Planning and Implementing
Local Infrastructure Works

Guidelines for Tambon Administrations

Tambon Administrations

International Labour Organization

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Annexes

Introduction

These guidelines have been prepared for the engineers and technicians in the Tambon Administrative Organisations. These guidelines deal with the practical day to day activities of the engineers and technicians who are involved in the development and maintenance of public facilities for the tambons.

Chapter 1 introduces the basic set-up of the Tambon Administrative Organisation. It deals with amongst others the organisational structure, division of responsibilities, budgets and classification of tambons.

Chapter 2 introduces the concept of Local Level Planning (LLP) comprising rural infrastructure planning, accessibility and participation. It introduces the "Integrated Rural Accessibility Planning" process (IRAP), a set of tools that can be used by TAO officials to identify and prioritise interventions that will improve rural access through constructing, operating and maintaining rural infrastructure facilities.

Chapter 3 introduces the concept of Labour Based Technology (LBT), defined as the construction technology which, while maintaining cost competitiveness and engineering quality standards, maximises the opportunities for employment, supported by light equipment. Special consideration is given to the cost effectiveness, technical design standards and employment generating aspects, to best fit the specific country needs and long term capacities, while simultaneously supporting decentralisation efforts. The annexes provide some examples of work norms applicable to common tasks in labour based works.

Finally, the video CD inserted at the back of these guidelines shows the application of labour based technology in practice in Thailand.

Acknowledgments

These guidelines have been prepared for and in collaboration with the Ministry of Interior and the Department of Public Works Technical Training Institute of the Royal Thai Government. The original version was prepared by consultants Narong Leungbootak and Aniruth Thongchai and Paul Munters from ILO ASIST AP and first published in Thai language. The current version has undergone further developments carried out by the technical team in ASIST AP with substantial editing inputs from Chris Donnges, Bjorn Johannessen, Chloe Pearse and Pisit Tusanasorn. Acknowledgments are also due to the Public Works Department which contributed heavily to the production of the training video included in this document.

Chapter 1

Tambon Administrative Offices

Tambon Administrative Offices

The Thai Government Policy of Decentralization under the Sub-district Council and Sub-district Administration Act of 1994 (BE 2537) established the Tambon Administrative Organisation in an effort to improve decentralised governance and to introduce participatory planning and decision making at local level. The Tambon Administrative Offices are expected to increase the capacity of the Tambons to generate income by the creation of jobs, to promote the effective use of local resources, to create opportunities for the local communities to participate in solving typical local problems, with initiatives taken by and for the people. This all in order to improve the quality of life at local level.

A tambon is the smallest unit of local governance in Thailand. There are around 7000 tambons. The average size of a tambon is about 6 by 6 km, and the average number of households is around 1000. Tambons are sub-divided into 5 classes (see Figure 1) according to their annual income. Most of the tambons fall into category V and have an annual income of less than 3 million Baht.

Figure 1: TAO Classification

Class	Number of TAOs	Income
I	78 (1%)	> 20 million Baht
II	65 (1%)	12-20 million Baht
III	68 (1%)	6-12 million Baht
IV	298 (1%)	3-6 million Baht
V	5,788 (90%)	< 3 million Baht

Generally, half of the income is available for development and maintenance of infrastructure (roads, water, etc) within the tambon. However, the TAO budgets will become increasingly important for public investment because they are expected to expand in combination with more administrative responsibilities in the future. The current responsibilities are given in Figure 2.

Of all the TAO responsibilities, the technical services to be provided are under the responsibility of the technicians and engineers (see Figure 3). These include development and maintenance of public facilities and infrastructure works, that are specified under the Act BE 2537 and Building Control Act BE 2522.

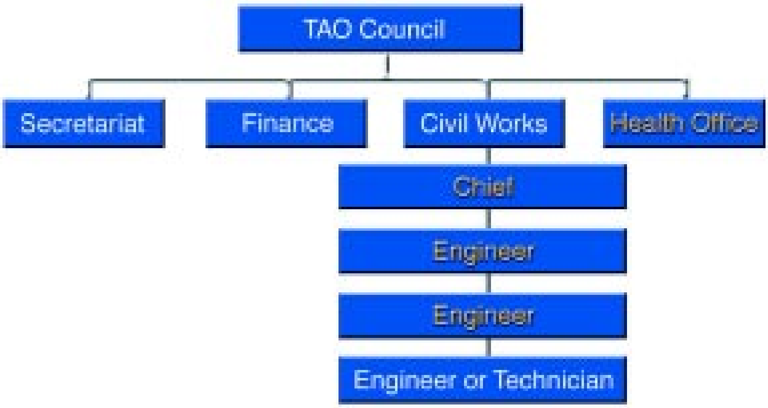
Figure 2: Responsibilities of the Tambon Administrative Organisations

- ✓ Development planning with the public in local affairs.
- ✓ Providing public utilities by construction and maintenance of roads, walkways, water transportation facilities, marketplaces, parks, recreation facilities, water supply, sanitation, ports and docks, drainage systems and other local infrastructure assets.
- ✓ Foster economic development through income and employment generation, local trade and investment, tourism, education, art and cultural development.
- ✓ Foster social welfare and quality of life through amongst other family health care and medical services, and opportunities for children, women, elderly, and disadvantaged.
- ✓ Promotion of democracy, liberty and civil rights through amongst others public safety, law and other.
- ✓ Foster sustainable livelihood through community sanitation, waste management, natural resource management and environmental preservation.

The Tambon Administrative Organisation and Planning

The TAO Councils make decisions, set priorities and give approvals, while the TAO officials prepare the plans. The engineers and technicians play an important role in providing the councils with sound technical information as a basis for good planning and thus must be able to obtain data necessary for the planning process.

Figure 3: Typical Tambon Administrative Structure



In order to provide the councils with sound technical information for public facilities, such as schools, healthcare centers, religious centers, TAO centers, bus-stops, solid waste dumps, sports grounds, parks, etc, surveys on the location and design of these facilities must be carried out by the TAO engineer or technician. This data should then be checked against the planning norms prescribed by central government for such facilities. Generally, service ratios "facilities/person" or "number of person/facilities" versus the national service ratio norms are used for the planning of facilities.

The planning and management of infrastructure such as rural roads, water supply, waste disposal, waste water treatment, storm drainage systems, etc are the responsibilities of the TAO. TAO technical officers must not only assist and participate in the planning, but also in the management, operation and maintenance of all these assets. For this propose it is useful to maintain a map showing the locations of existing infrastructure in the tambon.

TAO planning should involve all stakeholders, the TAO council, the communities (Mooban) and the TAO officers. This is best done by applying a participatory approach, involving all stakeholders in the processes of identification, prioritisation, planning, implementation, monitoring and evaluation of infrastructure.

As described in Chapter 2, early inclusion of all stakeholders in the planning process will facilitate access to most of the needed data, will create a sense of local ownership of the assets and generate a greater community feeling and awareness of the living environment. The TAO technician or engineer has a key role to play in coordinating all activities from the beginning of data collection to the completion of project works. The tools to do so is discussed in Chapter 2.

Tambon Administrative Organisation and Project Implementation

After the TAO Council approves a project proposal, the detailed design of the infrastructure works is required. At this stage the technician needs to define all technical elements needed. During this process it is also necessary to define how to build the infrastructure - by which combination of which resources. An important issue in this matter is the choice of construction technology.

By properly addressing this choice of technology from the start, the overall cost of the works can be reduced and the relative use of local resources (labour, materials and equipment) can be increased without increasing cost or decreasing quality. In both cases the local community can benefit from proper analysis of the technology choice to be made.

In Chapter 3 specific attention is given to the choice of technology and its inclusion in the preparations of infrastructure works. Examples of the effective use of labour based technology in Thailand related to the construction of bamboo reinforced concrete are given. Also alternative designs of a bridge, a building and an irrigation channel are discussed, which show the effectiveness of appropriate choice of technology to reduce costs and increase the use of local resources, while maintaining quality.

After the detailed project preparations have been completed and the TAO council has approved them, the actual implementation of the works can commence. In a separate section, specific issues related to the use of labour based technology are discussed and practical advice on the proper organisation and implementation of the works is given.

Finally, as an addition to the video CD included in the back of these guidelines, the key features the labour based construction of gravel roads is discussed in a bird's eye view.

Chapter 2

Local Level Planning

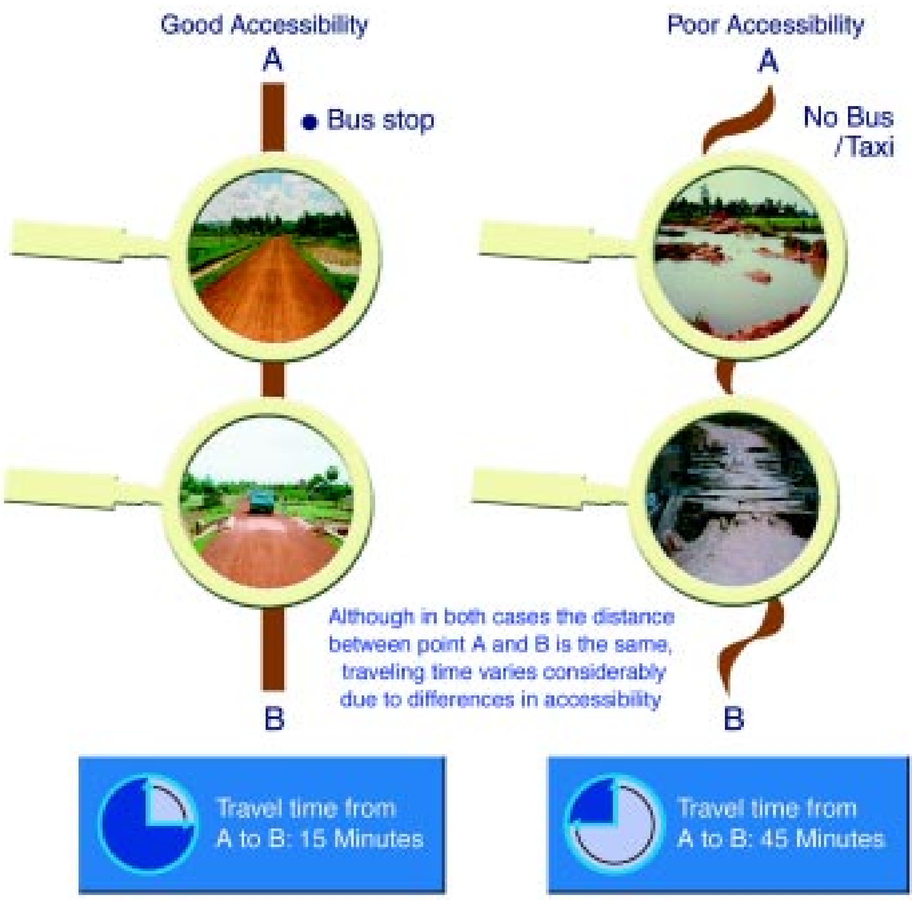
Local Level Planning

All households, rural and urban, poor and rich, need to have access to public facilities, goods and services in order to fulfill their basic, social and economic needs and be able to enjoy a social and economically productive life. Access can be defined as the ease or difficulty of reaching locations where facilities, goods and services are available.

What is Accessibility?

While it is difficult to give a complete definition of accessibility, it is much easier to explain accessibility by comparing the two situations as depicted in Figure 4.

Figure 4: Accessibility Comparison



The left hand side of this figure depicts good accessibility resulting from a good road including good bridges and good transport facilities (taxis, buses). The right hand side describes poor accessibility due to a road in poor condition, poor or broken bridges and no access to public transport services. Due to these differences in accessibility, people need to apply different efforts to achieve the same result: to travel or transport their goods from location A to B. This is reflected in the time needed to travel or the cost involved in traveling.

In the example in Figure 4, points A and B represent the point of departure and point of destination. As can be seen from Figure 5, these points could relate to facilities, goods and services on which households depend.

Figure 5: Accessibility of Services and Goods

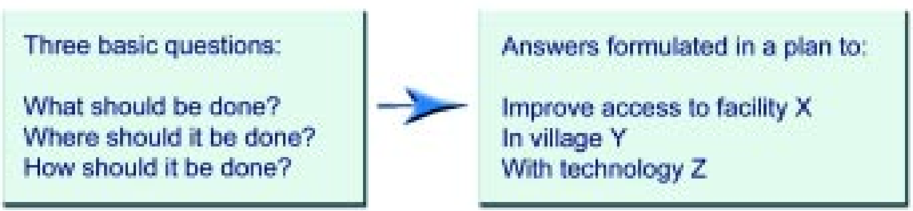
Since the households' welfare depends on the availability of these goods and services, it is important that the TAO serves the population by properly addressing accessibility in their planning system.

Two factors are of overriding importance. Firstly, planning for facilities and services should be done at the tambon level where knowledge about the present conditions and constraints is best.

Secondly, planning should involve all stakeholders, the TAO council, the Mooban and the TAO officers, during the identification, prioritisation and selection of interventions.

By using a participatory approach, answers can be found to the three most fundamental accessibility questions that are related to sustainable infrastructure development (see Figure 6).

