

Definition for Labour-based construction

1 Typical Activities

All construction work can be broken down into self contained activities that can be achieved by an individual or a group of workers if they are equipped with the correct tools. The permutations are many and can of course be specified in the most convenient way for the work in hand. However, to allow meaningful comparison between projects and programmes, some standards have emerged which have been found to have good universal application.

The three most common standards are those developed in the Kenyan Rural Access Road Programme, the parameters specified in the original World Bank study into labour based methods, and the parameters proposed in the ILO workplans manuals based on various projects carried out in Francophone multi-sector projects.

Such documents as these, and others quoted in the ASIST source book, should be consulted by any project designer requiring detailed solutions for specific circumstances or ‘pre-cooked’ solutions relating to say dams, tree planting, paved roads etc. These activities will also constitute the major activities for any labour-based construction project and as such will have the biggest effect on costs and output for most projects. Based on these activities project planners can evolve a realistic set of activity norms tailored to their needs.

Activities are often combined into one global activity. A good example of this is the operation of taking material from a borrow pit to form a nearby embankment. In large projects in Asia this would commonly be described as one activity: excavate, load, haul, unload (ELHU). However, in Africa this would be set as three discreet tasks, excavating to a stockpile (E), loading into a wheel barrow (L), and hauling to the embankment (H) for unloading (U).

1.1 Site clearing:

This activity covers the removal of all obstacles before serious excavation commences.

For general reference, definitions based on the type of tool necessary to clear the bush can be used to identify bush density (see table 1 below). All clearing is measured in square meters except for substantial trees and boulders, which will require individual tasks to be set.

Table 1 : Bush Clearing characteristics

<u>Bush Type</u>	<u>Suitable tools</u>
Light bush	Bushknife, brush-hook
Medium bush	Scythe, axe, bowsaw
Dense bush	Axe, chainsaw, plantpuller

1.2 Excavations

This is the most common labour-based activity and can be applied to many items in a construction.

Excavation is required:

- to produce a level road formation platform in virgin terrain
- to obtain material to raise or widen a road
- for the primary activity in producing road side drains, even if the side drain work may be broken down into first digging a trench and then sloping the sides
- in quarries to obtain gravel for surfacing
- to form the embankments of irrigation canals
- to obtain material for small earth dams

Even the activity of breaking up rock boulders is strictly speaking excavation. This activity can usually be carried out by hoe or shovel, but as the material hardens, a mattock, pickaxe or even a heavy crowbar will be needed. For fractured rock, chisels and hammers can be utilized, but for very hard rock, drilling and blasting will be necessary. For soft material, the worker will only require one handtool such as a hoe or shovel, but for harder materials each worker will need to be equipped with two tools, typically a pick to loosen the material, and a shovel to remove it.

The method of disposal of the excavated material needs to be well defined in how the activity is specified. Many projects expect the excavator (the person who does the excavating) to load material into a headbasket, wheelbarrow or trailer as part of the operation. In other cases the excavator is expected to “throw” the material out of the road reserve, or into the centre of the road, to contribute towards the camber formation.

Thus the excavation parameter for this study is defined as including loading or throwing, providing this does not include a lift of more than one meter, or a throw of more than four meters.

The most important parameters for excavation is the hardness of the material. This can alter the expected productivity by a factor of four or greater. Materials are typically described as soft, medium, hard, very hard or rock and these terms are used in comparison of different project data.

All excavation is measured in cubic metres of in situ material.

Table 2: Soil excavation characteristics

Activity definition	Soil Description		Suitable tools
	Cohesion	Non Cohesion	
Soft	Soft	Very loose	Easily excavated with a shovel or hoe
Medium	Firm	Loose	Can be dug with a shovel
Hard	Stiff	Compact	Mattock, pick or other Swung tool required
Very Hard	Very stiff or hard	Dense or very dense	Crowbar required in addition to pick
Rock		Rock	Sledge hammer and chisels required

1.3 Hauling

Hauling is cost effective when carried out manually only for distances of up to 150 metres. For greater distances equipment becomes necessary. Typically, headloading is the most effective method up to 50 metres, at which wheelbarrows are most suitable. However, it should be noted that headloading is not common in Africa as a construction operation, whereas in some parts of Asia, headloading is utilized for considerable haul distances (sometimes up to 100 metres).

Productivity is very dependant on the condition of the haul route and the height through which the material must be moved, often referred to as the ‘lift’.

Equipment haulage is typically carried out by a tractor, trailer or trucks.

Table 3 presents the haulage range and capacity for typical equipment used on labour based projects. All haulage is measured in loose cubic metres of material for a specified haulage range.

