2)	Bridge Excavation	Cubic meter
204(3)	Foundation Fill	Cubic meter
204(4)	Excavation ordered below Plan elevation	Cubic meter
204(5)	Shoring, cribbing, and related work	Lump sum
204(6)	Pipe culverts and drain excavation	Cubic meter

(source: MTCPW Standard Specifications, 2005)

Payment of Embankment

Pay Item number	Description	Unit of Measurement
205(1)	Embankment	Cubic meter
205(2)	Selected. Borrow for topping	Cubic meter
205(3)	Selected Borrow for topping	Cubic meter
205(4)	Earth Berm	Meter

(source: MTCPW Standard Specifications, 2005)

Building Base Courses

- Road base courses require the right grade, slope, thickness, materials and compaction.

Payment of Subgrade Preparation

Pay Item number	Description	Unit of Measurement
206(1)	Subgrade preparation (Common material)	Square meter
206(2)	Subgrade preparation (Existing material)	Square meter
206(3)	Subgrade preparation (Unsuitable material)	Square meter

Payment of Compaction Equipment and Density Control Strips

No payment.

(source: MTCPW Standard Specifications, 2005)

Payment of Overhaul

Pay Item number	Description	Unit of Measurement
208(1)	Overhaul	Cubic-meter-kilometer
208(2)	Overhaul of Borrow, Case 1	Cubic-meter-kilometer

Payment of Aggregate Subbase Course

Pay Item number	Description	Unit of Measurement
301	Aggregate Subbase Course	Cubic meter

Payment of Aggregate Base Course

Pay Item number	Description	Unit of Measurement
302	Aggregate Base Course	Cubic meter

Payment of Crushed Aggregate Base Course

Pay Item number	Description	Unit of Measurement
303	Crushed Aggregate Base Course	Cubic meter

Payment of Lime Stabilized Road Mix Base Course

Pay Item number	Description	Unit of Measurement
304	Lime Stabilized Road Mix Base Course/ (New or Salvaged) Soil-Aggregate	Cubic meter

Payment of Portland Cement Road Mix Base Course

Pay Item number	Description	Unit of Measurement
305	Portland Cement Road Mix Base Course / (New or Salvaged) Soil-Aggregate	Cubic meter

Payment of Asphalt Stabilized Road Mix Base Course

Pay Item number	Description	Unit of Measurement
306	Asphalt Stabilized Road Mix Base Course/ (New or Salvaged) Soil-Aggregate	Cubic meter

Payment of Portland Cement Treated Plant Mix Base Course

Pay Item number	Description	Unit of Measurement
307	Portland Cement Treated Plant Mix Base Course / (New or Salvaged) Soil-Aggregate	Cubic meter

Paving

You have to consider plant production capabilities, haul truck units, route distance, paving width, thickness and speed.

Payment of Aggregate Surface Course

Pay Item number	Description	Unit of Measurement
401	Aggregate Surface Course	Cubic meter Compacted in place
401(1)	Gravel Surface Course	Cubic meter Compacted in place
401(2)	Crushed Aggregate Surface Course	Cubic meter Compacted in place

Payment of Bituminous Concrete Surface Course, Hot-Laid

Pay Item number	Description	Unit of Measurement
411	Bituminous Concrete Surface Course, Hot-Laid	Tonne

Payment of Portland Cement Concrete Pavement

Pay Item number	Description	Unit of Measurement
412(1)	PCC Pavement (Plain)	Square meter
412(2)	PCC Pavement (Reinforced)	Square meter

Next Schedule

6th Road Class Room Lesson

Construction of Road Structure (Retaining Wall, Gabion, Box Culvert)

ANNEX-6

CLASSROOM LESSON ON FLOOD CONTROL

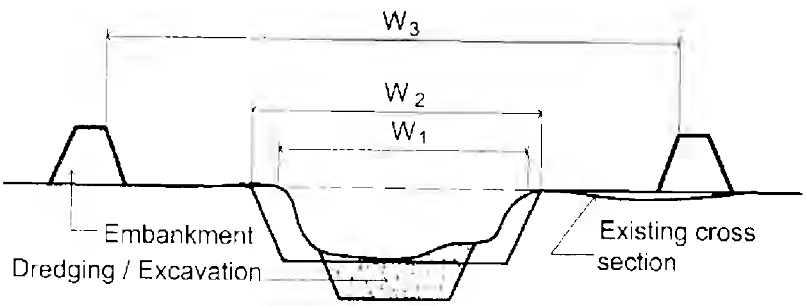
Planning of Flood Control (1)

11th May 2013

Categories of Flood Control

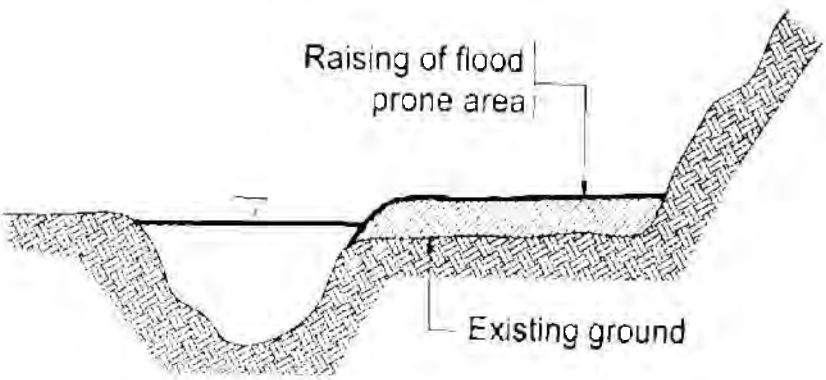
- (1) To increase the river discharge capacity
- (2) To protect flood prone area from overflow
- (3) To reduce and/or control the peak discharge of flood
- (4) To prevent inland flood
- (5) To prevent bank collapse and harmful degradation
- (6) To prevent obstruction against river flow and/or maintain/conserve the good condition of the river in order to keep the flow uninterrupted.

(1) To increase the river discharge capacity

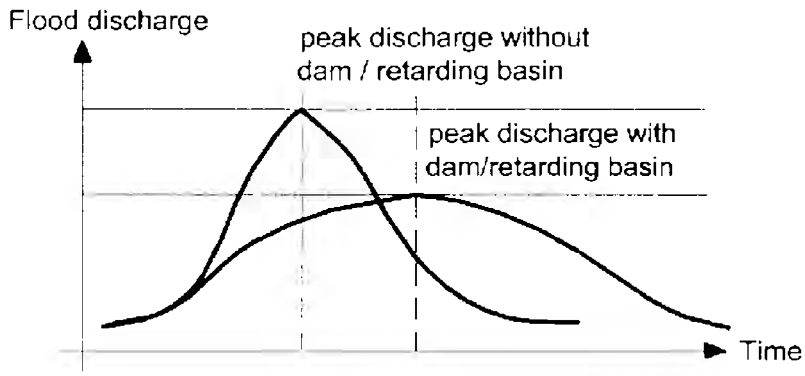


W_1 = Existing river width
W_2 = Improved river width by widening
W_3 = Improved river width by diking

(2) To protect flood prone area from overflow

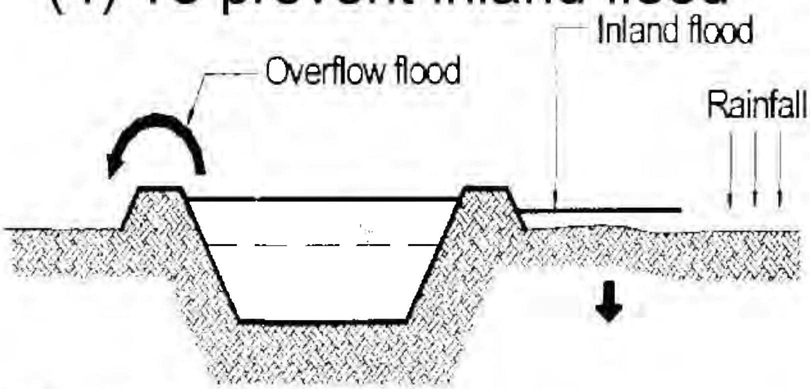


(3) To reduce and/or control the peak discharge of flood



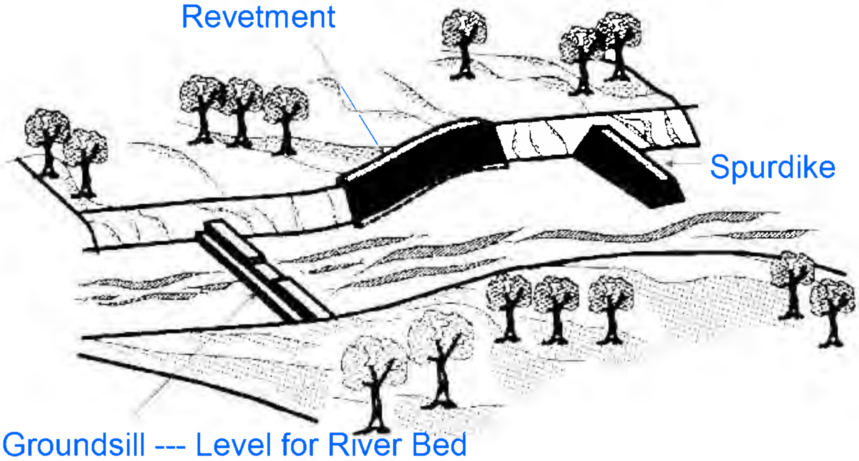
Hydrograph of reduction of peak discharge

(4) To prevent inland flood

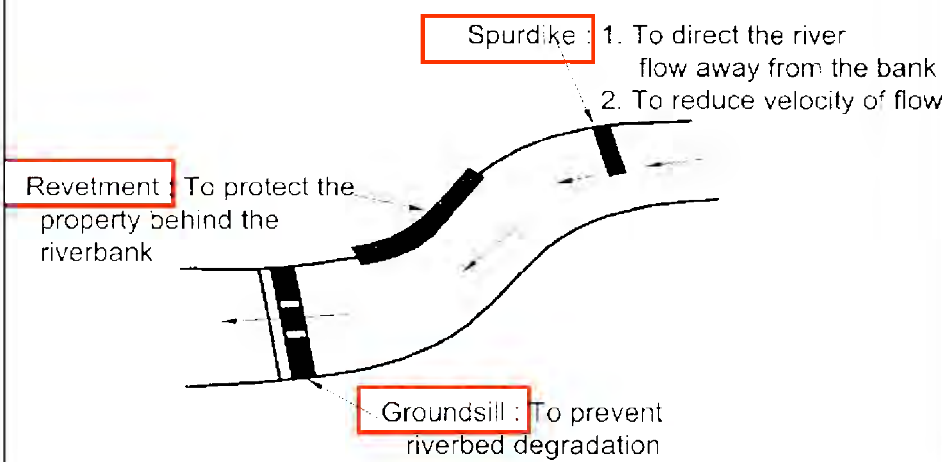


Inland Flooding could be prevented by:
(1) Lateral improvement (Ex. Storm drain, drainage main, open canals, ditches, etc.)
(2) Tributary improvement (Ex. Branches of main river)
(3) Pumping station

(5) To prevent bank collapse and harmful degradation



(5) To prevent bank collapse and harmful degradation



(6) To prevent obstruction against river flow and/or maintain/conserve the good condition of the river in order to keep the flow uninterrupted

- By sabo works (for sediment control)
- By regular maintenance (channel excavation / dredging)

Necessity of Flood Control Plan

Flood Control Plan should be formulated from the basin-wide view point, and requires proper coordination with the other plans such as:

(1) Irrigation development plan

(2) Road network / bridge plan

(3) Sabo plan

(4) Environmental management plan

Design Flood Freaquency

- Design Flood Frequency is expressed by return period, i.e., the probability (expressed in years) where a flood of a target size/magnitude is likely to occur. The return period should be determined based on the size of catchment area, the degree of importance of the proposed project area and economic viability of the project.

Flood Control Project Implementation Plan

- (1) Channel plan (1:1,000-1:10,000)
- (2) Cross section (Existing/ Design)
- (3) Longitudinal profile (Existing/ Design)
- (4) Structural design drawings
- (5) Cost estimates
- (6) Benefit estimation
- (7) Environmental/ Social Impact
- (8) Project evaluation

Next Schedule

2nd Flood Control in Class Room Lesson;

(1) Topographic Survey

(2) Hydrologic Analysis

3rd Flood Control in Class Room Lesson

(1) River structures

Planning of Flood Control (2)

18th May 2013

Topographic Information for Master Plan

- To understand the general profile of a river system, catchment area and flood prone area, the following maps are required;

1. Topographic map with a scale of 1:50,000 or larger
2. Land use map
3. Geological map
4. Other available map from the related Local Government Units

Topographic Information for Master Plan (contin.)

- From the maps mentioned, the following activities shall be conducted:
- 1. Delineate catchment area
- 2. Classify the geological/ geographical features of each sub-catchment area
- 3. Classify the existing vegetation by each sub-catchment area

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- 4. Identify the flood prone sites roughly. (Exact area should be identified and determined from the field investigation and water level analysis)
- 5. Identify the cities and municipalities in the flood prone area.
- 6. Identify the important public facilities such as national road, provincial road, city hall, church and school, etc. within the flood prone area.
- 7. Classify the land use in flood prone area, such as commercial area, residential area, industrial area, agricultural area, etc.
- 8. Identify the changes in the river course and longitudinal profile.

General Information

- Collect all information regarding land use, population, economic activities, future development plans, etc. within the catchment area and flood prone area.

1. Population by city / municipality
2. Increasing ratios of population by city
3. Statistics of commercial activities per year by region and city
4. Statistics of industrial product per year by region and city
5. Statistics of agricultural products per year by region and city
6. Long term and medium term development plan by region, city and municipality.

Hydrologic Data

- Collect the following hydrologic data of the river basin:

1. Daily rainfall data of all gauging stations within and around the catchment area throughout the recording period from meteorological observatory and other related agencies.
2. Hourly rainfall data of all gauging stations within and around the catchment area during the duration of the flood.
3. Hyetographs of past typical floods on all synoptic rainfall gauging stations from meteorological observatory and other related agencies.

Hydrologic Data (contin.)

4. Data on the maximum water levels during peak floods at all water level gauging station from gauging station and by interview. (For rainfall and runoff analysis)
5. Discharge measurement record for all water level gauging stations.
6. H-Q (Height-Discharge relationship) rating curve for all water level gauging stations (with location, cross-section and flow velocity during flooding time)

Field Survey for Master Plan

- Conduct field survey as follows:

1. River cross sections at typical sites

- - Every 500 m to 1,000 m intervals along the stretches of river proposed for improvement

2. Longitudinal profile

- - Rough profile of the river to be taken from topographic map
- - Longitudinal profile taken from cross section survey

3. Identification of the riverbed material

- - By segment features of the river

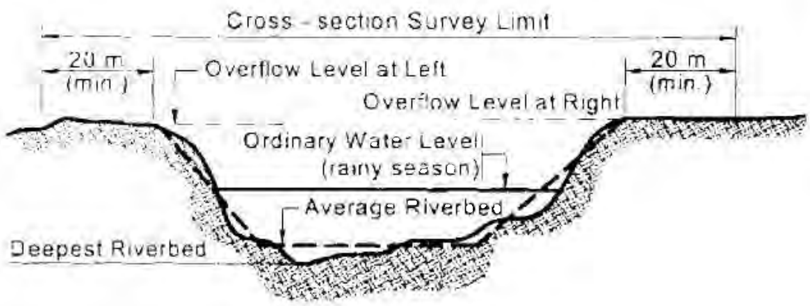
Field Investigation for Master Plan

- Conduct field investigation and interviews to get the following information.

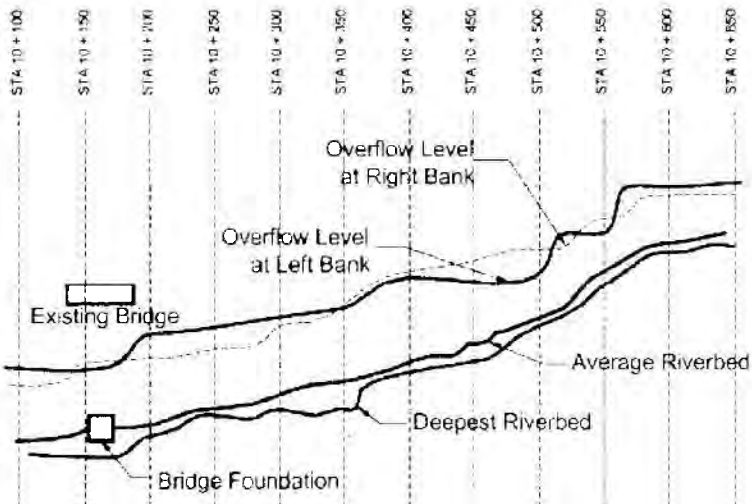
1. The information/ records of past floods (Frequency, area, depth, during of flooding)
2. Conditions of the existing river facilities.
3. History of flood control activities in the basin.

Project Implementation Plan

- 1. Need more detail topographic survey
- 2. Need more detail cross section survey



- 3. Need more detail longitudinal profile survey



Material Survey

- The type of materials of riverbank and water area shall be surveyed and indicated in the topographic map and cross section profiles in order to:
- - Determine the riverbed characteristics (Manning's "n")
- - Determine the quality of riverbed materials (if suitable for construction use)
- - Determine the relationship of diameter of riverbed materials, riverbed gradient, etc. with the velocity of flow.
- - Classify the river segment based on the river morphology.

Hydrologic Analysis

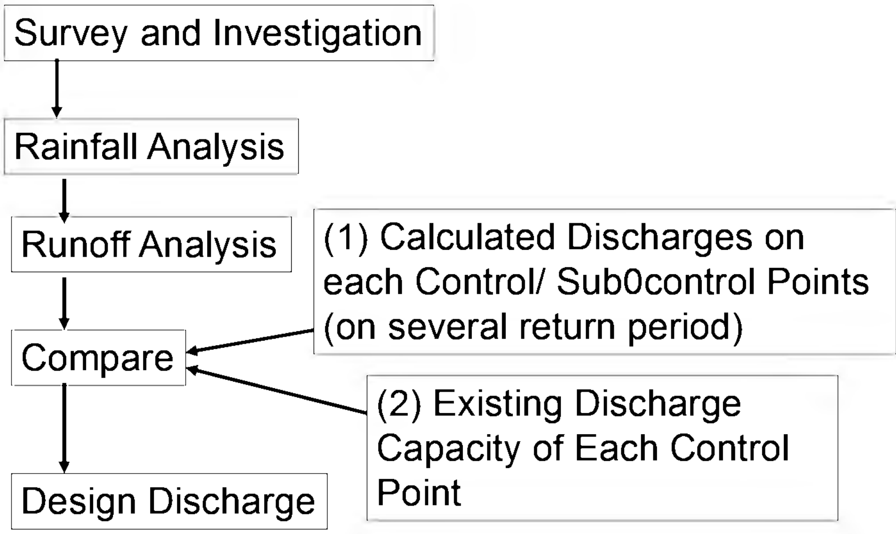
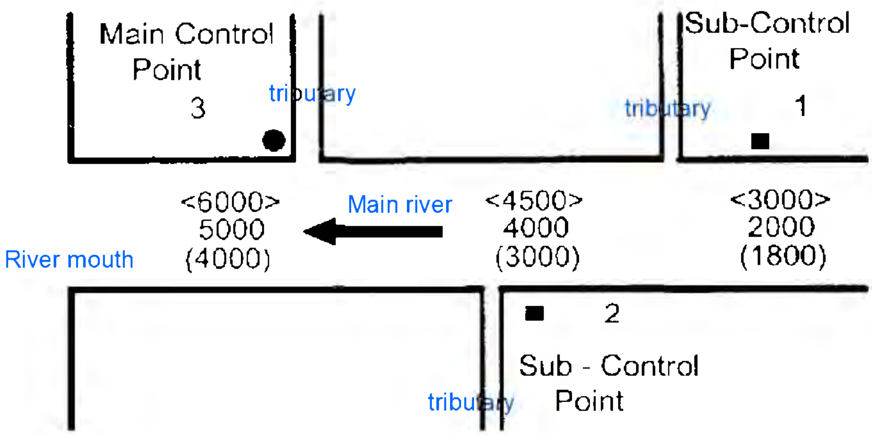


Diagram of Discharges (Example)



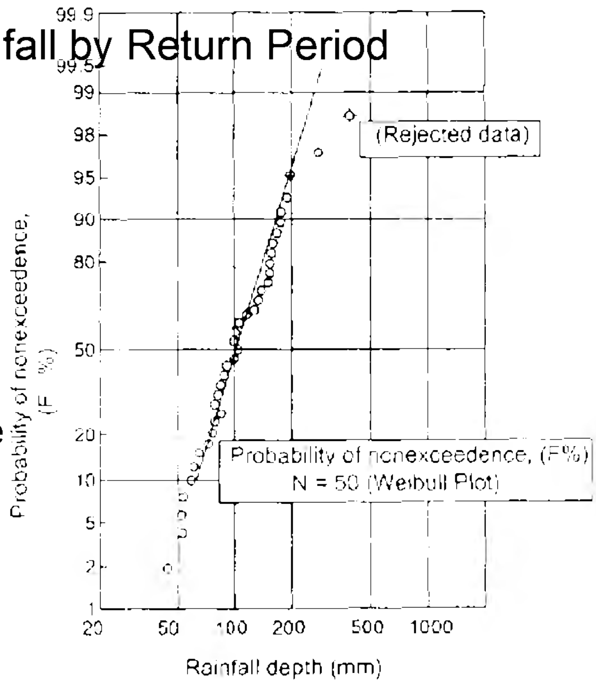
<Q> = Long-term target discharge
Q = Design discharge
(Q) = Existing discharge capacity

Rainfall Analysis

1. Delineation of catchment area
2. Calculate average rainfall in catchment area
3. Calculate annual maximum average rainfall (2-days, 3-days, etc.)
4. Calculate average rainfall by selected return periods
5. Collect typical rainfall patterns (hyetographs) of past major floods and establish typical rainfall accumulation mass curve for each duration.
6. Generate hyetograph for each duration and return period.