Figure 6: Accessibility Interventions



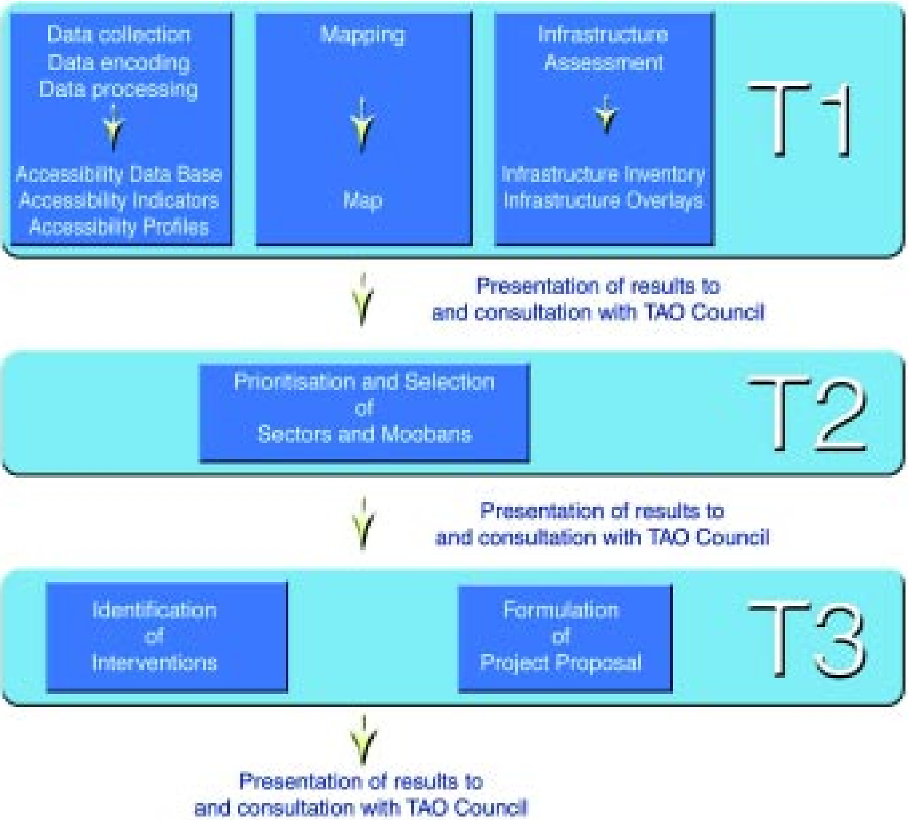
Integrated Rural Accessibility Planning

A planning procedure has been developed, aiming at incorporating these characteristics. It involves Moobans and the TAOs in the process of identifying and prioritizing the access problems and proposing solutions for improving the access to services and facilities, while making maximum use of local resources. This process includes various technical tools and is called Integrated Rural Accessibility Planning (IRAP).

IRAP consists of a set of tools which can be used to strengthen existing planning practices. Existing planning systems in use, no matter how rudimentary they may be, are the most sustainable forms of local level planning: they are being used by the local planners. IRAP seeks to strengthen the existing processes by introducing new techniques and procedures which can be integrated with the existing planning procedures to upgrade specific activities such as data collection techniques, mapping procedures, techniques for priority setting, etc.

IRAP focuses on the households and measures their access needs in terms of the time and effort required to access social and economic services. Due to limitations in access, a lot of time and effort is often spent on travel, as indicated in Figure 4. The main aim of using IRAP as a planning tool is to identify problems of access to services and goods and on this basis prioritize interventions that will improve access in rural areas. Although IRAP provides a comprehensive set of tools, its various activities can be grouped into a distinct set of stages and processes, as shown in Figure 7.

Figure 7: Overview IRAP Methodilogy T1, T2 and T3



Accessibility is an issue that affects several sectors, however, the interventions to address accessibility issues can be grouped. For example, roads, tracks and footbridges are means by which to access basic services such as schools and health centre facilities.

The underlying principal of accessibility planning is to improve the access to basic services that communities need. Such interventions may improve living conditions and make it easier for people to fulfill their basic social and economic needs. Time-savings as a result of improved access could be used for alternative social and economic activities.

IRAP is designed for use at the tambon and mooban level. Resources at this level are limited and consequently the planning techniques should not make intensive demands on the financial resources available. Since IRAP activities can be carried out by tambon staff, the cost of carrying out the planning exercise is therefore limited to field allowances and travel costs and initially some limited costs related to training.

T1 Situation Analysis

The aim of this activity is to produce a situation analysis that identifies the access problems in the moobans, both relating to the mobility of the population and the location and use of services and facilities. T1 comprises various activities that can be done simultaneously, so the whole situation analysis should not take more than 1 month.

Data Collection, Encoding and Processing

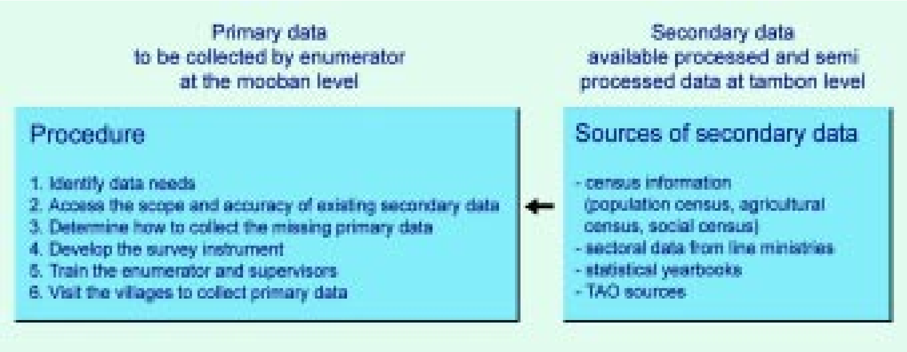
Specific information is generally required to identify the particular access needs, access constraints and access priorities of rural households. An example of required data is given in Figure 8. Depending on the local situation, the importance of certain access problems may vary. In order to focus better on the main access constraints, additional data may be sought, while other non-vital data may be left open. Not all of this information is always readily available. The TAO staff therefore may need to collect additional data to complement data that is already available.

Fgure 8: Example of required data for IRAP

This data is used to understand the access characteristics of the communities and to analyse present levels of access and calculate access indicators, which is used in the planning and decision making process. The TAO staff and mooban representatives involved in this process can provide the required information.

The IRAP analysis should be done at the tambon level. IRAP data, however, is primarily needed for the mooban level. Usually, two kinds of data need to be collected for IRAP purposes: primary data and secondary data. As described in Figure 9, primary data are those collected first hand by an enumerator, in the moobans and focuses on access and transport characteristics such as, use of facilities, travel purposes and travel times. Secondary data, such as population size, agriculture outputs, etc, refers to available processed and semi-processed data collected and compiled for a variety of other purposes at tambon level.

Figure 9: Data Collection



Using secondary data is usually less costly and requires less time to assemble. Normally, it can be compiled in the TAO office without field visits. Primary data, however, is first-hand data and needs to be collected directly from mooban representatives.

Figure 10: Data collection includes meetings with the population of the moobans

The persons who collect the primary data need to possess the right experience in conducting interviews at mooban level and need to be trained and instructed properly. A set of generic training modules and materials have been prepared for this purpose and are referred to as the "T-1 Training on Data Collection". It familiarises the TAO staff with the concepts underlying the IRAP process, the survey instruments and the skills necessary to collect the data needed (see Figure 11).

Figure 11: Survey Instruments for Data Collection

After data collection, the TAO staff needs to collate all primary and secondary data from the interviewers. It is important to emphasise the need to obtain good quality data. The data is used as a basis for planning and the planning may be less effective if the data is inaccurate. Wrong data can result in wrong decisions. Good quality data is defined as being accurate and up to date.

The collected data needs to be compiled into tables presenting the different moobans and the tambon as a whole. The computerization of the data can start as soon as the information has been collected by the interviewer and has been reviewed by the TAO staff to see if the quality is indeed good enough.

If the data meets these quality standards, it is ready for computerisation. This implies that the data is entered into different specially designed data forms presenting the data by sector and geographical area. These raw data form the Accessibility Data Base (ADB) and is subjected to periodic revisions. It is recommended that the ADB is updated every 2 years.

Accessibility Data Base Book

The Accessibility Data Base Book, commonly referred to as the ADB book, is a print out of all the mooban level data that has been entered in the data forms of the Accessibility Data Base (see Figure 12). The ADB Book is a mere compilation of raw mooban data and should be prepared at tambon level.

Figure 12: The Accessibility Data Base Book

Contents

Cover page with map of Tambon
Summary of consolidated data
General characteristics
Transport characteristics
Water supply characteristics
Education characteristics
Health care characteristics
Income generating activities characteristics
Market access
Village problems
Village priorities

Layout

- as attractive as possible
- well organised
- quickly accessible
- arranged by sector
- presenting village data
- using numerical values or text
- avoid codes

The ADB Book includes the "raw data" from the moobans and a summary of the consolidated data of all moobans in the tambon. Upon completion, the ADB Book should be presented at tambon level to explain its contents to TAO officials and to validate, correct and/or update the ADB Book. Both institutions and its representatives are likely to express keen interest in the ADB Books, which contain all the information collected. ADB Books by themselves, however, are not very informative and only present different "raw" data sets. There is no real analysis done yet except for the calculation of some tambon totals and averages.

Accessibility Indicators

An important element of planning is the prioritization of geographical areas where access, related to different sectors (water, health, education, markets, transport system, energy) needs to be improved. The main tool for identifying the priorities for improving accessibility are the Accessibility Indicators.

Accessibility Indicators show the difficulty or ease with which households have access to goods and services. As an aid to the decision making process, these indicators are objective measurements of the different levels of accessibility for different travel purposes in a mooban or within a tambon. In order to do so, the raw data in the

Accessibility Data Base is refined into a set of Accessibility Indicators which relate to the various sectors under consideration.

Accessibility Indicators are derived for different levels: mooban and tambon. For the mooban level they can be used to identify mooban interventions. For the tambon level, indicators are often use to identify moobans that are most disadvantaged in relation to basic needs and level of social and economic services.

A first step in the process of developing indicators is to decide on the variables to be used. Accessibility indicators generally relate to the number of households affected and levels of accessibility expressed in travel distances and travel times. The indicators are a function of different variables such as the number of households in a tambon, the average time spent to reach each facility/service, the frequency of travel to a facility and selected qualitative variables (see Figure 13).

Figure 13: Accessibility Indicators

Accessibility Indicators can be defined for:

- water
- firewood
- healthcare
- education
- fields
- markets

and many others

Example

In the case of water the Accessibility Indicator could be the number of households that do not have direct access to drinking water, multiplied by the time, on average, it takes for those households to reach the source of water in the dry season.

Accessibility Indicators are used to:

- categorise or rank moobans according to their level of access
- compare the level of access to goods and services between tambons, amphurs and provinces
- access the relative significance of access to each facility
- relate the levels of access to defined national of provincial standards
- monitor the development within or between tambons and sectors
- evaluate the impact of access improvement projects and interventions

It is recommended to keep the indicators as simple as possible. It is, however, possible to have indicators that are more complicated in that they include quality elements and perceived values. More complex indicators are not necessarily more accurate in identifying priority areas and risk to unnecessarily complicating the process.

At mooban level, the indicators can tell us something about the level of accessibility compared with national standards, averages and norms. At tambon level they show, for different sectors, which moobans should be assisted to improve access.

The available information in the database enables a planner to make an initial assessment of the total time, cost and effort required for a community to access certain goods, services or facilities. The indicators translate the actual level of access into numerical values. The indicators define the degree of access in a community as a whole. The larger the value of the Accessibility Indicators, the worse the access problem is. Indicators can then be used to rank moobans on an ordinal scale.

The TAO staff responsible for the development and calculations of indicators needs to understand the role of the indicators in the planning process and needs to be able to "construct" the indicators. It is important to differentiate between two groups of people: TAO staff responsible for calculating the indicators and the members of the TAO Council who will use the indicators to make decisions. The two groups of people are normally not the same. It is therefore important that both groups communicate with each other.

Once it has been agreed which variables make up the indicators and the relative importance of the different variables, the process of calculating indicators can start. From the existing Accessibility Data Base (ADB), the accessibility indicators are determined to provide a simple assessment of access conditions in a certain area and help to pinpoint problems and needs. Ideally to save time, this process is computerised. A simple function could use the data directly from the Accessibility Data Base to calculate the value of the different indicators. Once established, the indicators can be incorporated in Tambon Accessibility Profiles.

Note: If not all variables are considered equally important or if the planner wants to involve people to assess the importance of different variables, it is necessary to prepare weighting factors. In doing this the entire process of calculating indicators become more participatory, but unfortunately also more complicated. How to determine the correct weighting factors is beyond the scope of these guidelines.

Accessibility Profiles

A separate document, the Tambon Accessibility Profile, is prepared to briefly describe the tambon and summarise its access conditions. The Accessibility Profile is more of a descriptive character, more reader-friendly and can be disseminated on a larger scale. It provides aggregate and average mooban conditions. The Tambon Accessibility Profile, together with the indicators, will reflect levels of access in the tambon.

The preparation of the Tambon Accessibility Profile requires processed data, a standard format and people capable of analyzing the raw data and transferring data into meaningful statistics. The Accessibility Profile can be a one-page document summarizing some key statistics by sector or, alternatively, a short report describing the tambon, complete with a map and a short analysis of each sector. An example is given in Figure 14.

