Ethiopian TVET-System

Irrigation and Drainage Design and Construction Supervision

NTQF Level IV

Module Title: Planning and Supervising Road Works

TTLM Code: EIS IDS4 TTLM 0920v2

This module includes the following Learning Guides

LG 42: Plan and Prepare for Road Works and Maintenance

LG Code: EIS IDS4 M09 0920LO1-LG-16

LG 43: Evaluate Road Construction Materials

LG Code: EIS IDS4 M09 0920LO2-LG-17

LG 44: Supervise Road Construction and Repair Work

LG Code: EIS IDS4 M09 0920LO3-LG-18

LG 45: Monitor Environmental Impact of Road Works

LG Code: EIS IDS4 M09 0920LO4-LG-19

LG 46: Report the outcomes of Road Construction and Maintenance Supervision

LG Code: EIS IDS4 M09 0920LO5-LG-20

Instruction Sheet	Learning Guide 16: Plan and Prepare for Road Works and Maintenance

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Receiving and prioritizing Requests for road works
- Assessing Site of road works and cause of defect to determine required materials, resources and safety precautions.
- Identifying and incorporating quality assurance requirements to preparation for road work.
- Assessing Traffic management requirements and adequate notification to the public of future road works and expected delays is arranged.
- Establishing and outlining work schedules, required equipment, resources, materials and optimum timing to complete works.
- Referring appropriate plans, specifications or drawings to ensure quality assurance is adhered to and maintained.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Receiving and prioritizing Requests for road works
- Assessing Site of road works and cause of defect to determine required materials, resources and safety precautions.
- Identifying and incorporating quality assurance requirements to preparation for road work.
- Assessing Traffic management requirements and adequate notification to the public of future road works and expected delays is arranged.
- Establishing and outlining work schedules, required equipment, resources, materials and optimum timing to complete works.
- Referring appropriate plans, specifications or drawings to ensure quality assurance is adhered to and maintained.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” in each information sheets.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After You accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result;
8. Then proceed to the next LG

Information sheet-1	Receiving and Prioritizing Requests for Road Works

1.1. Introduction

Highway engineering is an engineering discipline branching from civil engineering that involves the planning, design, construction, operation, and maintenance of roads, bridges, and tunnels to ensure safe and effective transportation of people and goods. Standards of highway engineering are continuously being improved. Highway engineers must take into account future traffic flows, design of highway intersections/interchanges, geometric alignment and design, highway pavement materials and design, structural design of pavement thickness, and pavement maintenance.

1.2. Program of works

A project manager needs to insure that resources required for and/or shared by numerous activities are adequate. Problems in this area can be indicated in part by the existence of queues of resource demands during construction operations. A queue can be a waiting line for service. Waiting for resources such as a particular piece of equipment or a particular individual is an endemic problem on construction sites. If workers spend appreciable portions of time waiting for particular tools, materials or an inspector, costs increase and productivity declines. Insuring adequate resources to serve expected demands is an important problem during construction planning and field management.
In general, there is a trade-off between waiting times and utilization of resources. Utilization is the proportion of time a particular resource is in productive use.

A few conceptual models of queuing systems may be helpful to construction planners in considering the level of adequate resources to provide. First, we shall consider the case of time-varying demands and a server with a constant service rate. In accordance with relevant clauses of the Conditions of Contract and prior to commencement of permanent works, the Contractor shall submit a fully detailed and time related program showing the order of procedure and method in which the Contractor propose to carry out the Works. The program shall be so detailed as to show:

- The order of work
- Planned rate of progress
- Amount and type of equipment proposed
- Details of methods to be employed
- Details of Temporary Works

The Works shall be carried out so as to achieve a continuous and consecutive output of fully completed road. The order of execution of the Works shall be subject to reasonable adjustment as requested by the Engineer.

1.2.1. Temporary works

The Contractor shall supply the Engineer with drawings for approval showing the layout and general arrangement of all Temporary Works he proposes to construct for the purpose of the Contract including, but not limited to:

- Campus, including accommodation for staff and labor.
- Offices
- Laboratory
- Workshops
- Stores
- Aggregate crushing plants
- Bitumen storage facilities, etc.
- Concrete manufacturing plants
- Precast concrete yards
- Temporary river crossings
- Temporary bypass and access roads

In order to provide these equipment and other necessary materials including identify appropriate location for those equipment studies in different stage is necessary.