Average Rainfall by Return Period

Relationship of Probability of non exceedance and Rainfall Depth (mm)



Runoff Analysis

- There are many methods for runoff analysis already developed/ being developed. Methods of runoff analysis are the following:

1. **Rational Formula** --- simple river
2. **Unit Hydrograph Method** --- many tributary river (consider time-lag)
3. **Storage Function Method** --- dam or inland flood area

Rational Formula

- $Qp = \frac{ciA}{3.6}$
- where:
- Qp = maximum flood discharge (m^3/s)
- C = dimensionless runoff coefficient
- I = rainfall intensity within the time of flood concentration (mm/h)
- A = catchment area (km^2)

Next Schedule

3rd Flood Control in Class Room Lesson
(1) River structures (dike, revetment)

4th Flood Control in Class Room Lesson
(2) River structures (spur dike, weir)

Planning of Flood Control (3)

1st Jun 2013

Today's Lesson

- Design of River structures

(1) Channel Characteristic
(2) Channel Morphology
(3) Economic Analysis
(4) Dike
(5) Revetment
(6) Spur dike
(7) Groundsill
(8) Weir

(1) Channel Characteristics

- Characteristics and morphology of channel are determined by several factors. The main ones are:

(1) Discharge and its hourly change (refer Class Room No.2)

(2) Sediment load and its hourly change

(3) Bed materials and topography around river channel, and

(4) Followed by local climate, riparian vegetation and land use in the drainage basin.

River Segment and Channel Characteristics

Classification	Segment M	Segment 1	Segment 2		Segment 3
			2-1	2-2	
Geography	Mountain	Allivial	Narrow Plane	Natural Levee	Delta
Diameter of Typical Riverbed Materials	Various materials	More than 2 cm.	3-1 cm,	1-0.3 mm	less than 0.3 mm
Riverbank Material	Many tyoes of soil and rocks appear on the banks as well as on riverbed	Riverbank material is composed of thin layer of sand and silt which is same as the riverbed	Lower layer of the riverbank material is the same with the riverbed.	Mixture of fine sand, clay and silt. Same material with riverbed	Silt and Clay

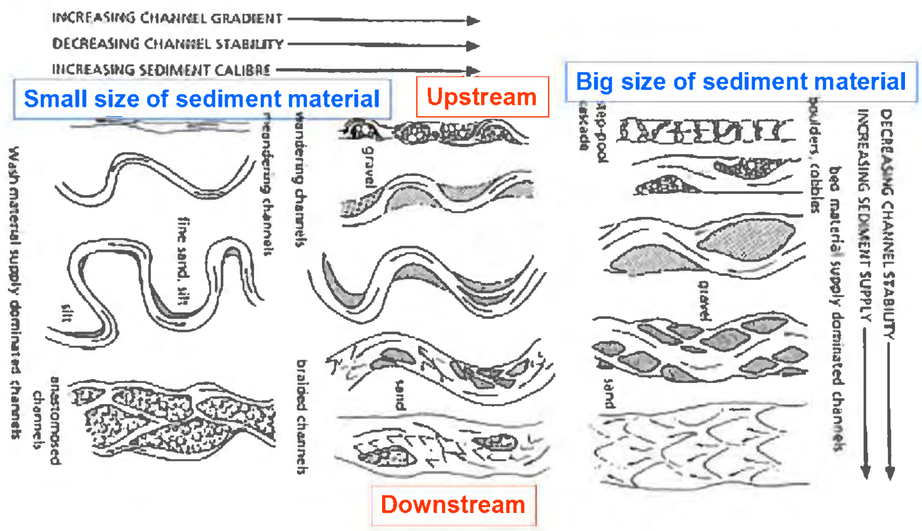
Upstream **Downstream**

River Segment and Channel Characteristics (contin.)

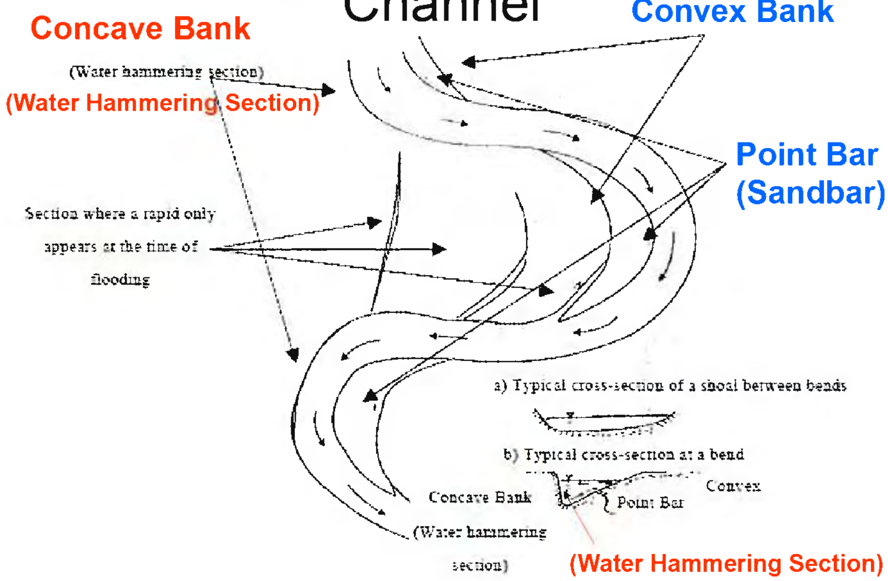
Classification	Segment M	Segment 1	Segment 2		Segment 3
			2-1	2-2	
Gradient	Various Generally steep gradient	1:60 – 1:400	1:400 – 1:5,000		1:5,000 – Level
Meandering	Various	Few bend / meander	Heavy meandesing		Large and small meandering
Bank Scouring	Heavy	Heavy	Medium. Mainstream cources changes where bigger riverbed materials exist.		Weak. Location/ course of stream is almost fixed.
Water Depth of Annually Maximum Flood	Various	0.5–3.0 m	2.0–8.0 m		3.0–8.0 m

Upstream Downstream

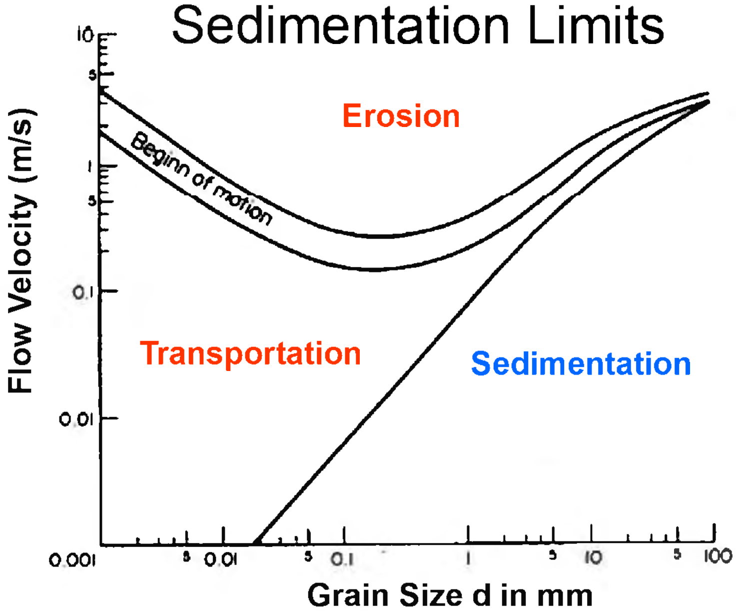
(2) Schematic Diagramme of Channel Morphology



Characteristics of Meandering Channel



Erosion, Transportation and Sedimentation Limits



(3) Economic Analysis

- The projects shall be subjected to economic evaluation to determine their viability and justify the implementation.

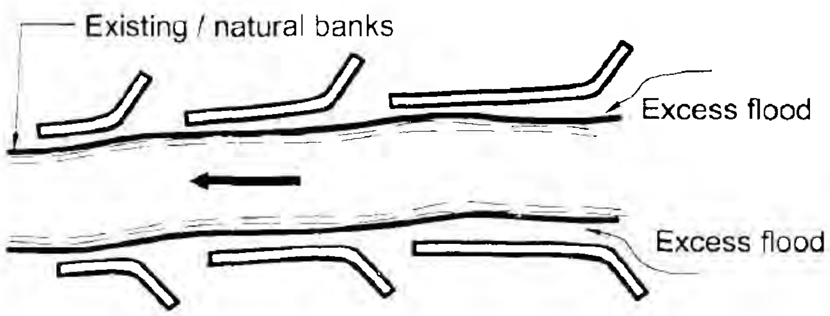
a) The Net Present Value "**NPV**" should be at least nil. NPV = (Present Value of Benefits) – (Present Vale of Cost)

b) The benefit-Cost Ratio "**B/C**" should be at least one.

c) The Internal Rate of Return "**IRR**" should be at least 15 %. IRR = Discount Rate that will make the Present Value of Benefits equal to Present Value of Cost.

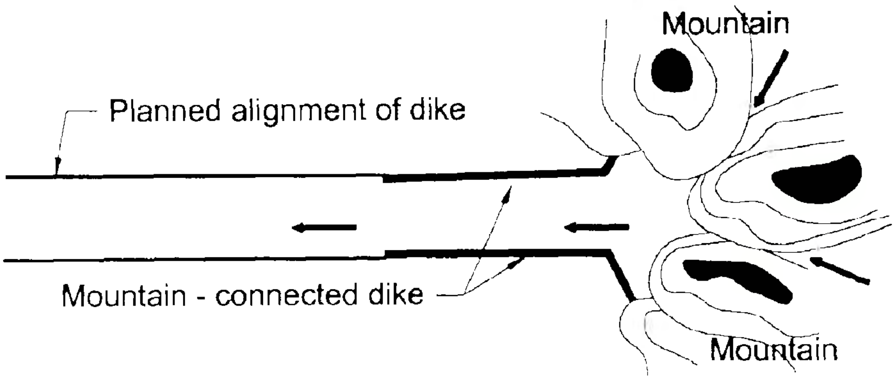
(4) Dike

a) Open Dike



(4) Dike (contin.)

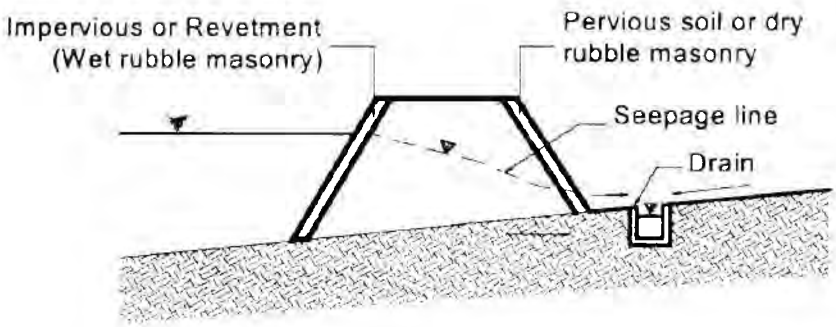
b) Mountain-Connected Dike



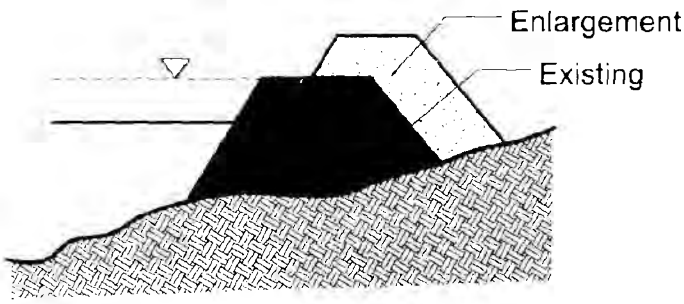
Main cause of damages on Dike

1) Erosion (Scouring)
2) Overflow
3) Seepage
4) Earthquake

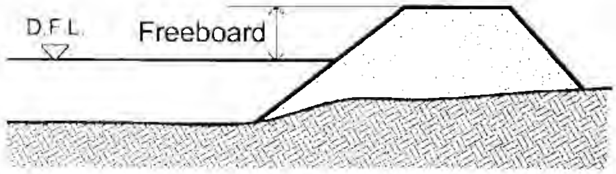
Countermeasure against Seepage



Enlargement of Existing Dike



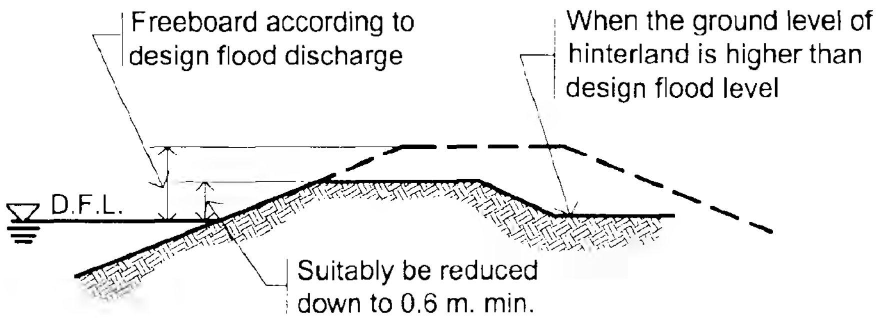
Height of Dike



Dike Height = Design flood level + Freeboard

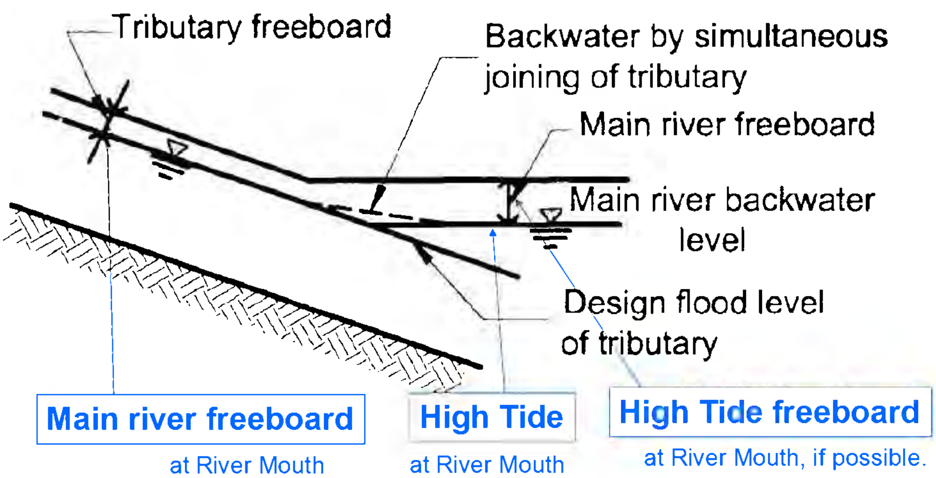
Design flood discharge (m^3/s)	Freeboard (m)
Less than 200	0.6
200 and up to 500	0.8
500 and up to 2,000	1
2,000 and up to 5,000	1.2
5,000 and up to 10,000	1.5
10,000 and over	2

Height of Dike (exception)



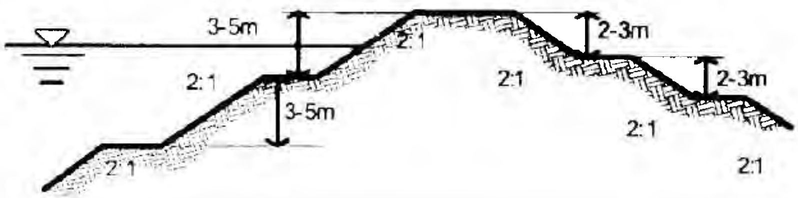
- **Freeboard is reduced down to 0.6 m minimum, when hinterland is higher than design flood level.**

Back Water



The dike , affected by high tide, should be generally covered on the respective three faces by concrete or similar material, taking into account the wave overtopping action.

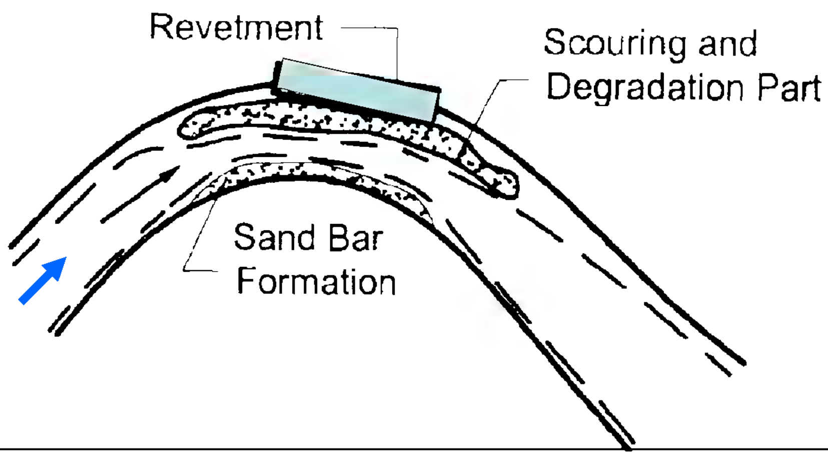
Arrangement of Berm



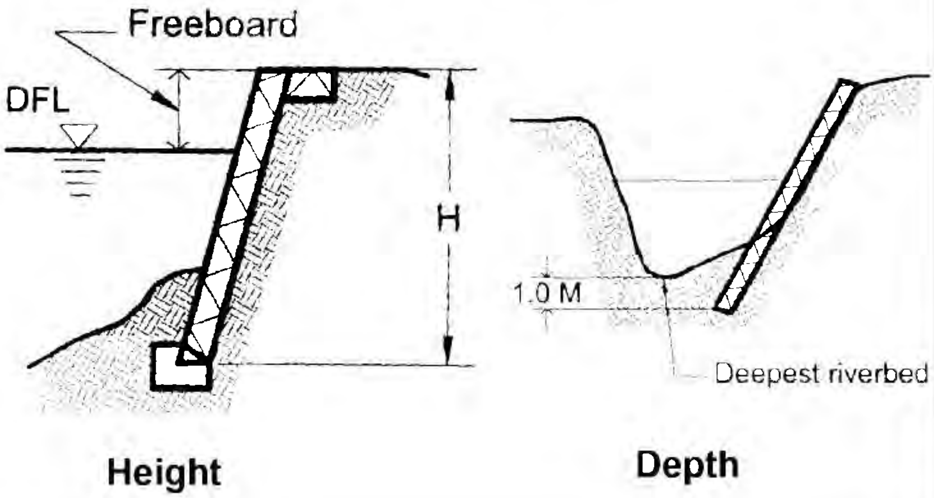
Design flood discharge (m^3/s)	Crest Width (m)
Less than 500	3
500 and up to 2,000	4
2,000 and up to 5,000	5
5,000 and up to 10,000	6
10,000 and over	7

(5) Revetment

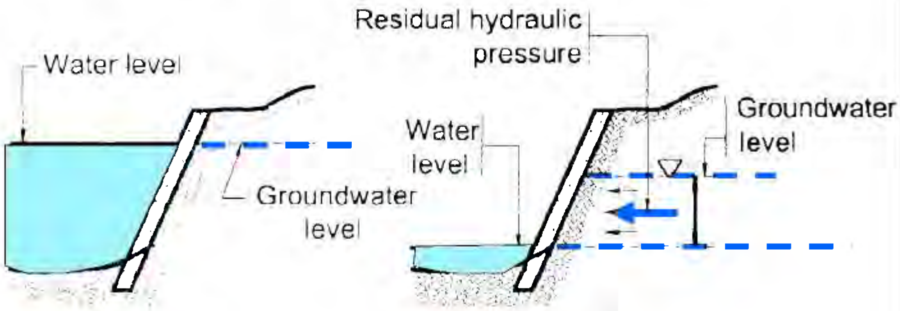
a) Construction of Revetment at River Bend



