




DFID Department for International Development

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South East Asia Community Access Programme (SEACAP 17)



1. Introduction to SEACAP17

- Construction of Pavement Trials with low cost pavements for low volume road in rural accesses
- Fund G ADB Loan for the construction, Grant aided by DfID for Technical Assistant and construction supervision, and budget from the Government of Lao PDR
- Collaboration between MCTPC, SEACAP (DfID) and ADB in NEC Project

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1. Introduction to SEACAP17



- Contract duration: 15/Jan/06 – 14/Sep/07
- Actual Completion: 23/Aug/07
- Employer: Ministry of CTPC
- Consultant: Roughton International (UK) in association with Lao Transport Engineering Consult
- Contractor: Guangdong No.3 Water Conservancy and Hydroelectric Engineering Board (PR China)

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1. Introduction to SEACAP17



- Number of Roads = 7_F total length = 28.424km.
Carriageway width » 1x3.50m, Shoulder width»2x0.50m. Formation width»4.50m
- SEACAP pavement trials consist of 8 types_F total length = 4.140km (*see details in next section*)
- Total construction cost= 9,558M LAK (1,006,001\$)
 - { normal gavel road = 7,879M LAK (829,335\$)
 - { trial pavement = 1,679M LAK (176,666\$)

(cost as above is actual construction cost)

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1. Introduction to SEACAP17



- Normal gravel road of R3 Access Roads and SEACAP pavement trials are combined in one contract.
- Cause of two project combined in one contract, the project named Rural Access Roads Package 1 and SEACAP17, Houayxai District Bokeo Province



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2. Objectivity of SEACAP



- Construction of accesses to villages in rural area with low cost, community contribution
- Poverty alleviation
- Dissemination of technique of low volume road construction for rural access roads with simple method of construction, low cost, and compliance with local condition.






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2. Objectivity of SEACAP

- Use of machine in combination with labour based in construction and maintenance
- Use of local resources and use of natural material is available in location of project
- Manpower development, local people can continue the construction and maintenance of access roads by apply technique and construction method from this trials

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3. SEACAP (DfID) and ADB Collaboration

Activities funded by SEACAP	Activities funded by ADB
Technical Assistance for managing and supervising the SEACAP access roads on specifically identified access roads of Route 3.	Cost of civil works associated with the selected access roads.

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4. Geography Condition

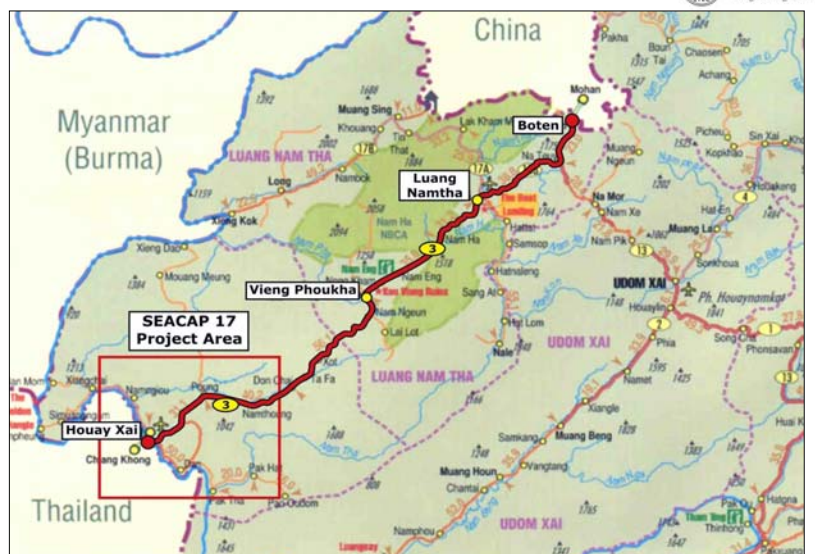


- Construction of roads access to villages locate in the area of National Road No. 3 Project in Houaxai District, Bokeo Province
- All existing roads are tracks and paths for pedestrians, and only some section farm tractor can pass in dry season
- Topography condition in the project area most access roads lay in rolling terrain, some sections are in flat terrain, low level and flooded area

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4.1 NEC Project Location





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LTEC
Lao Transport
Engineering Consult

4.3 ທຣັກ[ມັກ'ເກດຊິກດຊວດກ໌+ເລັກ]
Existing track before construction




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Existing Condition R. No.2  



ROAD No.2.2
0 + 800

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Existing Condition R. N. 3.2



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Existing Condition R. N. 5





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Construction Period for Trial Pav.



