

Local Resource Solutions
to Problematic Rural Roads Access
in Lao PDR

SEACAP Access Roads on Route 3



Module 1 Report

Executive Summary

Background

The Government of Lao PDR has been consistently active to promote economic growth and alleviate poverty through national policies, regional co-operation and bilateral co-operative ties. The development of the road sector remains a cornerstone in this strategy and aims to overcome difficult access conditions, which adversely affect community access to services and markets, resulting in higher input and lower output prices.

The SEACAP 17 Project aims to identify cost-effective community orientated approaches for improving all year access to remote rural areas through a low-cost and local resource based improvement of roads. The trials will be undertaken as part of the Asian Development Bank's (ADB) funded Northern Economic Corridor (NEC) Project by way of trial sections on the access roads linking Route 3 with the outlying villages.

Progress

The main activities completed under Module 1 were the preparation of the trail pavement designs, specifications and cost estimates and the drafting of the data collection programme, training and dissemination strategies. The SEACAP designs were incorporated into the NEC standard bid documents and submitted to MCTPC in March 2005.

MCTPC issued the invitation for bids on the 11th May 2005 with a bid closing date of 1st July 2005. Bids were submitted in two envelopes – technical and financial. The technical bids have been opened and are being evaluated. Prior to financial bid opening an addendum to incorporate the SEACAP trials is to be issued to the qualified bidders, who will resubmit their financial bids.

Planning

Specific research activities will be conducted during and after construction in conjunction with DCTPC/MCTPC staff where appropriate, including data collection, monitoring, etc. Training events will be organised at key stages in the project as shown in the Activity Schedule in Appendix 3. These will ensure all involved are conversant with the project objectives and techniques to be adopted for construction, quality control, data collection and monitoring.

Pavement Selection

The aim of this project is to take relatively sophisticated pavement structures as developed under SEACAP and apply them to identified problematic sections on the selected access roads.

Based on site inspections and discussions with MCTPC staff and members of the SEACAP programme, 8 categories of pavement types have been selected to be trialled under this project. These were presented and accepted by all stakeholders at the Initial Project Workshop held in Vientiane in December 2004. The options focus particularly on the use of locally produced cement, and are selected from proven pavement technology from the region and worldwide. They include bamboo reinforced concrete, Otta seal, geocells, hand packed stone, mortared stone, concrete paving blocks and engineered natural surface.

Training

Training sessions will be conducted to ensure transfer of knowledge at all levels in the province. The training will be in the form of workshops, discussion groups and on-the-job training and will

cover all aspects of the research together with management issues relating to the project implementation and future maintenance of the project roads.

The local contractors are not familiar with the trial pavements being introduced and will require some training to ensure the pavements are properly constructed. To achieve this we have included a 100m 'training section' for each pavement type, which will be used to closely supervise and instruct the contractor on the construction techniques for the trial pavements. This will ensure that the trial sections are properly constructed and can be accurately monitored and evaluated

Towards the end of the project a pavement design workshop will be held in Vientiane. This will serve to generate buy-in from the various stakeholders on the strategy for pavement design and construction.

Dissemination

One of the main objectives is to disseminate information via national, international and regional agencies. For this process to be a success, the information must easily accessed and available to a wide audience. To achieve this objective, information on the progress and outcome of the pavement trials will be distributed through various organisations including the SEACAP Coordination Committee, TKP, IFG local institutions and international donors. This will be achieved through workshops, liaison, a periodic newsletter and posting information on websites.

Constraints/issues

There are some issues that may affect the outcome of the project. These include the local contractors' experience in the trial pavements and their preference towards machine based construction. The contractor training proposed under this project and close liaison with the provincial staff and communities will ensure that these issues are fully addressed and resolved.

The question has been raised of what will happen if a trial pavement fails. The trial pavements incorporated have been tried and tested in south east Asia and Africa. With close supervision and assistance to the contractor through on-the-job training, the standard of construction will be maintained and a durable pavement will be constructed. This will ensure that the trial pavements have a significantly longer life than the standard gravel pavements and will provide cost effective treatments

Next steps

The following activities are planned for the period leading up to the start of construction:

- A workshop will be held during August to introduce the project to a wider audience within MCTPC. Invitations will also be extended to other local organisations who have an interest in the SEACAP research or are part of the dissemination strategy..
- On completion of bid evaluation, MCTPC will issue the Letter of Acceptance for the access road contracts. Within 28 days of the letter of acceptance the contractor will submit his work programme. Based on this we will prepare a mobilisation plan for the supervision staff.
- Prior to handing over the site to the contractor, resettlement and compensation issues must be resolved. We will work closely with the NEC Project Manager and Oriental Consultants to ensure the process is completed in a timely manner and complies with the ADB requirements.

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Abbreviations

ABD	Asian Development Bank
CRM	Community Road Model
DCTPC	Department of Communication Transport Post and Construction
DFID	Department for International Development
DOR	Department of Roads
DRR	District and Rural Roads
GOL	Government of Laos
IFG	International Focus Group
IRAP	Integrated Rural Accessibility Planning
LBES	Labour Based Equipment Supported Maintenance
LECS	Lao Expenditure and Consumption Survey
LRD	Local Road Division
LRN	Local Road Network
LSRSP	Lao Swedish Road Sector Project
LTEC	Lao Transport Engineering Consult
MCTPC	Ministry of Communication Transport Post and Construction
NEC	Northern Economic Corridor
NGPES	National Growth and Poverty Eradication Strategy
NRN	National Road Network
PRoMMS	Provincial Road Maintenance Management System
PRTP	Participatory Rural Transport Planning
RDC	Research and Development Committee
RI	Roughton International
RIP	Rural Infrastructure Project
RMF	Road Maintenance Fund
RMP1	Road Maintenance Project 1
RMP2	Road Maintenance Project 2
RMS	Road Management System
SCC	SECAP Coordination Committee
SEACAP	South East Asia Community Access Programme
Sida	Swedish International Development Cooperation Agency
TCTI	Transport and Communication Training Institute
THIP	Third Highway Improvement Project
TKP	Transport Knowledge Partnership

1 BACKGROUND

The Government of Lao PDR has been consistently active to promote economic growth and alleviate poverty through national policies, regional co-operation and bilateral co-operative ties. The development of the road sector remains a cornerstone in this strategy. There is however still a lot to be done. It is estimated that some 90% of the poverty in Lao PDR is rural-based with a strong correlation between access to basic infrastructure services and the incidence of poverty. The very poor (estimated to some 17 per cent of the population) live in remote areas where infrastructure is especially scarce. Villages in the Northern region are particularly isolated; some have no access to social services even during dry season. A Poverty Impact Study of rural roads constructed under LSRSP¹ indicated that all villages, having been provided with road access, to a greater or lesser extent were now producing more in general, than before. Expenditures had increased more than threefold; there was evidence of positive impact on education, health, commerce, agriculture, land use and gender. Furthermore, transport costs had decreased.