Table 3: Haulage equipment characteristics

Haulage equipment	Recommended Hauling range (m)	Capacity
Headbasket	4 – 50	0.02m³
Western Wheelbarrows	25 – 150	0.08m³
Animal cart (2 oxen or donkeys pulling)	100 – 150	0.07m³
Tractor and trailer	250 – 5000	3 – 3.5m³
Tipper truck	2000 upwards	5 – 6m³

1.4 Loading, unloading and spreading

These activities are often combined with others as a single activity. Loading is often part of the excavation activity where no double handling of the material is involved, and lifts are less than one metre. Similarly loading, unloading and spreading is often included with the haulage activity when material is being obtained for a gravel road surface from a stockpile. However, it is important to have data on the separate activities so that a project can evolve its own norms.

Loading refers to loading of pre-excavated stockpile, and can be applied to any material. However, it must be remembered that if material is left to stand for a considerable period and subjected to wetting and drying, it will need to be re-loosened, which constitutes a new excavation task. Loading heights of more than one metre are very difficult by manual methods, and loading bays should be fashioned to avoid this problem. Loading is measured in loose cubic metres of material.

Unloading is probably unique to labour-based activities in civil engineering. It does not refer to wheelbarrows or headbaskets, but to emptying non-tipping trailers or trucks. Unloading is measured in loose cubic metres of material.

Spreading refers to the general activity of converting loosely dumped soil or gravel into smooth and even road surface. It includes moving material by shovel, hoe, rake and use of leveling devices such as chamber board and string lines. Spreading can be measured in loose cubic metres or square metres of material for a given thickness.

Table 4 lists the typical handtools used for these activities

Table 4: Tools for loading, unloading and spreading

Activity	Suitable tools
Loading	Short or long handled shovel
Unloading	Short or long handled shovel
Spreading	Shovel, hoe, rake, sledgehammers, Camber board, string lines

1.5 Compaction

It is not generally recommended to use manual methods for compaction of road pavements. Most research and experience shows that it is not possible to achieve enough impact to make any significant difference to the density of the pavement material. Compaction should be carried out either by towed or self-propelled equipment.

Manual compaction can be used for backfill to drainage structure or in maintenance operations (such as filling of potholes) using hand rammers. Pavements are best compacted with a vibrating rollers. Manual compaction is specified in cubic metres of compacted material, and equipment compaction in square metres.

When specifying compaction equipment it is important to know the daily output required. Most labour-based projects produce a maximum of 500 – 1000 square metres of formation or gravel pavement a day, and the equipment should be matched to that output.

Table 5 specifies the typical tools and equipment used for compaction on labour-based projects.

Activity	Tools/Equipment	Typical unit weight
Manual compaction	Rammer	7.5 kg
Equipment compaction	Pedestrian operated Vibrating roller	1.25 tonne
Equipment compaction	Towed dead weight Roller	1.0 – 2.0 tonne
Equipment compaction	Towed vibrating roller	600kg

1.6 Culvert laying

Culvert laying is the most common drainage operation that can be specified as a single activity. More complex activities such as erecting retaining walls, providing concrete drifts, or installing small bridges are best split down into their component parts. The task for culvert laying includes excavation, providing bedding material, laying and backfilling the pipe segments, and providing upstream and downstream headwalls.

A typical set of tools for a culvert laying team is set out in Table 6 below.

Table 6: Tools for culvert laying

Typical tools required for culvert laying team	Pick and shovel for each worker, plus 5 crowbars, 5 wheelbarrows, 5 sledgehammers, 5 handrammers, boning rods, heavy rope.
--	--

2. Work Methods

In all literature on labour based construction there is much reference to daywork, taskwork and piecework. These are very straightforward concepts, but unfortunately they are sometimes defined in different ways as different projects.

Daywork means simply that a worker is paid a fixed rate for being present on a site for a full working day, which is usually 8 hours of work. The amount of work produced depends entirely on the supervisor's ability to encourage the worker, and the worker's own motivation and sense of responsibility. In many circumstances this can lead to low productivity, especially with permanent staff who have no particular incentive to work hard.

Piecework is a method of setting work, usually preferred by the private sector. The worker is allocated an amount of work for an agreed rate of pay. The work they do is measured and the more they do the more they are paid.

Taskwork evolved on projects where the workers were subject to government regulations, which meant they could not be paid more than the prevailing government wage for a days work. Some other incentive had to be provided. Setting a realistic task, or amount of work to be completed for the day, meant that workers could work as hard as they wanted and then go home to do other things. Tasks are generally set to be achievable in 70 percent of the working day (a working day being assumed as 8 hours) but are often completed in 50 percent of the working day (ie in 4 hours). This approach has proved very successful in practice, inference doubling the productivity of the individual worker as well as halving the costs.

Group tasks – this is done where the nature of work requires the cooperation of a team, such as excavating and loading material into trucks or trailers. There is no basic difference in the concept, and task quantities are usually a simple multiple of the individual tasks making up the group.

The most common mistake is to confuse taskwork with piecework, by setting more than one task in a day. If a project is in the situation where it can pay a variable rate to the worker according to output, then this should be considered as piecework. There is no problem with setting work norms based around the recommended daily task, and then paying for more work on a pro rata basis. However, the project must then be set up to accurately measure the amount of work completed, with the agreement of the worker.