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 Consulting Consult



No.	Type of Pavements	Started	Finished
1	Hand Packed Stone	9/4/07	4/5/07
2	Otta Seal (Double, Single)	11/4/07	2/5/07
3	Natural Surface	2/4/07	6/4/07
4	Mortared Stone	3/5/07	4/8/07
5	Concrete Paving Block	11/6/07	10/7/07
6	Bamboo R.C.	30/4/07	25/5/07
7	Geo-cell	26/5/07	12/6/07
8	Sand Seal	1/3/07	10/3/07

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5. Facile Matter and Difficult Matter in Implementation

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5.1. Facilitation

- Project location near the town, there is convenience in communication and liaison
- MCTPC and PMU has advised and directed the consultant during project is in progress
- Local authorities, especially DCTPC of Bokeo Province has given a good cooperation with the consultant
- Headquarter and Experts follow up, help and advise in technique relates to trial pavements

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5.2. Difficulty



- Since SEACAP trial sections are constructed on the access road of R3 Project, work programme of SEACAP shall comply with work programme of R3 project
- R3 is a big project and it needs a large quantity of crushed stone/crushed rock at the same period as SEACAP17 project needed, this problem was consequent to quarry/crushing plant could not be supplied as required



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5.2. Difficulty (cont.)



- The contractor has insufficient equipment, cash flow and qualified professional staffs.
- Trial sections shall be constructed after the construction of standard gravel road of R3 project has been completed in order to avoid the pavement is damaged by successive heavy equipment.
- Terrain condition of the project site is difficult for temporary detour during construction



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6. ຈົບເຮັດໂຄງການໂຄງສ້າງ SEACAP17

BENEFIT FROM
SEACAP17



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6.1 Social - Economic

- People in rural area get all year accessible roads
- People in rural area can access to public facilities
- People in rural area get employ
- People can transport their product to market
- To sustain tourism
- Opportunity for the development/investment



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6.2 Technical



- Technical dissemination on low volume road for rural accesses road, low cost and use of local resources
- Manpower development, and skill training for local labours
- Support the establishment of technical standard and manual for low volume/low standard road



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End of Part I



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II. Pavement Structures of Trial Pavements

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1. SEACAP PAVEMENT TRIAL

Srn.	Road No.	Type of Pavement	Length (m)
1	2	Hand Packed Stone	500
2	3.2	Single Otta Seal	250
3		Double Otta Seal	250
4		Engineered Natural Surface	400
5		Mortared Stone	600
6	5	Concrete Paving Block	500
7		Bamboo Reinforced Concrete	575
8		Geo-cell	400
9	8	Sand Seal	665
Total length (m):			4,140

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2. Select Location for Trial Section



- Selected location with difference of topographical feature such as flat, flooded area, and steep gradient
- Selected location with difference of geological condition such as soft soil, agricultural soil, good quality in engineering soil
- Defined pavement type to compliance with condition of each location

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3. Detailed Survey and Design for Construction



- Details topographic survey and data collection
- Sub-soil investigation on the alignment, conducted test pits at 50m interval and collected sample to Laboratory
- DCP test on the alignment at 10m interval and 5 tests per cross-section
- Material sources investigation

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Detailed Survey and Design for Construction



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4. Details of Pavement Structure



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4.1. Sand Seal



- Seal coat MC-3000, rate 0.80 l/m² and spreading sand covers with a rate of 0.012m³/m². Use of steel wheel roller 12t compacts entirely
- Prime coat MC-70, rate 0.85 l/m²
- Crushed stone base course 150mm thick, CBR≥80%
- Granular sub-base 120mm thick, CBR ≥25%
- Selected sub-base 150mm thick, CBR≥7% (depending upon existing sub-grade?)

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4.2 OTTA SEAL



- Construction Method is the same as Chip Seal, it comprises of double seal and single seal Otta seal
- Seal coat MC-3000, rate 1.6 – 1.8 l/m², grain size of aggregate 0 - 13mm, rate 0.015 m³/m²
- Prime coat MC-70, rate 0.85 l/m²
- Crushed Stone Base Course 150mm thick, CBR≥80%
- Granular Sub-base 120mm thick, CBR≥25%

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Compare OTTA Seal and Chip Seal



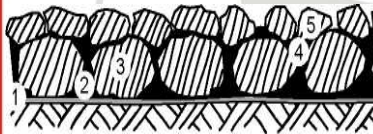
Single Chip Seal



Single Otta + Sand Cover



Double Chip Seal



Double Otta Seal



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Otta Seal Pavement



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4.3 Bamboo R.C.