1.3. Reconnaissance Survey

The purpose of the reconnaissance survey is to evaluate the feasibility of one or more corridor routes for a highway between specific points that may be many kilometers away.

Mostly a desk study, good reconnaissance survey can be the greatest single money-saving phase in the construction of a new road.

Hence the engineer should make ample provision in both time and finance for this stage of highway location study. The following is a useful checklist of the general information required in the first phase of the reconnaissance study for a major highway, irrespective of whether it is in a rural or in urban area.

- General Land Survey
  - ✓ Location of site on published maps and charts
  - ✓ Aerial survey, where appropriate
  - ✓ Site boundaries, outlines of structures, and building lines
  - ✓ Ground contours and natural drainage features
  - ✓ Above ground obstructions to view and flying, e.g. transmission lines
  - ✓ Meteorological information
- Permitted use and restrictions
  - ✓ Planning and statutory restrictions applying to the particular areas
  - ✓ Tunnels, mine-works (abandoned, active and proposed)
  - ✓ Ancient monuments, burial grounds, etc
- Ground conditions
  - ✓ Geological maps
  - ✓ Flooding, erosion, landslide and subsidence history
  - ✓ Construction and investigation records of adjacent sites
- Sources of material for the construction
- Drainage and sewerage
- Water supply
- Electric and gas supply
- Telephone and others

The first step in the reconnaissance survey is the location and acquisition of all maps and data relating to the area, as well as the most suitable air photographs. These are then thoroughly studied. A visit to the area may also be considered desirable at this stage.

1.4. Preliminary Location Survey

The preliminary survey is a large-scale study of one or more feasible corridor routes. It results in a paper location and alignment that defines the line for the subsequent final location survey. This paper location and alignment should show enough ties to existing topography to permit a location party to peg the centerline. In many cases field details for final design may also be obtained economically during the preliminary survey phase.

The preliminary survey is made for the purpose of collecting the additional physical information that may affect the location of the highway within a given corridor area, the shape of the ground, any potential ground subsidence problems, the limits of the catchment areas, the positions and invert levels of streams and ditches, and the positions of trees, banks and hedges, bridges, culverts, existing roads,power lines and pipe lines, houses and monuments are determined and noted. These are then translated into maps, profiles and (frequently) cross sections that can assist the engineer in the determination of preliminary grades and alignments and the preparation of cost estimates for alternative centerlines.

1.5. Final location survey

The final location survey is a detailed layout of the selected route. This survey, much of it is very often carried out as part of the preliminary survey, serves as the dual purpose of fixing the centerline of the road and at the same time collecting physical data which are necessary for the preparation of plans for construction purposes.

Self-check 1	**Written test**

Direction I: choose the best answer (2 point each)

1. -------- is a detailed layout of the selected route
   A. reconnaissance survey
   B. Final Location Survey
   C. Preliminary location survey
   D. All

2. Which one of the following is information required in first stage under reconnaissance
   A. General Land Survey
   B. Permitted use and restrictions
   C. Ground conditions
   D. All

Direction II: Short answer

1. List at list 5 activities should have been carried out before road construction is started. (10 point)

Note: **Satisfactory rating – 7 points** **Unsatisfactory - below 7 points**

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet 1: Multiple Choice

1. _____
2. _____

Answer sheet 1: Short answer

1._____
_____
_____

Information sheet-2	**Assessing Site of road works and cause of defect to determine required materials, resources and safety precautions**

2.1 Introduction

Road maintenance involves interventions or works required to keep the road, its structures and property within the road margins as near as possible to their as-constructed or rehabilitated condition.

The purpose of road maintenance is to ensure that the road remains serviceable until the end of its design life. Maintenance therefore performs the important function of:

- Prolonging the life of the road by reducing the rate of deterioration (both on-carriageway as well as off-carriageway), thereby safeguard previous investments in construction and rehabilitation,
- Lowering the cost of operating vehicles on the road by providing a smooth running surface,
- Keeping the road open on a continuous basis by preventing it from becoming impassable.

2.2 Road Maintenance Works

Road maintenance works are classified into three types: namely, routine, periodic and emergency.