(5) Revetment



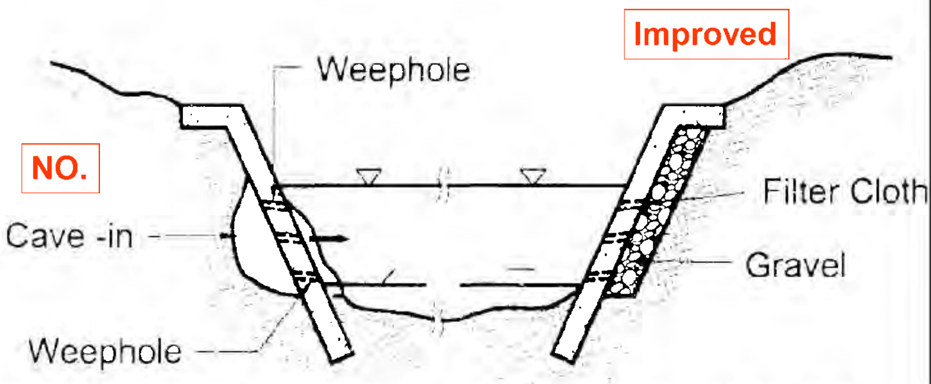
Drainage Pipe / Weep Hole



(a) During flood (b) After flood

Development of Residual Hydraulic Pressure without Drainage Pipes/ Weep Holes

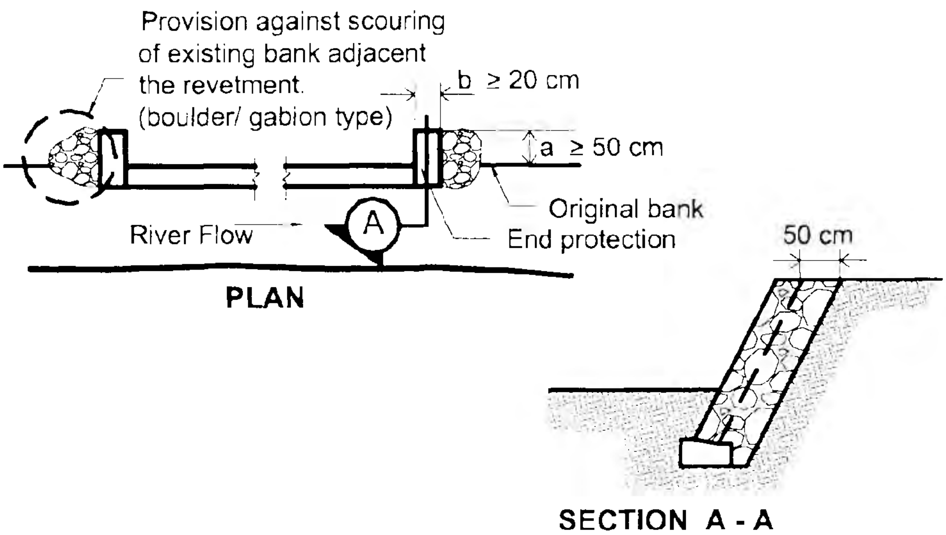
Prevention of Outflow of Backfill/ Behind Material



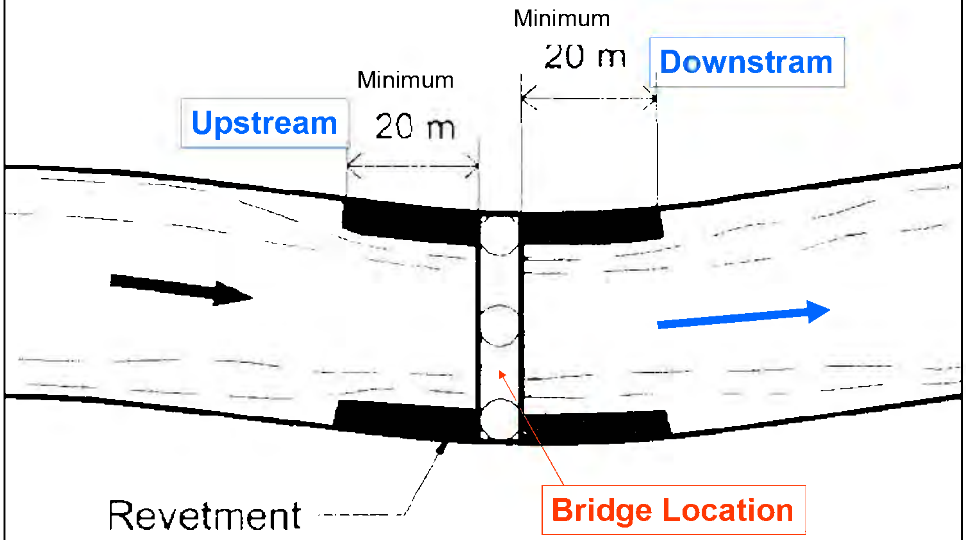
Weep hole without filler-cloth and gravel

Weep hole with filter cloth and gravel

End Protection Work



Revetment at Bridge Abutment

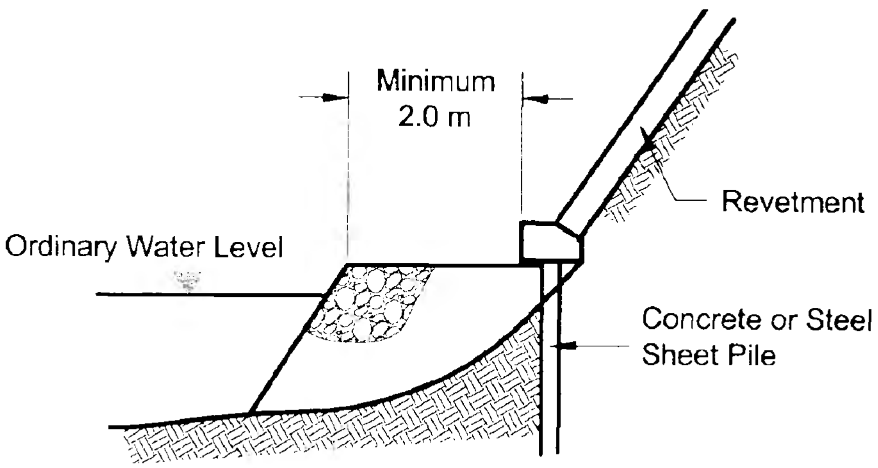


Countermeasure Works for Stability of Revetment

On degrading river or on end portions where revetment is always subjected to direct water attack, appropriate countermeasures (i.e., gabion mattress, spur dike) shall be provided for possible scouring resulting to its damaged/ destruction.

In case of ordinary deep water level area, sheet pile or concrete pile should be provided with adequate foot protection works.

Protection against scour at deep water area/ high tide



Selection of Type of Revetment

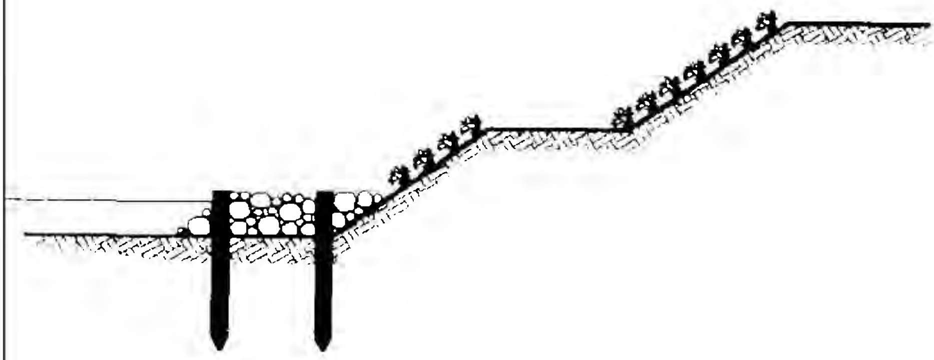
NO	Type of Revetment	Allowable Maximum Velocity (m/s)	Slope (H:V)	Height (m)	Remarks
1	Sodding with grass or some other vegetation (Natural bank)	< 2.0	Milder than 2:1	–	This revetment type is preferably built above the ordinary water level. If revetment is lower than the ordinary water level, use other type.
2	Wooden pile fence	< 4.0	Milder than 0.6:1	5	Preferably for rivers with considerably few boulders in riverbed and bank
3	Dry boulder riprap	< 5.0	Milder than 1.5:1	3	Small vegetation can grow in consideration to environment
4	Gabiom mattress, spread type	< 5.0	Milder than 1.5:1	–	Not preferable for rivers with salt waters. Not preferable for rivers where large boulders (> 20 cm diameter) are present
5	Grouted riprap, spread type	> 5.0	Milder than 1.5:1	5	If the height of bank is higher, provide berm
6	Gabion mattress, pile-up type	< 6.5	1:1 to 1.5:1	–	For interim use (Beginning/ End protection works)
7	Grouted riprap, wall type	> 5.0	Steeper than 1:1	–	Leaning wall type, rubble masonry

Selection of Type of Revetment (contin.)

NO	Type of Revetment	Allowable Maximum Velocity (m/s)	Slope (H:V)	Height (m)	Remarks
8	Rubble concrete	> 5.0	Steeper than 1:1	–	Gravity type
9	Stone masonry	> 5.0	Steeper than 1:1	–	Gravity type
10	Crib wall	> 6.0	Steeper than 1:1	–	
11	Reinforced concrete with concrete sheet pile foundation	–	Steeper than 1:1	–	Minimum thickness of 20 cm. Provide temperature bars 12 mm diameter spaced not to exceed 40 cm on center, both ways
12	Steel sheet pile	–	–	–	When ordinary water level is very high (affected by tidal fluctuation). Foundation depth must be analyzed considering the flow velocity, foudation material and scouring depth for keeping its stability.
13	Steel sheet pile and reinforced concrete (segment combination)	–	Milder than 1.5:1but not steeper than 1.5:1	–	When ordinary water level is very high (affected by tidal fluctuation). Foundation depth must be analyzed considering the flow velocity, foudation material and scouring depth for keeping its stability.

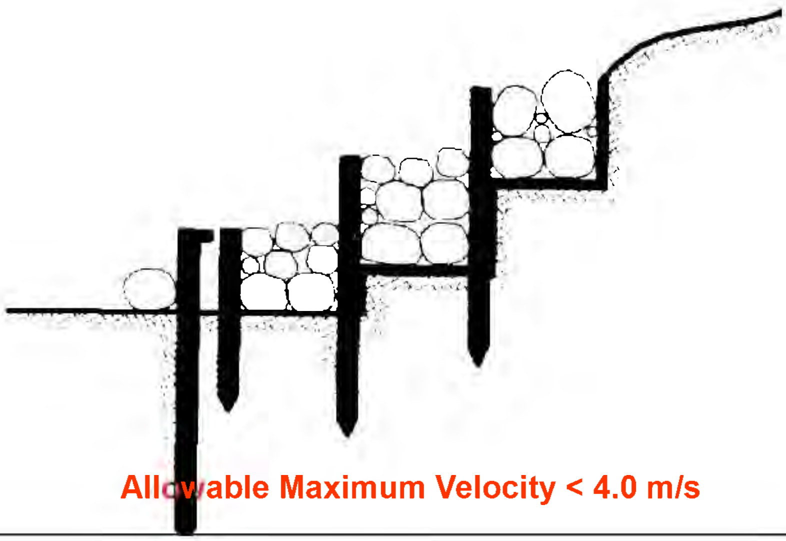
(source: Flood Control Manual, Japan)