- Construction method is the same as the method of construction of PCC pavement with wire mesh reinforcement, this trial use of bamboo mesh instead of wire mesh
- Bamboo shall have a min. thickness of 5mm, min. age of 4 years, and dried
- Joint between concrete slab may or may not install Dowel Bar
- This trial Dowel Bar was not installed, but max. slab length = 5m



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Bamboo R.C.



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Bamboo R.C.



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4.4 Geocell

- Use of plastic cell with a specific thickness installs on approved sub-based/sub-grade surface, then pour concrete into the cells and compact by hand lightly
- Plastic cell is used as a formwork for insitu cast concrete block. Plastic cell shall be left on the pavement and embedded in the concrete and it cohered all concrete blocks flexibly on the pavement
- Thickness of Geocell in this trial are 75mm, 100mm, 150mm

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Geocell



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Geocell



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4.5 Concrete Paving Block



- Use of precast concrete block on approved sub-base/sub-grade
- Method of construction is the same as paving block/tile on side walk or on a yard
- Joint between block shall be sealed by sand or crush dust, or dry mortar. This trial sealed by sand mixed with soil (1/3 by volume soil/sand)



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Concrete Paving Block



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4.6 Hand Packed Stone



- Use of stone from quarry or from river place close to each other on approved sub-base/sub-grade
- Inserted small stone or gravel into the void, then fill of sand or crush dust mix with smaller chips
- Watering and use of light roller compact lightly
- Stone may or may not be dressed its shape, depending upon the objectivity of the project
- Method of construction is similar to Water bound Macadam construction method



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Hand Packed Stone



EDGE BEAM SECURED AND LARGE STONES LAID ON EDGE



LARGE STONES WEDGED WITH SMALLER ONES THEN BLINDED



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Hand Packed Stone



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Hand Packed Stone



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4.7 Mortared Stone



- Method of construction is the same as Hand Packed Stone but use of cement mortar fill of joint between stones, it is similar to grouted stone riprap for protection
- Hand Packed Stone or Stone Packing has ever applied for heavy maintenance on National Road No. 8 in Borikhamxay Province. But the size of stone is thicker (25 – 30cm), the joint was filled by bitumen and overlaid by chip seal
- This project used stone thickness of 10cm for Hand Packed Stone and 6cm for Mortared Stone

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Mortared Stone




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5. Summary of Pavement Structure



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6. Advantages and Disadvantages of each type of Pavement

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6.1 Sand Seal



Advantages:

- Low cost facilitate in construction and maintenance, high strength
- Prevent loose and erosion occurs on pavement
- Reduce dust, and prevent water seepages in the pavement structure

Disadvantages:

- Needs equipment and needs to import bitumen
- Needs technicians who has experience in construction of bituminous surface dressing
- Bituminous surface is soft can be scratched out easily and it has some reaction with alkaline

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6.2 Otta Seal



Advantages:

- Low cost and facilitates in construction and maintenance, high strength
- Combination grade of aggregate, cleanness of aggregate is not strict, natural river gravel and crushed gravel can be used
- Quality is the same as general bituminous surface dressing, but Otta Seal surface is thicker
- Can apply with main road has high traffic volume

Disadvantages:

- Needs equipment and needs to import bitumen
- Needs technicians who has experience in construction of bituminous surface dressing

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6.3 Stone Packing Pav.

Advantages:

- Labour based and not need much equipment
- Facilitates in construction and maintenance, not required high technology
- Use of natural material, except mortared stone pavement needs cement for masonry
- High strength

Disadvantages:

- Required neatness in work, times consume, needed a lot of labourers
- Since cement mortar is at joint for mortared stone is designated as rigid type, cracks occurred at joints
- Required stone quarry or outcrop stone which can easily break and dress of its shape

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6.4 Concrete Paving Block

Advantages:

- Beautiful road surface, can be paved in various textures surface
- Can be sustained heavy traffic load if road base has been constructed properly and increase the strength of concrete blocks

Disadvantages:

- Required neatness in work, times consume, needed a lot of labourers
- If road base was not constructed properly, when heavy vehicle traffic through the blocks depress and undulation shall occurs

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6.5 Bamboo R. Concrete



Advantages:

- Use of natural material, except cement and joint seal material need to import
- Facilitates in construction
- High strength and long serviceability

Disadvantages:

- Take a long times until age of concrete can carry the load
- High cost for construction and maintenance
- Difficult in maintenance, if crack happened need to remove entire a slab

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6.6 GEOCELL



Advantages:

- High strength pavement and stability cause of it is bound by plastic cell
- Long serviceability
- Facilitate in construction, faster than construction of PCC slab pavement

Disadvantages:

- High construction cost, needs to import Geocell and needs to pour cement concrete
- Difficult in maintenance and take a long times until concrete age can carry the load

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7. Conclusion and Recommendation



- For high traffic volume road, or at steep gradient and has facilitation to use equipment in construction. Otta Seal may be applied
- Or the access to villages and low volume traffic road, flat terrain, soft soil. Hand Packed Stone may be applied, but stone thickness should be 20cm (Min.)
- If the road is built in the village area only, no heavy vehicle traffics through. The following types of pavement may be applied: Mortared Stone with dressed stone, concrete paving block, clay brick

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III. Design and Construction Practice on SEACAP 17



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1. Drawings and Specifications



- Conditions of contract was prepared by the Consultant of R3 Project
- Drawings, technical standard, bill of quantities and cost estimate were also prepared by the Consultant of R3 Project
- SEACAP17 has designed trial pavements and prepared technical specification for those trials as a supplementary specification

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2. During Construction



- Training of the Contractor
 - There was a training section (20-100m) before each trial sections was constructed
 - The contractor's staff had insufficient skills to benefit properly from the training given
 - The contractor has lack of engineer to manage with quality control
 - Language and clear communications were difficult. Almost of engineer, technicians and labourers are Chinese

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3. Technical Specifications



➤ Appropriate Specifications

- Some specifications were found to be inappropriate when applied in Lao particularly in this area. For example the shape of hand knapped stone
- Some specification were found to be inappropriate for labour based. For example: quality of concrete material, bituminous surface, quality of material
- Small scale contractors have expertise in local construction techniques but require considerable help when using non-standard techniques

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3. Technical Specifications



- Some specifications for Rural Access Roads of R3 were found to be inappropriate when applied in the construction. For example: measurement and payment for tree removal, and earthworks

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4. Research and Construction



➤ Research/ Construction Interface

- When a research improvement was identified during the project we were unable to pursue it due to contractual funding constraints
- As the experience from this SEACAP17 revealed, the trial pavements to be constructed for the research purpose should be made a contract exclusively
- Our power as supervisor does not permit us to force the contractor to rectify poor work

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5. Conditions of Contract



- Contractors should be encouraged to use local labour in order that the expertise is not lost in the country
- Our power as supervisor does not permit us to force the contractor to employ professional staffs in conformity with qualify as specified in the bidding documents
- Measurement and data collection on trial sections were not specified in the contract requirement, therefore it was become a responsibility of the consultant

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6. Design and Construction



As the problems were found by supervision team during construction stage, can be concluded as follows:

1). Hand Packed Stone

- { weight of stone can be increased stability, fixed. Thus the appropriate thickness of stone , $h \geq 15\text{cm}$ (design, $h = 10\text{cm}$)
- { surface of stone should be smooth, straight and without sharp angle in order to avoid vehicle wheel catch and loose
- { thicker sand cushion should avoid, use of coarse material for construction of sub-base for water infiltration instead of apply thicker sand cushion, and provide filter layer on shoulder

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6. Design and Construction



2). Mortared Stone

- { Mortar at joint seal is cracked when impacted by traffic load
- { the stability is the same as described in paragraph 1). Above. Thickness of stone, $T \geq 15\text{cm}$ x design, $h = 6.5\text{cm}$)
- { Thick sand cushion should not apply as described in paragraph 1). Above. If thicker sand cushion is applied shall be covered by mortar immediately after sand has been compacted thoroughly.

(This method was applied for mortared stone at the causeway end)

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Mortared Stone at Causeway End R3.2



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Mortared Stone at Causeway End R3.2



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6. Concrete Paving Block



3). Concrete Paving Block

{ Sand cushion without mortar cover and seal the joint by sand should not apply at steep gradient ($G \leq 3\%$)

{ Material for sub-base and shoulder as described in paragraph 1) should be applied, but construction will increase

{ As the result from deflection test, pavement deflection on this type of pavement is high cause of sand cushion laid beneath the blocks



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Concrete Paving Block



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Thankyou



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