S4-P3

ADB

Strategic Program for Climate Resilience

Mainstreaming Climate Resilience into Development Planning (TA 8179)

(September 2013-April 2019)

CAMBODIA'S RESPONSE TO CLIMATE CHANGE-SIHANOUKVILLE

Traditional/Indigenous Practices for Climate Change Adaptation in Cambodia

Name of Presenter: Thai Vathara
Position of Presenter: National Infrastructure & Climate Change Specialist
Organization / Ministry: ICEM
Date: 30 November 2016

CLIMATE INVESTMENT FUNDS

icem

Traditional Practice Adaptation Measures – Experiences in Cambodia:

- **Surface Dressing** (Minimize abrasion, erosion, pothole, crack, dust control,…)
  - Laterite/Mountainous Sand Pavement,
  - Stone Block Pavement,
  - Burned Brick Pavement,
  - Concrete Block Pavement,
  - Bamboo-Concrete Pavement,
  - Reinforced-Concrete Pavement,
  - Bitumen Pavement,
- **Base-Course** (Minimize penetration, strengthen base, long period of soak,…)
  - Sand-Aggregate Base,
  - Mix Aggregate Base,
  - Macadam Base,
  - Water Bound Macadam Base,

Traditional Practice Adaptation Measures – Experiences in Cambodia:

- **Drainage** (Minimize water penetration to base, erosion, quick relief flowing water, …)
  - Side Drain,
  - Mitre Drain,
  - Scour Checks,
  - Drifts,

- **Slope Protection** (Minimize water penetration, erosion, protect active pressure, land slide, …)
  - Side Slope Protection,
  - Retaining Wall,
  - Palisading,
  - Abutment Wall,
  - Erosion Control,
  - Turfing

Indigenous/Traditional Practices Collected
A- Surface Dressing

- CLIMATE RESILIENCE SURFACE-LATERITE/MOUNTAINOUS SAND SURFACE DRESSING. It provide a strong surface layer which is passable all year round, dust control.

- CLIMATE RESILIENCE SURFACE-STONE BLOCK PAVEMENT. It reduce abrasion of surface, strengthen surface. Shape by hand with practice handtools.

Indigenous/Traditional Practices Collected
A- Surface Dressing

- CLIMATE RESILIENCE SURFACE-BURNED BRICK PAVEMENT. Using clayed burn (Solid Brick) from Firewood Kiln, filling gap by Sand or Mortar.

- CLIMATE RESILIENCE SURFACE-CONCRETE BLOCK PAVEMENT. Using precast concrete from printing mould with many type of shape.

Indigenous/Traditional Practices Collected
A- Surface Dressing

- CLIMATE RESILIENCE SURFACE-BAMBOO REINFORCED CONCRETE PAVEMENT. Using Bamboo strip with Wiresteel or Nail, Pouring concrete with vibrating compaction.
- CLIMATE RESILIENCE SURFACE-BAR REINFORCED CONCRETE. Using bar reinforced (plain & deformed bar) and Pouring concrete with vibrating compaction.

Indigenous/Traditional Practices Collected
A- Surface Dressing

- CLIMATE RESILIENCE SURFACE-BITUMINOUS CARPETING. This work consist of DBST/SBST bituminous surface treatment layer involving the application of a bituminous material followed by an Aggregate cover specified.

Indigenous/Traditional Practices Collected
B- Base-Course

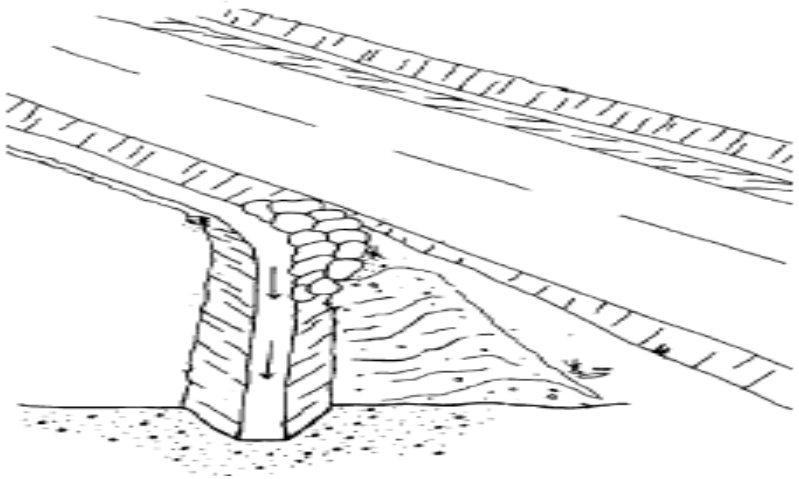
- Climate Proof Road-Mix Aggregate Base. (Consist of mixture of hard durable crushed rock particles and mineral filler which satisfies gradation),
- Climate Proof Road-Cement Stabilized base, (Agg. Shall be proportioned and mixed with cement and water in a central mixing plant),