Routine maintenance is based on routine (daily) inspection of the condition of pavement, cut and fill slopes, drainage, bridges and other structures and facilities to monitor any defects and damage. The results of routine inspection will be promptly reported to the operation office for follow-up maintenance works to be undertaken either continually throughout a year or at certain intervals every year. The term “preventive maintenance” refers to repair that addresses causes of deterioration leading to the need for costly rehabilitation work in future.

Periodic maintenance is based on detailed inspection performed at certain time intervals such as seasonally or yearly depending on the type and kind of facilities. It includes checking and testing the conditions of various structures and facilities. Defects and damage will be reported for repairs or remedies. Maintenance plans covering several years will be developed.

Emergency maintenance basically comprises works to restore road and road related facilities to their normal operating conditions after they are damaged by road accidents or natural causes.

It is impossible to foresee the frequency, but such maintenance requires immediate action.

Table 1: summarizes typical activities of each type of maintenance work

Type	Activity
Routine Including	• Clearing of pavement • Mowing and maintenance of plants

Preventive	• Clearing of ditches and culverts • Repair of traffic signs and road markings • Shoulder grading • Pothole patching and crack sealing • Repair of sealants and expansion joints of bridges • Repair of cut and fill slopes
Periodic	• Re-graveling • Resealing/surface dressing • Overlay • Maintenance of traffic signs and road markings
Emergency	• Removal of debris or obstacles from natural causes • Repair of damage caused by traffic accidents

For routine maintenance activities, an appropriate mix of labor and equipment is required to provide works of adequate quality in a cost-effective manner. In a “labor-based” economy, the aim is to apply a labor/equipment mix that gives priority to labor, but supplements it with light/intermediate equipment where necessary for reasons of quality or cost. The term “labor-based” thus indicates that flexible and optimal use is made of labor as the predominant resource in so far as cost-effectiveness and quality aspects are ensured. It is important to distinguish between an optimal use of labor and maximum use of labor. The latter could degenerate into a “make work” approach where cost-effectiveness and quality aspects are ignored.

2.3 Identify cause of deterioration and failure of roads

Before rectifying a defect, the underlying cause of the problem should be identified. In many cases therefore the corrective activity alone may not be enough, the underlying cause must also be dealt with. Road deterioration involves the worsening of roads over a period of time due to various causes.

Deterioration leads to defects and subsequent failure of the road structure. Water is the main contributor to the wear and damage of low-volume rural roads. It can be in the form

of ground water, surface water (streams and rivers) or rain and can damage the road in several ways:

- by washing away soils (erosion and scouring),
- weakening the load bearing capacity of the road pavement,
- by depositing soils (silting) that obstruct the passage of water, or
- By washing away entire sections of the road and its structures.

Damage and wear to the road can be reduced if the flow of water is controlled. Minor damages can easily be repaired as part of the regular maintenance provided to the road and its structures. If the flow of water is not properly managed, the deterioration of the road will be more serious and occur more rapidly. This leads to higher maintenance demands and in the worst cases result in serious damages that may obstruct the passage of traffic.

When carrying out drainage maintenance, it is important that the reasons for the damages are fully understood. When surveying, it is essential to establish the exact cause and effect of any drainage failures. The performance of the drainage system should therefore be observed during rainy periods, in order to obtain a realistic impression of the how, and how much, water is moving in the vicinity of the road. On this basis, good preventive measures can be made that hopefully reduce future maintenance demands - and increase the lifetime of the road.

2.3.1. Deterioration of the Carriageway and Shoulders (Surface Drains)

Drainage of the road surface is provided by shaping the carriageway with a camber or a cross slope. The combination of stagnant water on the road surface and traffic can quickly cause erosion of the road surface. Secondly, if surface water penetrates into the road body, it reduces the load bearing capacity of the pavement, which may cause further damage to the road. To avoid these problems, it is important to secure adequate drainage of the road surface.