Accessibility is essential to promote rural development in general and agricultural development. Difficult accessibility conditions hinder farmers' adoption of new technologies, use of information and support services and result in higher input and lower output prices or prevent the reach of input and output markets altogether. Accessibility is also important for the development of off-farm employment because it increases the rural population's mobility, allowing those seeking off-farm employment to travel to areas with demand for unskilled labour.

The SEACAP 17 Project aims to identify cost-effective community orientated approaches for improving all year access to remote rural areas through a low-cost and local resource based improvement of roads in Lao PDR. The trials will be undertaken as part of the Asian Development Bank's (ADB) funded Northern Economic Corridor (NEC) Project by way of trial sections on the access roads linking Route 3 with the outlying villages.

The ongoing NEC project will improve Route.3 from Houay Xai on the Thai border with Lao PDR to Boten on the Chinese border. The 228 km long Route 3 will be upgraded from the existing poor quality gravel road which becomes impassable during the wet season to a 7 m wide paved carriageway with shoulders of between 1.5 and 2.5 m wide. The ADB will finance one third of the cost of the NEC project, covering the construction of 74 km of the middle section.

The objective of this research is to extend the present methodologies for the construction of rural access roads used locally in Lao PDR, regionally in South East Asia and worldwide to specific lengths of rural access roads in problematic terrain in Lao PDR. These rural access roads are often impassable during the rainy season due to pavement failure over relatively short lengths. This study aims at identifying cost-effective methods of improving all-year access to the rural poor through low-cost locally resource based improvement of these problematic lengths of road resulting in sustainable rural access roads.

¹ Lao Swedish Road Sector Project, Sida

2 NEC PROJECT

2.1 Project Management

The NEC project is managed by MCTPC through its Project Manager. MCTPC have appointed Oriental Consultants to prepare detailed designs for the NEC access roads in the three districts of Houay Xai, Vieng Phoukha and Namtha. Oriental are responsible for supervising work on the access roads in Vieng Phoukha and Namtha districts and the ADB funded portion of Route 3. They also have a coordinating responsibility for the three sections of Route 3 including the sections funded by the Thai and Chinese governments.

The SEACAP project has taken over the access roads in Houay Xai District and will have full supervision responsibilities for the roads in that district. This has been formalised through a Memorandum of Understanding signed by DfID, ADB and MCTPC. All matters relating to supervision of the SEACAP access roads will be addressed to the NEC Project Manager.

2.2 NEC Access Road Design

The NEC access roads are designed according to the MCTPC Specification for Local Roads, which provides the standards for road geometry and drainage. The pavement design is based on the following:

- Gravel wearing course $\text{CBR} \geq 25\%$, thickness 20cm,
- Subgrade is selected material. $\text{CBR} \geq 8\%$
- Traffic < 50 vpd

The pavement thickness has been calculated based on a representative traffic mix, 20 year traffic volume and gravel loss of 8% per year. This method of calculating pavement thickness has been accepted by MCTPC and ADB, however recent research in South East Asia suggests that annual gravel loss can be as high as 5cm (25%).

2.3 Progress

The NEC consultant completed the access road designs and bid documents in February 2005. The documents were submitted to ADB for approval and the invitation for bids for all three access road packages in Houay Xai, Vieng Poukha and Namtha districts was advertised in May 2005.

Bid evaluation is in progress and is expected to be complete by the end of July.

2.4 Issues

The concern about the NEC pavement design would be erosion of the pavement and eventual loss of access. This has been addressed in two ways. SEACAP will introduce more robust pavements on the majority of the steep gradients, which will maintain access through the problematic areas. In addition to this, the NEC construction contract includes an item for the provision of material stockpiles along the access roads for future routine maintenance. This will allow maintenance and minor repairs to the gravel sections of the access roads where pavement loss becomes problematic. It is therefore considered that the pavement design for the remainder of the Huay Xai access roads will be adequate for the level of service to be provided.

The question has been raised of what will happen if a trial pavement fails. The SEACAP trial pavements incorporated into the NEC contract have been tried and tested in south east Asia and Africa. As such we are not carrying out trials on un-tested pavements and the designs have been proved in practice. With close supervision and assistance to the contractor through on-the-job training, the standard of construction will be maintained and a durable pavement will be constructed. The original NEC pavement design as detailed in para 2.2 is not a durable pavement and it is reasonable to accept that the SEACAP pavements will have a significantly longer life and provide cost effective treatments.

3 SEACAP

3.1 Progress and Constraints

3.1.1 Progress to Date

The main activities carried out under Module 1 were the preparation of the trial pavement designs, specifications and cost estimates and the drafting of the data collection programme, training and dissemination strategies, which will be implemented as part of the other Modules.

Module 2 Construction of SECAP access roads and data capture

Module 3 Data interpretation

Module 4 Information dissemination and training

The design report and draft bid documents were handed over to Roughton International (RI) towards the end of February 2005. The SEACAP designs were incorporated into the bid documents and submitted to MCTPC in March 2005.

MCTPC issued the invitation for bids on the 11th May 2005 with a bid closing date of 1st July 2005. As the SEACAP project had not been formalised at that time, the original NEC bid documents were issued to the bidders. Bids were submitted in two envelopes – technical and financial. The technical bids have been opened and are being evaluated. Prior to financial bid opening an addendum to incorporate the SEACAP trials is to be issued to the qualified bidders, who will resubmit their financial bids.