Indigenous/Traditional Practices Collected
B- Base-Course

- CLIMATE PROOF ROAD-MACADAM BASE. It is suitable for hilly terrain: (i) It can withstand the wet climate, (ii) Provide better slip resistance (road on gradient), (iii) Easier repaired when it is locally damage.
- WATER BOUND MACADAM BASE- It consist of crushed first class brick aggregates well graded and of desired strength, Max size of brick aggregate 38mm according to Specification.

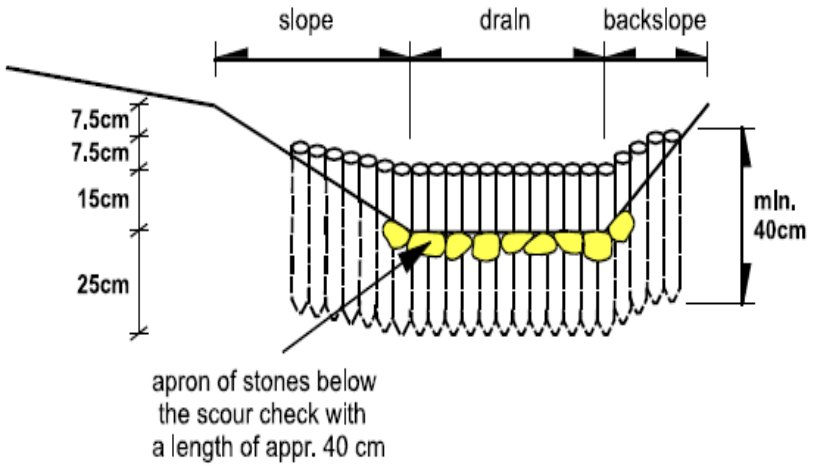
Indigenous/Traditional Practices Collected
C- Drainage Protection

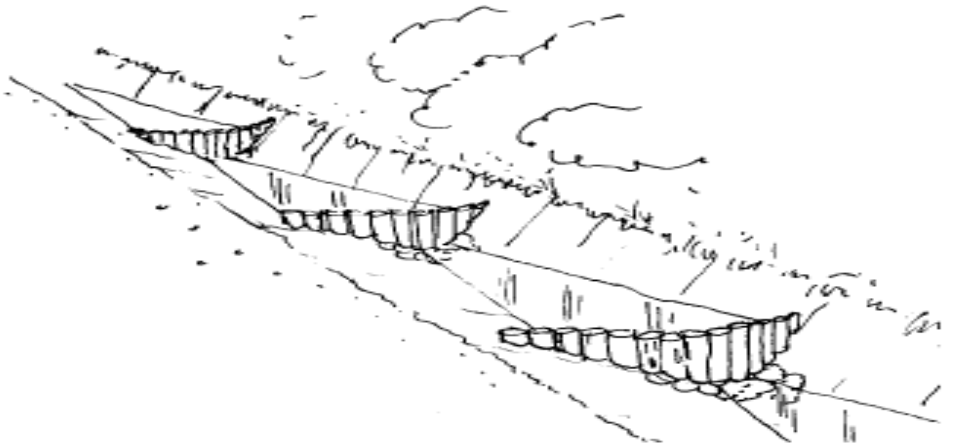
- Erosion Control and Protection-Side Drain. (It collect water from carriage way, dispose of it quickly, control manner to minimise damage),
- Erosion Control and Protection-Mitre Drain. (Determine during the initial stage setting out the alignment, to isolate water from sidedrain)