Figure 14: Example of a Tambon Accessibility Profile

General Characteristics

- number of moobans
- number of houses
- number of people
- percentage of mooban with a source of electricity

Water Supply

Percentage of mooban
- using improved only
- using traditional sources only
- where water quality is satisfactory (dry)
- where water quality is satisfactory (wet)

Transport

Percentage of moobans with
- all year road access
- dry season only road access
- no road access
- all year round transport services
- dry season only transport services
- no transport services

Economic Activities

Percentage of mooban
- marketing at least one crop
- marketing at least one non-food item
- never self sufficient in rice
- with a rice mill

Average time to market

Education

- percentage of moobans with complete school coverage
- percentage of moobans with incomplete school coverage
- population/classroom ratio
- population/teacher ratio
- grade 1 pupil/100 population ratio
- grade 5 pupil/100 population ratio

Health Care

Percentage of moobans with
- healthcare centre
- nurse
- regular visits of medical staff

Average travel time to pharmacy

TAO staff are often only involved in data collection and submitting this information to higher authorities. Decentralisation efforts, however, aim to strengthen the TAO capacity to interpret and use data for planning purposes at tambon level.

Mapping

Accessibility mapping is an integral part of the IRAP procedures. It allows the TAO staff to visualise the location of moobans and infrastructure within a tambon and can help in the identification and prioritisation of access problems. It also facilitates the formulation of interventions and provides guidance in the selection of the best development alternatives (see Figure 15).

Figure 15: Accessibility Mapping

Purpose of Accessibility Mapping

- to provide a picture of access conditions in a given area
- to facilitate the identification of access problems
- to formulate interventions
- to enhance communication with an audience
- to evaluate the impact of access improvement projects

Components

- tambon and mooban boundaries
- population centres
- infrastructure
- service centres
- water bodies

Colourful, large size maps, immediately attract the attention of the audience while visualising access conditions and access priorities in a given area. Maps also facilitate discussions and reactions from the audience since they allow reviewing issues on common grounds.

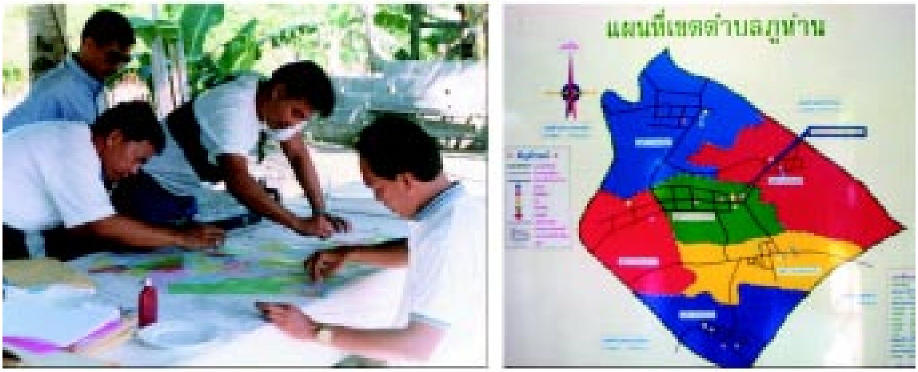
Maps enable integration of different sector analyses and provide a technical tool to demonstrate how improvement interventions (projects) can be used to solve access problems. Equally, mapping provides a monitoring mechanism for the levels of access in a tambon.

IRAP maps need to be based on existing topographic or other official base maps. It is necessary for the TAO mapping team to visit the areas for which the maps are prepared to collect additional information and to verify base maps.

Handmade accessibility mapping has been developed as a "user-friendly" process that can be easily understood. The TAO staff can prepare good quality maps using inexpensive materials that are locally available.

Note: If the maps are produced manually, it is difficult and laborious to make changes. It is recommended that after the necessary capacity has been established in the tambon to produce, read and use access maps, the TAO moves to the next level where the mapping process is computerised. How to use this so-called Geographic Information System (GIS) software is beyond the scope of these guidelines.

Figure 16: Preparation of maps and overlays that show the levels of access to various services in the tambon.



Rural Infrastructure Assessment

Rural infrastructure includes local roads, bridges, schools, health centers, markets, electricity networks, irrigation schemes, water supply, sanitation, storm water drainage and telecommunications. In order to plan for additional or improved infrastructure, the TAO staff first needs to know what is already there. The TAO staff needs to prepare an inventory of the existing rural infrastructure assets. This inventory has two main elements: the inventory form and the inventory overlays.

(i) Infrastructure Inventory Form
The infrastructure inventory is primarily based on a set of forms to record data for individual road links, water supply, schools and health centres, irrigation schemes, markets, electricity networks and rural telecommunications. The inventory includes all infrastructure assets in the tambon.

Figure 17: Infrastructure Survey

Objective
to make an overall assessment of the condition and extent of the rural infrastructure in the tambon

Purpose

- to prepare a list of all infrastructure assets in the tambon
- to locate all infrastructure on the tambon map
- to assess the quality and capacity of the infrastructure assets
- to identify the needs for improvement
- to identify the maintenance requirements and responsibilities

The infrastructure inventory includes the IRAP road inventory. The aim of the road inventory is to carry out an overall assessment of the condition and geographic distribution of the road network in the tambon. The IRAP road inventory does not provide any technical information on the specific condition of each road link nor provide data on the cost of maintaining or improving existing links. It is a first inventory to generate a general picture on the overall status of the (rural) road network. The road inventory together with the mooban data can be used to prioritise individual road links for maintenance or rehabilitation/improvement purposes.

(ii) The Infrastructure Overlays
The infrastructure overlays are transparent overlays for the existing IRAP tambon map. Different types of infrastructure are identified on these overlays by different colours and different shaped lines and dots. The overlays are produced manually.

It is recommended to have different overlays for the transport sector, the point sources (markets, health facilities and schools) and the water, electricity, sewage, storm water and telecommunication distribution systems.

The road key map overlay is in fact a simple road map identifying the different road links and areas served. The road key map can also identify areas that have trail or river access. Roads are shown by different shaped lines with different colours to identify their classification.

T2 Prioritisation and Selection

The main objective of this activity is to identify priorities for improving access in selected villages in the tambon. This activity, resulting in priority listings of villages by sector, should be done through a participatory prioritisation workshop. It involves the analysis of data, indicators and maps to allow a comparison of different levels of accessibility between moobans and across sectors and to identify mooban priorities based on the existing levels of access to various services.

Figure 18: Prioritisation and selection with the involvement of the moobans identifies the sectors and tambon priorities

The accessibility indicators, profiles and maps are the tools that together provide a quick and systematic procedure to identify priority moobans for improving access. The profiles provide an overall overview to be compared with national norms as indicated in the five year plan of the Ministry of Interior. The Accessibility Indicators enable planners to rank moobans in order of accessibility, or better, lack of accessibility. The maps provide a simple means of visualising accessibility.

Figure 19:

The map on the photograph identifies priority areas for improving access. It shows priority villages for improving water supply (blue dots), primary education services (pink dots) and primary healthcare (orange dots). In addition, it shows the priority road links (yellow dots) for rehabilitation. Once the priorities have been agreed upon (T-2 activity), they will need to be developed into project proposals with a clear implementation plan and budget. (T-3 activity).

During the workshop, the sectoral objectives for access improvements are defined. If national targets exist, these are used to define overall objectives. The targets should be realistic and attainable, based on the available resources. An appropriate target could be to secure direct access to potable water to all households not exceeding a distance of 500 meters, all year around.

One of the main objectives of the workshop is to inform the population about the findings and recommendations of the IRAP application in the tambon and to solicit further support for improving access. The typical participants are TAO staff together with TAO Council members.

The end result is a list of priorities by mooban and by sector, ranked according to their levels of inaccessibility. The priority moobans would be moobans that have a relatively large population affected by poor (or a lack of) access and have generally poor access to certain facilities, goods or services. All information such as statistics, maps, indicators and priorities are now available. The outputs, findings and recommendations should be presented to the TAO Council and thus provide the initial support for the interventions to be prepared in the next planning stage.

The identification of priorities can never be an entirely mechanical, computer programmed process based only on indicator. The indicators and maps are merely tools to be used as a guide during prioritisation. The TAO staff knowledge and understanding of local characteristics, constraints and realities also have an essential role to play in this process.

Due to the importance of this part of the planning process, a standard training course (referred to as the T2) has been developed and as part of this a set of training materials and modules have been prepared. This training is conducted for key people at the tambon level, including TAO staff and the TAO Council. The main objective of this training is to strengthen the TAO capacity to use maps, data and indicators to identify priority access improvements. As a last activity of the training, participants are instructed and guided in how to present the outputs, findings and recommendations to the TAO Council.

T3 Identification and Formulation

The prioritisation exercise described above results in a ranking of priority moobans and the type of access to be improved. The activity however did not yet identify what could be done to improve access or how interventions could best be implemented.

For this reason, mooban representatives need to be invited to a workshop on project identification and design, referred to as the T-3 Training. TAO staff and sometimes TAO Council members representing the different sectors should also participate in this workshop. The main objective of the workshop is to identify the most appropriate way of intervention and to formulate the development interventions.

A TAO staff member will need to be selected to become the resource person for this activity. The main instruments used in this training is a problem/objective tree and a standard project template. These instruments are often further developed and examples should be ready prior to the conduct of training.

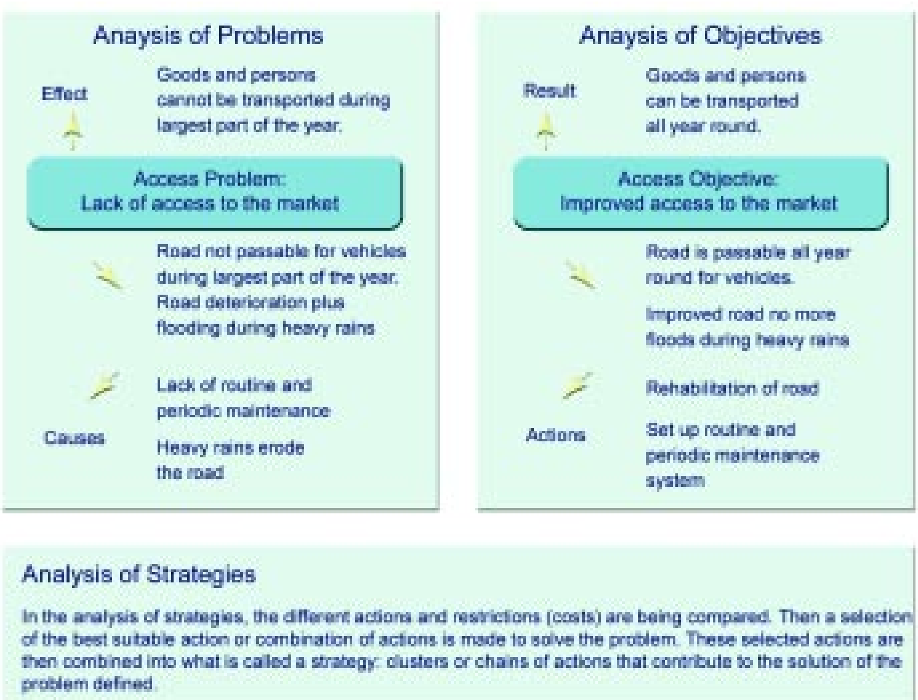
Identification of Interventions

Once a mooban has been identified as a priority, TAO staff, together with mooban representatives, need to identify the types of interventions needed to improve accessibility in a particular sector. If a mooban is identified as a priority for improving access to a market place for example, the question that remains to be addressed is: what needs to be done to improve access to this particular service? The combined mooban and TAO staff need to work sector by sector to identify the most appropriate and feasible intervention during the first part of the workshop.

It is important that this identification process is based on the IRAP strategy of having two main categories of access interventions, namely interventions that improve mobility such as roads, bridges, tracks and trails, transport services and low-cost means of transport and interventions that improve the distribution of facilities and services such as water supply, schools, markets and health centers. Therefore, an accurate analysis of the existing situation is important. A good approach to such an analysis for selecting a suitable intervention is to use a Logical Framework (see Figure 20).

(i) Problem Analysis
A part of the problem analysis has already been carried out during the situation analysis (T1) and the prioritisation and selection (T2) and resulted in a set of access problems that needs to be addressed. What has not yet been done is a proper analysis of the causes of these access problems. A thorough problem analysis forms the base of any action to solve a problem. In a problem analysis, cause-effect relations are examined. In the analysis the involved parties, mooban and TAO staff, identify the real access bottlenecks to which they attach priority.

Figure 20: Logical Framwork Situation Analysis



The analysis is best presented in a diagram showing the effects of a problem on top and its causes at the bottom, such as in the left-hand panel in Figure 20. It shows which causes are underlying the problem.

When preparing a problem diagram, it is important to break down the main problem into related problems. Very often, one problem can have many causes resulting in a problem tree with many branches. Once the causes of the problem is clear, it is possible to take the next step to consider the possible solutions.

(ii) Objective Analysis
In the preceding section, it was explained how access problems can be broken down in to causes and effects. With the problem diagram already prepared, the second step is to formulate an objective. This will in the next turn lead to the identification of an appropriate intervention. During the objective analysis, the negative situation of the problems diagram is converted into 'positive achievements'.

The objective describes the future situation once the problems identified have been solved. For each of the boxes of the problems diagram, the negative essence has to be changed into a positive achievement. The result is a diagram of objectives.