3.1.2 Constraints

It is not anticipated that the pavement trials will be problematic; however there are some constraints that need to be considered during the trials.

Recent experience has shown that the local contractors are not in favour of labour based methods, as demonstrated on the RMP1² project where labour based equipment supported maintenance was not successful. Several of the trial pavements are labour based and we will work closely with the contractors and DCTPC to ensure the optimum use of community labour during construction. This will involve a sensitisation process to promote the benefits of labour based methods to the contractors and communities together with training in labour based construction techniques.

² World Bank Road Maintenance Project

Although the local contractors are experienced in the standard gravel and bituminous pavements, they are not familiar with the trial pavements being introduced. For each pavement option a 100 metre training section will be constructed with assistance from the supervision team to ensure the contractors understand the various construction techniques.

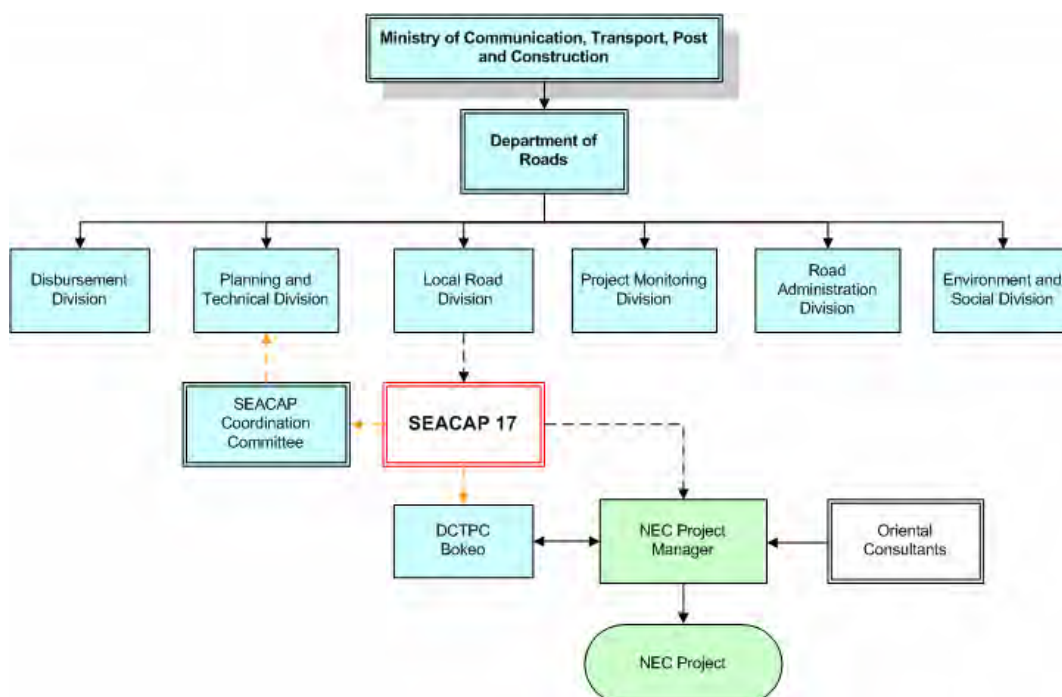
The site conditions on the project roads do not appear to present any problems, however we will continue to monitor such aspects as slope stability, drainage etc. during construction to ensure that any preventative measures are taken.

The rain season in the project area lasts from June to September although in Bokeo province August is the only month with significant rainfall. It is normal practice for contractors to continue working though the rain season, stopping work during rainy days. We will ensure that the construction of trial pavements is not affected by this practice and that any incomplete pavements are adequately protected during the rain season.

3.2 Management and Planning

The project is being implemented through MCTPC. Figure 1 shows how SEACAP will work with the Local Road Division on the research aspects of the project and through the NEC Project Manager for the supervision role.

Figure 1 MCTPC / SEACAP Organisation



MCTPC have identified the Local Road Division as the point of contact for the project and the Deputy Director Local Roads has been assigned as the project coordinator. In addition, MCTPC has formed a SEACAP Coordination Committee (SCC), which will be the focus for all research activities and information dissemination. In this role, the SCC will make a valuable contribution to the success of the project through the promotion of the SEACAP objectives to the key decision makers and the implementation divisions.

Supervision of the civil works is being undertaken in accordance with ADB guidelines and all contractual matters will be handled through the NEC Project Manager. In addition the

Department of Communication, Transport Post and Construction (DCTPC) in Bokeo Province will be involved in various matters such as compensation payment, post construction monitoring and maintenance. As our local partner, Lao Transport Engineering Consult (LTEC) play a key role in supervision. All supervision staff including environment and resettlement experts are provided by LTEC who have considerable experience in road construction in Lao PDR.

Our approach during Module 2, construction and data capture, will be to work in conjunction with all the above parties to ensure the objectives of the project are met. RI's role as supervision consultants and the Engineer's Representative will be carried out in accordance with ADB guidelines and procedures as defined in the Memorandum of Understanding, including quality control and payment certification, environmental management, resettlement / compensation and reporting.

Specific research activities will be conducted in conjunction with DCTPC/MCTPC staff where appropriate, including data collection, monitoring, etc. Training events will be organised at key stages in the project as shown in the Activity Schedule in Appendix 3 . These will ensure all involved are conversant with the project objectives and techniques to be adopted for construction, quality control, data collection and monitoring.

The SCC will meet on a regular basis, current scheduled at three monthly intervals. These meetings will focus on the research aspects of the project and will be the means to disseminate information within MCTPC and local organisations.

The SCC is also linked to the MCTPC Research and Development Committee of the Planning and Technical Division, who will be actively involved in the data interpretation under Module 3. The outcome of the research will be presented in a series of manual and guidelines for use on future projects. The SCC and RDC will be instrumental in mainstreaming the results of the research within MCTPC.

3.3 Pavement Options

Based on site inspections and discussions with MCTPC staff and members of the SEACAP programme the SEACAP pavement structures have been grouped into 8 categories. This has resulted in a list of pavement types that are proposed to be trialled under this project and were presented and accepted by all stakeholders at the Initial Project Workshop held in Vientiane in December 2004. The options focussed particularly on the use of locally produced cement, and were selected from proven pavement technology from the region and worldwide. From the options presented at the workshop the following were selected to provide a suitable range of alternatives that could be tested under local conditions.