Indigenous/Traditional Practices Collected
C- Drainage Protection

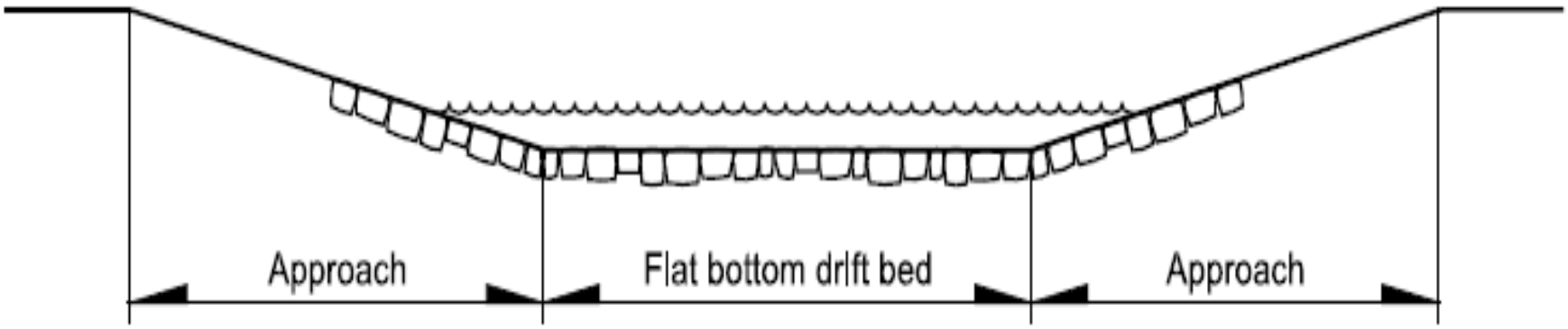
- Erosion Control and Protection-Score Check. (The drainage water will gain high speed which may cause erosion of side drain when road gradient are steeper than 4%),





Indigenous/Traditional Practices Collected
C- Drainage Protection

- EROSION CONTROL AND PROTECTION-DRIFT. (Drifts provide an efficient and economic method of allowing water to cross from one side to the other. Drifts will be flooded for short periods and the road will be closed for traffic. Normally it's constructed to pass river streams which are dry during long periods of the year).



Indigenous/Traditional Practices Collected
D- Slope Protection

- BIOENGINEERING FOR SIDE SLOPE PROTECTION – ROCK REVETMENT WORK FOR STREAM BANK, EMBANKMENT SLOPE, CUT SLOPE, BRIDGE ABUTMENT, AND OTHER SURFACE COMPOSED OF ERODIBLE MATERIAL.
- BIOENGINEERING FOR SIDE SLOPE PROTECTION – RETAINING WALL.

Indigenous/Traditional Practices Collected
D- Slope Protection

- BIOENGINEERING FOR SIDE SLOPE PROTECTION – PALISADING. (It consist of 2 layer pre-cast plate (1050x650mm) fitted with RCC post of (150x150mm), 3 m long, 0.9 m c/c to be driven 2/3rd of the total length).
- BIOENGINEERING FOR SIDE SLOPE PROTECTION – ABUTMENT WALL.

Indigenous/Traditional Practices Collected
D- Slope Protection

- BIOENGINEERING FOR SIDE SLOPE PROTECTION – EROSION CONTROL AND PROTECTION – DOWNSTREAM CAUSEWAY
- BIOENGINEERING FOR SIDE SLOPE PROTECTION – TURFING (This item shall consist of applying turfing to stabilize the earthen shoulder and slopes of the embankment)

Selected sample case: (Build Climate Resilient Road with MACADAM Base Method)

- **Macadam** is a type of road construction pioneered by Scottish engineer John Loudon **McAdam** (1756—1836).
- **Macadam** method was brought to **Cambodia** since **1930** by French, first the roads construction in Phnom Penh capital. Older roads in Cambodia were developed between **1890** and **1950.**

John Loudon McAdam

Brief Content of Adaptation:

1- Description of the Practice - Provincial Road (PR-1489A

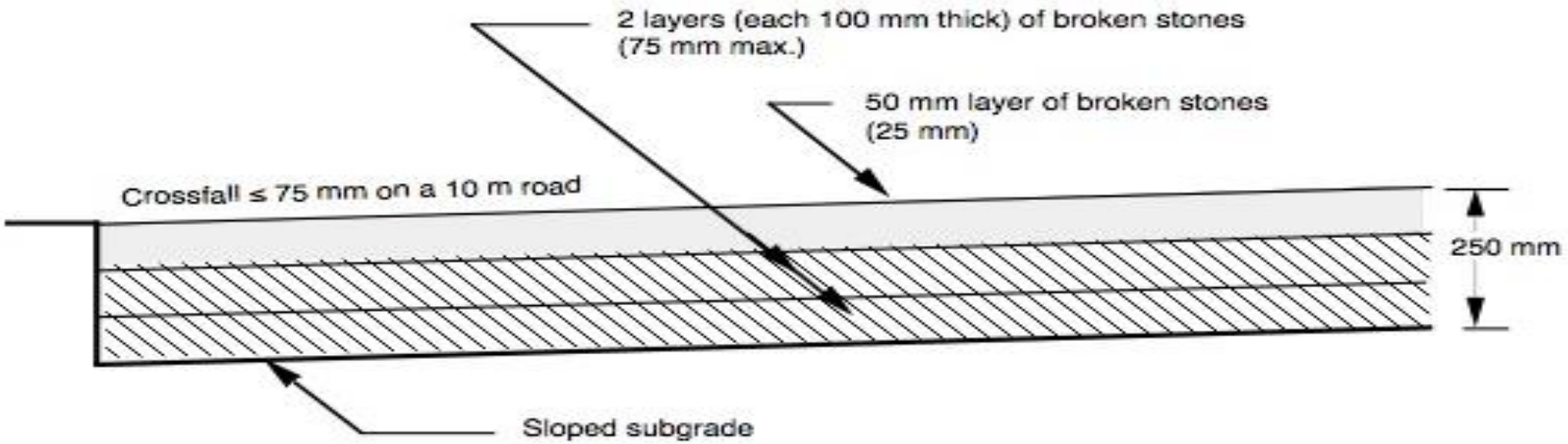
- It was built on a seawater floodterrain where soft-soil pit foundation.
- PDPWT/Koh Kong used soil mixed with amour rock to form a subgrade, due to high tide seawater over flow the road and water may soak the sub-base of the road.
- Macadam Base can not penetrate well and withstand for the wet condition.
- Regarding to the erosion, PDPWT used amour rock to protect the toe and the slope of the road embankment.