It is important to realise that often a choice of actions is available to solve a problem. Some actions appear to be less realistic in a specific situation, others more so. Therefore, a selection needs to be made on the basis of an analysis of different strategies.

(iii) Strategic Analysis
In many cases, a problem can be solved in different ways. In order to select the most appropriate action or combination of actions to solve the problem, it is necessary to analyse the actions first. Different clusters or chains of actions that contribute to a solution can be referred to as a strategy. For example, the problem of limited access to potable water can be solved with the construction of an improved hand dug well, with the construction of a gravity system or with the construction of a bore hole. Each of them are strategies to solve the problem of limited access to potable water.

During the analysis the strategies are compared according to criteria such as the priorities of the population of the mooban, the available budget, the available labour and other local resources at village level, the likelihood of success, the local situation, the time frame, etc. For the above example on access to water, this means that the solution of an improved hand dug well would be the best strategy in case the available budget is limited. The improved hand dug well is the cheapest option. It would also be the best strategy in case there is no road access for the drilling machinery and in case of flat land area where no gravity system is viable.

After the analysis of problems and formulation of objectives and strategies, one can identify the preferred strategy to be formulated in a project proposal

Formulation of a Project Proposal

After identifying the most appropriate and feasible intervention, the same combined mooban and TAO team need to work together to design the project. This could be a simple project write-up or project proposal using a standard template. It is important, however, to include measures that will minimise cost and maximise impact. It is here that the use of local resources including labour, raw materials and products needs to be maximised, as described in Chapter 3 of these guidelines.

Figure 21:

Through the analysis of problems and objectives, the preferred strategy is selected detailed in a project proposal

A project-proposal clearly states:
- a project purpose that contributes to the overall objective
- the concrete activities
- the availability of means by which the activities can be undertaken
- the expected results from the activities

Project design includes the preparation of a cost estimate. It is recommended to use standard specifications, norms and costs to prepare the preliminary project design. Such specifications, norms and costs should be made available prior to the workshop.

A short workshop would be sufficient to guide the combined mooban and TAO team through the project identification process and produce a set of project proposals. The mooban priorities are the main input for this training. On the basis of a proper problem analysis it should be possible to identify in a relatively short time the most appropriate solutions to existing access problems. Once these solutions and the objectives of a possible project are known, the participants can formulate the activities to achieve the objectives as a project.

The three main training documents therefore include a module on identifying interventions, a module on designing interventions and a module on cost guidelines and technology.

Participation and Consultation

As shown in Figure 7, the separate parts of T1, T2 and T3 are linked by presentations and consultations with the TAO Councils. These presentations and consultations are vital for the success of the project. They not only ensure that the community via the TAO Council will see their real needs being addressed, but will also give the local communities full responsibility and ownership, even before the assets are created.

The indicated presentations and consultations are however not enough. During the processes T1, T2 and T3, full participation of the local communities is needed. This will be a challenge and will require the full consent of the TAO Council, the planners and technicians. It includes the sharing of all the information and ideas that exist, discussing them with experts and non-experts. The planners need to develop skills to moderate the workshops and to increase the involvement of the local population and TAO staff in the projects.

Epilogue

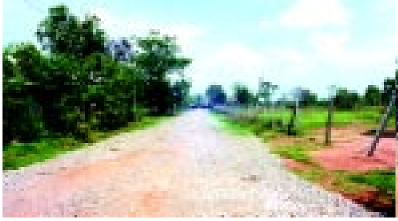
In all activities, the different stakeholders of the mooban need to work together with the Tambon Administrative Organisation to find the most appropriate answers to the "what, where and how" questions.

Integrated Rural Accessibility Planning covers several sectors. In particular, it provides detailed data on the level of access that rural households have to services and facilities. These include the transport system, water, energy, health, education, markets, agricultural inputs, agricultural outputs, crop marketing and post-harvest facilities.

Accessibility Planning is gender sensitive and involves both men and women in the local level planning process and takes account of the clear distinction between the sexes in terms of transport needs and patterns. In doing so, gender specific perspectives and needs are incorporated into the planned interventions and the burden of transport may be reduced for both sexes.

IRAP has been designed to assist local-level planners to make appropriate investments of the limited funds available to them. The focus on the local level also provides a basis for developing the capacity of local-level planners. Two points are necessary to raise here. The IRAP procedure is not a planning system. It provides a basis for establishing priorities for access improvement in the sectors that it deals with. It is a tool for rural development planning that captures access problems and identifies a set of prioritised interventions that address these problems in rural communities. It can be easily integrated into existing local level planning structures and procedures.

IRAP is useful not just because it provides an effective local planning tool. Its real importance lies in its potential to bring together the two aspects of accessibility - mobility and proximity - in a sensible manner. It suggests that access, rather than transport, should be considered as the main facilitator of development.




Chapter 3

Labour Based Technology

Labour Based Technology

The construction or rehabilitation of infrastructure such as roads, bridges, dams, irrigation channels, public utility buildings and many others, can be done in numerous ways. Before commencing works, the engineer and the TAO decision-makers have to choose not only on what or where to build the asset, but also decide how to build the asset i.e. the method of construction and the technology to be used. These decisions are important when the potential exists to make use of local resources, which may have many advantages for the local population.

The underlying principles for doing this are explained in Figure 22, and can be used as guidance. Since the use of appropriate technology can have a major influence on the success of a project, this chapter emphasises the choice of technology.

Figure 22: Rural Infrastructure Construction

In order to develop rural infrastructure with the participation of the mooban during works implementation, the project should:

- adopt appropriate construction techniques which are familiar to the community
- emphasise labour-based construction methods to maximise involvement of community members
- use local construction materials wherever possible to promote chained activities in the local construction industry

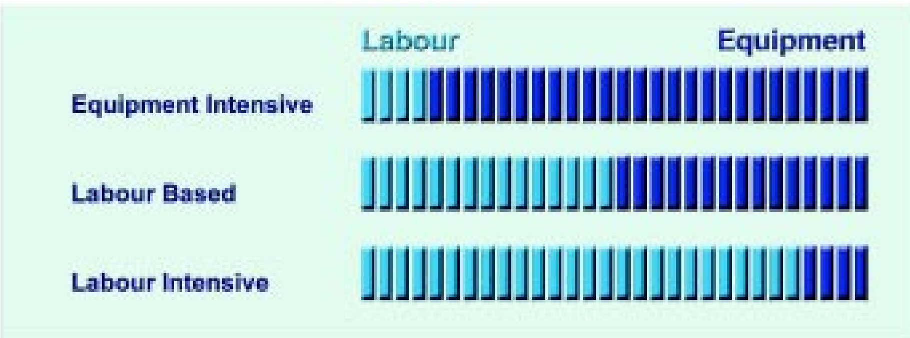
Choice of Technology

Construction technologies can be classified into three groups on the basis of their use of labour and equipment: equipment intensive, labour based and labour intensive technologies. The choice of the technology affects the overall cost, the overall duration of the works and the overall quality of the asset produced. Some works allow only one type of technology, while other works can be done in various ways.

In selecting the most appropriate technology, it is important that efficient use of resources is being made, quality standards are maintained and time limitations are observed. Labour based technology, defined as the construction technology which maximises opportunities for employment, while supported by light equipment, should only be used under the strict condition of cost competitiveness, acceptable engineering quality standards and timely completion of works. If they are well prepared and supervised.

Labour based work methods can be competitive and more economical while still providing lasting benefits.

Figure 23: Potential shift in labour contents by using labour-based methods



By shifting from the use of equipment to labour, the overall labour content of a project can in some cases be significantly improved.

	Equipment Based	Labour Based
Public Buildings	20-30%	25-35%
Water Reticulation	5-15%	25-35%
Sanitation	5-15%	25-35%
Rural Roads	5-15%	30-70%
Dams	10-20%	50-70%
Irrigation	15-25%	30-70%

As described in Figure 23, some types of works allow a switch from equipment based to labour based technology thus allowing for a significant increase in the use of local labour. Besides the overall cost, the overall duration of the works and the overall quality of the outputs, there are other factors that influence the choice of technology. The choice of technology not only determines the amount of labour needed and which tools can be used, but also what role local contractors can play, what locally available materials can be used and finally how much the local community can be involved.

Local involvement in the construction of assets is very important, because it can create a sense of ownership of the assets and enables the local community to acquire some technical or managerial skills. Through its involvement, the community may gain experience in project management and work organisation. This may form a good basis for future cooperation in development activities, such as during the maintenance of the infrastructure. While the experience with joint responsibilities in infrastructure operation and maintenance may enhance other community participatory activities.

Figure 24: Labour Based Technology and Community Participatory

The use of local materials and equipment is beneficial for local manufactures and makes the project less dependent on foreign imports of materials and expertise and thus saves foreign exchange, which results in a large part of the infrastructure budget being spent on wages for community members. A portion of this is saved as funds for generating other economic activities, or can be used for local consumption and thus increase the consumer products manufacturing activities.

In Thailand, especially bamboo reinforced concrete roads have received attention, and TAOs now gain experience with the execution of labour-based infrastructure projects (see Figure 25).

Figure 25: Bamboo Reinforced Concrete Road Construction

In 1989, the Public Works Department of Thailand started a program to construct bamboo reinforced concrete paved village roads. The objective was to reduce the unemployment rate in rural areas by applying labour-based construction techniques. During the initial phase of the program, labour-based construction methods were strictly applied, and rapidly gained wide support. The average labour content was estimated to be approximately 20% of the construction cost.

However, during the period of rapid economic growth in 1994 to early 1997, wages rose and many other social constraints posed difficulties in applying labour-based techniques. Due to modifications in the technology, more equipment was introduced, replacing skilled and unskilled labour. Ready mixed concrete from commercial mixing plants was widely used instead of concrete mixed manually by local labour. This resulted in a reduction in the labour content in the total construction cost to as low as 10%.

In 1998 the Public Works Department reverted back to applying labour-based methods in the construction of bamboo reinforced concrete pavement for village roads. Altogether 883 village road projects, with a total road length of over 500 kms spreading all over the country were constructed. Labour content was estimated to around 15% of the total construction budget, and an estimated 760,000 work days of employment was generated. Also the Japan funded Miyasawa program adopted this as preferred technology, and prescribe it for project proposals.

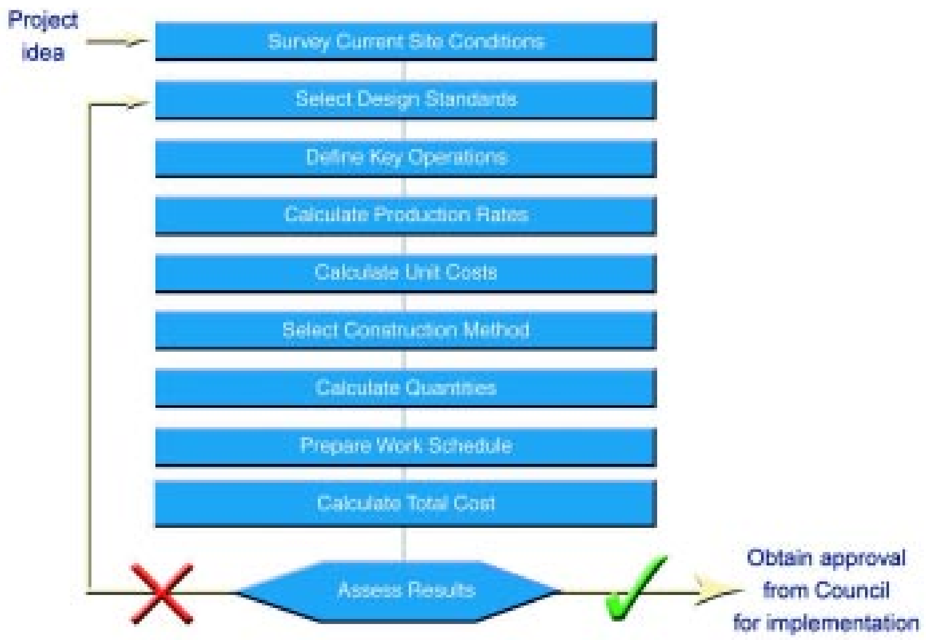
Through its long experience, the Public Works Department has accumulated a wealth of knowledge on bamboo reinforced concrete pavement construction. However, most of the junior and middle level engineers/technicians have experience mainly in the use of equipment-based methods. Training is therefore needed to refresh the knowledge and shift the attention towards more labour-based methods.

Labour-based construction methods can only be efficiently applied if the project is properly designed, planned and implemented. Due consideration should therefore be given to the use of simple work methods, the availability of adequate tools and equipment and making use of small equipment and tools where appropriate. Adequate time should be made in the project schedule, adequate labour availability needs ensured and reasonable wage rates and welfare policies adopted to motivate the workers. A thorough discussion on all these aspects would be beyond the scope of this guide. Instead, an overview of selected topics and some practical guidelines are given in the following section.

Preparation of Infrastructure Projects

Although a variety of approaches for the preparation of an infrastructure works project do exist, they mostly follow the process as indicated in Figure 26. It involves several steps and it includes a feedback cycle in order to guarantee that all requirements are met prior to the submission and subsequent approval and implementation of the project. In the following section, these steps are discussed and some guidelines provided on how to ensure a proper preparation.