- **Bamboo Reinforced Concrete:** A bamboo reinforced surface consists of a layer of concrete, reinforced with strips of bamboo, and laid upon a compacted base. The concrete surface is strong and impervious.
- **Otta Seal:** An Otta seal comprises of a layer of binder followed by a layer of aggregate that is rolled into the binder using a roller or loaded trucks. It is different to surface dressing in that an 'all in' graded gravel or crushed aggregate is used instead of single sized chippings. It depends for its success on the binder being squeezed up through the aggregate by the action of extensive rolling.

- **Geocell:** The specified Geo Cell paving to be used for these trials is a patented system called Hyson Cells (3D Bubble Lock Cells). Hyson Cells is formwork fabricated from plastic sheeting that is used to cast interlocking concrete block paving in situ. The plastic formwork is sacrificial and remains embedded in the concrete.
- **Hand Packed Stone:** A hand packed stone surface consists of a layer of large stones into which smaller chips are packed. Remaining voids are filled with a blinding of sand or lateritic gravel to form a strong and semi-impervious matrix.
- **Mortared Stone:** A mortared stone surface consists of a layer of large stones, placed closely together to form a tight surface. The voids are filled with mortar to form an impervious layer.
- **Concrete Paving Blocks:** Concrete blocks are formed by mixing aggregate, sand, cement and water. The concrete mixture is placed into moulds, compacted and left to set and harden. A concrete block surface consists of blocks arranged side by side. Gaps between blocks are then filled with fine material to form a strong and semi-impervious layer.
- **Engineered Natural Surface:** Where the existing subgrade material comprises natural gravel with the same characteristics as the pavement layer, it will be possible to incorporate this material into the pavement structure to reduce the thickness of added pavement material. In some instances the natural surface can be shaped and compacted without the addition of gravel. Tests carried out during construction will determine if and where this is possible without compromising the quality of the designed pavement.

In general the pavement option maximise the use of local materials, in particular cement produced in Lao PDR. Otta seal and geocells utilise imported materials, however we consider these options to have great potential which justifies the additional costs during the trials as discussed in paragraph 3.4.6.

3.4 Pavement Design

3.4.1 General Approach

The standard approach access road pavement design is to apply a standard pavement to the whole road. The SEACAP 17 concept is to carry out a detailed assessment of the conditions over which the rural access road is to be constructed and to apply different, more appropriate pavement structures to short sections of road. It is well understood that most roads that are impassable are such because of a short problematic section of the road which prevents traffic traversing the entire road. This can be likened to the weak link in a chain which when placed under load causes the chain to break, if the weak link is strengthened then the entire chain is perceived stronger. Therefore the aims of this project are to take relatively sophisticated pavement structures as developed under SEACAP and apply them to identified problematic sections on the selected access roads.

It is accepted that these sophisticated pavements are considerable more expensive than the minimum standard pavement structures for rural access roads, however, it is largely understood that current pavement design practice generally overdesigns the vast majority of

the pavement. The common design parameters are to design against the 90th percentile design parameters such as subgrade CBR. This actually means that 90% of the road is overdesigned and that 10% of the road will fail. By splitting the road into shorter sections a higher percentile value can be used which increases the efficiency of this design technique. This is shown schematically in Figure 2.

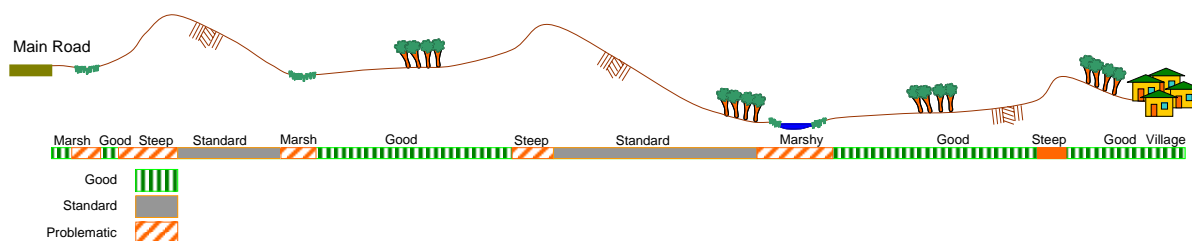


Figure 2 Varying Conditions along an Access Road

Importantly, this approach not only ensures that the problematic lengths are provided with a more robust pavement structure but the good areas are not over designed.

3.4.2 Delineation of In-Situ Subgrade Areas

In order to undertake an optimal pavement design the road should be subdivided into similar subgrade areas. While, too finer delineation may lead to confusion during construction it is desirable to locate three broad categories:

Table 1 Definition of Subgrade

➤ Problematic Areas	These are areas where the gradients are steep and the surface suffers from severe erosion during the wet season. Also, flat low swampy areas where the subgrades are poor quality and vehicles get bogged down during the wet season.
➤ Good Areas	These are areas where the in-situ material is found to have a good bearing capacity and with some drainage correction the road would be passable throughout the year. In general, these areas are expected to along undulating terrain with good drainage where the application of an engineered pavement or even a surface will have little benefit.
➤ Potentially Poor Areas	These lengths are those lengths of the road that are almost always passable throughout the year. However, during severely wet periods these section may be problematic and therefore they would benefit from a low cost surface being applied. These sections are typically those low lying areas prone to occasional flooding or areas that pass through low quality materials that have severely reduced strength when wet.

Therefore there are three critical items that need to be determined along the proposed route of the access road:

- Topography (Vertical and Horizontal Alignment),
- Drainage, and;

- Subgrade Condition.

It is also important to consider geology, topography and drainage or major soil boundaries so that an appropriate design bearing capacity is defined for each in-situ subgrade unit. In order to properly design a road some soil survey should be conducted along the length of the road alignment to define the design subgrade bearing capacity. It is recommended that the 'material depth' to which the subgrade bearing capacity is defined for rural access roads is 700 mm.