Brief Content of Adaptation:

2- Project location:

- Macadam Base Road is located in Mondul Seima District. Koh Kong Province.
- Road (PR-1489A) is situated in coastal eco-zone, with soft-soil pit condition, heavy rain-fall,

  - **1st Layer: Crushed Stone Max.75mm (100mm thickness)**
  - **2nd Layer: Crushed Stone Max.75mm (100mm thickness)**
  - **3rd Layer: Crushed Stone Max. 25mm (50mm thickness)**



Brief Content of Adaptation:

3- Parties involved

- **Organisation:** PDPWT/Koh Kong
- **Community:** Local authority, Skilled & Unskilled Labour, local contractors

4- Climate change threats & impacts

The key issues to be considered for the resilient road, to adapt the site condition and climate threats:

(i)- Soft-soil pit foundation,

(ii)- Wet condition,

(iii)- Abrasion & Erosion due to storm, weather, tornado,

(iv)- Steep Gradient.

The project site (PR-1489A) is directly vulnerable to climate threats:

(i)- Seawater intrusion, (ii)- High tides and sea-level rise,

(iii)- Storms and storm surges, (iv)- Tornado, (v)- Weather,

(vi)- Heavy rain and flooding.

Brief Content of Adaptation:

5- Adaptation Measure

(i)- Develop guideline & standard for Macadam Roads resilient to climate change,

(ii)- Develop climate maps & climate vulnerability index for Macadam Roads,

(iii)- Coordinate with institutional ministries to strengthened and more data available for sharing.

Adding to that, PR-1489A were applied **DBST** to protect the road from the effects of sun and run-off water:

(i) Slow down the oxidation process,

(ii) Prevent penetration to the road base,

(iii) Minimize abrasion and washout problem,

(iv) Secure the dust blow,

Brief Content of Adaptation:

The project was started in 2009 and finished in late 2013

Macadam base course works: the stone to be laid by hand tidy

Brief Content of Adaptation:

6- Advantages:

- ***Labour base intensive:*** was the potential for increased employment in road construction at local areas.
- ***Using simply and locally handtools:*** such as string line, line level, wooden peg, profile board, wheelbarrow, hammer,
- ***Withstand to wet condition***: good resistance to water and the stone skeleton is less susceptible to the water present in the layer.
- ***Modernization***: It have been used successfully in South Africa for many decades and under developing countries.

Brief Content of Adaptation:

7- Disadvantages:

- ***Time consuming:*** The stone layers have to be spread/placed by hand tidy.
- ***Stone pieces:*** used in macadam road are keyed together by means of sand, clay and water used. The binding effects of sand and clay depend upon the compaction and optimum moisture content, often difficult to meet standard gradation and flakiness specifications.
- ***Workmanship & Supervision***: Need to be serious, tolerable, genius, adjustable, proper control and supervise).

Brief Content of Adaptation:

8- Cautions

- Compaction: (i)-Thickness limitation (layer by layer, max.150mm with adequate & appropriate compaction equipment), (ii)- Compaction requirement (95%-98% MDD, Moisture content),
- Quality of materials: (sound, touch, durable, dense, clean, gradation, flakiness,…),
- Workmanship: (The finished surface shall be uniform and smooth, camber 3%, leveling,…)
- In addition, surface drainage would have to be careful, by providing ditches and culverts, as a means of channeling the drained water away from the road and into the creeks and streams.

Brief Content of Adaptation:

9- Cost Range

- Typical road width 7m consumes about 20 workdays to complete 1km road length within 50 days.
- Costs schemes depend on location, labour, availability of material, transport and the amount of minor works of the system.

Thank you