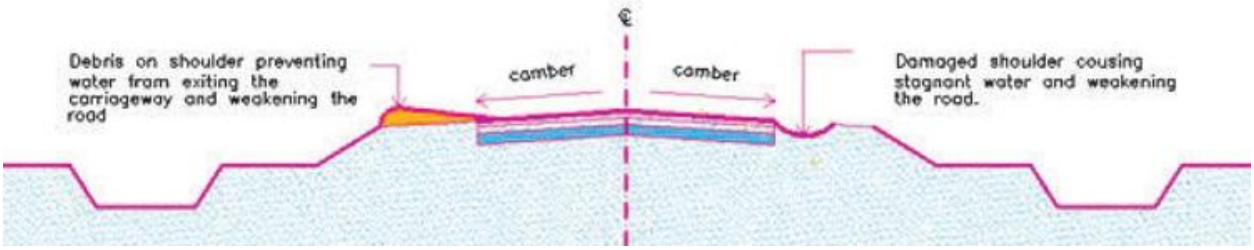


Figure 1: Deterioration of road caused by stagnant water

The road shoulders need to be maintained to their original shape and slope to allow for water to be drained off the road surface. Standing water at the edge of the road softens the shoulders and also causes water to penetrate the road pavement, resulting in loss of bearing capacity of the shoulders and the road carriageway.

Ruts are caused by the deformations in pavements with insufficient strength to cater for the prevailing traffic, mostly as a result of improper mix-design, weak pavement, intrusion of sub-grade clay into base course, poor compaction works or overloaded vehicles. It often takes place on roads with a high prevalence of heavy traffic for which the pavement was not designed. The longitudinal depressions resulting from rutting compromises the road camber, restricting water from being drained from the road surface.

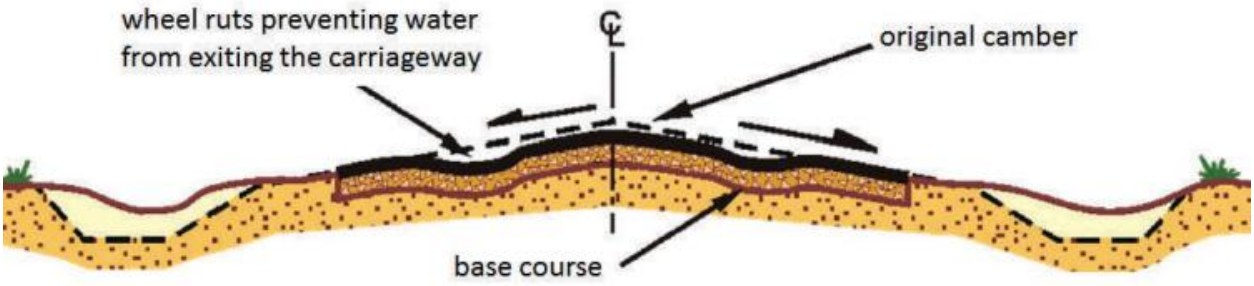


Figure 2.2: Degradation of carriageway

Potholes are depressions found randomly distributed over the carriageway and shoulders. They occur on sections of the road where the road base has been exposed to high moisture levels due to cracks on the paved layer.

Potholes are a common surface defect on both paved and unpaved roads. They develop under the action of tyres, especially from heavy vehicles.

Potholes increase rapidly in size during the rainy season when water collects inside the hole. Besides causing discomfort to the road users, potholes allow water to penetrate into the pavement, thereby compromising its load bearing capacity, which in turn accelerates the deterioration of the pavement and its surface.

Potholes often develop as a result of poor drainage of the base course.

Blocked side drains or culverts, resulting in water penetrating are the reason for such damages.

Figur 2.3: Potholes on road

Edge failures of paved roads are caused by weak materials used in shoulders and poor shoulder maintenance that leaves the surface of the road pavement higher than the adjacent shoulder. Edges are often more vulnerable to settlements due to shoulders consisting of poor materials or with poor drainage.

Figure 2.4: Damaged road edge

Figure 2.5: raveling

Raveling is a process in which the surface layer loses its aggregate particles due to insufficient binder in the surface seal.

Delamination is a result of poor bonding with the underlying surface or insufficient stability of the wearing course, resulting in a total loss of the surface seal. The loss of the surface seal may eventually lead to the development of potholes unless the defect is addressed by patching or resealing the failed section.

Figure 2.6: Delamination

Figure 2.8: Depression

Cracks in the road surface can develop in various patterns and frequency. Most cracks are caused by movements or settlements in the underlying pavement layers as a result of

poor materials or workmanship, instability of fills and shoulders or movements in the subgrade. Settlements may also take place on aged pavements or as a result of traffic increases necessitating higher pavement standards. If left unattended, cracks develop into potholes, causing further damage to the pavement and its surface.