Figure 26: Project Preparation



Survey Current Site Conditions

In order to determine the most appropriate configuration of the infrastructure to be constructed, specific information on the type of works and the site conditions is needed (see Figure 27).

Figure 27: Required Information for Designing Infrastructure

Type	General Information	Information on Site Conditions
Buildings	Functional Uses Size and number of rooms required Typical design in the local areas Lighting requirement Ventilation requirement Building permit authority Local design codes Local construction materials available for uses	Site topography Site plan Foundation soils Wind direction
Weirs	Relative location of benefiting agricultural land Method of water extraction from the pooled reservoir Water level in the pooled reservoir Local construction material/equipment available	Cross section of the channel at the weir location Highest and lowest water level and flow rate Soil conditions in the river bed and banks
Irrigation Channels	Required cross section of channel Maximum depth of low Location of water control structures	Gradient of canal bed Soil conditions along the canal alignment
Roads	Number and types of vehicle traveling on the road Types and width of the required pavement surface Required road alignment Locations of natural construction material	Topography along the road alignment Soil conditions along the road alignment Location of water crossing Peak flood water level
Bridges	Types of vehicles travelling on the bridge Required width of bridge deck	Cross section of river channel at bridge location Peak flood water level Soil conditions
Household Water Supply System	Location of water source Quality of water required Number of households to be served	Channel alignment Soil conditions in the river bed and banks

For common infrastructure such as buildings, existing structures can be studied as examples. Information on functional and operational problems could then be acquired from these structures in order to compare advantages and disadvantages of various designs. For complicated structures such as bridges and weirs, technical advise should be sought from qualified personnel.

Select Design Standards

The selection of appropriate design standards should be carried out by a technician or engineer. If there is no technician or engineer available, assistance should be sought from technical units of other authorities.

Designs standards for various types of community infrastructure are available from some government agencies e.g. a bridge design of ARD, a weir design from Ministry of Interior.

With the appropriate design standards, a qualified engineer or technician can start preparing the design of the desired infrastructure. Since designs of infrastructure should be related to the specific conditions of the work site, the information collected in the first step will be of vital importance and more field surveys might be needed. As shown in Figure 28, other considerations may be taken into account, such as social and environmental effects. In the final paragraphs on the assessment of the results a few examples will be given of improvements used in Thailand.

Figure 28: Example of Design for a Building

Observed Characteristics

Reinforced concrete structures 29 m^3
165 m^2, 1/2 brick wall, plastered both sides
Aluminum doors and windows
Steel trust roof, asbestos cement roofing
Asbestos cement board ceiling
Timber cladding

Total Price (Baht)	541,320	
	Unit Prices	
Local Material	847	26%
Imported Material	1,345	41%
Labour	576	18%
Equipment	161	5%
Profit & Overhead	352	11%

↓

Recommended Characteristics

Reinforced concrete structures 29 m^3
165 m^2. 1/2 brick wall, plastered both sides
Timber doors and windows
Timber trust roof, no ceiling

Total Price (Baht)	469,649	
	Unit Prices	
Local Material	685	24%
Imported Material	1,188	42%
Labour	507	18%
Equipment	161	5%
Profit & Overhead	305	11%

Remark: due to serious health dangers for workers when processing asbestos, many countries has prohibited the use of asbestos in construction works. If asbestos needs to be removed, use protective cloths and masks.

Source: A study on Unit Costs of Infrastructure Projects in the upper North Region. Dr Aniruth Thongchai, Chiang Mai University 1999.

Define Key Operations

Based on the design, key work operations need to be defined. These key operations need to be made more specific by defining the activities. Finally, details should be prepared for every activity, based on a field survey, on the nature of the activity given the prevailing site conditions. An overview of key operations and activities is given in Annex 1.

Calculating Task Rates

After the definition of key operations and activities, task rates need to be calculated for every activity. It is important to know in detail which task rates to use for the various activities in different circumstances (hard or loose soil, wet or dry soil, thick or sparse bush, etc.). Task rates vary with the site conditions. Therefore, it is important to verify the estimated task rates with actual rates of completed works in similar projects. Otherwise site trials may be useful. An indicative table of task rates is provided in Annex 2.

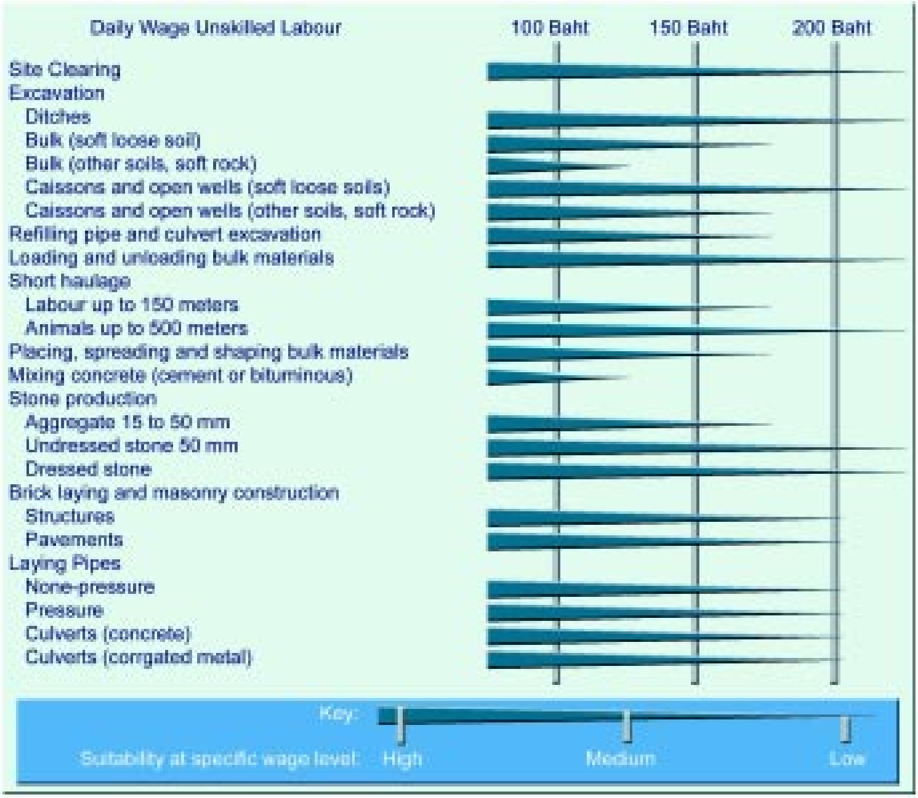
Calculate Unit Costs

By combining task rates with local wage rates and prices on materials and equipment, unit costs can be calculated. Unit costs are typically broken down into material, labour and equipment components. Consideration should be given to the fact that the unit cost rates for construction activities vary from region to region due to differences in material and labour costs.

Select Construction Method

After having estimated the construction quantities, the construction method applied in each work activity can be selected. In order to maximise benefits to the local community, attempts should be made to avoid using large construction equipment and imported materials, and to maximize the cost effective use of local construction materials and create local employment. This should be taken into consideration when selecting the construction methods. Indication of the suitability of certain activities for labour-based technology for a given wage level for unskilled labour is provided in Figure 29.

Figure 29: Suitability of Activities for Labour Based Technology



Alternative construction methods are compared based on the unit cost for every activity. On the basis of these comparisons, a final choice of construction method is made for every activity. An example is shown in Figure 30. For all activities, the existing alternative construction methods and related unit costs are stated. The alternatives that turn out to be more expensive or less suitable technically will be replaced by the cheapest solution that will still deliver the same quality of works as required by the set design standards.

Figure 30: Example of Comparing Alternative Construction Methods

Activity	Unit	Alternative I	Alternative II	Alternative III	Construction Method
A. Site Preparation					
Clearing	Baht/m²	10	[5]	1*	
Stump and Rock removal	Baht/No.	[50]	100		I: Using manual labour
Grubbing	Baht/m²	[50]	100		II: Using a bulldozer
Setting Out	Baht/m	[9]			
B. Earth Works					I: Manual labour for excavation, ditching sloping and camber formation. Watering with truck and mechanical compaction by pedestrian roller. II and III: Fully equipment based using an excavator and grader for all earthworks.
Excavation to level	Baht/m³	} [60]	64.5	65.5	
Ditching and Sloping	Baht/m³				
Forming Camber	Baht/m³				
Watering and Compaction	Baht/m³				
C. Embankment					Same as under B
Fill lell than 50 cm.	Baht/m³	} 61	[58]	45*	
Fill over 50 cm.	Baht/m³				
D. Gravelling					I: Excavation, loading and hauling by frontwheel loader and tipper trucks. Leveling by hand. Compaction with vibrating rollers. II and III: Same as I, except leveling by grader.
Excavation, Load and Haul	Baht/m³	[135]	200		
Spread and Compact	Baht/m³	60	[45]	55	

*Alternative is technically *not* feasible

Calculation of Quantities

When all details of the construction plan and choice of technology have been prepared the detailed quantities of work need to be estimated. These quantities form the basis of the total cost analysis and ultimately determine the future inputs of labour, materials, tools and equipment. An example for a road construction project is given in Figure 31.

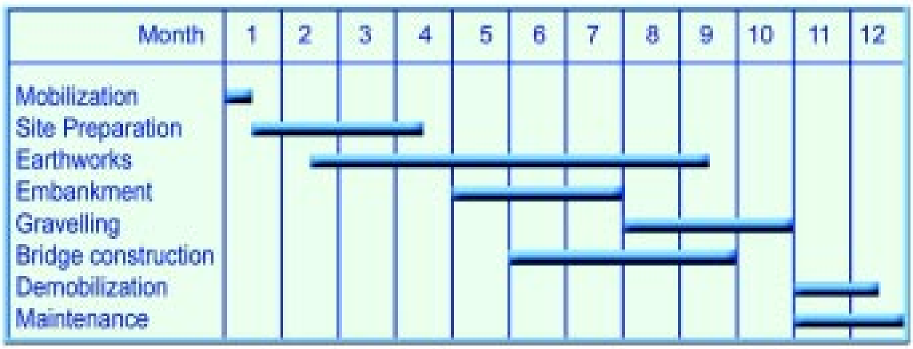
Figure 31: Example of Estimated Quantities

Activity	Unit	Kilometer 0-1	1-2	2-3	3-4	4-4	Total	Task Rate	Work days
A. Site Preparation									
Clearing	m^2	1,700					1,700	75	23
Stump and Rock removal	No.	6		1		2	9	4	2
Grubbing	m^2	3,000		3,000	3,000		9,000	55	164
Setting Out	m	1,000	1,000	1,000	1,000	1,000	9,000	50	100
B. Earth Works									
Excavation to level	m^3	106	730	136	45	96	1,111	1.5	741
Ditching and Sloping	m^3	1,076	165	748	725		1,713	1.6	1,696
Forming Camber	m^2	5,500	5,500	5,500	5,500	5,500	27,500	80	344
Watering and Compaction	m^2	5,500	6,130	5,500	6,256	11,800	35,186	90	391
Reshaping	m^2	5,500	5,500	5,500	5,500	5,500	27,500	80	344
C. Embankment									
Fill lell than 50 cm.	m^3		282	282	360	3,041	3,683	1.8	2,046
Fill over 50 cm.	m^3						0		
D. Gravelling		990							
Excavation, Load and Haul	m^3	990	990	990	990	990	4,950	contractor	
Spread and Compact	m^3	990	990	990	990	990	4,950	8	619
								Total	6,470

Prepare Work Schedule

On the basis of the estimated quantities, the number of workdays is calculated for each activity. Taking into consideration the proper construction sequences, the starting and finishing dates of each activity is determined. These can be presented in the form of a bar chart, as shown in Figure 32. Delays should be minimised, and an optimal sequence needs to be defined for the execution of the works.

Figure 32: Example of a Bar Chart



Because the construction work is broken down into a series of activities with a well-defined scope and clear input requirements, this can be used to create an overview of resource requirements (material, labour and equipment) at the various construction phases. This is a very useful tool for the planning of each activity as well as for monitoring purposes during works implementation.

Construction works can be sped up by increasing the number of workers and equipment if available. However, it is better to schedule the works such that available resources are optimally utilised. Sometimes, a different sequence might be more cost effective, because idle time can be minimised.

Estimating Total Cost

In this last step before the overall assessment, all the data collected and generated is assembled to arrive at the total cost of tasks, activities and the overall project. Labour cost typically includes wages of workers and supervisors, but does not include the expenses for some administrative staff. Overhead costs are expenses for administering the project, such as the travelling cost to coordinate or supervise the project, office supplies, communication facilities and salary for an office clerk. These are normally budgeted for by accounting around 11% of the total project costs.

For construction projects executed by external contractors, additional costs should be calculated of around 20-30% of the project cost to cover for contingencies, profits, taxes and risk.

Since the content of labour is higher in labour-based projects than in an equipment based project and thus will rely more on the motivation of the workers, it is very important to assure that wage payments are made on time. The payments should be planned in advance in order to avoid a cash-flow problem. Payments and other time related variables could therefore be indicated in the bar chart, in order to keep a close eye on upcoming events.

Equally important is to assure the availability of resources, to take into consideration the difficulty of the works and to allow some flexibility in timing to minimise materials, machines and workers standing idle.

Apart from scheduling the various construction activities, a construction plan should also give a summary of resource utilisation, such as budget allocation and timing of disbursements, and manpower and equipment utilisation. During the implementation of the project, these issues need to be carefully monitored.