Further, it is necessary to differentiate between localised appropriate or poor in-situ soils and more general in-situ subgrade areas. Localised soil should be treated separately from the rest of the pavement design. Often, localised poor soils will be removed and replaced with suitable material.

3.4.3 Gradient Criteria

The road is divided up along its length according to the following gradient criteria.

Description	Gradient
Flat	>2%
Average	2 – 5%
Steep	>5%

This is based on research in SE Asia which has found the gravel loss on roads on gradients of >4% to be greater than 50 mm per year depending on other factors such as rainfall and traffic. Based on the characteristics of the SEACAP project area, 5% gradient was taken as the criterion for steep sections.

3.4.4 Construction Considerations

In accordance with our TOR, we have made maximum use of the NEC access road designs. We have not altered the geometric alignment, drainage or embankment protection works as designed by Oriental Consultants. At specific locations along the access roads the NEC gravel pavement has been replaced with a SEACAP trial pavement. The pavement types selected for the trials are taken from those presented at the Knowledge Exchange Workshop in December 2004. Typical cross sections of the pavement options are given in Appendix 5.

The pavement designs have different layer thicknesses depending on the subgrade strength. The NEC Access Road Component Design Report does not provide any subgrade test results and we have therefore based our designs on the minimum subgrade strength according to the NEC Specification. During construction it will be necessary to carry out subgrade tests to confirm the trial pavement designs. This may result in cost savings where the subgrade is of a higher strength than the Specification requirements.

The remaining sections of the access roads will be constructed as per the NEC standard pavement design. The NEC specification for pavement material is based on locally available materials, with a CBR requirement of 25%. During the monitoring phase, some sections of the natural gravel pavement will be used for comparison with the SEACAP pavements.

The approach adopted is for a trial pavement to be constructed over a 400m -500m length. In addition there is a 100m 'training section' for each pavement type, which will be used to closely supervise and instruct the contractor on the construction techniques for the trial pavements. This will ensure that the trial sections are properly constructed and can be accurately monitored and evaluated.

Typically we have targeted problem areas that restrict access due to subgrade condition or gradient. From visual inspection, flat sections through low lying areas appear to be problematic due to soft subgrade and drainage provision. Based on the criteria in para 3.4.3 we have selected 'steep' sections for the trials where the gradient exceeds 5%.

The road profiles in Appendix 4 show the sections with grades classified as 'steep' and 'flat' from which the trial locations were selected. As mentioned in this report, we did not receive any subgrade investigation results from the NEC consultant.

The trial locations at present are provisional. There are several factors that will influence the final locations which will be determined at commencement of the contract. These include:

Subgrade condition	A detailed investigation will be carried out at the commencement of construction, following which the locations for the trials can be finalised.
Land acquisition	None of the present locations for the trials are situated in village or cultivated areas. However if it is necessary to relocate any trial sections the new locations will be elected to avoid or minimise any resettlement or land acquisition.
Environment	The current locations for the trial sections are not in environmentally sensitive areas. Any new trial locations will be selected to avoid any negative environmental impact.

3.4.5 Specifications

The specifications for each of the trial pavements were developed from similar projects in the region and worldwide. In producing the Specifications we have minimised the use of unfamiliar construction practices and terminology. Where a new concept is introduced, it is carefully explained to ensure MCTPC and the contractors fully understand the design principles and construction requirements.

The specifications were developed from the following sources and adapted to suit the Lao environment.

- **Geocell** – from Hyson, the manufacturer of Geocell fabric
- **Otta Seal** – from The Design and Construction of Otta Seals, Ministry of Works Transport and Communications, Botswana
- **Concrete Block** – South Africa Transport and Communications Commission (SATCC) Standard Specifications
- **Bamboo Reinforced Concrete, Hand Packed and Mortared Stone** – Low Cost Road Surfacing Project, Cambodia

3.4.6 Cost Estimates

Cost estimates have been prepared for each the pavement design option. Unit rates have been derived based on recent bid prices or from first principles, utilising LTEC's experience of road construction in Lao PDR. During construction, data will be collected to produce labour plant and materials inputs that can be used to provide accurate costs for Lao PDR.

The cost of the Geocells is particularly high, however this is due to the cost of importing the proprietary Hyson Geocell fabric. If this option proves to have high potential, local fabrication of the Geocell fabric can be investigated which will result in a significant cost reduction.

The estimated cost for the full Huay Xai district contract package (28.8km) is US\$983,500, which compares with the original NEC estimate of US\$735,800. The cost estimate has been submitted to MCTPC and ADB for approval. .

The detailed cost estimate is provided in Appendix 6

3.4.7 Design Issues

Subgrade investigation was not carried out during the design phase for the NEC access roads. The NEC consultant design specifies a single 200 mm layer of gravel wearing course to be constructed along the length of all rural access roads. In the absence of a subgrade investigation for these roads it has been necessary to make several assumptions in the preparation of the SEACAP pavement designs.

The NEC Specification provides minimum CBR values for material in cut and fill and for subgrade preparation. These can be summarised as:

Subgrade in cut (top 300mm)	if CBR \geq 5% design CBR=5% If CBR < 5% replace with material with CBR \geq 8%
Embankment (top 300mm)	CBR \geq 8%

Adopting the subgrade design bearing capacity to be CBR=5% will satisfy the minimum subgrade conditions, however, for much of the road this may result in an over design as the subgrade may exceed the minimum CBR=5%.

The SEACAP pavements have been designed on this basis. During construction detailed subgrade investigation will be carried out and the pavement designs refined accordingly.

3.5 Training

The local contractors are experienced in the normal construction practices, such as earthworks, drainage structures, gravel and bituminous pavements. However they will not be familiar with the trial pavements being introduced and will require some training to ensure the pavements are properly constructed.

To achieve this we have included training sections in the designs. The approach adopted is for a trial pavement to be constructed over a 400m -500m length. In addition there is a 100m 'training section' for each pavement type, which will be used to closely supervise and instruct the contractor on the construction techniques for the trial pavements. This will ensure that the trial sections are properly constructed and can be accurately monitored and evaluated.