Figure: Cracks

Depressions are caused by the uneven settlement of the pavement layers often for the same reasons as when rutting occurs. Depressions are more common on older roads with limited pavement strengths and which is experiencing an increase in heavy traffic. Depressions on new roads are either a result of construction faults, using poor quality materials or when the drainage fails resulting in the pavement being saturated with water. Depressions can also develop as a result of differential movements at structures, often found at bridge and culvert approaches.

1.1.1. Deterioration of the Side Drains, Miter Drains and Catch-water Drains

Side drains collect water from the carriageway and surrounding areas and lead it to an exit point where it can be safely discharged. The side drains need sufficient capacity to collect all rainwater from the road carriageway and dispose of it quickly and in a controlled manner to minimize damage.

The main challenge in terms of maintaining good quality side drains is to control erosion and silting. Erosion is caused by large quantities of water travelling at high speeds. Soil erosion can be reduced by various design measures such as widening the side drains, installing scour checks, lining the side drains and by leading the water away from the road before it builds up a significant flow and speed.

Not properly maintained catch-water drains may start pooling water and reduce the stability of the slope and trigger landslides. The risk of silting can be reduced by maintaining a continuous downhill gradient with a clear outlet at the end.

1.1.2. Deterioration of the Side Slopes

Slide slopes are prone to erosion by water. This may be caused due to poor construction on embankment fills, cut slope being too steep, properties of in-situ material of the soil, and loss of vegetation cover.

1.1.3. Deterioration due to Vegetation

Tall grass and bushes have a tendency to collect debris, which in turn may compromise the performance of the drainage system of the road. Excessive vegetation along the road also reduces the line of sight for traffic. Clearing vegetation in the road reserve is important in order to maintain good off-carriageway drainage. Removing bush and grass allows for the free flow of water on slopes and in drains.

Grass on shoulders, side slopes and in drains should be cut, leaving the roots intact. Healthy growth of grass stabilizes soils and provides these surfaces with good protection from soils eroding during extensive rains.

Figure: Deterioration due to Vegetation

Self-check 2	**Written test**

Direction choose the correct answer (2 points each)

1. One of the following is different from other
   A. Clearing of pavement
   B. Resealing/surface dressing
   C. Shoulder grading
   D. Clearing of ditches and culverts

2. -------is caused by weak materials used in shoulders and poor shoulder maintenance.
   A. Delamination
   B. Raveling
   C. Edge failure
   D. Depression
3. ---------- refers to repair that addresses causes of deterioration leading to the need for costly rehabilitation work in future.
   A. Emergency maintenance
   B. Preventive maintenance
   C. Periodic maintenance
   D. All

Note: **Satisfactory rating - 3points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information sheet-3	**Identifying and incorporating quality assurance requirements**

2.2 Quality management

Quality has been defined as "the totality of characteristics of an entity that bear on its ability to satisfy stated or implied needs. Quality management is a repetitive cycle of measuring quality, updating processes, measuring, updating processes until the desired quality is achieved.

1.2.1. The Purpose of Management of Quality

The main principle of project quality management is to ensure the project will meet or exceed stakeholder's needs and expectations. The project team must develop a good relationship with key stakeholders, specially the donor and the beneficiaries of the project, to understand what quality means to them. One of the causes for poor project evaluations is the project focuses only in meeting the written requirements for the main outputs and ignores other stakeholder needs and expectations for the project.

Quality must be viewed on an equal level with scope, schedule and budget. If a project donor is not satisfied with the quality of how the project is delivering the outcomes, the project team will need to make adjustments to scope, schedule and budget to satisfy the donor's needs and expectations. Project quality management is broken down into three main processes: Quality Planning, Quality Assurance, and Quality Control.
Project management consists of four main processes:

- Quality Definition
- Quality Assurance
- Quality Control
- Quality Improvements

2.3 Quality definition

The first step on the quality management is to define quality, the project manager and the team must identify what quality standards will be used in the project, it will look at what the donor, beneficiaries, the organization and other key stakeholders to come up with a good definition of quality. In some instances the organization or the area of specialization of the project may have some standard definitions of quality that can be used by the project.
Identifying quality standards is a key component of quality definition that will help identify the key characteristics that will govern project activities and ensure the beneficiaries and donor will accept the project.

1.3.1. Sources of Quality Definition

Donor: One source for definition of quality comes from the donor; the project must establish conversations with the donor to be familiar with and come to a common understanding of what the donor defines as quality.

