

LABOR-BASED CONSTRUCTION AND MAINTENANCE

1 Background

1. Labor-based road construction and maintenance is a generally accepted practice in many parts of the world. However, even with good supervision some tasks are difficult or impossible to achieve manually. For example, tasks such as setting out the road geometry, cutting ditches, and placing materials can be successfully done manually. However, achieving acceptable compaction without machines is very difficult, if not impossible, and it is difficult and expensive to correct the situation later. Deep seated weak layers in an embankment for example can become a long-term problem, and can cause settlement and excessive erosion. For the uppermost pavement layer, better materials must be provided and these are unlikely to be available nearby, and therefore are very difficult for labor-based projects to obtain. Sub-standard materials in the pavement provide little resilience to the vehicle loadings, resulting in severe deformations and eventually become impassable in wet conditions. Durability against traffic and climate is likely to be poor.

2. In contrast, there are tasks that cannot be undertaken by machines, such as cleaning culverts. Use of construction machines in concert with labor is a far more acceptable practice than labor alone.

3. For the rural roads under this project, the speed of restoration is of the essence, especially for those that must be completed before the onset of the 2012 wet season. Hence, the use of labor-based construction within the works should be approached as a means of achieving greater output than is possible with machines alone. Use of local labor will also prepare selected member of the local community to assist with later maintenance of roads by building their skills and experience during construction. This short report will elaborate this concept.

2 Opportunities under the Flood Damage Emergency Reconstruction Project

4. The floods have caused a loss of livelihoods and therefore greater hardship in rural communities. For example, farmers have been unable to cultivate their land or work for other farmers as they normally would, and face considerable and immediate hardship without paid work. This highlights the benefits of a labor-based approach to utilize local labor to help mitigate this situation.

5. It should also be recognized that the durability of the roads restored to their previous condition before the floods is under threat from future rains and flooding, and they are still vulnerable. This is because it is the nature of roads restored to a Gravel Wearing Course (GWC) standard (locally known as laterite surfaced) that regular and relatively frequent maintenance will be required. They cannot be sufficiently engineered to be flood free and they cannot be designed to resist the effects of traffic and climate without maintenance. The cost is simply too high and is never warranted. Eventually, a selection of rural roads will be made to provide primary access within a particular rural area. Those roads will be engineered to a higher standard than the others. They will be raised, structured and geometrically correct and probably paved with a bituminous treatment. They will provide the vital permanent access and support local roads of minimal length that will have an acceptable but lower standard. They will be under threat especially during every wet season. The objective is to establish an effective low cost maintenance regime and put it in-place immediately after reconstruction.

6. In doing the flood reconstruction of rural roads, it is essential to use machines to ensure maximum work rates to achieve the urgent targets; labor-based methods would be

unable to achieve the necessary work rates. The initial civil works contracts will focus on restoring the original road shape and placing a GWC (laterite). This is best done by machines. However, opportunities for labor-based construction using local labor are needed where machines cannot work at all, or cannot work at the required restoration pace. Hence, the approach and activities would include the following:

- (i) local labor should be employed by the contractor to work alongside the contractors' skilled workers, and unskilled labor should not be "imported" from distant locations. Their activities will include cleaning cross drainage structures (culverts etc). The contractor should be given a contractual responsibility to transition the local labor force from unskilled to semi-skilled;
- (ii) roadside longitudinal ditches, culvert inlets and outturns should be reshaped to improve drainage;
- (iii) damaged berms to guide water flows should be reconstructed where necessary;
- (iv) locations for new cross drainage structures can be excavated and shaped using local labor if it enhances output;
- (v) placement of slope protection using gabion boxes;
- (vi) the local population should be engaged to plant grass seedlings and shrubs in the vicinity of their homes as a nursery. These would be purchased later by the contractor and planted by local labor on the shoulders and side-slopes of the roads to prevent or mitigate erosion.

2.1 Cement Concrete Road Sections

7. Construction of GWC roads involves the placement of vast quantities of "unbound materials" which is more suitable for machines than labor. At the same time the types of materials being shaped and placed raise dust when they are trafficked during their service life. Ideally, these types of roads are much more suitable for areas with low populations. The dust is widely accepted to be a health hazard to roadside communities so commonly seen along the rural roads in Cambodia.

8. Within towns and communities, cement concrete roads can be constructed as an alternative to GWC roads. Unreinforced cement concrete roads are technically suitable for Cambodia and they are common in some countries with climatic conditions similar to Cambodia such as the Philippines. They are entirely suitable for labor intensive construction.

9. Construction cost is higher but they are very durable with an expected life of about 30 years, and maintenance is very low. Vehicle operating costs are also low for this type of pavement. They are most suitable as short sections within towns.