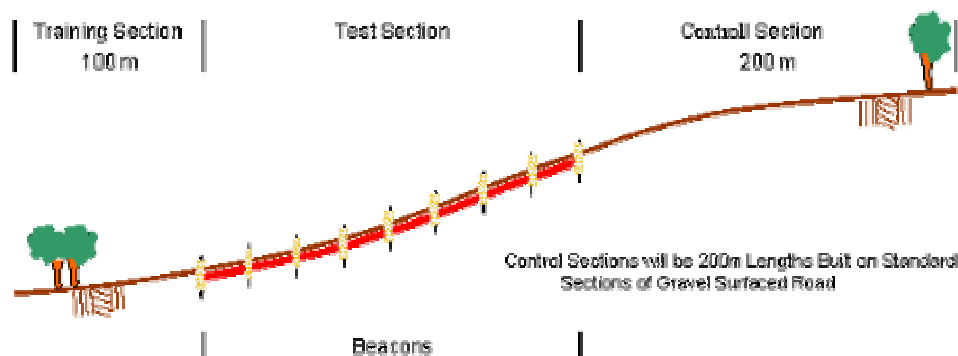


Figure 3 Trial Section Layout

Maintenance is also a key component of this project and we will ensure that the provincial staff and, where appropriate, the local communities are conversant with the maintenance management and activities required to ensure the roads are maintained as required.

Training will be provided in a series of workshops in maintenance planning and labour based techniques for the SEACAP pavements. Through the workshops we will explore ways the communities can work together with the DCTPC to ensure sustainable year round access.

3.6 Supervision

The Memorandum of Understanding between DfID, ADB and MCTPC requires RI to undertake all supervision tasks for the civil works contract in Houay Xai District. The supervision team will include the Team Leader, who will act as the Engineer's Representative, Deputy RE, junior engineers/inspectors, materials technicians and surveyors. There will also be short term inputs from environmental and resettlement experts. All supervision staff with the exception of the Team Leader will be provided by LTEC.

The supervision tasks for the works will include the normal day to day activities of monitoring, quality control and reporting as well as the key aspects of resettlement / land acquisition and environmental management.

3.7 Resettlement & Land Acquisition

The access road construction comprises the improvement of existing access roads to 4.5 m width including shoulders and follows the existing alignment in the most part. As such there will be no resettlement however there will be a minor amount of land acquisition and crop compensation to be paid. To ensure ADB procedures are complied with we will review the land acquisition plans and compensation payments to ensure that all landowners are fully compensated. This will involve check on the compensation documentation together with meetings at village level to ensure that there are no outstanding issues or complaints about the process.

3.8 Environment

The environmental mitigation measures set out in the Project Environmental Management Plan (EMP) prepared for the Northern Economic Corridor apply to all activities required for design, mobilisation, construction and operation of the access roads. As part of the

supervision responsibilities we will ensure that the mitigation measures outlined in the EMP are properly implemented.

The Contractor will carry out an Environmental Management Action Plan based on the EMP prepared by the MCTPC with assistance of the Consultant, to implement the mitigation measures. Also, the Contractors will conduct self-monitoring to ensure the effectiveness of the compliance on the mitigation measures. Second party monitoring will be undertaken by the local communities to protect their surrounding environment and will inform on any environmental issues caused by the Project. In this process, we will liaise closely with the contractor and communities to ensure all matters are resolved quickly and satisfactorily.

3.9 Data Capture

Data required by the research comprises technical and social data. These data will be collected by survey teams comprising the consultant supervision staff and provincial staff.

An initial training workshop will be conducted at the commencement of the supervision team mobilisation period to ensure the teams are familiar with the data required and the objectives of the research. This training will also provide the opportunity to review the data collection procedures and prepare a detailed data collection programme.

Detailed data requirements include the following.

3.9.1 Pre-Construction Data

In order to prepare guidelines on the application of the trial pavements data on the existing road is required. The data required to make decisions on type of pavement to be constructed include the following:

- Subgrade assessment;
- Horizontal and vertical alignment;
- Ground water and cross drainage;
- Distance from the main road;
- Availability of construction materials and their proximity; and
- Traffic

Much of this data is already available. Accurate subgrade data was not available in the NEC Design Report and will be collected at commencement of construction when testing facilities are available on site. At this stage we will review the locations for the trial sections and the designs based on actual subgrade CBRs

3.9.2 Construction Data

Detailed data will be collected during construction relating to the quality of materials and workmanship, labour, equipment and materials inputs, construction times etc. to provide all necessary data on the constructed pavement and method of construction.

Much of this data is required by the Specification. Detailed instructions on the collection of other data will be provided for the supervision staff to ensure the quality of the data.

The NEC Specification provides adequate testing regime for the general access road works. To ensure adequate data is provided for the research component of the project, additional testing will be carried out on the trial sections during construction. These tests are within the normal scope of materials testing and will require no special expertise from the materials engineers.

3.9.3 Socio-Economic Data

The general data for the province can give an overall indication of the social conditions of the rural communities. However, more specific data is required in order to determine the specific access problems faced by the communities and the benefits accruing from the provision of sustainable access.

The project does not allow for a full socio-economic survey such as would be undertaken for Integrated Rural Accessibility Planning (IRAP), however some basic data can be obtained by the social/resettlement specialist during the construction phase. This data will include:

- Village location (distance from main road)
- Services within village
- Village population
- Distances to services outside village (health, education, markets)
- Mode of transport, no of trips and travel times during dry / wet seasons
- Historical data on access constraints

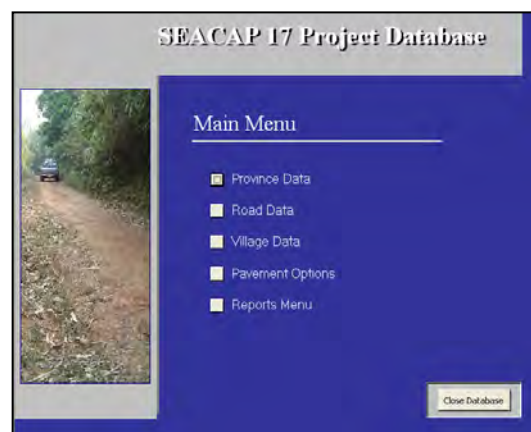
3.9.4 Database

In order to store and analyse project data, a database has been developed in Microsoft Access. The database has been designed for ease of use and will be owned by MCTPC.