Beneficiaries: Another source for quality definition comes from the beneficiaries; the project team must be able to understand how the beneficiaries define quality from their perspective, a perspective that is more focused on fitness for use, the project outcomes must be relevant to the current needs of the beneficiaries and must result in improvements to their lives.

1.3.2. Quality Characteristics

All material or services have characteristics that facilitate the identification of its quality. The characteristics are part of the conditions of how the material, equipment and services are able to meet the requirements of the project and are fit for use by the beneficiaries. Quality characteristics relate to the attributes, measures and methods attached to that particular product or service.

- **Functionality** is the degree, by which equipment performs its intended function, this is important especially for clinical equipment, that the operation should be behave as expected.
- **Performance,** it's how well a product or service performs the beneficiaries intended use. A water system should be designed to support extreme conditions and require little maintenance to reduce the cost to the community and increase its sustainability.
- **Reliability,** it's the ability of the service or product to perform as intended under normal conditions without unacceptable failures. Material used for blood testing should be able to provide the information in a consistent and dependable manner that will help identify critical diseases. The trust of the beneficiaries depend on the quality of the tests
- **Relevance,** it's the characteristic of how a product or service meets the actual needs of the beneficiaries, it should be pertinent, applicable, and appropriate to its intended use or application

- **Timeliness,** how the product or service is delivered in time to solve the problems when its needed and not after, this is a crucial characteristic for health and emergency relief work
- **Suitability,** defines the fitness of its use, it appropriateness and correctness, the agriculture equipment must be designed to operate on the soul conditions the beneficiaries will use it on.
- **Completeness,** the quality that the service is complete and includes all the entire scope of services. Training sessions should be complete and include all the material needed to build a desired skill or knowledge.
- **Consistency**, services are delivered in the same way for every beneficiary. Clinical tests need to be done using the same procedure for every patient.

Quality characteristics are not limited to the material, equipment or service delivered to the beneficiaries, but also applies to the material, equipment and services the project staff uses to deliver the project outputs. These include the vehicles, computers, various equipment and tools and consulting services the project purchases and uses to carry out its activities.

1.3.3. Quality plan

Part of defining quality involves developing a quality plan and a quality checklist that will be used during the project implementation phase. This check list will ensure the project team and other actors are delivering the project outputs according to the quality requirements.

2.4 Quality assurance

Quality Assurance (QA) is a systematic process that ensures product and service excellence. Quality assurance processes assure improvements in design of products, products, processes, services, concurrent engineering, experimental design, design team formation and management.

Assurance is the activity of providing evidence to create confidence among all stakeholders that the quality-related activities are being performed effectively; and that all

planned actions are being done to provide adequate confidence that a product or service will satisfy the stated requirements for quality.

Quality Assurance is a process to provide confirmation based on evidence to ensure to the donor, beneficiaries, organization management and other stakeholders that product meet needs, expectations, and other requirements. It assures the existence and effectiveness of process and procedures tools, and safeguards are in place to make sure that the expected levels of quality will be reached to produce quality outputs.

Quality assurance occurs during the implementation phase of the project and includes the evaluation of the overall performance of the project on a regular basis to provide confidence that the project will satisfy the quality standards defined by the project.

One of the purposes of quality management is to find errors and defects as early in the project as possible. Therefore, a good quality management process will end up taking more effort hours and cost upfront. The goal is to reduce the chances that products or services will be of poor quality after the project has been completed.

Quality assurance is done not only to the products and services delivered by the project but also to the process and procedures used to manage the project, that includes the way the project uses the tools, techniques and methodologies to manage scope, schedule, budget and quality. Quality assurance also includes the project meets any legal or regulatory standards.

1.4.1. Quality Audits

Quality audits are structured reviews of the quality management activities that help identify lessons learned that can improve the performance on current or future project activities. Audits are performed by project staff or consultants with expertise in specific areas. The purpose of quality audit is to review how the project is using its internal processes to produce the products and services it will deliver to the beneficiaries. Its goal is to find ways to improve the tools, techniques and processes that create the products and services. If

problems are detected during the quality audits, corrective action will be necessary to the tools, processes and procedures used to ensure quality is reestablished.