10. Cement concrete roads are jointed pavements simply designed to achieve a suitable concrete mix of aggregates, sand and cement, and placed to a prescribed thickness. The processes involve preparation of the ground, placement of a simple wooden formwork to hold the wet concrete within a "bay" with dimensions usually half the width of the road and 4.5m long. Wheelbarrows of different sizes to measure the correct quantities of aggregate and sand assist quality control and compaction is carried out using rods or pokers. A small concrete mixer is usually used to blend the aggregates and sand with the cement. One or more bays are constructed each day until the work is complete. Reinforcing bar is used to make the connection between the end of one day's work and the next, and with the other traffic lane. Excepting the concrete mixer which is available for any concrete construction, the work is achieved entirely by labor. The skills attained from this approach are very valuable in the community in the long-term for the construction of more permanent buildings as development progresses. It is not restricted to roads.

11. A short section of road within a town could be constructed under the Project as a demonstration trial. It would form part of the permanent civil works.

2.2 Maintenance

12. As mentioned above, the reconstructed roads will require maintenance during the period of the project. Their durability and resilience against normal and exceptionally wet years will be far more assured if the maintenance activities are undertaken in a timely manner. The concept described below is based on the “length-person” (historically “length-man”), a proven means of providing long-term employment and delivering maintained rural roads at low cost.

13. Its basis is that roads engineered to GWC standards deteriorate rapidly and require frequent maintenance. Roads with poor and irregular surfaces (road roughness) cause high costs for the roads users. Road roughness is the primary determinant of road user costs (as per the widely adopted Highway Development and Management Model - HDM-4) which itself is used for the calculation of the benefits of road investment. It causes high fuel consumption and vehicle maintenance costs. This means that suppliers of agricultural goods will pass on the higher transport costs thus increasing the cost of goods and lower farm-gate prices for farmer's produce. For families and individuals the cost of fuel and maintenance of their vehicle prevents money being spent on necessities such as education and health services. All locally purchased brought-in goods are also expensive for the same reason.

14. The length-person approach begins with assigning a person(s) responsible for a length of reconstructed road. The length depends upon an assessment of the road itself and a simple measure of its rate of deterioration against the work output of a person. Provided they maintain it, they are paid on a regular basis, the period would be weekly and monthly. The maintenance work is predefined and includes the regular activities for routine maintenance. These are grass- cutting and patching of defects and potholes on the roadway and shoulders and minor shape adjustments on the side-slopes and along ditches, and cleaning cross-drainage structures. Each of these problems begins with only small areas affected and if rectified quickly, these seldom escalate to the major problems commonly seen on the rural roads.

15. Achievement of the tasks is simple and many of the local population who are engaged with agricultural activities will have little difficulty in grasping the skills required. The support they require is:

- (i) Basic “hand-on” training on simple road repair techniques
- (ii) Provision of road making materials (laterite). A stockpile of suitable material is placed as their resource in advance of needs.
- (iii) Basic tools to effect the repairs by hand. These are tools to excavate and shape repairs, a wheel barrow to transport their materials as they require them, and a hand rammer to achieve compaction of the placed material. A camber board, a simple wooded shape, is also provided so they can estimate if work is required and to check their work is to standard.

16. The intention is their work place is local and easily reachable and is most probably immediately outside the home of individuals selected from among road side communities.

3 Management and Control

17. Within the period of the project the contractor is responsible for rectification of defects and supervision of the length-persons. The supervision consultants will have overall responsibility for the contractor. It is intended that the contractor is paid for a duration beginning with his defect liability period and extended as necessary, but the work is undertaken by the length-persons.

18. The benefit for the contractor is that they do not have to maintain long-term employees within the locality of their construction work.

19. Periodic inspection is carried out by a contractor's supervisor at low cost by simply riding along the road using a motorcycle and judging that work has been carried out satisfactorily. And payment is made by a recordable system. Observation, the comfort of the journey and the time it takes is sufficient to approve works and make payment. The supervision consultant also makes periodic inspections to maintain hierarchical control for payment to the contractor.

4 Impact

20. During construction a selection of local persons will receive income and are trained to become semi-skilled in specific civil works tasks. The skills remain in the locality and are utilized for road maintenance works.

21. Local people will have gained the skills to seek work opportunities under other projects such as within the multitude of small contracts implemented.

22. Contractors are able to release many of their more permanently employed staff for future projects. They retain responsibilities under contract for this project. This is especially attractive because of the very geographically diverse locations of the road sections under this project. They should be paid to provide basic skills training, tools and materials.

23. Benefit monitoring should be undertaken by MRD to determine the scope for extending the experience of the labor based aspects of the project as a means of effectively implementing rural road maintenance. It should be considered alongside other labor intensive maintenance currently or previously undertaken by the MRD to merge the most effective aspects for a future program.