The database has been designed for the data requirements already identified. After discussion with the social/resettlement expert, the database will be revised to include any additional data requirements. Analysis and report formats will be developed in consultation with MCTPC, the social/resettlement specialist and the pavement specialist.

The preferred location for the database is within the research establishment of MCTPC. This will facilitate easy analysis and dissemination of project data. It will also allow the use of the database to be expanded to include other projects and where necessary the database will be further developed to allow for additional research needs. At this stage Dr. Maisy Viengvilay, Head of the Research and Development Committee and a member of the SCC will manage the database. This can be reviewed at a later date to establish the database within the MCTPC organisation.

A selection of the screens contained in the database are shown in Appendix 7



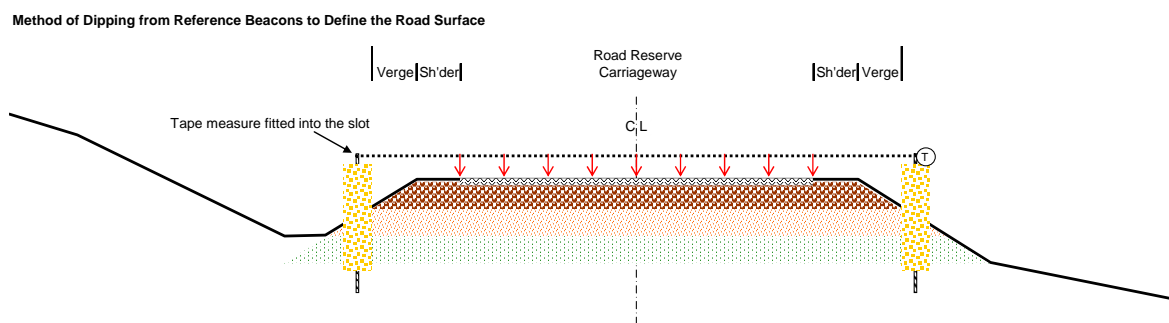
3.10 Monitoring

In order to determine the performance of the rural access roads the following method of monitoring is proposed.

3.10.1 Post Construction Monitoring

During construction, monitoring beacons will be installed at 10 m intervals along the trial sections. These will provide reference points for the post construction monitoring, dividing the trial sections into 'Blocks' for monitoring. Each Block can be described and any distress graphically represented by sketches and photographs. The format of this will be finalised during the construction of the trial lengths. A method of measuring the rutting and surface deformation is to be conducted by 'dipping' from a line between the beacons as shown:

Figure 4 Layout of Monitoring Beacons



The proposed monitoring to be conducted twice yearly, before and after the rainy season, is as follows:

- Visual inspections including sketches and photographing each Block;
- Surface profile measurement between beacons;
- Surface rut measurement using a standard straight edge;
- Roughness measurement using a MERLIN;
- Surface texture testing (sand patch), as necessary;
- Deflection testing under a standard load including the deflection bowl, as necessary;
- Radius of curvature testing under a standard load, as necessary, and;
- Sophisticated Monitoring using the Keros Prima 100 Portable FWD, as necessary.

In addition to the trial pavement sections, section of the standard NEC pavement will be monitored in a similar manner to act as controls for analysis of the SEACAP pavement performance.

3.11 Maintenance

Maintenance is a key issue in MCTPC and a nationwide strategy is being implemented through the World Bank and Sida projects. In line with the MCTPC maintenance strategy we will prepare a routine maintenance programme for the Huay Xai project roads. To facilitate this we propose to use Roughton International's road asset management system ROMAPS.

ROMAPS was previously introduced into MCTPC a part of the Third Highway Improvement Project and is known to MCTPC. However during the Lao Swedish Road Sector Project, a new system PRoMMS was introduced, which is now being implemented in the LSRSP provinces. The data collected for ROMAPS is compatible with the PRoMMS data requirements and can be incorporated into PRoMMS if required.

ROMAPS uses visual conditional assessment for network-level asset management and routine maintenance planning. The data can be collected by local supervisors and managers and entered directly into the system at province level.

The SEACAP pavements will require a different approach to the gravel pavements and this will be addressed during Module 2. Training will be given to DCTPC staff and the local communities in maintenance techniques for the SEACAP pavements. Skills in producing specific pavement materials for future maintenance, such as concrete block paving, will be developed during the trial pavement construction and such materials can be stockpiled in secure locations for use in the maintenance activities.

4 TRAINING AND KNOWLEDGE TRANSFER

4.1 Training and Workshops

Training sessions will be conducted to ensure transfer of knowledge at all levels in the province. The training will be in the form of workshops, discussion groups and on-the-job training and will cover all aspects of the research together with management issues relating to the project implementation.

The trial pavements are new to Lao PDR and to ensure their success, all parties involved must understand the design, construction and quality control issues. There is also the need to develop an understanding of the pavements being introduced and to promote the benefits of long term solutions.

The target groups for the training will include:

- MCTPC/DCTPC staff
- LTEC supervision staff
- Contractor
- Local village groups

Topics will include:

- Introduction to SEACAP
- Construction methods and quality control for trial pavements
- Post construction monitoring
- Maintenance

In addition, training will be given to specific staff in the use of the project database and on maintenance planning using ROMAPS.

Towards the end of the project a pavement design workshop will be held in Vientiane. This will serve to generate buy-in from the various stakeholders on the strategy for pavement

design and construction. The workshop will also be used to discuss further research options and the means for mainstreaming the pavement technology. The workshop will form part of the information dissemination strategy and will where possible involve TKP, IFG and other international organisations.

4.2 Knowledge Transfer and Dissemination

The trial pavement designs being introduced through this project have been successfully implemented in other countries in the region. However previous projects in Lao PDR have only used conventional gravel and asphalt pavements. There is therefore a lack of knowledge of alternative pavements within Lao PDR and the ability to successfully implement them. The lessons learned from the construction and maintenance of alternative pavements within Lao PDR must also be made available to the international community to add to the existing knowledge base.