1.4.2. The PDCA cycle

The most popular tool used to determine quality assurance is the Shewhart Cycle. This cycle for quality assurance consists of four steps:
Plan, Do, Check, and Act. These steps are commonly abbreviated as PDCA.
The four quality assurance steps within the PDCA model stand for:

- Plan: Establish objectives and processes required to deliver the desired results.
- Do: Implement the process developed.
- Check: Monitor and evaluate the implemented process by testing the results against the predetermined objectives
- Act: Apply actions necessary for improvement if the results require changes.

The PDCA is an effective method for monitoring quality assurance because it analyzes existing conditions and methods used to provide the product or service to beneficiaries. The goal is to ensure that excellence is inherent in every component of the process. Quality assurance also helps determine whether the steps used to provide the product or service is appropriate for the time and conditions. In addition, if the PDCA cycle is repeated throughout the lifetime of the project helping improve internal efficiency.
The PDCA cycle is shown below as a never-ending cycle of improvement; this cycle is sometimes referred to as theShewart/Deming cycle since it originated with Shewart and was subsequently applied to management practices by Deming.

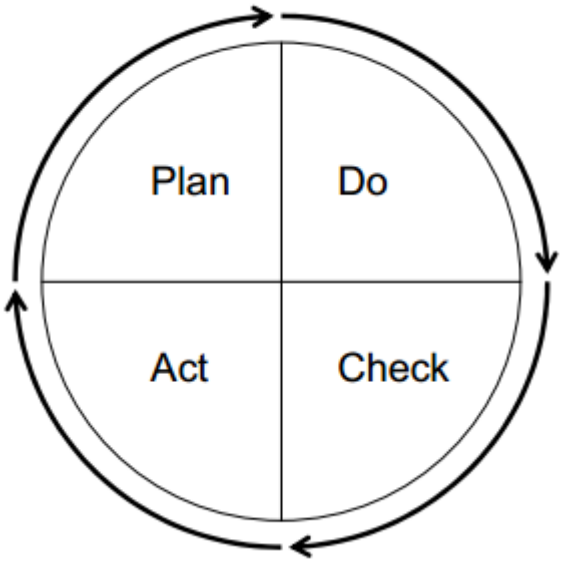


Figure 8: The Shewart/Deming Cycle

2.5 Quality control

Quality control is the use of techniques and activities that compare actual quality performance with goals and define appropriate action in response to a shortfall. It is the process that monitors specific project results to determine if they comply with relevant standards and identifies different approaches to eliminate the causes for the unsatisfactory performance.

The goal of quality control is to improve quality and involves monitoring the project outputs to determine if they meet the quality standards or definitions based on the project stakeholder's expectations. Quality control also includes how the project performs in its efforts to manage scope, budget and schedule.

- **Acceptance**; The beneficiaries, the donor or other key project stakeholders accept or reject the product or service delivered. Acceptance occurs after the beneficiaries or donor has had a change to evaluate the product or service.
- **Rework**; is the action taken to bring the rejected product or service into compliance with the requirements, quality specifications or stakeholder expectations.
- **Adjustments;** correct or take the necessary steps to prevent further quality problems or defects based on quality control measurements. Adjustments are identified to the processes that produce the outputs and the decisions that were

taken that lead to the defects and errors. Changes are taken to the Change Control processes of the project.

2.6 Quality improvement

It is the systematic approach to the processes of work that looks to remove waste, loss, rework, frustration, etc. in order to make the processes of work more effective, efficient, and appropriate.

Quality improvement refers to the application of methods and tools to close the gap between current and expected levels of quality by understanding and addressing system deficiencies and strengths to improve, or in some cases, re-design project processes.

A variety of quality improvement approaches exists, ranging from individual performance improvement to redesign of entire project processes. These approaches differ in terms of time, resources, and complexity, but share the same four steps in quality improvement:

- **Identify** what you want to improve; the project using the data found in the quality control process identifies the areas that need improvement.
- **Analyze** the problem or system, the team then investigates the causes for the problem and its implications to the project, the causes may be internal or external to the project.
- **Develop** potential solutions or changes that appear likely to improve the problem or system, the team brainstorms ideas and potential solutions to the problem, taking in consideration its impact to the project schedule and budget. After careful considerations the team decides and chooses the best alternative.
- **Test** and implement the solutions. The team may decide to test the solution on a small scale to verify that it is capable of fixing the problem, it testes for the initial assumptions made about the problem and once it confirms that the solution is a viable alternative, it then proceeds to implement in a full scale the solution.