Assessment of Results

After all these preparations, an assessment needs to be made to justify the execution, based on past experience or by comparison with projects elsewhere. If for some reason the project is too expensive, creates too little employment or for other reasons does not meet the expectations as formulated in the project proposal, the process may need to start all over from the selection of the design. Only after a positive assessment should the approval for implementation be obtained from the TAO council.

An example showing how considerable cost savings can be made by proper assessment of the results and redesigning of the project, is given in Figure 33.

Figure 33: Example of Recommended Design of an Irrigation Channel

Physical size of irrigation canal 1069 cubic meters

Observed Characteristics

Reinforced concrete Channel
U-Shape 0.80 * 0.80 metre
0.15 thick wall / bottom
50% of total volume is earthwork

Total Price (Baht) 1,538,151

	Unit Prices	
Local Material	286	20%
Imported Material	718	50%
Labour	222	15%
Equipment	59	4%
Profit & Overhead	154	11%

Recommended Characteristics

Reinforced concrete Liner
Trapezoidal Shape
0.08 m thick reinforced Liner
70% of total volume is earthwork

Total Price (Baht) 900,098

	Unit Prices	
Local Material	143	18%
Imported Material	339	40%
Labour	234	28%
Equipment	31	4%
Profit & Overhead	90	11%

Remark: by changing to a trapezoidal channel shape and reducing the thickness of the vertical reinforced concrete wall to a thinner liner reduces the amount of concrete required. No form work is needed. More earthwork is required in back-sloping the channel wall before concreting. This design is very suitable for labour-based works methods.

Source: A study on Unit Costs of Infrastructure Projects in the upper North Region. Dr. Aniruth Thongchai, Chiang Mai University 1999.

In another example, a bridge (see Figure 34) with prefabricated concrete piles were replaced by concrete spread footings

manufactured on site, thereby avoiding the use of a driving crane, and instead use labour to excavate the abutment foundations. The resulting total cost is only slightly cheaper, but increases the use of local labour.

Figure 34: Example of Recommended Design of a Bridge

Physical size of bridge : 30 meters

Observed Characteristics	Total Price (Baht)	781,565	
		Unit Prices	
Prestressed concrete piles (factory made)	Local Material	5,008	19%
Reinforced concrete piers and decks	Imported Material	12,049	46%
4.00 meter clear width	Labour	3,616	14%
0.50 meter foot paths both sides	Equipment	2,267	9%
Reinforced concrete post / 2" pipe rails	Profit & Overhead	3,113	12%

Recommended Characteristics	Total Price (Baht)	754,998	
		Unit Prices	
Reinforced concrete Spread footings	Local Material	6,589	26%
Reinforced concrete piers and decks	Imported Material	10,712	43%
4.00 meter clear width	Labour	4,171	17%
0.50 meter foot paths both sides	Equipment	570	2%
Reinforced concrete post / 2" pipe rails	Profit & Overhead	3,125	12%

Remark: changing from pile founddations to spread foundation avoids the use of a pile driving crane. Labour can be used to excavate the abutment foundation. This design is more suitable for labour-based works methods.

Source: A study on Unit Costs of Infrastructure Projects in the upper North Region. Dr. Aniruth Thongchai, Chiang Mai University 1999.

These improved designs illustrate the importance of good preparations, the resulting lower costs and the potential for replacing heavy equipment with labour and replacing imported materials with locally produced materials, while maintaining or improving quality.

Project Implementation

After securing the approval of the TAO Council for the implementation of the project, the construction works can commence, either by the community or a local contractor. Infrastructure projects can be completely contracted out, but can also be executed partly by the Tambon Administrative Offices. For those parts that are not contracted out, the technician will act as the supervisor, rather than the inspector. The following section provides some general guidelines for implementation.

For more detailed or technical information, the ILO has developed appropriate guidelines for various stages of the project cycle (planning, implementation and maintenance), for different functions to be performed (execution, contracting, supervising, monitoring) and for different types of works involved. It is however beyond the scope of this guide, to elaborate in detail on such issues so only a few indications will be given.

Obtain Permissions

Before construction can start, all necessary construction permits need to be obtained. For this, the detailed project documents need to be submitted to the authorities concerned (see Figure 35).

Figure 35: Special Permits

In some cases special permits are needed from specialised authorities.

Royal Forestry Department:	Construction works in reserved forest areas.
River Authority:	Construction works in major rivers and streams.
Royal Irrigation Department:	Construction works within the boundaries of irrigation canal zones.
Highway Department:	Construction works of (new) roads joining to the main highways.

Certain types of construction works are required by law to be designed and supervised by accredited engineers to ensure public safety and to secure prescribed professional standards.

Besides the involvement of all community members during the planning stage, they should also be informed about the proposed construction plan before the work starts. Community meetings should be organized for this purpose. Permission to use land near the construction site for working areas has to be negotiated with the owners.

Procure Materials

Inquiries on sources and prices of construction materials should have already been made during the planning stage. Decisions on where to buy and at what prices should be made prior to the start of the construction in order that procurement can proceed in time.

For construction materials used in large quantities, supply contracts may need to be signed. In these contracts delivery schedules need to be included. Make sure that construction materials are delivered on site prior to their scheduled usage in order to avoid disruption of works.

Although some construction materials can be stored outdoors, a sheltered area is required for storing delicate materials, for instance cement bags. Proper and secure storage space of adequate size is therefore required. Due consideration should be given to what and how much to be stored, in order to optimize storage space. For convenience, storage facilities should be as close as possible to the construction site.

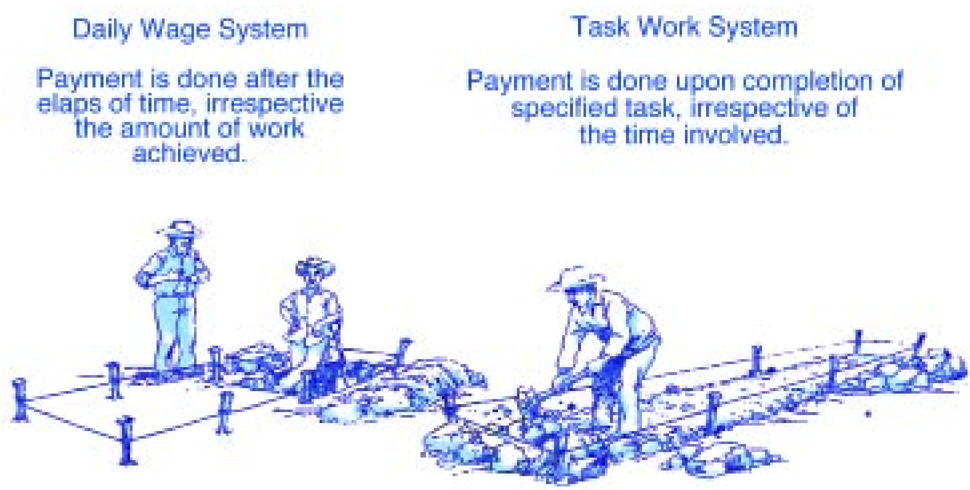
Delivery of construction materials needs to be checked by a qualified person to ensure compliance with design and quality specifications. Also, records on receiving and disbursing construction materials need to be kept.

Recruit Workers

The workers should be recruited by public announcement of the works and by informing villagers well in advance about employment opportunities. Villagers from the communities served by the infrastructure projects should be given first priority for works. A quota system can be used to distribute employment opportunity among the various community factions.

As indicated in Figure 36, payments to the workers can be done in two ways. Experience shows that for labour-based works, the task work system is preferable to the daily wage system, due to the self-motivation, the lower costs of supervision and the higher productivity. However, the task work system will require close supervision and monitoring in the daily organising of work and overall setting of task sizes.

Figure 36: The time work system and task work system



Contractors can be engaged to undertake not only large or complicated construction works, but also small and simple works. When engaging contractors, certain conditions can be stipulated in the contract document to ensure maximum benefits to the community. Such conditions typically try to avoid the use of large construction equipment and to maximize local labour employment.

Organising Works

With all resources available at the project site, it is necessary to assign tasks to workers and to coordinate the works. Attention should be given to assign suitable tasks to workers which fit their capacities and to properly balance the number of workers among the various tasks according to their level of difficulty. Also, the limitations of the workspace as well as the availability of tools should be taken into consideration at this stage.

Balancing of gang sizes, i.e. ensuring that labour is used in the most efficient way and that each of the operations on average proceed at the same pace, is the daily task of the technician. The optimal size of the gang varies according to the work being undertaken and depends on the volume of work in each operation, the task rates being used, the available labour and the sequence of operations. Good gang balancing is important because it also determines the length of the construction site.

If the works do not proceed according to planned progress, the underlying problems must be identified and corrected before the plan can be adjusted. Often, work delays result from inappropriate or poor tools/ equipment, delayed delivery of construction materials, wrong understanding of the tasks by workers or contractors, or different conditions at the site than anticipated. In order to monitor progress, and to signal problems, a reporting system needs to be put in place (see Figure 37).

Figure 37: Minimum Reporting Requirements

Daily Reports

Activities and amount of work achieved
Number of skilled and unskilled workers
Types and quantity of construction material used
Special equipment used
Problems occurred during works

Weekly or Monthly Reports

Summary of the work completed
Summary of resources utilised

Other records which are required for administrative works are:
- Muster roll
- Procurement records
- Record on material disbursement

An Example of Labour Based Road Construction

A large amount of the projects developed and implemented by TAOs consist of road construction. Labour based bamboo reinforced concrete roads have been mentioned in an earlier section. But another surfacing option, probably more suitable to the budget and traffic intensity of an average TAO and equally suitable for labour based construction, is the use of gravel.

For this purpose, a set of video CDs on the construction of labour based road construction has been developed by the ILO in collaboration with the Public Works Department of Thailand and distributed to the TAO provincial offices. The introductory video CD has been included in the back of these guidelines to explain the main principles. The following sections are derived from the step-wise setup on this video CD as a point of reference.

Survey and Setting Out Road Alignment

By conducting a topographic-survey, the alignment of the road is established, which describes where the roads will run. When the alignment has been established, the detailed setting out can begin by determining the road width and designing the slopes and drains along the side of the road.

Figure 38: Surveying and setting out of road aligment

Particular attention needs to be given to the alignment. The horizontal alignment is set out of the plane of the road and includes bends or curves. The vertical alignment covers the levels (usually at the centerline of the road) and the cross-section profiles of the road.

Finally, the full cross-section needs to be set out. This shows the actual shape of the road, the dimension of the camber, the side slopes and the drains.

Site Clearing

Clearing is the first work activity after setting out the alignment. Trees, vegetation and other obstacles must to be removed from the roadway. The clearing operation involves the removal of bush, grass and other vegetation (grubbing), trees, stumps and boulders. Big boulders can be demolished before they are removed or buried well below the road levels.

Figure 39: Site Clearing

Earthworks

This is often the most significant work operation in road construction. Earthworks basically consist of shaping a stable terrace or foundation for the road.

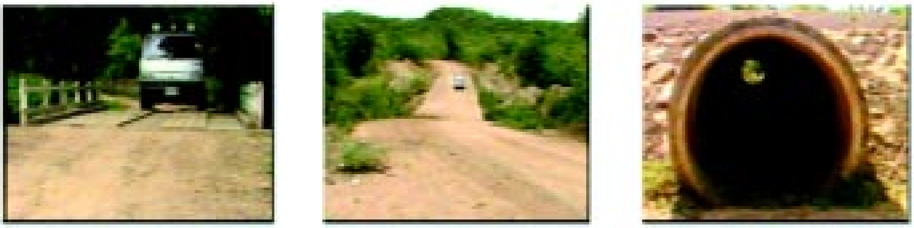
Earthworks include activities such as excavation (leveling, cut to fill, cut to spoil and borrow), soil transport (loading, hauling and unloading of the soil) and the filling, spreading and compaction. After each layer is unloaded, it needs to be spread and compacted. Compaction is very important to ensure the embankment is strong and durable. Measurement of the degree of compaction is an important quality monitoring tool.

Figure 40: Earthworks

Structures

Special structures need to be built in case the road must cross a waterway as well as for drainage purposes. Common structures are bridges, drifts and culverts.

Figure 41: Structures

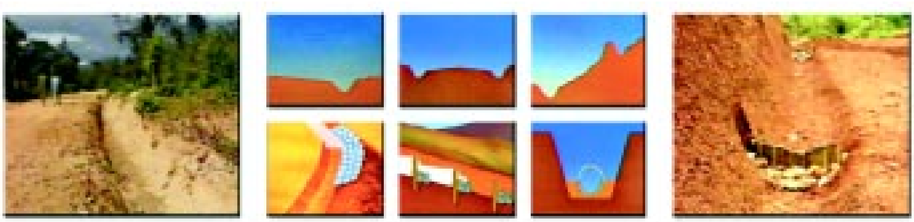


Drainage Systems

It is important that water is drained away as quickly as possible from the road surface and its border zones. This is to make sure that the water does not damage the road, its foundations and structures. Water should be drained in a controlled way so that drainage flows do not become too large or too fast and causes erosion. Drainage of water from one side of the road to the other side of the road must also be made possible.