1. Sodding with Grass or Some Other Plants (Natural Type)



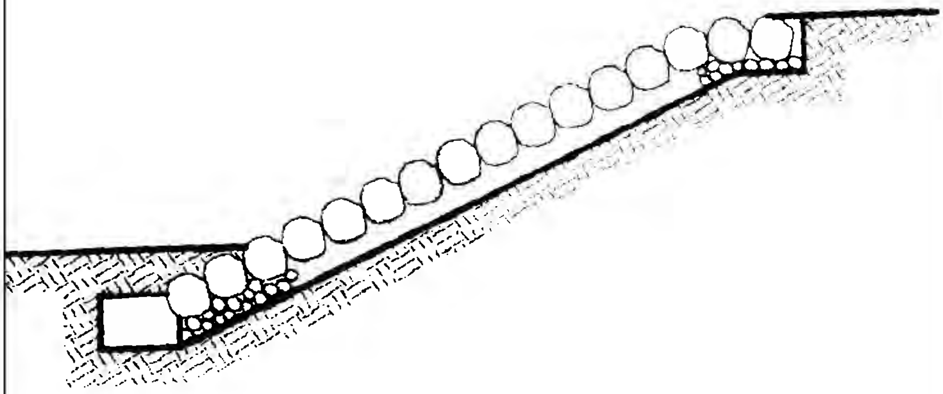
Allowable Maximum Velocity < 2.0 m/s

2. Wooden Pile Fence



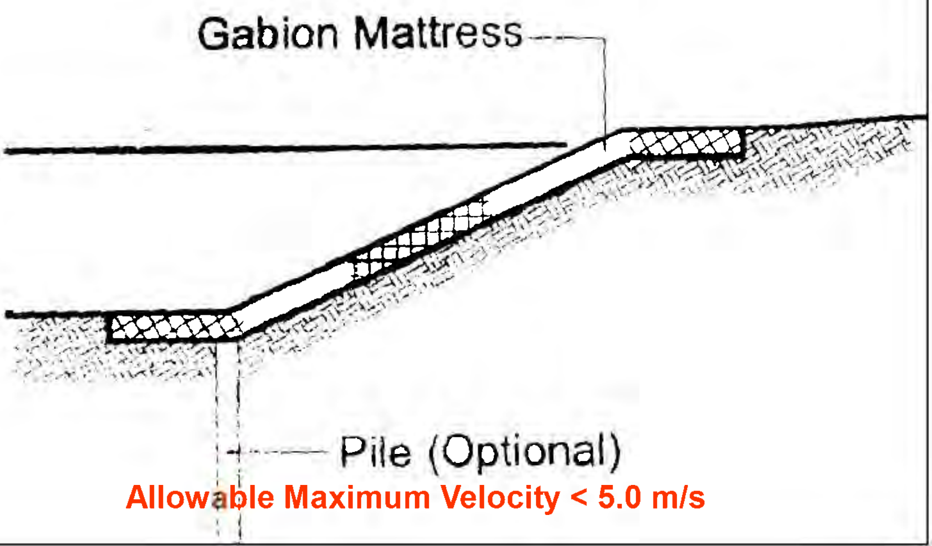
Allowable Maximum Velocity < 4.0 m/s

3. Dry Boulder Riprap



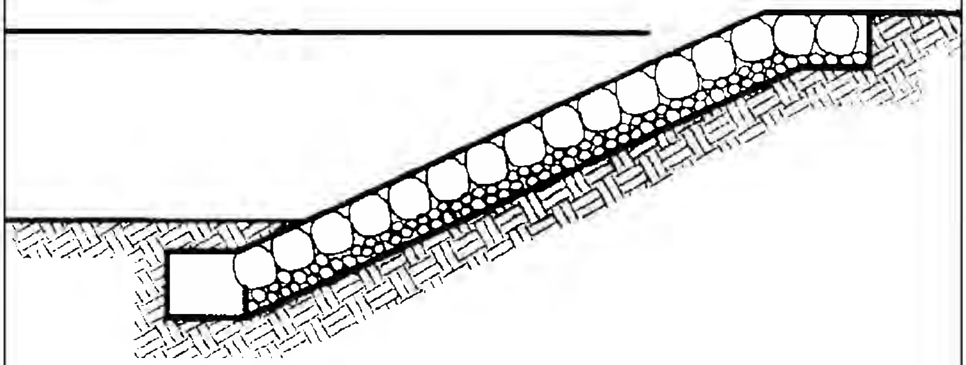
Allowable Maximum Velocity < 5.0 m/s

4. Gabion Mattress Spread Type



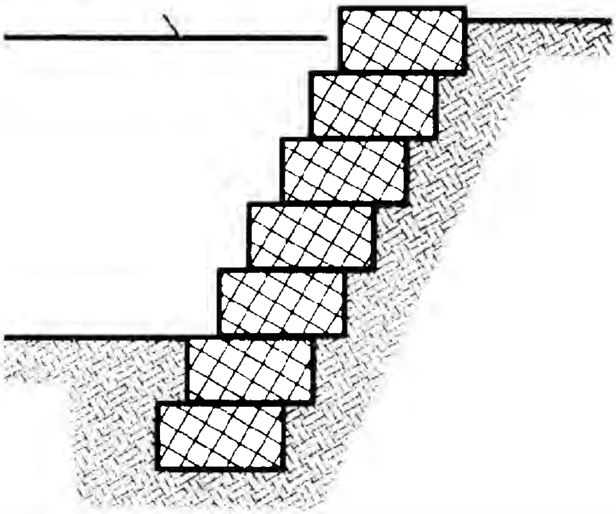
Allowable Maximum Velocity < 5.0 m/s

5. Grouted Riprap, Spread Type



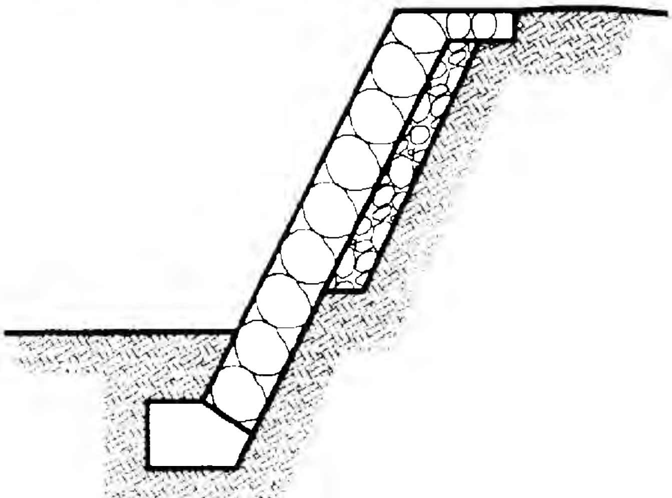
Allowable Maximum Velocity > 5.0 m/s

6. Gabion Mattress, Pile-up Type



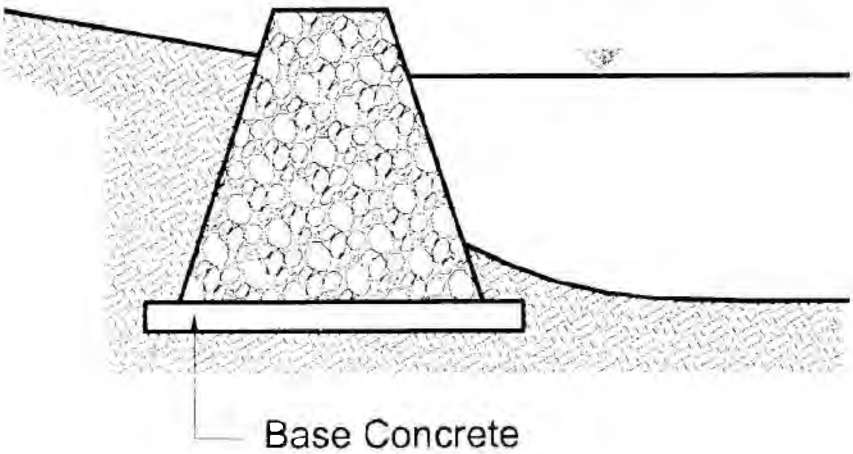
Allowable Maximum Velocity < 6.5 m/s

7. Grouted Riprap Wall Type



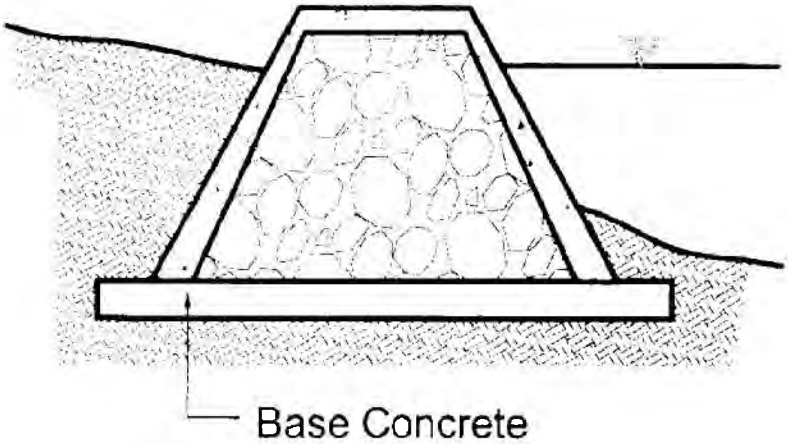
Allowable Maximum Velocity > 5.0 m/s

8. Rubble Concrete



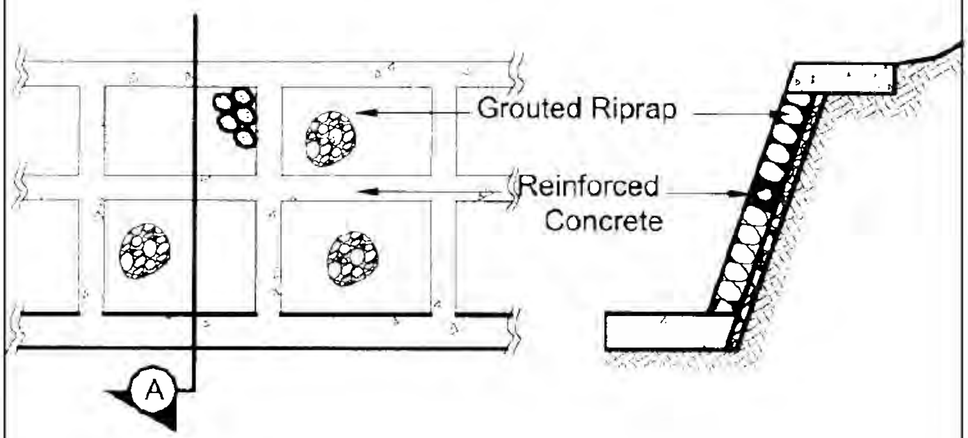
Allowable Maximum Velocity > 5.0 m/s

9. Stone Masonry



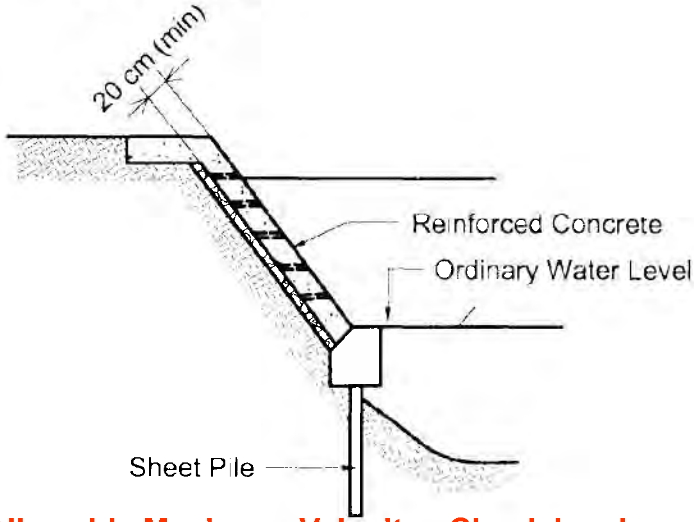
Allowable Maximum Velocity > 5.0 m/s

10. Crib Wall



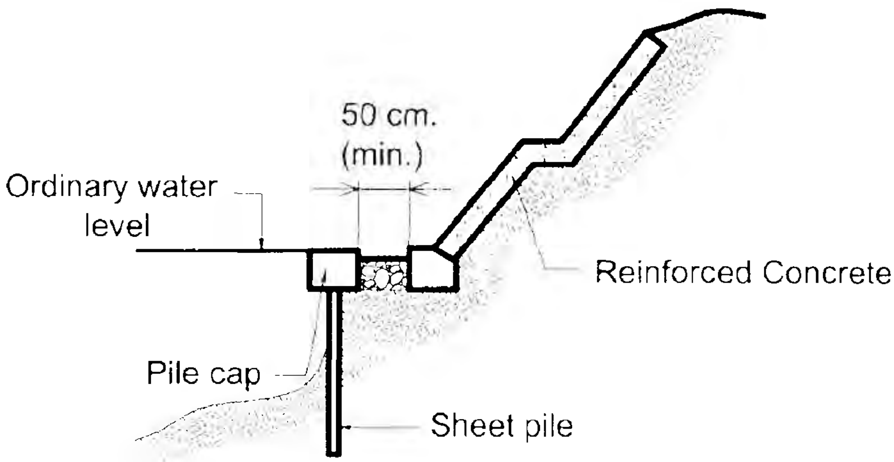
Allowable Maximum Velocity > 6.0 m/s

11. Reinforced Concrete



Allowable Maximum Velocity : Check local scouring depth based on velocity

12. Steel Sheet Pile and Reinforced Concrete (Segment Combination)



Allowable Maximum Velocity : Check local scouring depth based on velocity

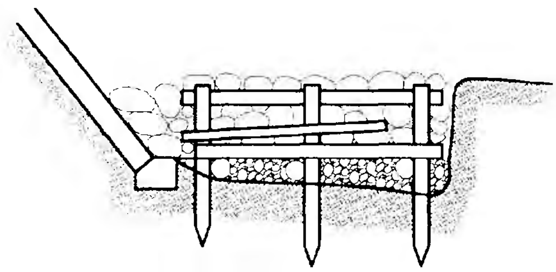
Foot Protection

Foot protection work is planned in order to protect the revetment foundation from local riverbed scouring and/or the degradation of riverbed. Foot protection reduces the force of flow at the foundation, thus reduces the abrupt scouring of riverbed.

Types of foot protection:

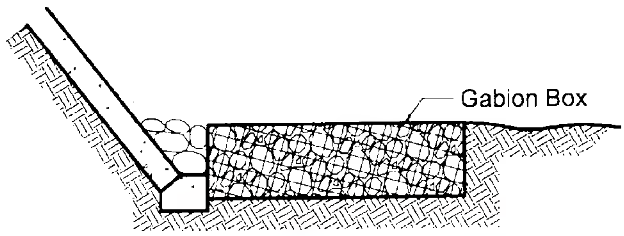
1) Wooden stockade
2) Gabion
3) Boulder
4) Concrete block

1) Wooden Stockade Type



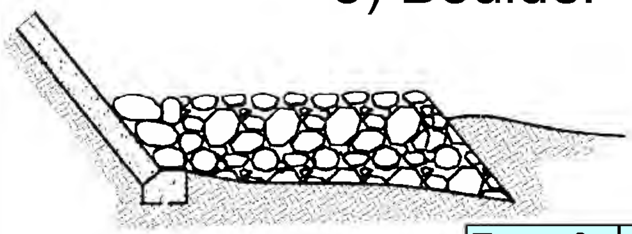
Type of Foot Protection	Water Depth (m)	Design Velocity (m/s)					
		1.0	2.0	3.0	4.0	5.0	6.0
		Diameter of Boulder (cm)					
Wooden stockade type	1.0	5	5	10	30	–	–
	2.0	5	5	10	15	35	65
	3.0	5	5	10	15	25	45
	4.0	5	5	5	15	25	40
	5.0	5	5	5	10	20	35

2) Gabion



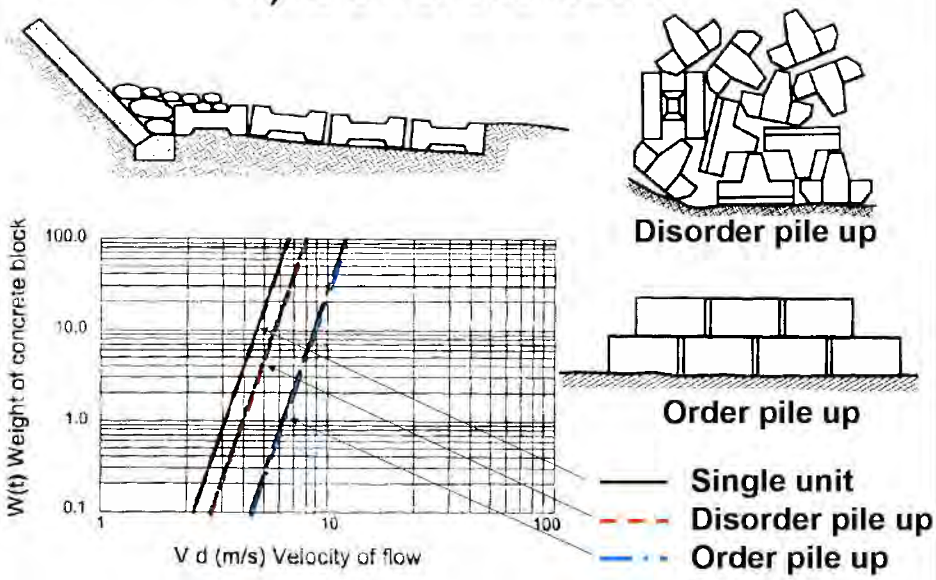
Type of Foot Protectio	Water Depth (m)	Design Velocity (m/s)					
		1.0	2.0	3.0	4.0	5.0	6.0
		Diameter of Boulder (cm)					
Babion type	1.0	5-15	5-15	5-15	10-20	–	–
	2.0	5-15	5-15	5-15	5-15	15-20	–
	3.0	5-15	5-15	5-15	5-15	15-20	15-20
	4.0	5-15	5-15	5-15	5-15	5-15	15-20
	5.0	5-15	5-15	5-15	5-15	5-15	15-20

3) Boulder



Type of Foot Protectio n	Design Velocity (m/s)	Diameter (cm)
Boulder Type	2	–
	3	30
	4	50
	5	80
	6	120

4) Concrete block



Relationship between Velocity (m/s) and Weight (t)

(6) Spur dike

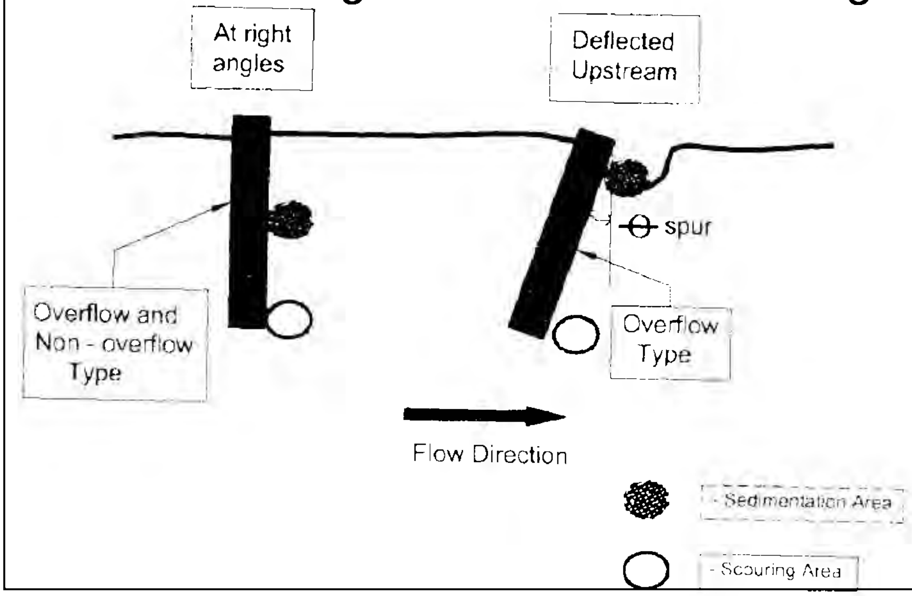
Purpose of spur dike are as follows:

- 1) Prevent bank scouring by reducing the river flow velocity.
- 2) Redirect river flow away from the riverbank.

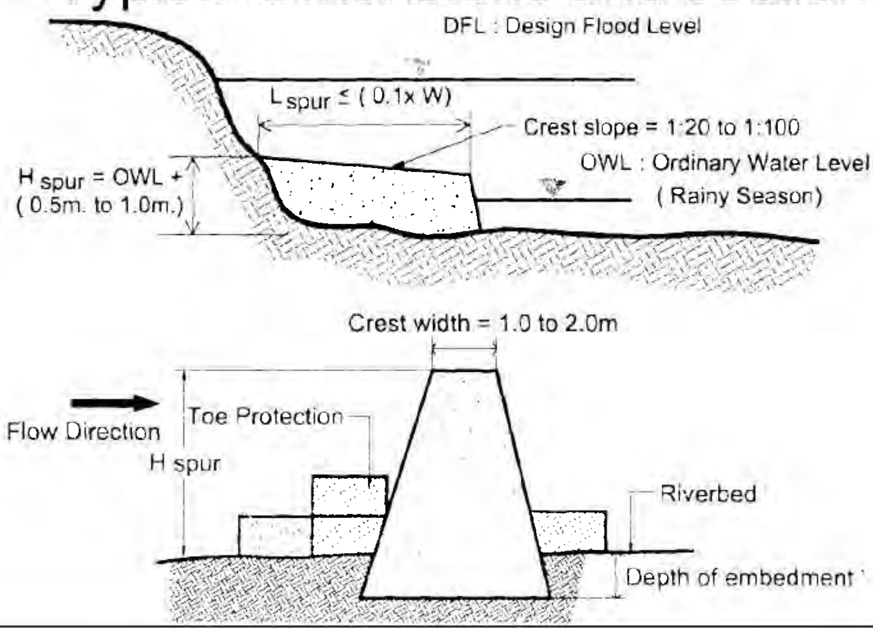
Types of Spur dike:

- 1) Permeable Type
- 2) Impermeable Type/ Semi-Permeable Type

Relationship between spur dike alignment and resulting sedimentation scouring



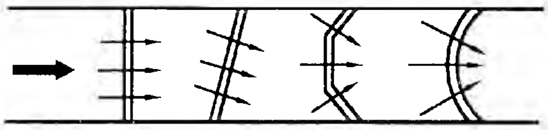
Typical dimensions and section



(7) Groundsill

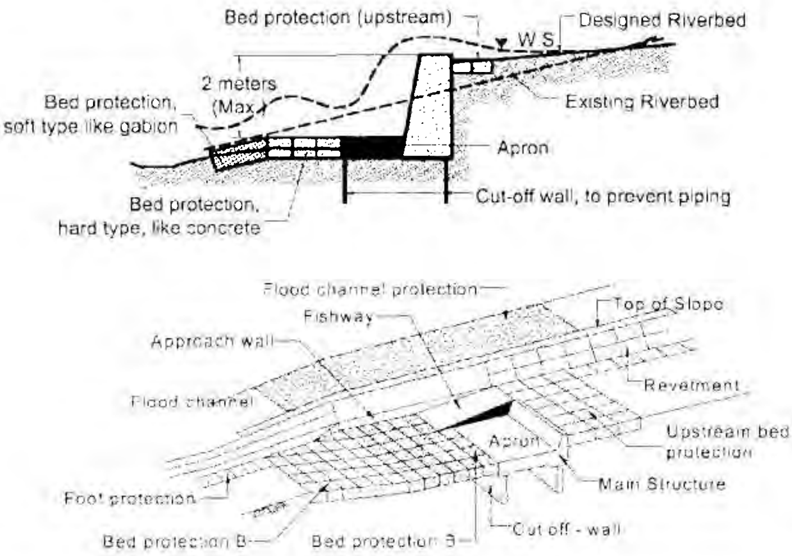
Purpose of groundsill is to fix the riverbed elevation in order to prevent riverbed degradation resulting to local scours under forces of turbulent flow during floods.

Type is 1) Drop structure type and 2) Sill type (No drop structure Type.



Plane Forms of Ground Sills and Flow Direction

Drop Structure Type



(8) Weir

- The location of a weir shall be selected according to the purpose of the construction.
- A curved section or a section with narrow section form of waterway shall be avoided as practically as possible. (It is difficult to control and maintain high velocity flow/ local scouring.)
- The weir is classified into an intake weir (irrigation etc.), diversion weir, tide weir, etc.

Next Schedule

4th Flood Control in Class Room Lesson
Construction of dike & revetment

5th Flood Control in Class Room Lesson
Construction of Gabion, Spur dike, & Weir

Planning of Flood Control (4)

8th Jun 2013

Today's Lesson

- Construction of River structures

(1) Dike

(2) Revetment

(1) Construction of Dike
1) Topographic Survey

Initially the extent of the dike footprint and any additional berms shall be surveyed and marked for the exact boundaries required to do the work.

2) Clearing, Grubbing and Stripping

- For new dike construction, changing the existing alignment or widening of the existing fill, the dike area shall be properly cleared, grubbed and stripped.

3) Dewatering

- Areas where minor seepage inflow is expected during sub-excavation of materials or trench excavation can likely be treated using conventional **ditching and sumping** techniques which are relatively inexpensive.
- **Pumping** to unwater a sealed **cofferdam** shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.
- Areas with moderate to major seepage will likely require more expensive and costly dewatering methods such as **well point or deep well dewatering.**

4) Cofferdam

- Cofferdams shall be constructed to adequate depths to assure stability and to adequate heights to seal all water.

Cofferdam

Comoro Bridge

5) Shoring

- Shoring with sheeting and/or bracing shall be adequate to support all loads imposed and shall comply with any applicable safety regulations.

Guide Beam for Sheeting Works

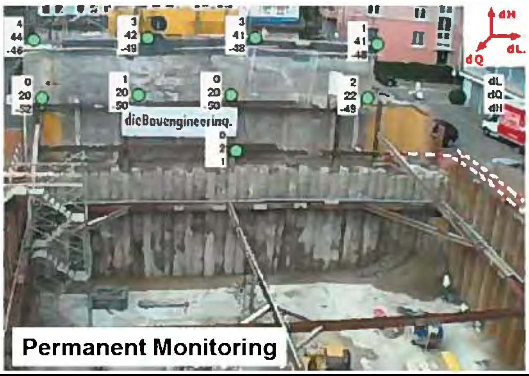
6) Excavation

- Stable excavation below the existing ground surface is highly dependant on **foundation soil** and **groundwater** conditions. Any proposed excavations shall be reviewed by engineer during the design and construction stages of a project.
- If space permits, the excavations can typically be carried out with **open cut slopes**.

7) Safety Control of Excavations

It is recommended that **monitoring gauges** be installed on the existing critical structures to permit measurement of any vertical and lateral deformations.

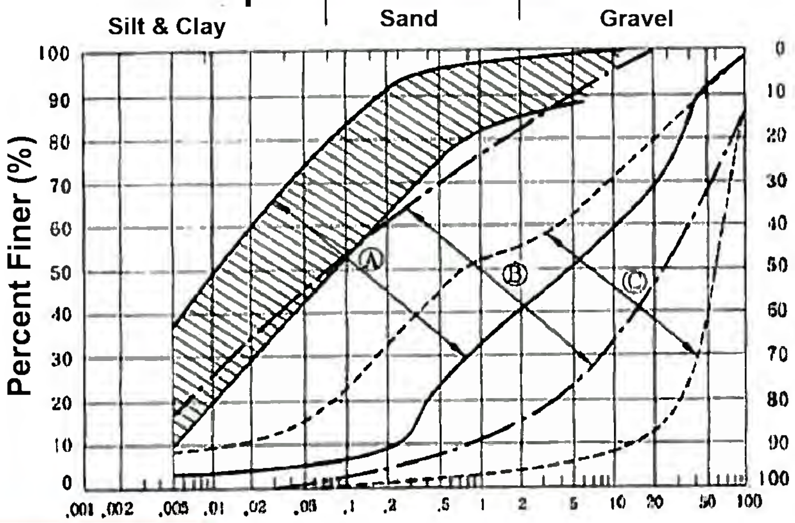
Gauges shall be monitored **prior to**, **during**, and **after** construction which is located close to any critical structures.



8) Production of Dike Materials

Dike fills shall limit the particle size to generally less than **100 mm** and shall not contain materials greater than 150 mm in diameter.

Proper Dike Material



Grain Size Test

A: Impermeable Material, B: Semi-permeable Material, C: Permeable Material

: Risk of Crack Occurrence

9) Compaction Fundamentals

- Soils containing fines can be compacted to a **specific maximum dry density** with a given amount of energy. However, maximum density can be achieved only at a unique water content.
- Maximum dry density and optimum water content are determined in the **laboratory** by carrying out Proctor testing on collected samples.

10) Compaction of Dike Fills

- Requirements of the more important compaction features, such as **water content limits**, **layer thickness**, **compaction equipment**, and **number of passes** will be contained in the specifications and must be checked closely by the inspector to ensure compliance.
- Specifications will generally state the type and size of compaction equipment to be used.

10) Compaction of Dike Fills (contin.)

- Uncompacted or loose lift thickness will be specified. Lift thickness specified will be based on type of material and compacting equipment used.
- Impervious or semipervious materials are commonly placed in **150 to 200 mm** loose lift thickness and compacted with **six to eight passes** of a sheepsfoot roller, or an approved alternative.

Sheepsfoot Roller

Bulldozer & Tire Roller

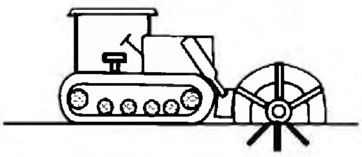
Vibrating Roller

Water Placement for Optimum Soil Moisture

Rapid Impact Compaction

Shallow Soil Stabilization

- If suitable materials are not, compaction grouting is the injection of a viscous **soil-cement** grout under pressure into soil mass, which consolidates and densified targeted soils insitu.



Stabilizer Type

Power Shovel + Stabilizer

Stepped Cut on Existing Dike

- Stepped cut is constructed by power shovel.
- Stepped cut is important for **integration** between existing dike and new embankment.

Reinforcing Filter Layer Placement

- Fiber reinforced composite is used, if necessary.