MCTPC as the client will be directly involved in implementation of the project through the SEACAP Project Manager and the NEC Project Manager based in Vieng Poukha. These staff will receive regular project reports outlining the activities and progress of the trials. Via the Project Managers, the content of the reports will be distributed throughout MCTPC and the DCTPCs.

One of the main objectives is to disseminate information via national, international and regional agencies. For this process to be a success, the information must easily accessed and available to a wide audience. To achieve this objective, information on the progress and outcome of the pavement trials will be distributed through the following organisations:

SEACAP Coordination Committee

MCTPC has recently formed the SEACAP Coordination Committee (SCC), with members from the Local Road Division, Research and Development Committee and Bokeo Province. The SCC will be the focal point for dissemination within MCTPC and other local organisations.

Transport and Communication Training Institute

The Transport and Communication Training Institute (TCTI) was supported by Sida in the late 1980's to provide training to government staff in all aspects of rural road management. As well as providing the opportunity to include the trials in the training courses they present, TCTI is also a member of regional forums which will allow the research to reach a wider audience.

Transport Knowledge Partnership

The Transport Knowledge Partnership (TKP) is an innovative approach to the need to make more effective use of available knowledge and encourage greater participation from developing countries in the management and application of knowledge. The TKP web site contains a searchable database of over 500 documents from 5 organisations, most of which can be directly accessed from the site.

International Focus Group

The International Focus Group on Rural Roads Engineering (IFG) is an association of interested members committed to the provision of sustainable transport access for the poor.

It provides a platform for the dissemination of knowledge and information on rural roads engineering within the context of poverty reduction. At present IFG has 20 member countries. IFG offers the opportunity to disseminate information through their web site, which provides a download page for users to access information, and through their workshops.

Recently, MCTPC were represented at the IFG workshop in Arusha by Somnuk Mektakul, Deputy Director Local Roads Division, who presented a paper on sustainable rural road maintenance in Lao PDR. Somnuk is now a member of the IFG Executive Committee.

International Donors

The ultimate success of the project in Lao PDR will be the adoption of the trial pavements by MCTPC and by the international donors on future projects. Discussions have taken place with donors and their consultants on the pavement trials and options being implemented. As well as the co-operation with ADB on the current project, considerable interest has been shown by the World Bank and Sida and both organisations are considering the possibilities of introducing trial pavements into their upcoming projects.

The Sida funded Lao Swedish Road Sector Project 3 (LSRSP3) has a basic access component in which village groups will participate in road planning, construction and maintenance. Several of the pavement options being trialed under SEACAP 17 are specifically orientated towards a labour based approach. These include bamboo reinforced concrete, geocells using locally produced fabric, cement blocks, hand packed stone and mortared stone

The introduction of the trial pavements into LSRSP3 would provide the opportunity to try the pavements in community based construction, which would complement the contract based approach being adopted by the NEC project. The Sida trials would also offer the opportunity for a joint SEACAP / Sida arrangement, with SEACAP providing technical expertise for the research aspects of the project.

Discussions have also been held with the World Bank, who have also expressed interest in the introduction of the SEACAP pavements into the RMP2 project. This would allow further testing of the machine based pavements such as Otta seal, which has been successfully introduced in many countries.

Other projects related to rural access such as the Sustainable Rural Mobility and Participation Project funded by the Japan Social Development Fund, and the Rural Infrastructure Project (RIP) Northern Lao PDR funded by KfW also provide the opportunity to liaise closely with the consultants and donors on the SEACAP pavement trials.

4.3 Knowledge Exchange Workshop

4.3.1 Organisation

The Knowledge Exchange workshop was held with two distinct purposes. First to introduce SEACAP and the SEACAP 17 project to the staff and consultants of MCTPC. The second and main objective was to share experiences from projects within Laos PDR and from the SE Asia region and worldwide.

The workshop was held at the Ministry of Communication, Transport, Post and Construction in Vientiane on the 15th and 16th December 2004.

4.3.2 Participants

The participants represented a cross section of local and international delegates.

From within MCTPC, participants included the heads and staff of the different divisions within the Department of Roads and from other departments that had a direct interest in the implementation of rural access infrastructure. In addition, international consultants working on projects for MCTPC were also represented including those of the ADB NEC project, Lao-Swedish Road Sector Project B and SEACAP 17.

International participants included Halcrow, appointed by DfID to manage the technical aspect of the SEACAP programme, Intech and TRL, both of whom are conducting research into rural access roads worldwide, and the Institute of Transportation Science and Technology in Vietnam.

The following presentations were given throughout the workshop.

- SEACAP Programme; P O'Neill, DfID
- The SEACAP Working Mechanism; P Caine Halcrow Group
- Introduction to SEACAP 17; M James Roughton International
- Trial Pavement Engineering; SD Gillette Roughton International
- Surfacing Research in South East Asia; R Petts Intech Associates
- Natural Gravels in Vietnam, Low Volume Rural Road Pavements; Dr J Cook TRL
- Experiences from Low Cost Surfacing Trials; H Kackada, Intech Associates
- Experience of Rural Access in Laos; Ounheuang Siriamphone MCTPC
- Experiences from the ADB 8 Project; Emilian Roy, Bourapha
- Community Participation; Hans Hedemalm, SweRoad
- Surfacing Low Volume Roads; T Greening TRL Zimbabwe
- Developing Appropriate Rural Road Standards for Vietnam; Dr Tam ITST Vietnam

The presentations were grouped into four sessions. At the end of each session, time was allowed for discussion and comments on the presentations. A full report on the workshop is given in Appendix 8.

5 PLANNED ACTIVITIES

The following activities are planned for the period leading up to the start of construction:

- A workshop will be held during August to introduce the project to a wider audience within MCTPC. Invitations will also be extended to other local organisations who have an interest in the SEACAP research or are part of the dissemination strategy..
- On completion of bid evaluation, MCTPC will issue the Letter of Acceptance for the access road contracts. Within 28 days of the letter of acceptance the contractor will submit his work programme. Based on this we will prepare a mobilisation plan for the supervision staff.

- Prior to handing over the site to the contractor, resettlement and compensation issues must be resolved. We will work closely with the NEC Project Manager and Oriental Consultants to ensure the process is completed in a timely manner and complies with the ADB requirements.