There are different drainage components used for roads, such as camber, catch water drains, side drains, scour checks, mitre drains, and culverts. In some terrain, the road requires only three or four of these drainage components. In other sections it may require all six. In any case, all components of the drainage system should work together to allow the water to flow "off the road", as well as "away from the road".

Figure 42: Drainage Systems



Gravelling

Once the road body has been built up in layers and well compacted to the right levels and profiles with the drainage system in place, the gravelling works can start.

Gravelling is done by placing a layer of gravel on the top of the earth road. This is done in order to ensure a strong and durable surface. It is important to locate a good source of gravel materials, preferably not too far from the road construction site. The gravel material is to be spread in thin layers of 15-20 cm and compacted well.

At this stage, it is important to organize the labour force, material delivery and equipment properly. Sufficient tools, equipment and labour to spread and compact the gravel at the desired speed need to be ensured. Also enough transport vehicles need to be arranged in order to deliver sufficient aggregate and gravel materials so that the work groups have enough (and not too much) materials to work with.

Depending on the choice of the tools and equipment the experience of the labour force, as well as the climatic conditions, the quantity and speed of the work can vary and this needs to be reflected in the original work plan. Sometimes, the number of transport vehicles from the quarry to the construction site might need to be adjusted. Wheel barrows can be used for short hauling, Itans or two wheeled tractor drawn trailers could be used for intermediate distances and trucks for long hauling distances.

Figure 43: Gravelling

Epilogue

The reliance on equipment-based, high technology, construction methods has evolved for a number of reasons. A particularly important factor has been the educational background of the technical leadership in most developing countries. Often acquired in engineering schools that advocated the latest technology and production methods, this background conditioned planners and engineers to favour the use of heavy equipment in all circumstances. Equipment- based methods were perceived to have productivities, costs and performance that were predictable; they were associated with high quality results; and they were surrounded by an aura of technological progress.

At the same time, the substitution of labour for machines appeared as an attractive alternative to engineers and planners. Large numbers of labour are needed to approach the output of a single piece of equipment. Doubts were entertained about the ability of unskilled workers to produce high quality work. Labourers were regarded as being undisciplined, unruly, unreliable and consequently, requiring extensive supervision. In sum, the extensive use of labour was judged to increase the risk of higher costs, to bring about longer construction periods and to produce results of dubious technical quality. These risks tended to make public sectors in most developing countries - the front line of potential users of labour-based works technology - resist the use of unskilled labour in construction.

Reliance on equipment has shown to have some disadvantages. Equipmentbased operations entails heavy expenditures of foreign exchange. Such costs might be an unavoidable burden for urgently needed high technology projects, but for the construction of smaller, more scattered and technically less demanding rural projects, politicians and administrators need to consider alternative solutions and put local resources to work. If much of the work could be done by hand, the rural population would not only receive the benefits of the finished product but would in addition secure much needed income from its construction, considerable employment from its maintenance and a sense of participation, civic pride and unity.

Annexes

Subdivision of Operation and Activities
Recommended Labour Productivity Rates

Sectors	Type of Project	Operations	Activities
Roads & Bridges	Road Construction Road Rehabilitation	a) Site preparation and support Operations	- Surveying and setting out - Setting up site (base camp, etc.) - Bush clearing - Stump removal - Land preparation (topsoil removal, etc.) - Temporary traffic diversion - Motorised transport: loading, transport, unloading of materials, workers, etc.
		b) Earthworks	- Excavation in soft soil - Excavation in hard soil - Rock excavation - Filling - Compaction - Motorised transport: loading, transport, unloading of materials, workers, etc.
		c) Graveling	- Opening and operation of borrow areas - Gravel excavation - Spreading and leveling - Compaction - Motorised transport: loading, transport, unloading of materials, workers, etc.
		d) Structures	- Excavation, culvert laying and backfilling, (culvert diam < 1,000 mm.) - Masonry for small structures & ditch lining (box-cutverts, dry wells, wing walls, small drifts, retaining walls) - Plain concrete - Reinforced concrete incl. prefabrication (culverts) - Slope stabilisation and protection - Setting up and filling of gabions - Motorised transport: loading, transport, unloading of materials, workers, etc.
	Road Maintenance (earth & gravel roads)	a) Rouutine maintenance	- Stockpiling of selected materials - Filling potholes and gullies - Localised regraveling - Motorised transport: loading, transport, unloading of materials, workers, etc. - Sloping and clearing of ditches - Clearing culverts - Repairs to masonry for small structures and ditch lining (box-culverts, dry wells, wingwalls, small drifts, retaining walls) - Concrete. (plain or reinforced) for repairs to structures - Slope stabilisation and protection - Repairing gabions

Sectors	Type of Project	Operations	Activities
		b) Periodic maintenance	- Stockpiling of materials - General reshaping - Spreading of surface materials - Compaction - Transport: loading, transport, unloading of materials, workers, etc.
	Structures Road bridges Retaining walls	a) Site preparation and support activities	- Surveying, etc. - Setting up of site (base camp. etc.) - Bush clearing - Stump removal - Land preparation. (top soil removal, etc.) - Temporary diversion of traffic - Transport: loading, transport, unloading of materials, workers, etc.
		b) Earthworks	- Excavation in loose soil - Excavation in hard soil - Rock excavation - Filling - Compaction - Transport: loading, transport. unloading of materials, workers, etc.
	Structures Road bridges Retaining walls	c) Structures	- Dressing stones, making blocks, bricks or aggregates - Dry and wet masonry - Plain concrete - Forms & reinforced concrete incl. prefab - Setting up and filling of gabions - Assembly and setting up pf prefabricated elements (culverts, pipes, sluices) - Transport: loading, transport, unloading of materials, workers, etc. - Preparing and laying Timber for decking - Protective rip-rap - Ancillary earthworks (backfilling, drainage)

Sectors	Type of Project	Operations	Activities
Irrigation and Drainage	- Construction of small-scale irrigation schemes - Rehabilitation of irrigation schemes - Improvement of drainage systems - Bottomland and swamp improvement	a) Site preparation	- Surveying, setting out - Site installation - Bush clearing, - Stump removal - Land preparation (top soil removal, stockpiling earth from cuts, etc.) - Transport: loading, transport, unloading of material, workers, etc.
		b) Earthworks	- Earth excavation - Excavation on rocky ground - Filling - Compaction - Sloping and levelling - Transport: loading, transport, unloading of materials, workers, etc.
		c) Structures	- Dressing stones, making blocks, bricks or aggregates - Dry and wet masonry - Forms and reinforced concrete, incl. prefabrication - Setting up and filling of gabions - Assembly and installation of prefabricated components (culverts, pipes, sluices) - Transport: loading, transport, unloading of materials, workers, etc.
		d) Lining, covering	- Dressing stones, making blocks, bricks or aggregates - Dry and wet masonry - Plain concrete - Forms and reinforced concrete, incl. prefabrication - Assembly and installation of prefabricated components (culverts, pipes, sluices) - Transport: loading, transport, unloading of materials, workers, etc.
		e) Plot improvement	- Stone removal - Deep plowing - Land forming (leveling, etc.) - Transport: loading, transport, unloading of materials, workers, etc.

Sectors	Type of Project	Operations	Activities
Water and Soil Conservation	- Anti-erosion bunds - Anti-erosion terracing - Gully treatment (incl. check dams) - Minor river training & bank protection - Dune stabilisation - Micro-catchments	a) Installation	- Surveying, setting out - Site installation - Bush clearing - Land preparation: top soil removal, stump removal - Transport: loading, transport, unloading of materials, workers, etc.
		b) Earthworks	- Earth excavation - Excavation on rocky ground - Filling - Sloping and levelling - Transport: loading. transport, unloading of materials, workers, etc.
		c) Biological protection	- Pitting - Planting, seeding - Turf preparation - Turf laying - Transport: loading, transport, unloading of materials, workers, etc.
		d) Structures	- Dressing stones, making blocks, or aggregates - Dry and wet masonry - Mortar masonry - Plain concrete - Forms and reinforced concrete - Setting up and filling of gabions - Fences and other minor structures - Transport: loading, transport, unloading of materials, workers, etc.
		e) Maintenance	- Earthworks - Beating up (grass, plants), Watering - Repairing masonry - Repairing concrete - Repairing fences and minor structures - Transport: loading, transport, unloading of materials, workers, etc.

ROADS

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Clearing & Grubbing				
Bush Clearing (Light)	250 sq.m.	1 worker	1 foreman	Brush Hook, Grass Cutter
(Medium)	125 sq.m.	1 worker		
(Dense)	65 sq.m.	1 worker		
Grubbing (Top Soil Removal)	150 sq.m.	1 worker		Hoe, Forked Hoe, Pick Mattock Crow Bar, Sledge Hammer & Cold Chisel
Boulder Removal (Loose)	150 sq.m.	1 worker		Axe, Bow Saw
Tree and Trump Removal (0.25 m. Dia.)	1 tree	1 worker		
Excavation, Spreading & Compaction of Soil Material				
Excavate & Load/ Throw (Soil)	2 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe Mattock, Pickaxe & Shovel
(Heavy Soil)	1.5 cu.m.	1 worker		
(Rock)	0.5 cu.m.	1 worker		
Unload	30 cu.m.	1 worker		Shovel & WheelbarrowRake
Spread, Shape & Water	5 cu.m.	1 worker		Spreader, Shovel & Hoe Roller
Compaction by Roller (150 mm. thickness)	50 sq.m	1 worker		
Compaction by Roller (150 mm. thickness)	1.500 sq.m.	1 worker		Roller
Hauling by Wheel Barrow				
Hauling Distance: 0 - 25 m	10 cu.m.	1 worker	1 foreman	Wheel Barrow
Hauling Distance: 26 - 50 m	7 cu.m.	1 worker	1 foreman	
Hauling Distance: 51 - 100 m	4 cu.m.	1 worker	1 foreman	
Sub-Base Preparation				
Excavate & Stockpile	25 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Load	5 cu.m.	1 worker		Shovel Wheel Barrow
Excavate & Load	25 cu.m	1 worker		Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Unload	30 cu.m.	1 worker		Shovel & Wheel Barrow
Spread, Shape & Water	5 cu.m.	1 worker		Rake, Shovel & Hoe Roller
Compact by Roller	2,000 sq.m.	1 worker		
Base Preparation				
Excavate & Stockpile	2.5 cu.m.	1 worker		Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Load	5 cu.m.	1 worker		Shovel Wheel Barrow
Excavate & Load	2.5 cu.m.	1 worker		Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Unload	30 cu.m.	1 worker		Shovel & Wheel Barrow
Spread, Shape & Water	12 cu.m.	1 worker		Rake, Shovel & Hoe Roller
Compact by Roller	1.500 sq.m.	1 worker		
Concreting (Roads)				
Screening of Aggregates (Gravel)	4 cu.m	1 worker	1 foreman	Screening Equipment

ROADS

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Screening of Aggregates (Sand)	2 cu.m.	1 worker	1 foreman	Screening Equipment
Fabrication & Installation of Forms	20 LM	1 worker		Hammer, Saw, Measuring Tape, Chisel
Fabrication & Installation of Rebars	100 KGS.	1 steelman 1 worker		Hammer, Saw, Measuring Tape, Chisel
Mixing & Placing of Concrete	10 cu.m.	2 masons 1 mixer op. 8 workers		Mixer, Shovel, Screen, Trowel, Float, Strikeboard
Erosion Protection				
Grouted Riprap	7.5 cu.m. 8 workers	2 masons 1 mixer op.	1 foreman	Mixer, Shovel, Screen, Trowel, Stone Hammer, Spirit level, String
Dry Riprap	7.5 cu.m.	5 workers		Measuring Tape, Stone Hammer Spirit Level, String
Installation of Pipe Culvert				
Culvert Cleaning	1.0 LM	1 worker	1 foreman	Shovel, Bucket
Excavate & Throw	4 cu.m.	1 worker		Hoe, Forked Hoe, Mattock Pickaxe & Shovel
(Heavy Soil)	2.5 cu.m.	1 worker		
(Rock)	0.5 cu.m.	1 worker		Hoe, Forked Hoe, Mattock
Excavate & Load Foundation Fill	3.0 cu.m.	1 worker		Hoe, Forked Hoe, Mattock
Unload Foundation Fill	30.0 cu.m.	1 worker		Shovel & Wheel Barrow
Compact Bed by Handrammer	50.0 cu.m.	1 worker		Handrammer
Fabrication of RC Pipe Culvert		1 mason 1 carpenter 1 steelman 12 workers		
1. 300 mm. diameter	15 LM			Mixer, Shovel, Bar Bender & Cutter, Carpenter Tools, culvert moulds
2. 460 mm. diameter	11 LM			
3. 610 mm. diameter	9 LM			
4. 760 mm. diameter	6 LM			
5. 910 mm. diameter	5 LM			
6. 1200 mm. diameter	3 LM			
Installation of RC Pipe		1 mason 1 carpenter 1 steelman 12 workers	1 foreman	
1. 300 mm. diameter	16 LM			Shovel, Hoe, Trowel, Spirit Level, String
2. 460 mm. diameter	14 LM			
3. 610 mm. diameter	12 LM			
4. 760 mm. diameter	10 LM			
5. 910 mm. diameter	8 LM			
6. 1200 mm. diameter	6LM			