Final Grading

Final Grading

Soil Compaction Test

Soil density using nuclear gauge (Radioisotope : RI)

Soil density by the sand replacement method

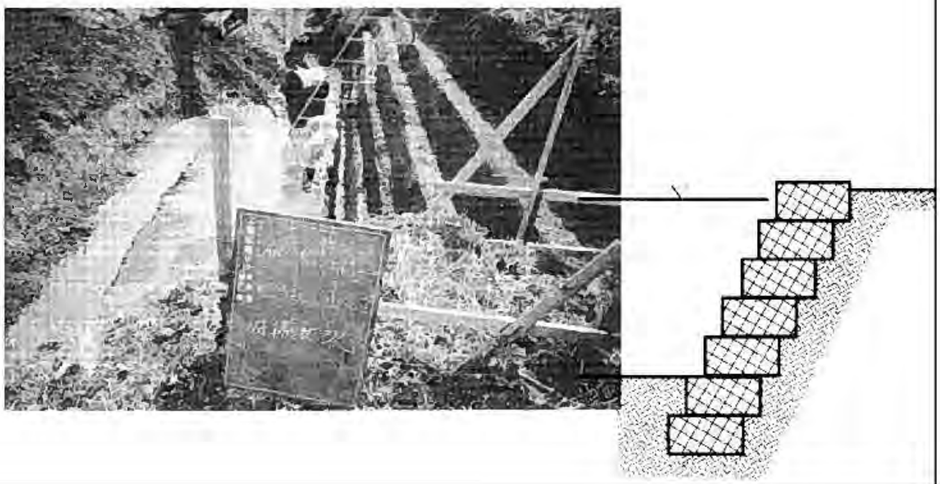
Sample of Inspection

Length of Slope

Thickness of One Layer

(2) Construction of Revetment

- Excavation for Gabion Mattress, Pile-up Type



- Filling the stone into Gabion.

- Curve portion of Gabion

Next Schedule

5th Flood Control in Class Room Lesson
Construction of Spur dike, Sabo Dam & Weir

Planning of Flood Control (5)

22nd Jun 2013

Today's Lesson

- Construction of River structures

(1) Spur Dike

(2) Weir

(3) Sabo Dam

(1) Construction of Spur Dike

Temporary Water Control System

- Temporary water control systems is necessary for dikes, by-pass channels, flumes and other surface water diversion works, cut-off walls.
- Pumping systems, including wellpoint and deep well systems, is used to prevent water from entering excavations for structures.

Working Drawings

- Working drawings for temporary water control systems, when required, shall include details of the design and the equipment, operating procedures to be employed, and location of points of discharge.
- The design and operation shall confirm to all applicable water pollution and erosion control requirements.

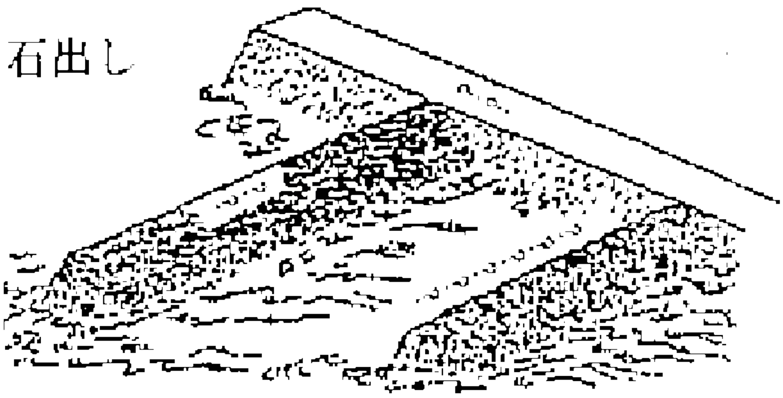
Construction Method of Spur Dike

(1) Underwater construction with crane

(2) **Dry condition work** with cofferdams/ shoring and/or temporary water control systems

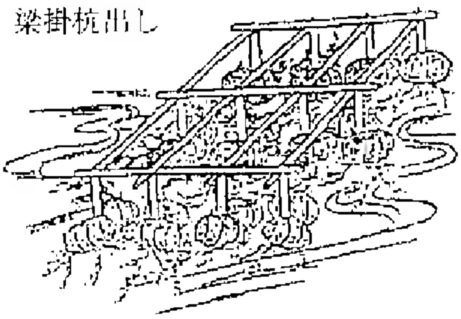
Traditional Spur Dike (1)

- Spur Dike by Stone



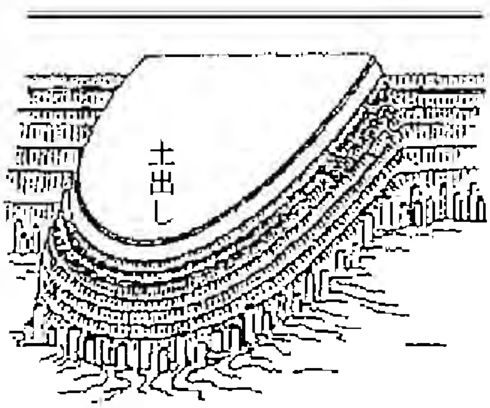
Traditional Spur Dike (2)

- Spur Dike by Wooden Pile and Basket



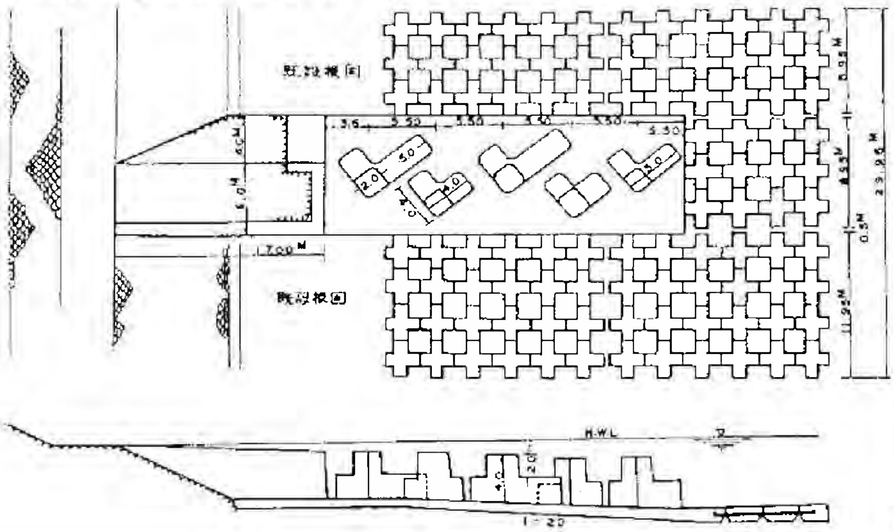
Traditional Spur Dike (3)

- Spur dike by soil embankment



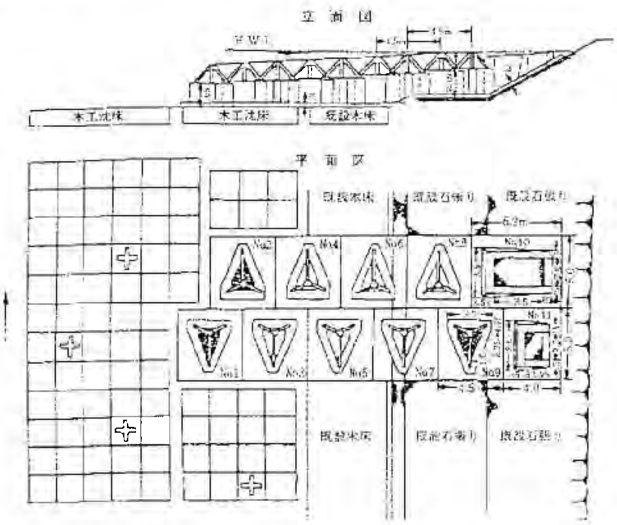
Kurobe River Spur Dike

For Segment 1, D>15 cm



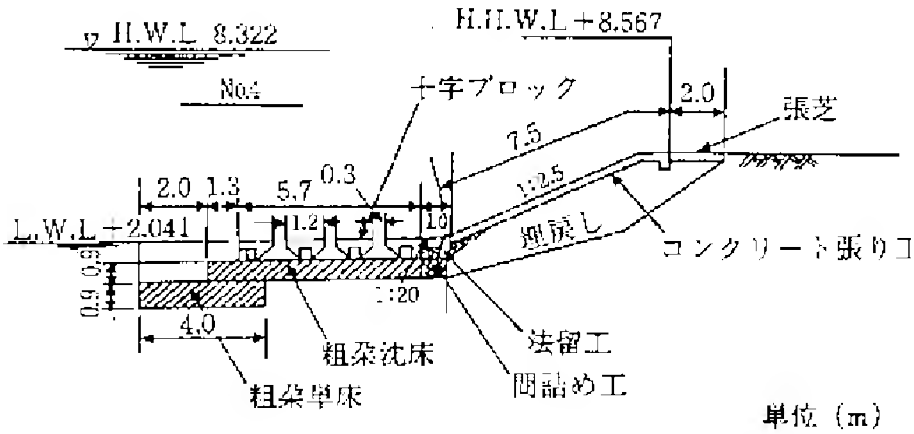
Fuji River Spur Dike

- **For Segment 1, 2 cm< D < 15 cm**

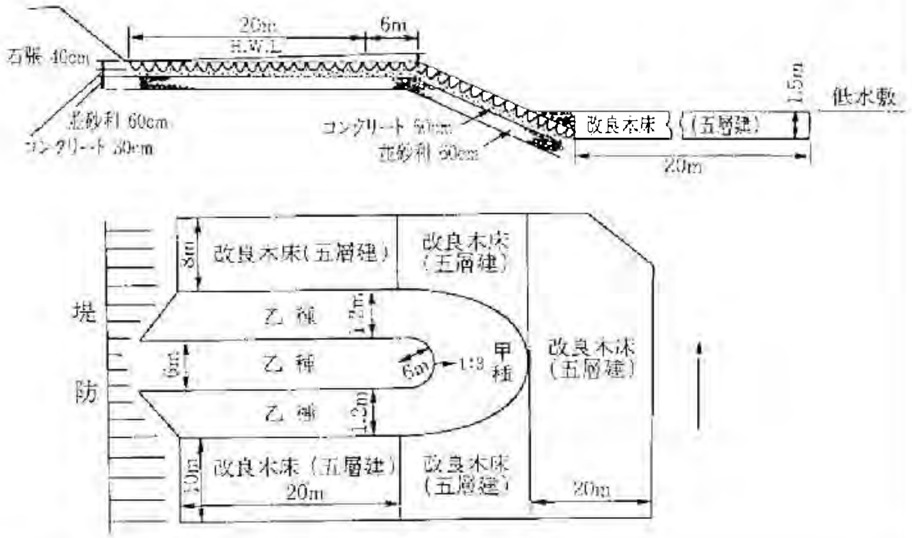


Mogami River Spur Dike

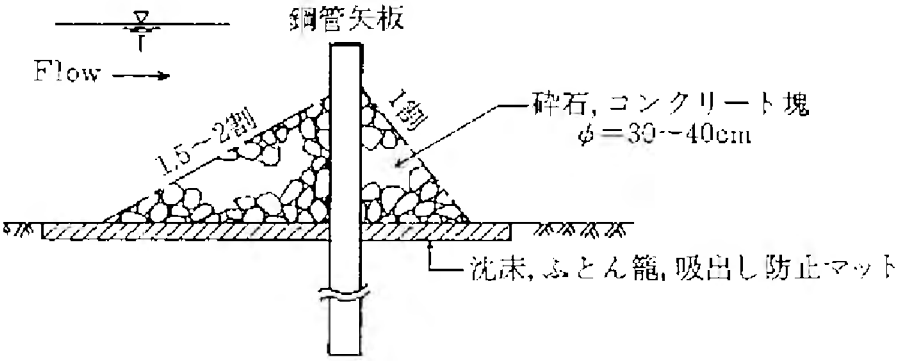
- **For segment 2-1**



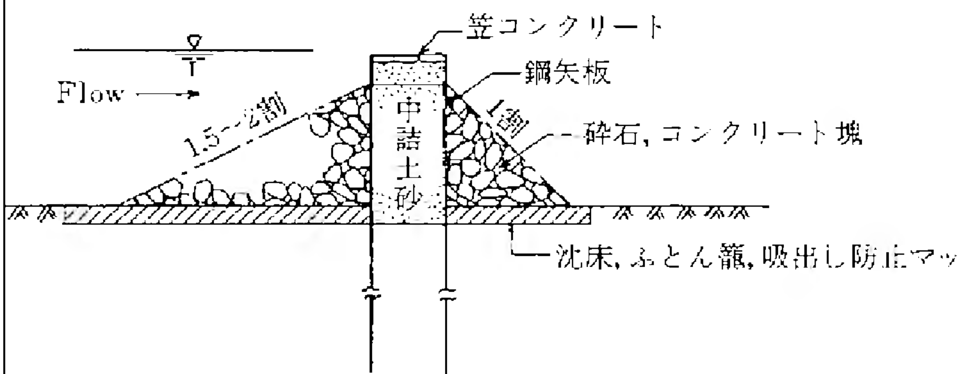
- **For segment 1**



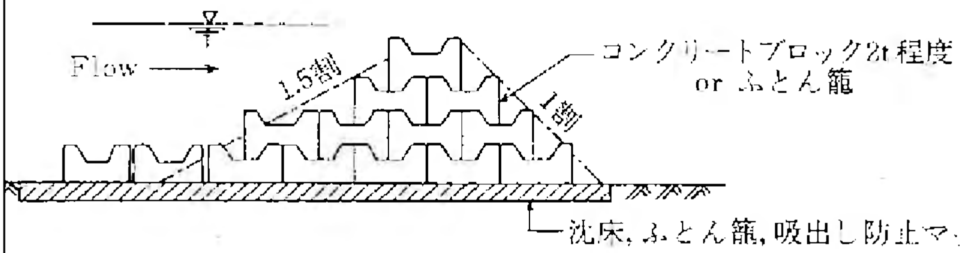
Latest Spur Dike (1)



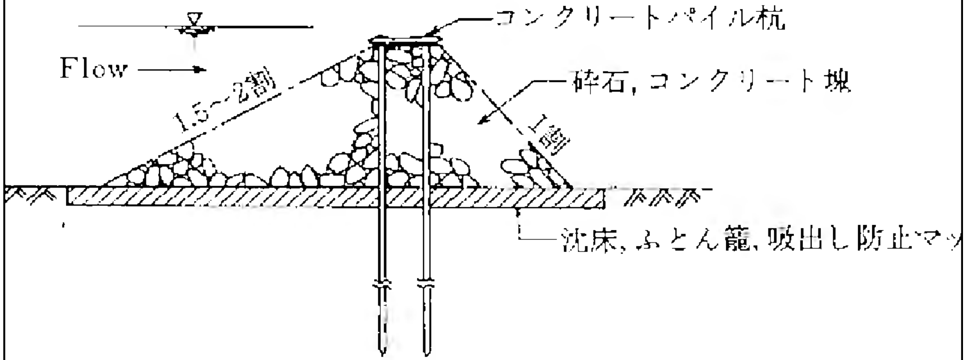
Latest Spur Dike (2)



Latest Spur Dike (3)



Latest Spur Dike (4)



Matanuska River Spur Dike in USA

- Existing spur dikes were installed in 1992. They have successfully protected their section of river bank from further erosion since their installation, but have required periodic maintenance and repairs.

Matanuska River Spur Dike in USA

- The photo shows the existing spur dikes and the natural bank. Existing spur dike has a round head.
- The preferred alternative is the barb-headed spur dike for bank protection.

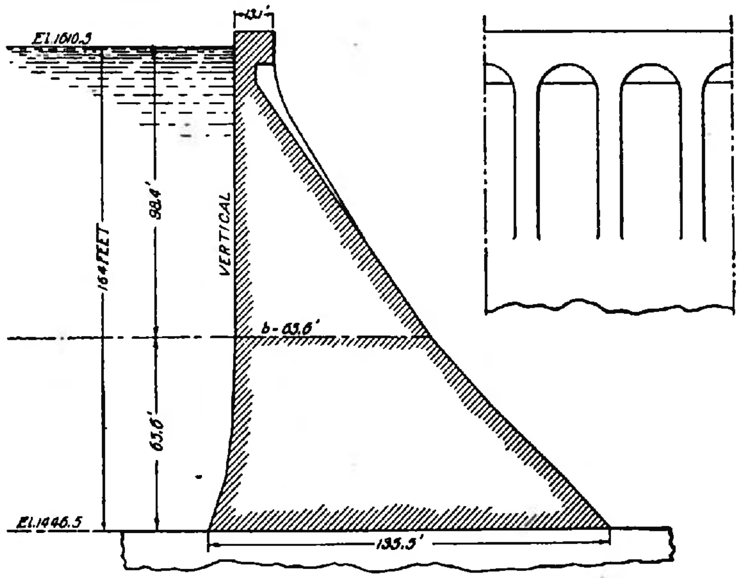
Akashi River Spur Dike

(2) Weir

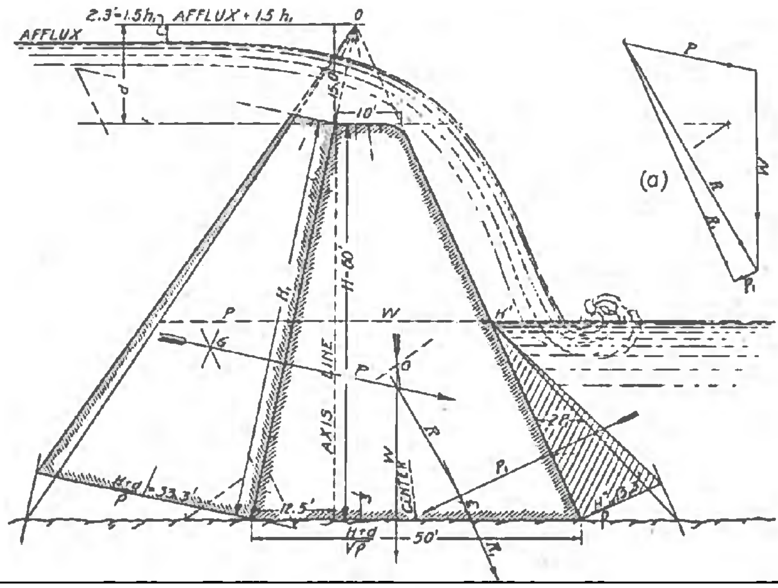
Dams and weirs may be classified as follows:

1. Gravity Dams
2. Gravity Overfalls, or Weirs
3. Arched Dams
4. Hollow Arch Buttress Dams
5. Hollow Slab Buttress Dams
6. Submerged Weirs
7. Open Dams, or Barrages

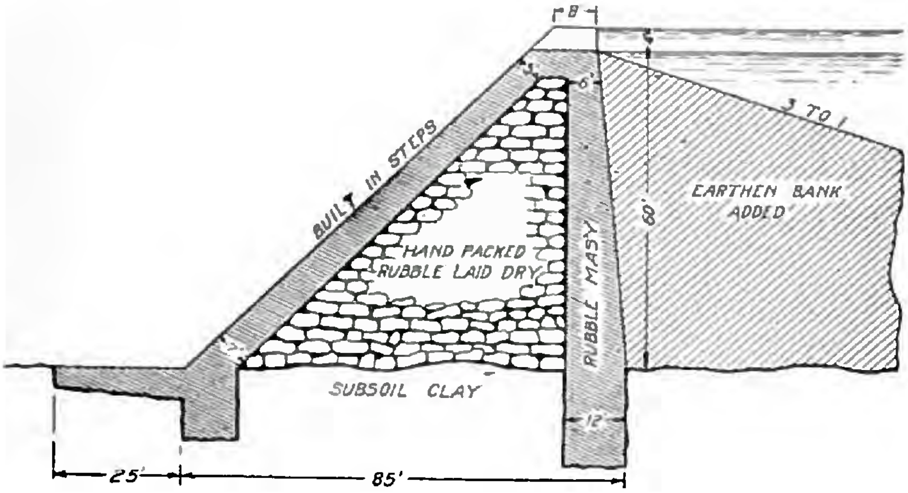
1. Gravity Dams



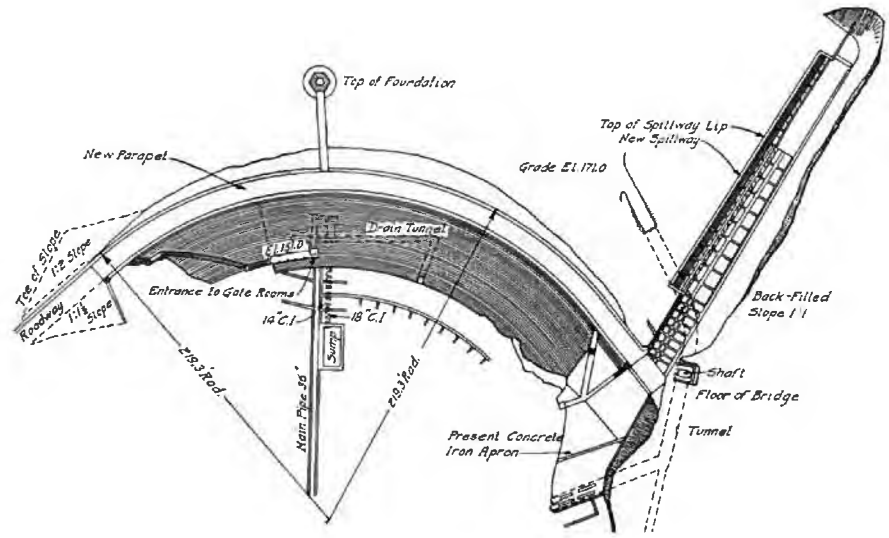
2. Gravity Overfall, or Weirs



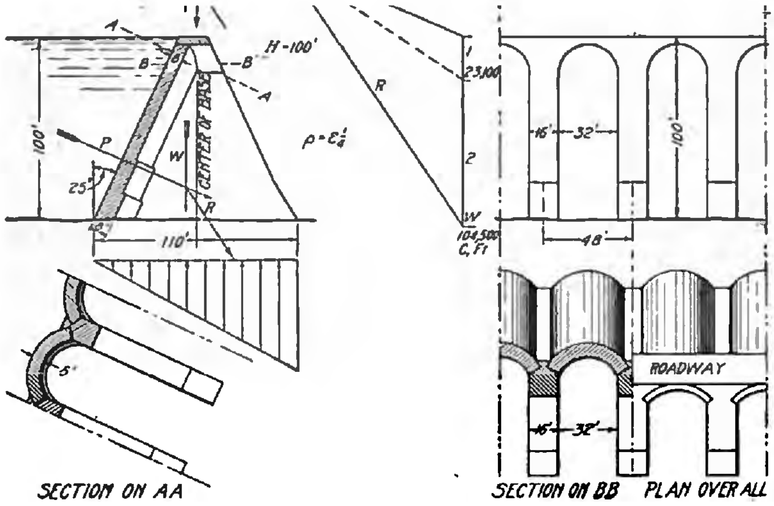
2. Gravity Overfall, or Weirs



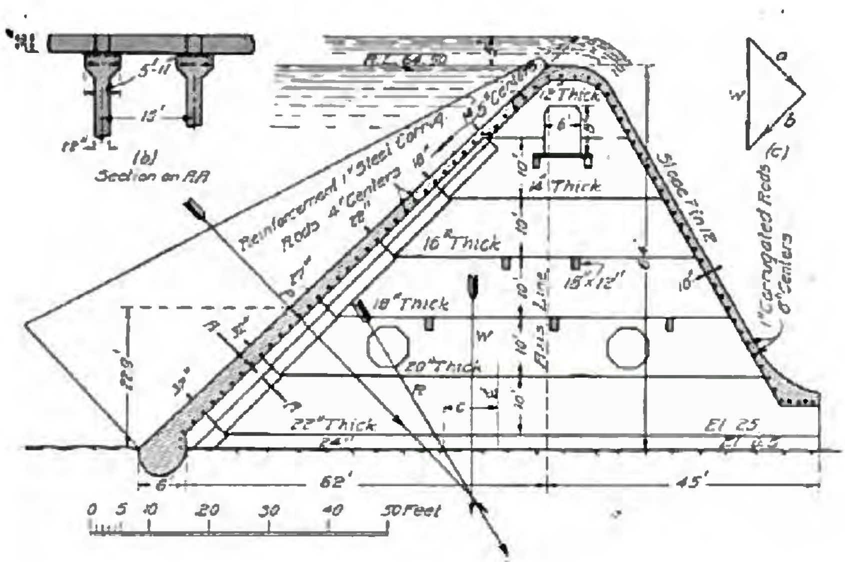
3. Arched Dam



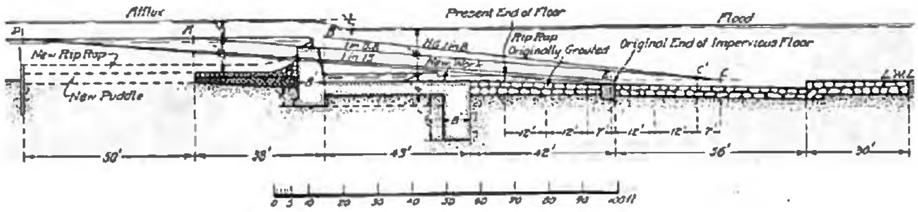
4. Hollow Arch Buttress Dams



5. Hollow Slab Buttress Dams



6. Submerged Weirs



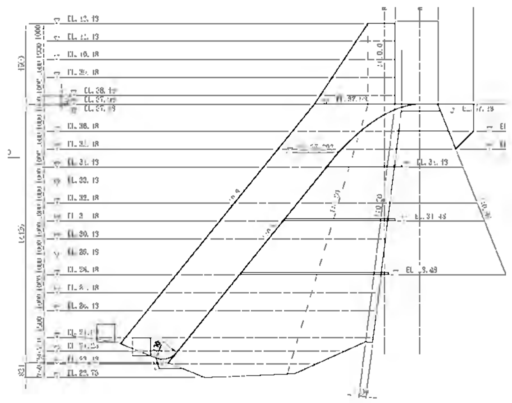
7. Open Dams, or Barrages

- Canal and sluiceway with sluice gate
- There are a lot of Irrigation dams in Timor-Leste.

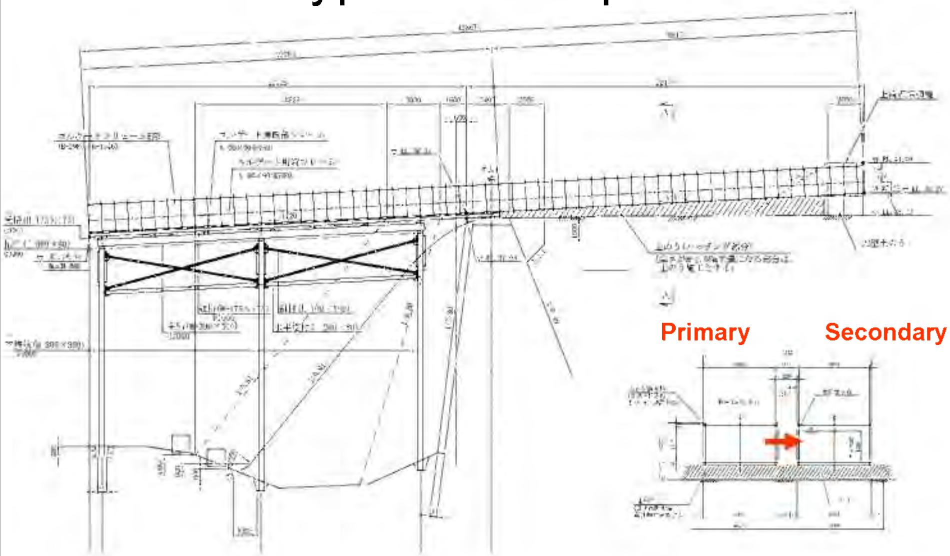
Construction Method of Weir/ Dam

- Place concrete of one lot is 0.75 m – 2.0 m due to control of cracking in mass concrete.

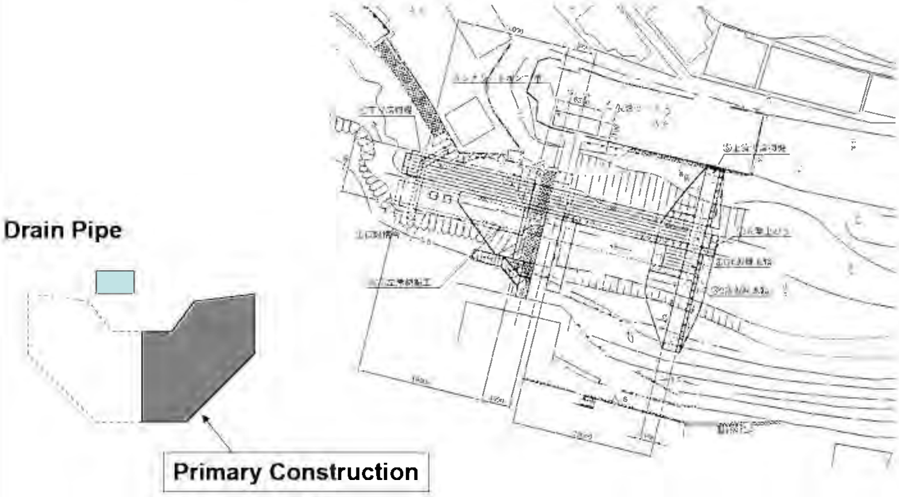
Elevation of each lot of concrete



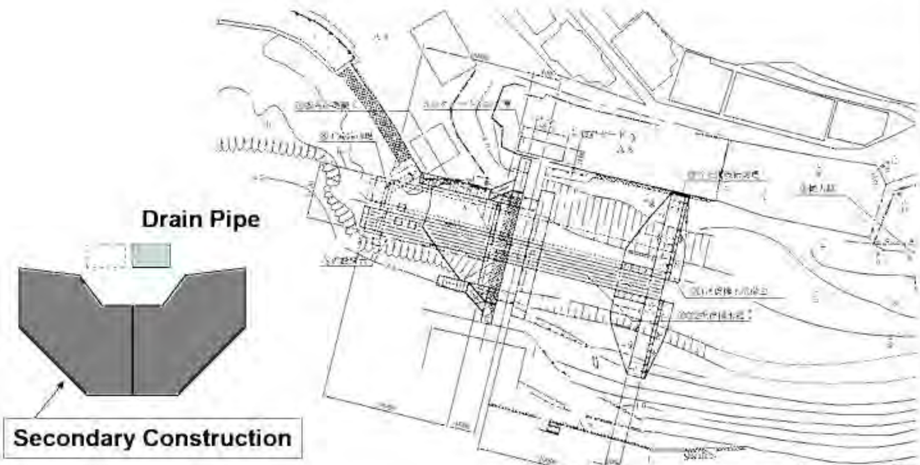
Temporary Water Control by U-type Drain Pipe



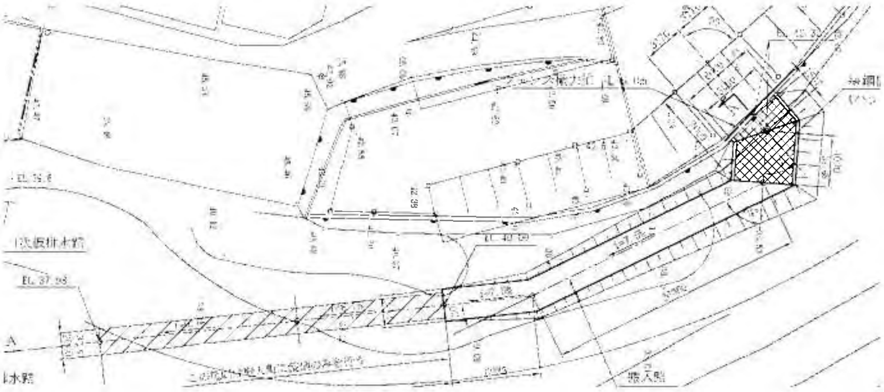
Primary Construction



Secondary Construction



Temporary approach road

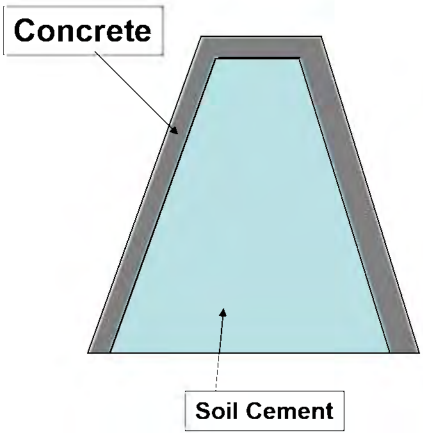


Sabo Dam made of Soil Cement

- Target strength is 1.5 N/mm^2.

Mix of cement

Sabo Dam made of Soil Cement



Next Schedule

6th Flood Control in Class Room Lesson
Cost Estimate

ANNEX-7

SHORT REPORT ON BRIDGE/ROAD

Comment on Comoro II Bridge on 15th July 2013

Mr. Hideo Matsushima

[Abstract]

Superstructure: PCI Girder, H= 1.70m, Total Length = 183.3 m, 30m+3@ 40m + 30m, Post Tensioning, Delivery PC Segmental I Girder from Indonesia

Substructure: Concrete Abutment, Pier, Pier Head, Deck Slab, Approach Slab

Foundation: Bore piles foundation (Casing diameter 1,000mm)

[Point 1] Bridge Carriageway Width & Approach Carriageway Width

Bridge Carriageway Width should be same width with Approach Carriageway Width, considering traffic safety. Especially it is necessary to remove the side walk, mounted up (Width= 50 cm, Height = 20 cm) next to Parapet.

Bridge Carriageway Width

Indonesian "Bridge Design Code MBS" Class B

W = 7.0 m = shoulder 0.5 m + roadway 6.0 m + shoulder 0.5m

Approach Carriageway Width

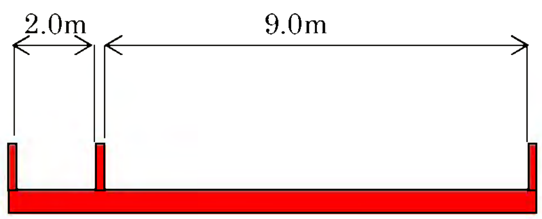
Indonesian "Bridge Design Code MBS" Class A

W = 9.0 m = shoulder 1.0 m + roadway 7.0 m + shoulder 1.0m

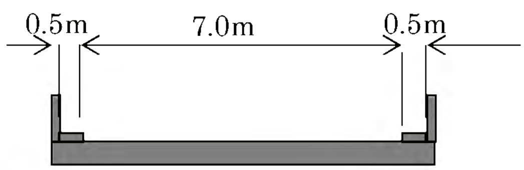
[Point 2] Footway (Pedestrian Width)

The Bridge in urban area requires footway, minimum with 1.5m and normally 2.0m-3.0m. Existing approach road has 2.0 m footway in front of Timor Plaza. Comoro bridge should has footway as following drawing.

Proposed Cross Section of Comoro II Bridge from Point 1 & 2



Existing Cross Section of Comoro II Bridge



[Point 3] Vertical Slope

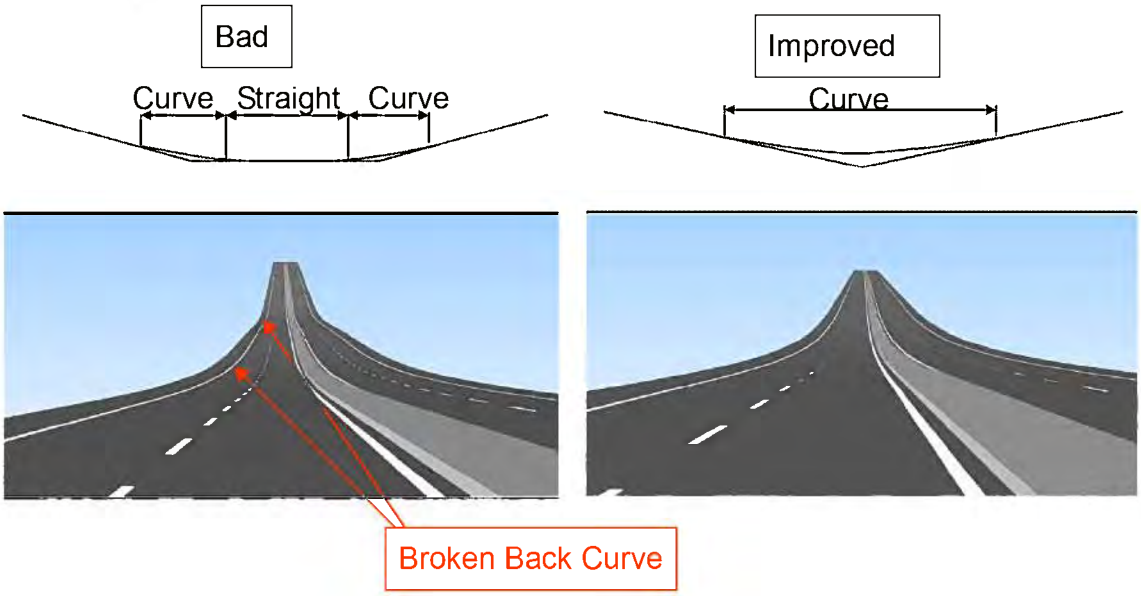
Vertical slope is decided by design speed and sight distance. Vertical slope is better less than 3 % or 4 %, which 4 % is shown in tender document. But it is 4.6 % as as-build drawing. It is a lack of sight distance and will cause traffic accident.

Sight distance of design speed, 60 km = 75 m

[Point 4] Vertical Curve

LV (Vertical Curve Length)= 50m + 4.00% slope + LV= 80m + 0.00% + LV= 80m + 4.00% + LV= 50m by tender document.

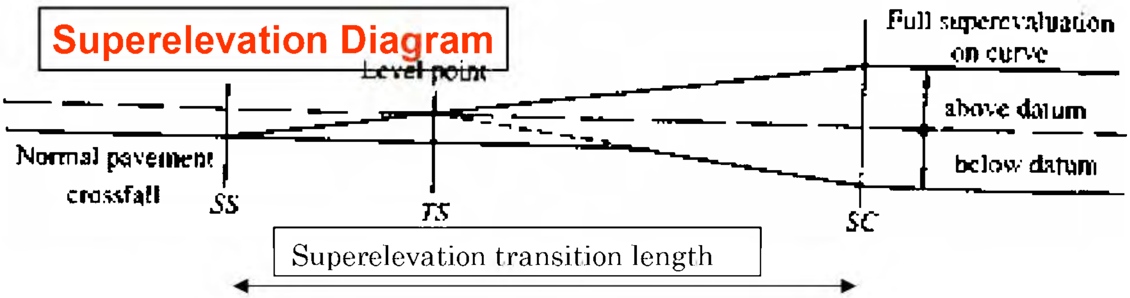
This is bad profile design as follows. One vertical curve is smoother than combination of curve & straight.

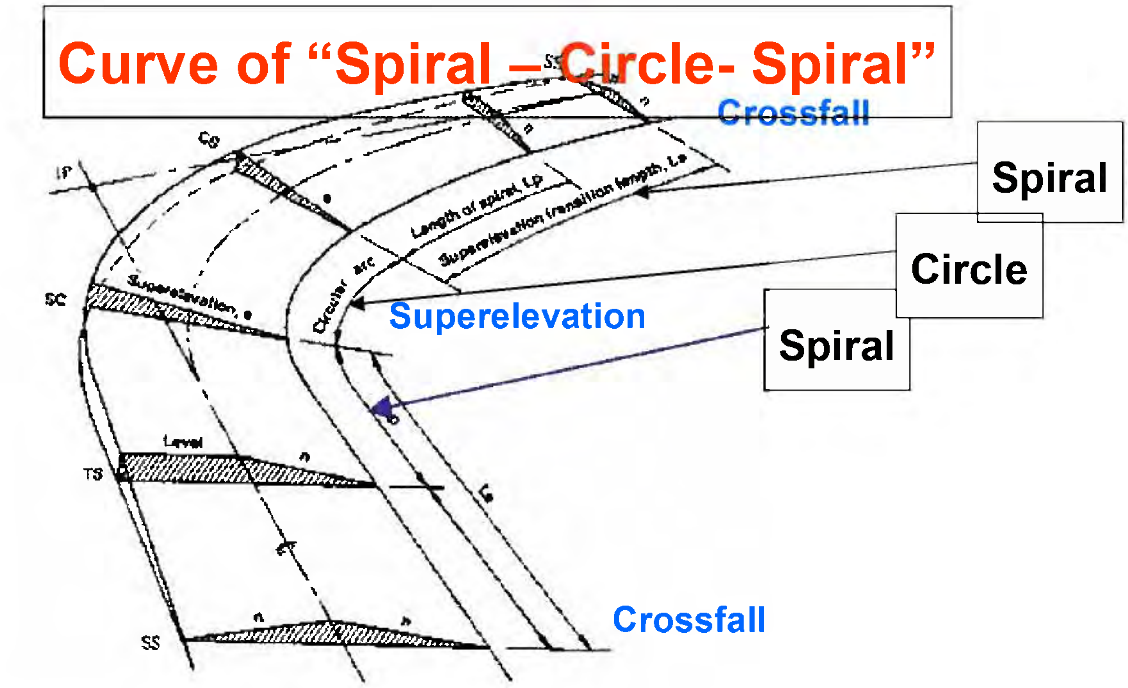


(source: Express Highway Design Standard of NEXCO, Japan)

[Point 5] Cross fall and Superelevation

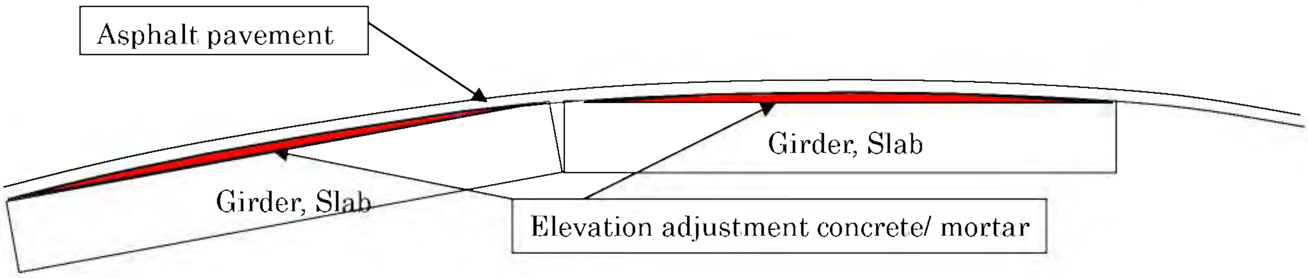
Tender document shows 2.0 % cross fall. As-build is superelevation. Point is transition between cross fall and superelevation. It is necessary to set the superelevation transition length, which is spiral curve length.