BRIDGES

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Clearing & Grubbing (Bridge Project)				
Bush Clearing (Light)	250 sq.m.	1 worker	1 foreman	Bolo, Brush Hook, Grass Cutter,
(Medium)	125 sq.m.	1 worker		
(Dense)	65 sq.m.	1 worker		
Grubbing (Top Soil Removal)	150 sq.m.	1 worker		Hoe, Forked Hoe, Mattock,
Boulder Removal (Loose)	150 sq.m.	1 worker		Crow Bar, Sledge Hammer & Cold Chisel
Tree & Trump Removal	1 Tree	1 worker		Axe, Bow Saw, Log Tong & Bold
Sub-Base Preparation (Approach)				
Excavate and Stockpile	2.5 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Load	5.0 cu.m.	1 worker		Shovel & Wheel Barrow
Excavate and Load	2.5 cu.m.	1 worker		Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Unload	30.0 cu.m.	1 worker		Shovel & Wheel Barrow
Spread, Shape & Water	5 cu.m.	1 worker		Rake, Shovel & Hoe
Compact by Roller	2000 sq.m.	1 worker		Roller
Base Preparation (Approach)				
Excavate and Stockpile	2.5 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Load	5.0 cu.m.	1 worker		Shovel & Wheel Barrow
Excavate and Load	2.5 cu.m.	1 worker		Hoe, Forked Hoe, Mattock, Pickaxe & Shovel
Unload	30.0 cu.m.	1 worker		Shovel & Wheel Barrow
Spread, Shape & Water	12 cu.m.	1 worker		Rake, Shovel & Hoe Roller
Compact by Roller	1500 sq.m.	1 worker		
Concreting (Approach)				
Screening of Aggregates				
(Gravel)	4 cu.m.	1 worker	1 foreman	Screening Equipment
(Sand)	2 cu.m.	1 worker		Screening Equipment
Fabrication & Installation of Forms	20 LM	1 carpenter 1 worker		Hammer, Saw, Measuring Tape, Chisel
Fabrication & Installation of Rebars	100 KGS;	1 steelman 1 worker		Hammer, Saw, Measuring Tape, Chisel
Mixing & Placing of Concrete	10 cu.m.	2 masons 1 mixer op. 8 workers		Mixer, Shovel, Screened Trowel, Float, Strikeboard

BRIDGES

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Erosion Protection				
Grouted Riprap	7.5 cu.m.	2 masons 1 mixer op. 8 workers	1 foreman	Mixer, Shovel, Screen, Trowel, Stone Hammer, Spirit Level, String
Dry Riprap	7.5 cu.m.	5 workers		Measuring Tape, Stone Hammer, Spirit Level, String
Rubble Masonry	6 cu.m.	2 masons 1 mixer op. 10 workers		Mixer, Shovel, Measuring Tape Stone Hammer, Spirit Level, String
Demolition of Existing Conc. Structure				
Slab and Wall	0.4 cu.m.	1 worker	1 foreman	Sledge Hammer, Cold Chisel, Wheel Barrow
Massive Concrete	0.25 cu.m.	1 worker		Sledge Hammer, Cold Chisel, Wheel Barrow
Fabrication & Installation of Reinforcement bars	100 kgs.	1 steelman 1 worker		Bar Cutter, Rebar Bender
Fabrication, Placing & Dismantling of Forms	3.5 cu.m.	3 carpenters 5 workers		Hammer, Saw, Chisel, Level, String, Crowbar
Mixing & Placing of Concrete	10 cu.m.	2 masons 1 mixer op. 8 workers		Mixer, Shovel, Screen,Trowel, Float, Strikeboard
Class “A” Class “B” Class “C” Lean Concrete	3.5 cu.m. 4.5 cu.m. 4.8 cu.m. 6.0 cu.m.			Mixer, Shovel, Trowel, Float, Bucket, Strikeboard

IRRIGATION

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Excavation				
A. Common Material				
1. Depth of Excavation: 1.5 m.				
A. FARNIDITCH	15 cu.m.	5 workers	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe, Shovel
B. Canal	12.5 cu.m.	5 workers		
C. Structure	10 cu.m.	5 workers		
D. Desilting	12.5 cu.m.	5 workers		
2. Depth of Excavation: 1.6-2.5 m.				
A. Canal	10.0 cu.m.	5 workers	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe, Shovel
B. Structure	8.75 cu.m.	5 workers		
C. Desilting	10.0 cu.m.	5 workers		
3. Depth of Excavation: 2.5m.& Deeper				
A. Canal	8.75 cu.m.	1 workers	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe, Shovel
B. Structure	7.5 cu.m.	1 workers		
C. Desilting	8.7 5 cu.m.	1 workers		
B. Slightly Hard Material				
A. Canal	5 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe, Shovel
B. Structure	3.25 cu.m.	1 worker	1 foreman	Hoe, Forked Hoe, Mattock, Pickaxe, Shovel
Loading of Materials				
1. Sand & Gravel	24.0 cu.m.	5 workers	1 foreman	Shovel
2. Common Earth	30.0 cu.m.	5 workers		Shovel
3. Cobbles	21.0 cu.m	5 workers		No Tools Required
4. Boulders	21.0 cu.m.	5 workers		No Tools Required
5. Cement	1,890 bags	5 workers		No Tools Required
6. Reinforcing Bars	36,000 kgs.	5 workers		No Tools Required
7. Lumber	24,000 bd ft	5 workers		No Tools Required
8. Plywood	1.500 pcs.	5 workers		No Tools Required
Unloading of Materials				
1. Sand & Gravel	24.0 cu.m.	5 workers	1 foreman	Shovel
2. Common Earth	30.0 cu.m.	5 workers		Shovel
3. Cobbles	21.0 cu.m.	5 workers		No Tools Required
4. Boulders	21.0 cu.m.	5 workers		No Tools Required
5. Cement	1,800 bags	5 workers		No Tools Required
6. Reinforcing Bars	36,000 kgs.	5 workers		No Tools Required
7. Lumber	24,000 bd ft	5 workers		No Tools Required
8. Plywood	1,500 pcs.	5 workers		No Tools Required
Fabrication and Installation of RSB				
1. Dam	96 kgs.	1 steelman	1 foreman	Rebar Cutter, bar Bender
2. Siphon	112 kgs.	1 worker		
3. Bridge	100 kgs.			
4. Others	80 kgs.			
Quarrying				
1. Sand & Gravel	17.5 cu.m.	5 workers	1 foreman	Shovel, Bucket
2. Cobbles	12.5 cu.m.	5 workers		
3. Boulder	10 cu.m.	5 workers		

IRRIGATION

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Demolition of Concrete				
1. Slab & Walls	2 cu.m.	5 workers	1 foreman	Sledge Hammer, Cold Chisel,
2. Massive Concrete	1.25 cu.m.	5 workers		Wheel Barrow
Screening of Aggregates				
1. Gravel	20 cu.m.	5 workers	1 foreman	Screening Equipment
2. Sand	30 cu.m.	5 workers		Screening Equipment
Manual Backfill				
Backfilling	15 cu.m.	1 worker	1 foreman	Shovel
Laying of Materials: Cobbles	10 cu.m.	1 worker		No Tools Required
Boulders	7.54 cu.m.	1 worker		No Tools Required
Spreading of Gravel & Sand on Filter Drain and Gravel Blanket				
Spreading of Granular Materials	12.5 cu.m.	1 worker	1 foreman	Shovel, Rake, Hoe
Concreting				
Grouted Riprap (With Mixer)	7.5 cu.m.	2 masons 1 mixer op. 8 workers	1 foreman	Mixer, Shovel, Trowel, Measuring Tape, Stone Hammer, Spirit Level, String
Grouted Riprap (Without Mixer)	5.5 cu.m.	2 masons 10 workers	1 foreman	Shovel, Trowel, Measuring Tape, Stone Hammer, Spirit Level, String
Rubble Masonry	6.0 cu.m.	2 masons 1 mixer op. 8 workers	1 foreman	Mixer, Shovel, Trowel, Measuring Tape, Stone Hammer, Spirit Level, String
CHB Setting				
1. Fence A. 4" CHB	14 sq.m.	1 mason	1 foreman	Shovel, Trowel, String, Level,
B. 6" CHB	10 sq.m.	2 workers		Hammer
2. Building A. 4" CHB	10 sq.m.			
B. 6" CHB	8 sq.m.			
Concrete Lining	4.5 cu.m.	2 masons 1 mixer op. 10 workers	1 foreman	Shovel, Trowel, String, Level, Hammer
Installation of Steel Gates				
1. 16 X 16 TO 24 X 24	2 Assembly	1 Mason		Level, Welding
2. Above 24 X 24	1 Assembly	5 Workers		Machine,Hammer, Blow Torch
Fabrication, Placing & Dismantling of Forms:				
1. 3000 PSI Concrete	3.5 cu.m.	3 carpenters 5 workers	1 foreman	Hammer, Saw, Chisel, Level, String, Crowbar
2. Canal Lining	4.5 cu.m.	1 carpenter 1 worker		Hammer, Saw, Chisel, Level, String, Crowbar

IRRIGATION

Operation / Activity	Output Per Day	Required Manpower		Tools Required
		Worker	Supervisor	
Mixing and Placing of Concrete				
1. With Concrete Mixer		2 masons 1 mixer op. 10 workers	1 foreman	
Class "A"	3.5 cu.m.			Mixer, Shovel, Trowel, Float, Bucket, Strikeboard
Class "B"	4.5 cu.m.			
Class "C"	4.8 cu.m.			
Lean Concrete	6.0 cu.m.			
Class "A"	2.5 cu.m.			Shovel, Trowel, Float, Bucket
Class "B"	3.2 cu.m.			
Class "C"	4.8 cu.m.			
Lean Concrete	4.5 cu.m.			
Plastering of CHB Wall	12 sq.m. (1 Side only)	2 masons	1 foreman	Shovel, Trowel, String
Fabrication of RC Pipe		1 mason 1 carpenter 1 steelman 12 workers	1 foreman	
1. 300 mm. Diameter	15 LM			Mixer, Shovel, Bar Bender & Cutter, Carpentry Tools
2. 460 mm. Diameter	11 LM			
3. 610 mm. Diameter	9 LM			
4. 760 mm. Diameter	6 LM			
5. 910 mm. Diameter	5 LM			
6. 1200 mm. Diameter	3 LM			
Installation of RC Pipe		1 mason 1 carpenter 1 steelman 12 workers	1 foreman	
1. 300 mm. Diameter	16 LM			Shovel, Hoe, Trowel, Spirit Level, String
2. 460 mm. Diameter	14 LM			
3. 610 mm. Diameter	12 LM			
4. 760 mm. Diameter	10 LM			
5. 910 mm. Diameter	8 LM			
6. 1200 mm. Diameter	6 LM			

ASIST AP is a regional programme of the Employment Intensive Investments Programme (EIIP) of the ILO, concerned with developing and mainstreaming poverty alleviation strategies through sustainable infrastructure development. The programme is implemented through four major fields of operation, viz: accessibility planning, labour-based works technology, small-scale contracting and infrastructure maintenance, thus providing a comprehensive approach to infrastructure development covering all stages from planning and construction to maintenance and operation.

Based in Bangkok, ASIST AP provides a full range of expert support to all stages of the project cycle from formulation, implementation, monitoring to final review and evaluation. These services include activities such as:

- planning, policy development and design of infrastructure programmes,
- influencing public investments in infrastructure towards the greater use of local resources,
- technical and managerial support to project implementation,
- information services,
- preparation of planning and implementation guidelines,
- developing appropriate methods for increased involvement of the domestic construction industry in infrastructure works,
- design and conduct of tailor-made training programmes, and
- design of appropriate maintenance management systems.

This document forms part of a range of publications from ASIST AP, in its efforts to develop and disseminate general and country specific guidelines, best practices and lessons learned in the context of planning and implementing rural infrastructure works programmes.

More information about ASIST AP can be found at **www.iloasist.org** or by contacting us at

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The Thai Government Policy of Decentralisation as defined under the Subdistrict Council and Sub-district Administration Act of 1994 established the Tambon Administrative Organisation (TAO) in an effort to improve decentralized governance, and introduce participatory planning and decision making at local level. The TAOs are now tasked with the provision of public utilities such as local roads, walkways, water transportation facilities, market places, recreation facilities, water supply, sanitation, storm water drainage and other local infrastructure. Equally, the TAOs are expected to increase the capacity of the tambons to generate income by the creation of jobs and promoting economic development. One of the strategies to achieve this goal is by promoting the effective use of local resources and by creating opportunities for the local communities to participate in solving typical local problems with initiatives taken by and for the people.

The TAOs are the smallest unit in local government in Thailand. There are approximately 7000 tambons, covering on average of 1000 households. Financial and human resources are therefore limited. Although tambons have various sources for revenue collection, their annual income is fairly limited. With the recent drive to transfer authority to this level of local government, there is obviously a strong demand for strengthening the capacity of the TAOs to carry out their newly acquired responsibilities. These guidelines have been prepared for the TAO engineers and technicians who are involved in the development and maintenance of local public facilities.

These guidelines attempt to provide TAO technical staff with an introduction to appropriate planning and works implementation methods. The first section introduces the basic concept of integrated rural accessibility planning, a set of tools that can be used by TAO officials to identify and prioritize interventions in a participatory manner. The second part of the guidelines introduces the concept of labour-based works technology and explains how this technology can be effectively applied to the type of works commonly carried out by the tambon administrative organisations.

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