[Point 6] Elevation adjustment concrete/ mortar

It is better to use the elevation adjustment concrete/ mortar as bellow due to smooth drive.



[Point 7] RC-Panel for Slab Deck

Tender document shows the RC-Panel for Slab Deck, span length is 1.30m and thickness is 70mm instead of form work. This structure of integration between slab concrete and RC-Panel is high durability and long-life. As-build is to use galvanized steel plate instead of RC-Panel. Galvanized plate will have corrosion risk within 20 years.

[Point 8] Expansion Joint

Tender document shows joint-less type, asphaltic Plug Expansion Joint, which are rubber type caulking, plate and binder. Its life-span will be 10 -15 years old. As-build is rubber type expansion joint, which life-span will be 5- 10 years old and cheaper than asphaltic Plug Expansion Joint

[Point 9] Drain Pipe

Tender document shows horizontal place drain pipe. It is easy to become clogged. As-build is change to straight drain type, and it is easy to maintenance. It is good.

[Point 10] Utility Box drain

Drain pipe should be bottom of utility box. Un-drained water cause to reduce life expectancy

Comment on Debos Road, Suai on 13th Aug 2013

Mr. Hideo Matsushima

[Abstract]

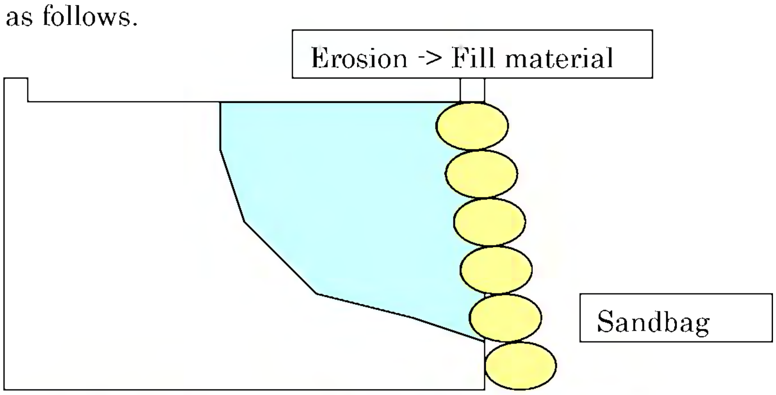
It is necessary to implement Emergency Rehabilitation of Debos Road in Suai by SEFOPE. In this year, road was damaged by flood.

Flood overflowed in the river bank, so that surface of road at the road of bridge side damaged and wingwall was broken.

[Point 1]

Temporary work is as follows.

Width is 5.5 m.



[Point 2]

Option 1: Bridge Plan

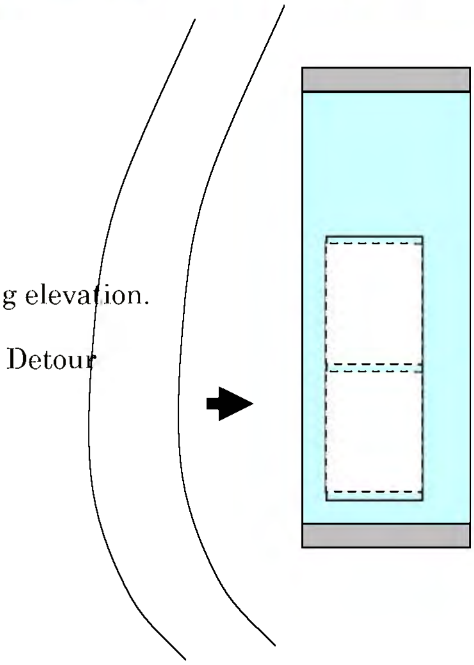
Width is 7 m, if Class B.

L = 20 m

(Consider flood prone area)

Flood water will be concentrated.

New Elevation is 2m higher than existing elevation.

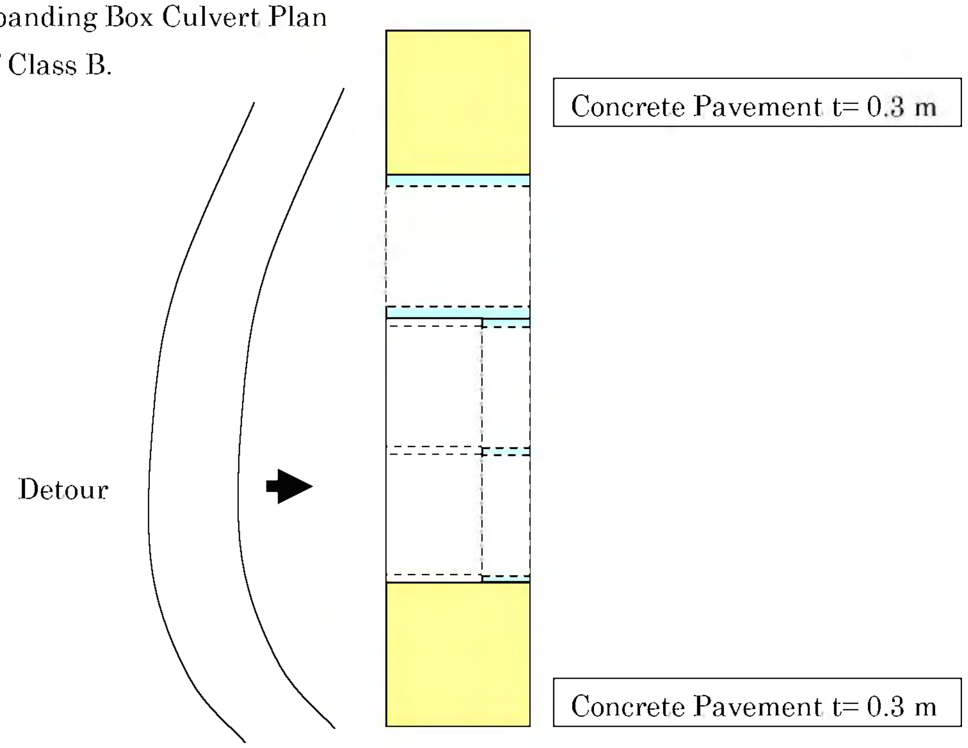


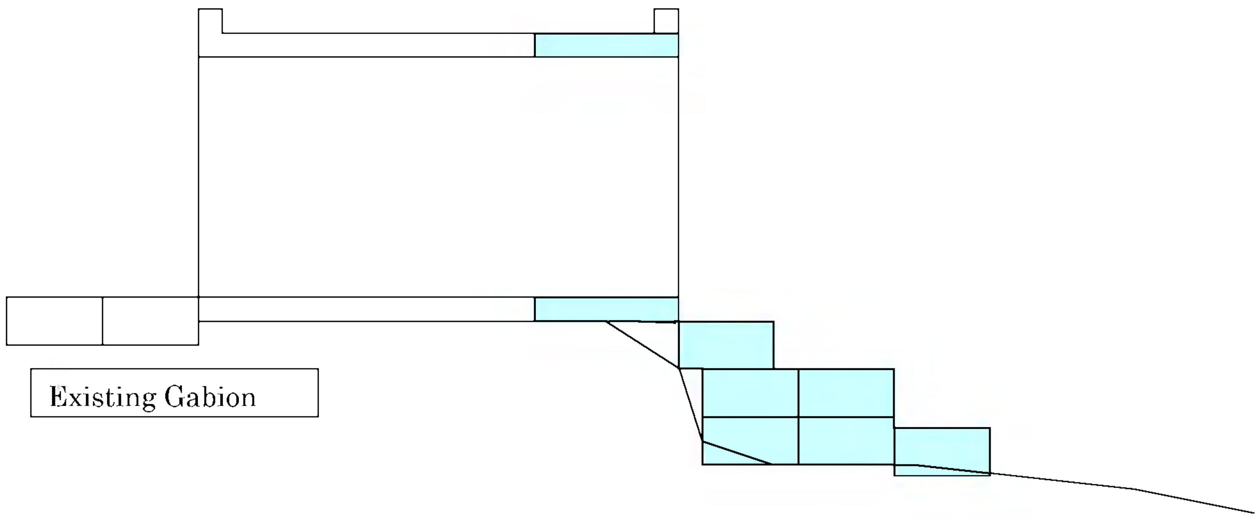
[Point 3]

Widening & expanding Box Culvert Plan

Width is 7 m, if Class B.

2@5m -> 3@5m



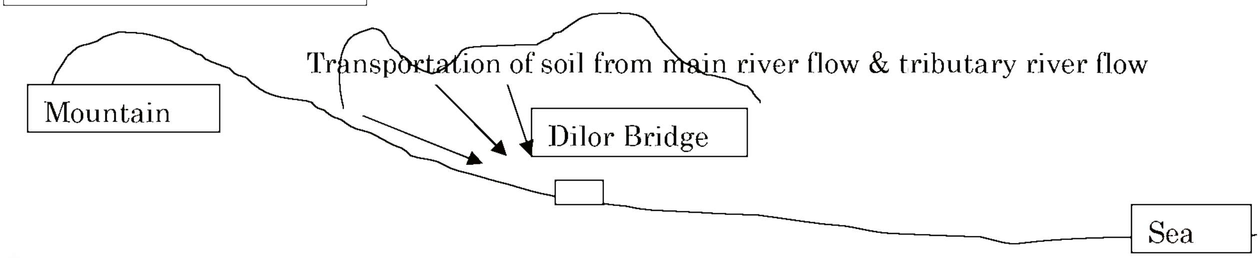


Comment on Dilor Bridge in Viqueque (3 span 60m= 180m)

Mr. Hideo Matsushima

[Point 1] General sedimentation area or Local sedimentation area?

General sedimentation area



If general sedimentation area, it is necessary to do rising of pier cap. It is difficult to maintain excavation of river bed every year.

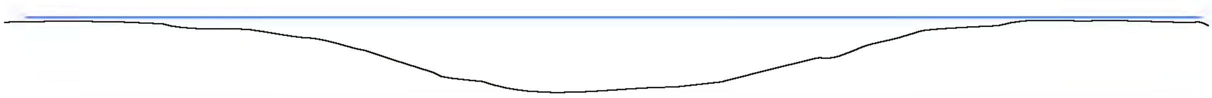
Local sedimentation area

Meandering flow occurs local scouring area at convex curve and local sedimentation, sandbar, at concave curve. In this case, it is useful to use the countermeasure of river flow change, like spur dike or groundsill.

[Point 2] Interview of Existing maximum flood water depth for resident old person. Probability of flood is normally used 100 years. Probability of flood by interview is normally from 30 years to 50 years, so that Design Flood Level (DFL) should be modified and increased than interview.

[Point 3] Flood-prone area or not?

Flood flow of flood-prone area is bellow. Flood flows widely before construction of bridge.



After construction, flood flows limited area, within bridge length, so that velocity increase and flood water level is higher than before.

Brief Description of Dilor Bridge

Dilor Bridge is located in Viqueque District. Its designed length is 180 meters with three (3) spans of 60 meter each. It was designed to support the pile cap of Abutments by ten (10) pieces R.C. Piles and the Pile Cap of pier 1 & 2 by fifteen (15) pieces and seventeen (17) pieces respectively. The size of the pile is 0.40 x 0.40 with length ranging from 15.00 to 17.00 meters. The superstructure will be a Modular Truss Bridge Class-B based from Indonesia Specifications.

The Contract for the construction of Dilor Bridge was awarded to PT DAYA MULIA TURANGGA JV PRECISION CORPORATION UNIP LDA. In the amount of US$ 3,251,535.80 to be completed within 365 calendar days. The Contractor received the Notice to Commence Work 31st of May 2011 and thereafter immediately start his mobilization period.

Consultant (Bonifica SpA) : Team Leader, Daniel V. Branzan

Comment on Jakarta II on 13th Aug 2013

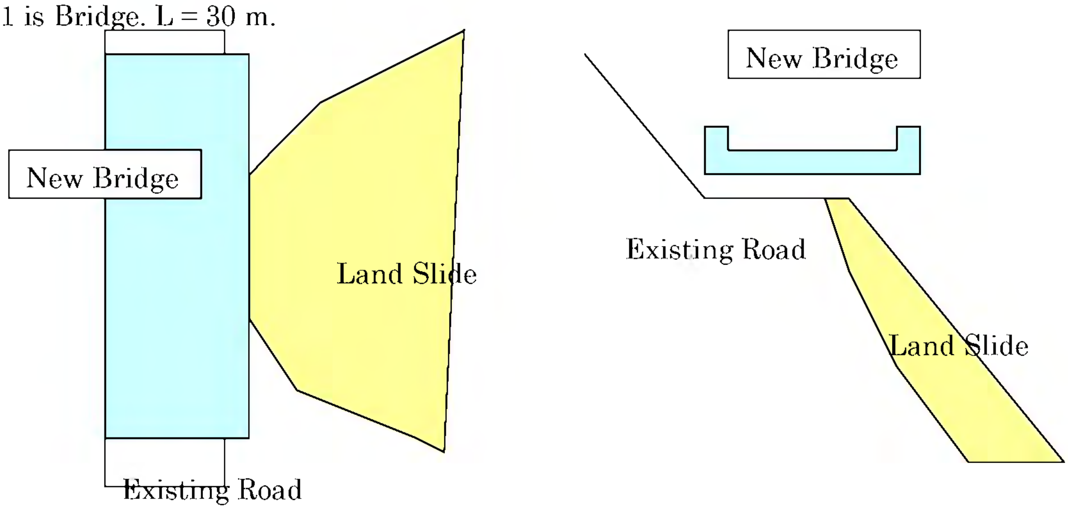
Mr. Hideo Matsushima

[Abstract]

It is necessary to implement Emergency work of Jakarta II road in Ainaro.

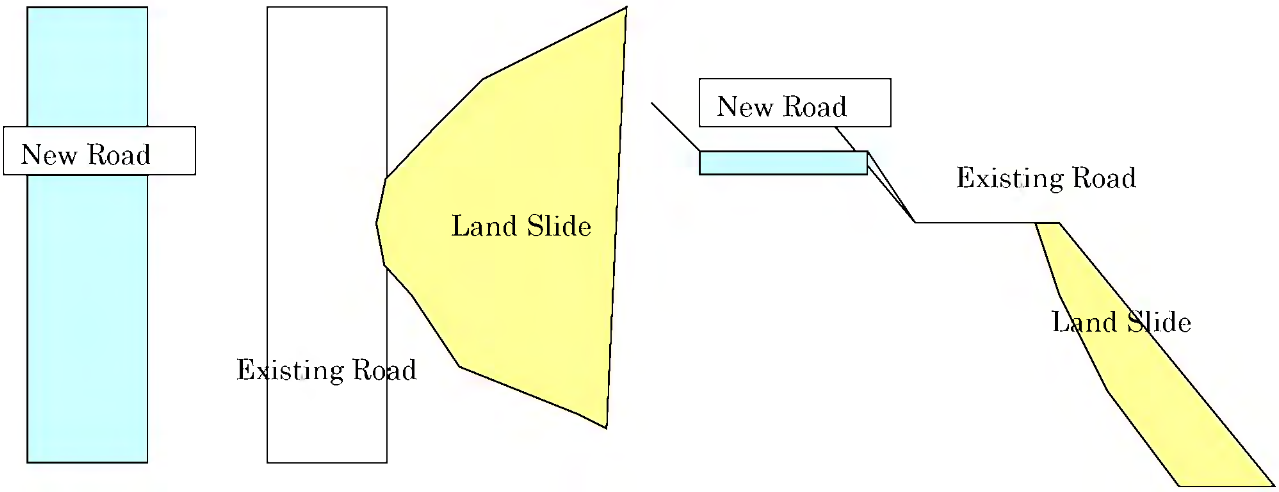
[Point 1]

Option 1 is Bridge. L = 30 m.



[Point 2]

Option 2 is new alignment. Sift is more than 20m from existing road.



Comment on Loes River Drawings (29th July 2013)

Mr. Hideo Matsushima

[Abstract]

FICA UNIPESSOAL Lda.
Rua Kofi Annan, Dato, Liquica District
No.Contacto: +670 77348345/ 77271597
Email: ficaunipIda@gmail.com

DRAWING DOCUMENT

PROJECT: RIVER PROTECTION IN MOTA LOES (NEW CONSTRUCTION OF GABION SLOPES PROTECTION AND RETAINING WALL REPAIR & MAINTENANCE)

LOCATION: MOTA LOES, MAUBARA SUB-DISTRICT, LIQUICA DISTRICT, TIMOR-LESTE

Layout Plan is as follows.

(From bridge to upstream)

(1) Site A, Retaining Wall Repair, Length = 370m --- Drawing A-002, A-003, A-004, A-005

(2) Site B, Retaining Wall Repair, Length = 50m --- Drawing A-006

(3) Site C, Gabion slopes protection Repair, Length = 512m --- Drawing A-007

(4) Existing Retaining wall (No repair work)

(5) Site A, Install New Gabion slopes protection, Length = 655m --- Drawing A-008

(6) Site B, Install New Gabion slopes protection, Length = 655m --- Drawing A-009

[Comment 1]

(Refer Class Room Lesson "Planning of flood control No.3")

Common belief is that river mouth is general transportation and/or sedimentation area, not general scouring area. Nearness of river structure like abutment, pier and retaining wall of dike, is local scouring area.

Normally, it is necessary to calculate the local scour depth with river structure by HEC-Analysis.

In my experience, I assume Loes river local scour depth is 4-6m near abutment due to narrow river cross section and 2-4m near retaining wall/ Gabion, when big flood river depth is 4m and velocity is 4m/s. This means second main flow is near river structure.

Countermeasure is two types.

(Countermeasure-1)

To put foot protection against the condition that main flow is near river structure.

(Countermeasute-2)

To put Spur Dike (Groin) due to reduction of local scour depth by redirection of river flow away from the riverbank

Your design/drawing concept is Countermeasure-1.

[Comment 2]

(1) Site A, Retaining Wall Repair, Length = 370m --- Drawing A-002, A-003, A-004, A-005

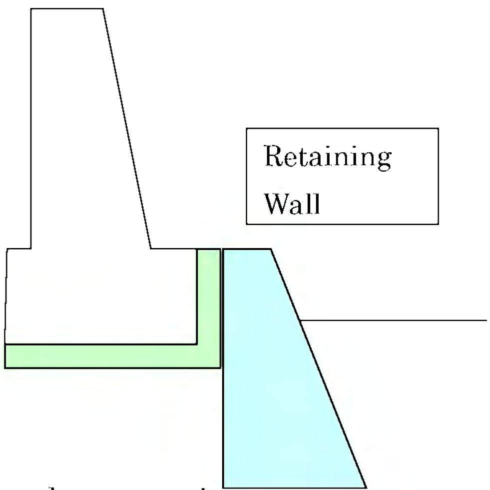
I assume maximum local scour depth is 4-6m. It occurred at maximum flood river depth, and decreased corresponding to flood river depth.

Concrete pile, 40 x 40 cm, is 6 m length. It is stable when big flood comes. In this case, Gabion slope protection will sink and move, but it is OK due to flexible structure. It is better to use 3m width of Gabion Slope Protection instead of 2m width.

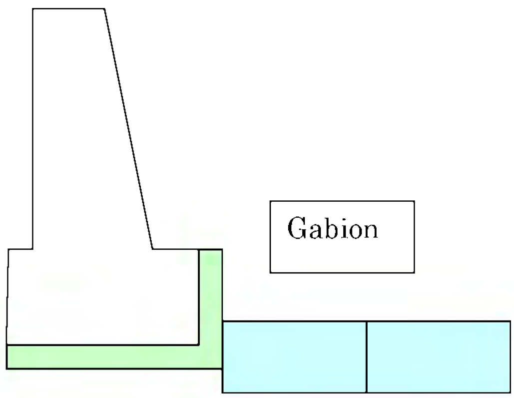
[Comment 3]

(2) Site B, Retaining Wall Repair, Length = 50m --- Drawing A-006

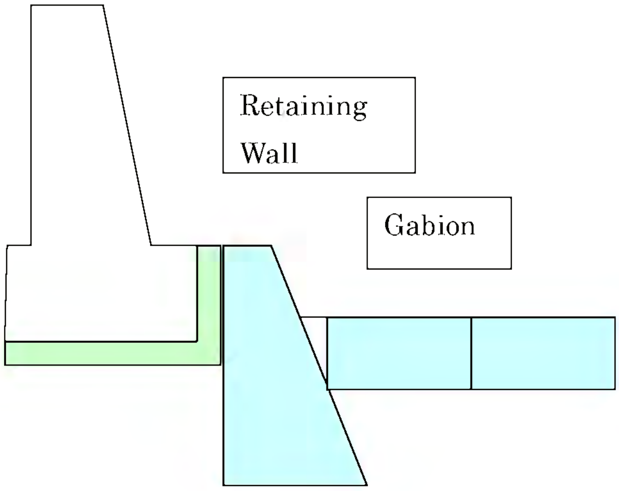
It is common damaged portion of river structure is easy to damage again, so that it is necessary to reinforcement structure, for example, more deep protection or more wide foot protection.



plan-1 more deep protection



plan-2 more wide protection



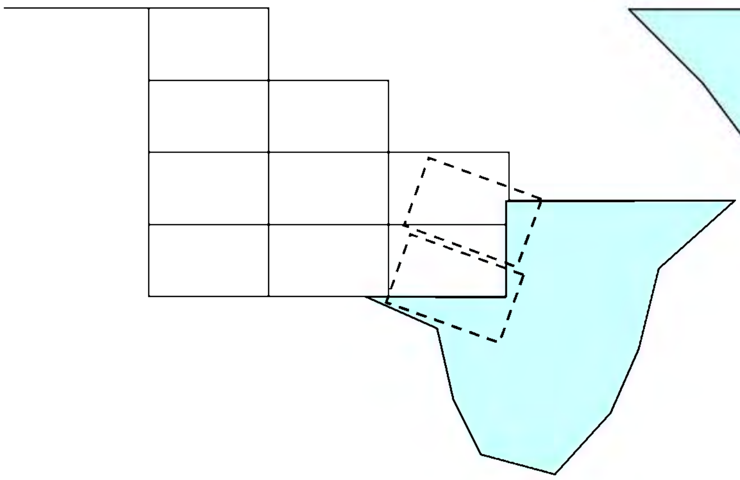
Best Plan Combination

You must consider the failure mode of retaining wall, if 2-4 m local scour occurs.

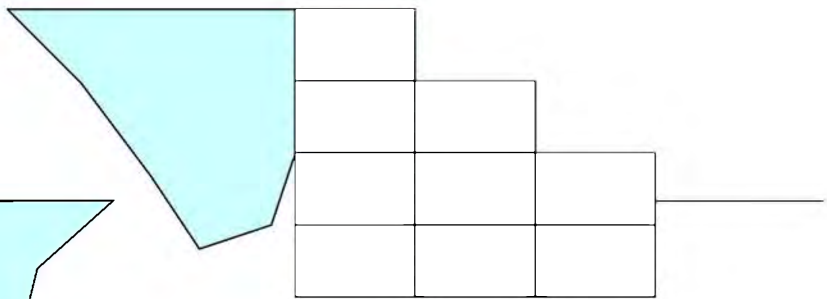
[Comment 4]

(5) Site A, Install New Gabion slopes protection, Length = 655m --- Drawing A-008

You must consider the two type of failure mode of retaining wall, if 2-4 m local scour occurs. This type may be stable for two type of failure mode.



Failure Mode-1 Local scour

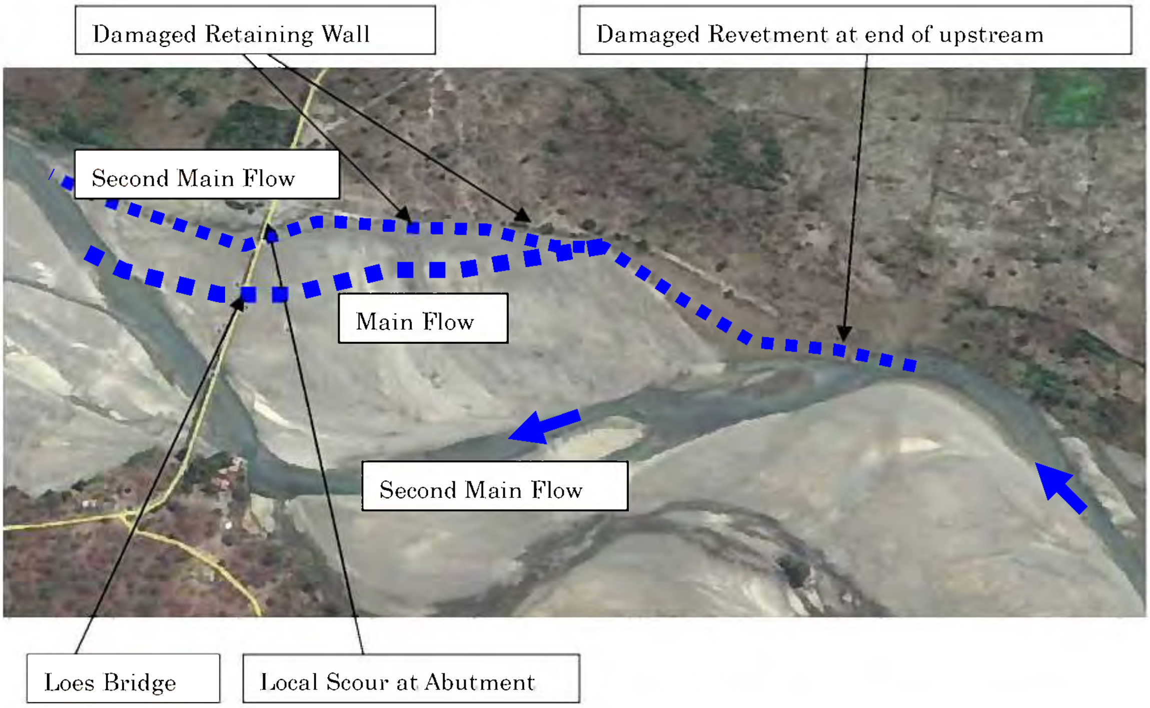


Failure Mode-2 Backfill scour

Comment on Loes Bridge and Loes River in Liquica (Site Visit on 8th July 2013)

Mr. Hideo Matsushima

[Abstract]

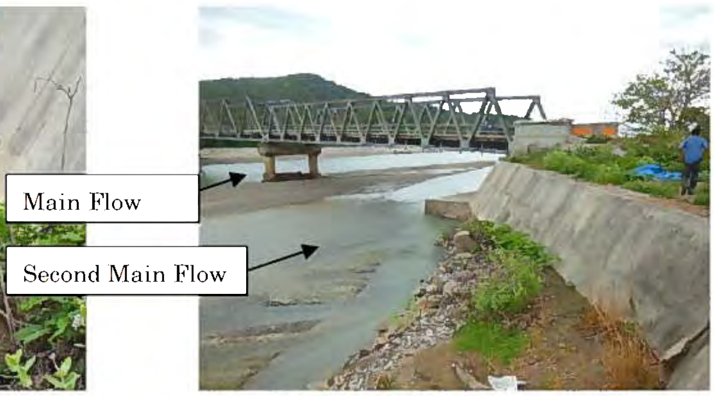


Main flow had sifted at right side from left side on Google map. Second main flow is near abutment and revetment of dike.

[Point 1] Local scouring at abutment

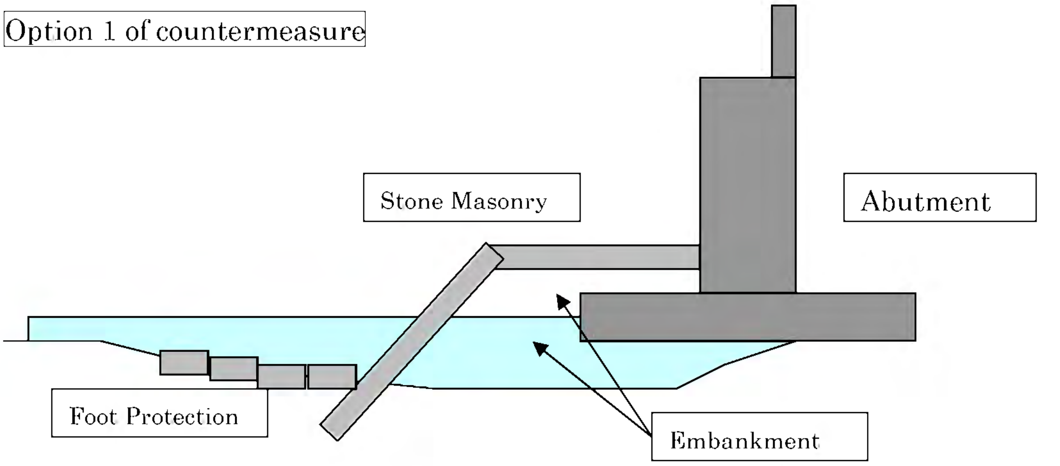
Second main flow occurred local scour at abutment and upstream side settlement of abutment occurred wide crack on abutment wall. This countermeasure is urgent due to high risk of flood damage.

Scouring at footing



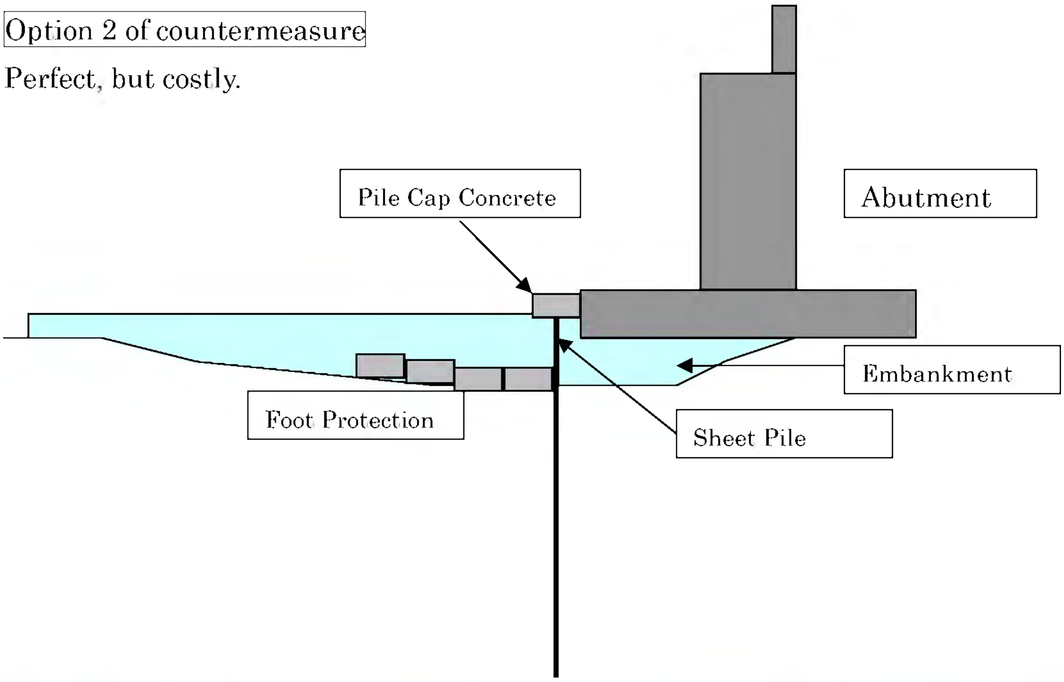
Second Main Flow

Option 1 of countermeasure



Option 2 of countermeasure

Perfect, but costly.



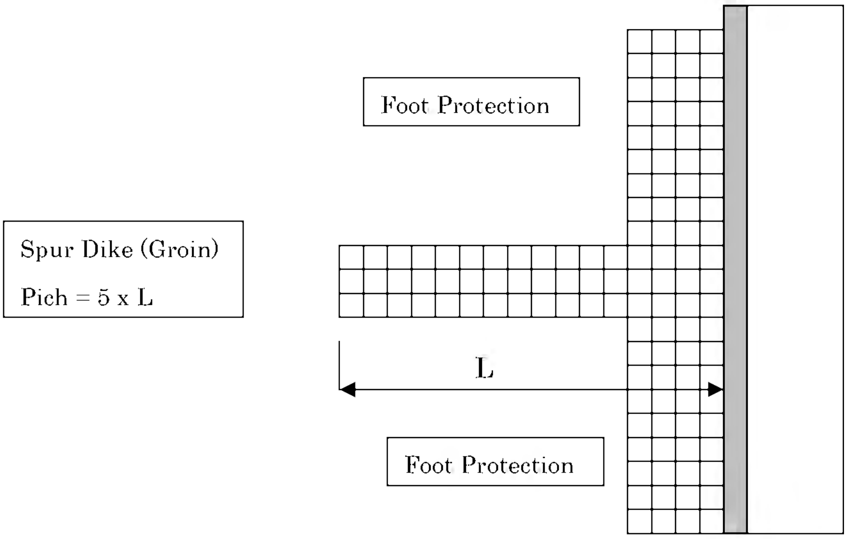
[Point 2] Damaged Retaining Wall

200m upstream from Bridge

100m upstream from Bridge

The reason of damage is local scouring at bottom of retaining wall. It is necessary not only to put foot protection for local scour, but also to set spur dike (groin) for redirection of river flow away from the riverbank.

Plan of countermeasure



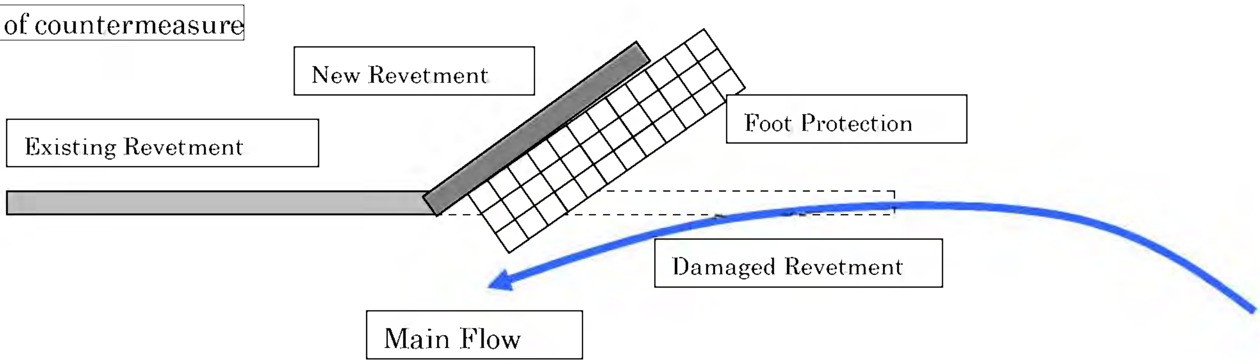
[Point 3] Damaged Revetment at end of upstream

Damaged Revetment

Washed Out of Revetment at End

Wrong direction of revetment was easy to have damage during flood. It is necessary to consider the end of abutment location based on main flow direction.

Plan of countermeasure



Comment on Loro Bridge, Suai on 13th Aug 2013

Mr. Hideo Matsushima

[Abstract]

It is necessary to implement Emergency Rehabilitation of Loro Bridge in Suai by SEFOPE.

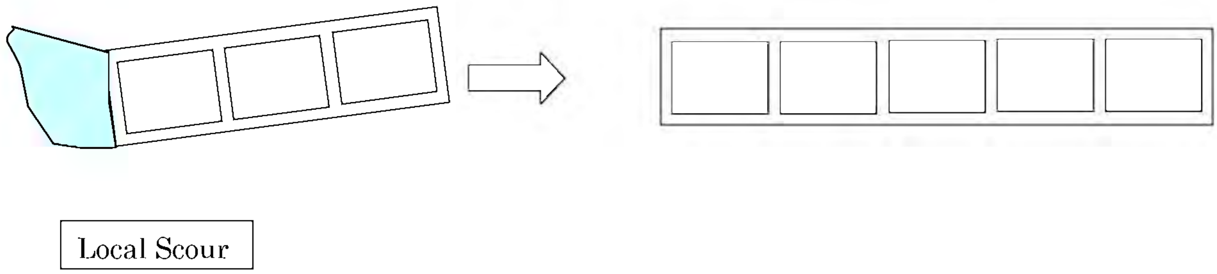
In this year, road was damaged by flood.

[Point 1]

Surface was damaged. Concrete pavement is long life for overflow.

[Point 2]

Expanding Box Culvert from 3@3m to 5@3m.



Comment on Lospalos - Iliomar Road Drawings on 2nd Aug 2013

Mr. Hideo Matsushima

Mr. Jiro Koyama

[Abstract]

Rehabilitation of Lospalos to Iliomar Road (km 0+000 – km 13+600) in Lautem

Ministry of Infrastructure, Secretary of Public Work, As-staked Drawing (STA 0+000-STA 2+000) and As-staked Drawing (STA 2+000-STA 13+600)

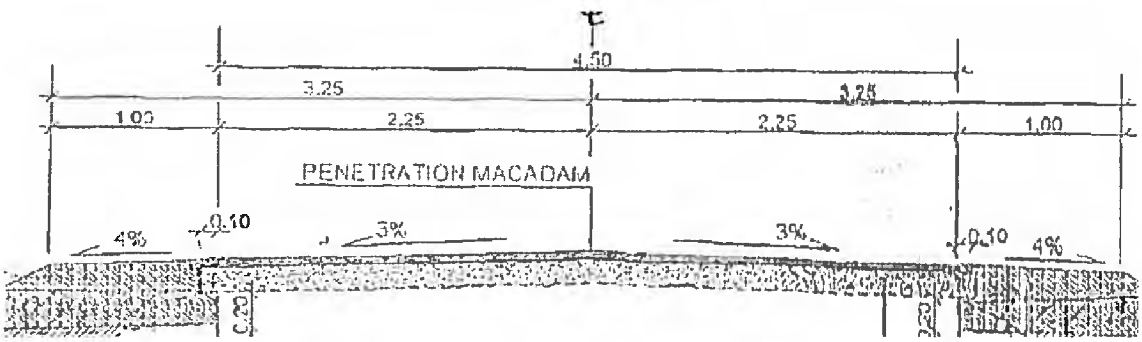
Contractor: KIAR MAEK UNIPESSOAL LDA

[Point 1]

Width of 150 mm thick crushed aggregate base course is not clear. regarding two set of drawings, one is 4.50 m in typical road section, and another is 4.70 m. Contractor explained 4.70 m is correct. But original BoQ shows 4.5 m as following list.

PAY ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST US $	TOTAL COST US $
300	SUBBASE AND BASE COURSE				
301	Aggregate Subbase Course	Cu.m.	5,600.00	28.50	159,600.00
303	Cruched Aggregate Base Course	Cu.m.	9,200.00	58.00	533,600.00
	TOTAL FOR SECTION 300				693,200.00

4.5m x 13600 x 0.15 = 9,180 m2



[Point 2]

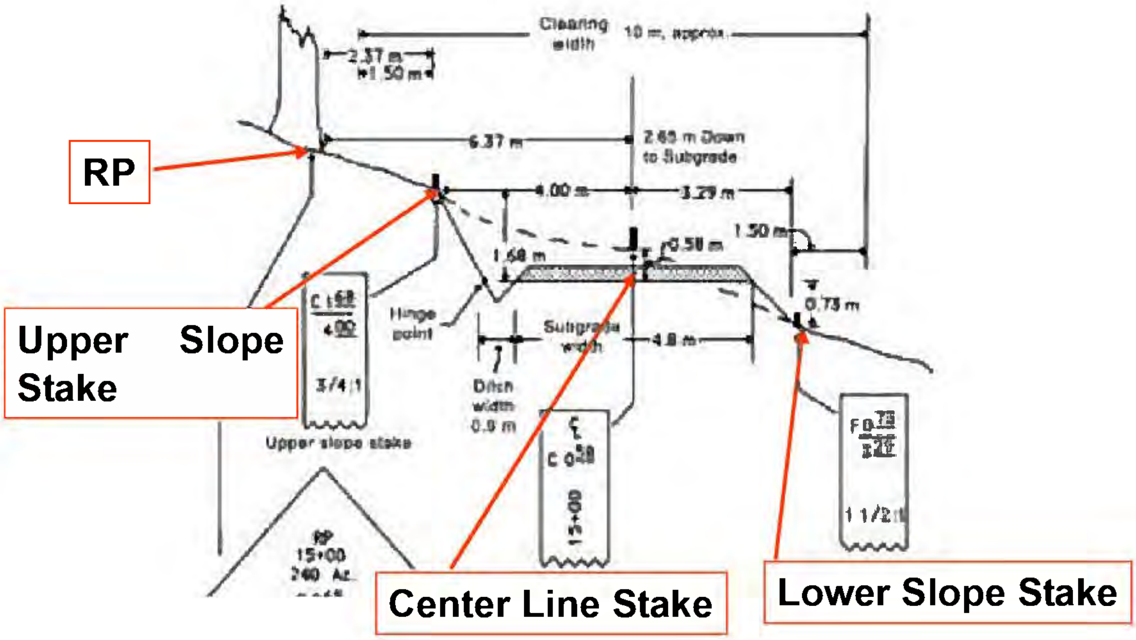
Some part of crushed aggregate base course was washed out by drain of rainfall. It is necessary to repair.

[Point 3]

Regarding sub base course, big stone which size is 20 cm was used in sub base course.

[Point 4]

It is necessary to check the centerline of crushed aggregate base course, using Reference Points, slope stake or center line stake. Consultant explained somebody stole them of bamboo stick, so that we were not able to measure centerline.



[Result]

It is necessary to recheck by ADN engineer in Lospalos.

Comment on Oges Road, Suai on 13th Aug 2013

Mr. Hideo Matsushima

[Abstract]

It is necessary to implement Emergency Rehabilitation of Oges Road in Suai by SEFOPE.

In this year, road was damaged by flood.

[Point 1]

At concave bank, erosion occurred and sedimentation of sand bar occurred at convex bank. River bed material is mainly rock, it means fix river bed. Counter measure is retaining wall and spur dike (Groin) is reasonable.