Self-check 3	Written test

Direction choose the correct answer (2 points each)

1. ------ is a systematic process that ensures product and service excellence.
   A. Quality plan C. Quality audit
   B. Quality control D. Quality assurance
2. -----is investigates the causes for the problem and its implications to the project
   A. Identify C. Test
   B. Develop D. Analyze
3. One of the following is the correct steps
   A. Do-Plan- Check- Act
   B. Plan-Do-Check- Act
   C. Check-Plan-Do-Act
   D. Plan-Check-Do-Act
4. ------is application of methods and tools to close the gap between current and expected levels of quality
   A. Quality plan C. Quality improvement

B. Quality control D. Quality assurance

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____
4. _____

Information sheet-4	**Assessing Traffic management requirements and adequate notification to the public**

4. 1 Introduction

The Event Traffic Management Design Guidelines (ETMDG) provide guidance on traffic control measures and devices used to warn, instruct and guide road users in the negotiation of events on roads including footpaths, shared paths and bicycle paths adjacent to the roadway in a safe manner. It is applicable to traffic management for all types of events which cause interference or obstruction to the normal use of a road by any road user. It also provides guidance for the planning and design of traffic management arrangements with the aim of providing a safe traffic environment for event participants and spectators.

The primary principle in developing traffic management plans (TMPs) and traffic guidance schemes (TGSs) is ensuring the safety of event participants, spectators, event personnel (including ETMs) and road users.

All necessary steps should be followed during the planning stage to ensure that:

- road users and event participants are suitably warned of changed conditions, and
- The necessary protection, delineation, and illumination is provided in order to protect all road users and event participants.

4. 2.2 Design principles

The MUTCD provides discussion on the principles for the development, installation and operation of TGSs for works on roads. Additional principles that apply to planning and designing traffic management for events are:

- ensure the protection of event participants, spectators and event personnel from hazards associated with general traffic
- provide adequate advance warning of changed road conditions to all road users (motorists, pedestrians and cyclists)
- plan to minimize impacts to all relevant stakeholders including government bodies, emergency services, public transport operators, local residents and businesses
- plan to minimize excessive traffic queues / delays and diversions, and
- Ensure adequate documentation and data is prepared to show that proposed traffic arrangements will have the desired outcomes.

4. 2.3 Risk factors

Events on road may result in the risk of injury to event participants (for example, collision between an event participant and a vehicle) and members of the public (for example, a pedestrian or spectator could be hit by a cyclist participating in an event). When determining if and what measures should be implemented to manage these risks, the relevant input factors and how they influence the likelihood and consequence / severity of risk should be considered. Key input factors that may assist with evaluating event traffic management risks include:

- traffic volume
- traffic speed
- size of event (participant and spectator numbers)
- density and speed of event participants
- event duration

- length of event in proximity to traffic
- separation from traffic
- age of participants and spectators
- road geometry (lane width / alignment)
- weather conditions
- time of day, and
- Static or non-static.

4. 2 Traffic volume

In order to facilitate the assessment of present and future traffic demands, for the development of need-based infrastructure accurate information and continuous monitoring of traffic by appropriate methods is necessary.

Implementing authorities must therefore ensure that sufficient and appropriate data is available to undertake necessary planning, design, construction and maintenance of the country's road network, which is aimed at meeting the prevailing traffic flow, future traffic growth and loading without considerable deterioration in the quality of service.

Traffic Data Collection and projections thereof of traffic volumes are basic requirements for planning of road development and management schemes. Traffic Data forms an integral part in the science of descriptive national economics and such knowledge is essential in drawing up a rational transport policy for movement of passengers and goods by both government and the private sectors. Traffic flow data is needed for different purposes. The major areas for which this data is required are:

- Planning prioritization and project initiation.
- Project design.
- Planning maintenance.
- National Transport Statistics.
- Road Safety Measures.
- Traffic Control.

Some of the key areas in which traffic flow data is needed for development and management of the road network include:

- Determination of a program of road widening needs and general improvement or strengthening of existing road through a program of reconstruction and construction of a new roads;
- To check the efficiency of the road network by comparing current traffic volume with the level of service or the calculated capacity;
- To establish the relationship between traffic volume, number of accidents and causes thereof, as well as determination of the probable occurrences;
- To plan prioritization of roads improvement schemes;
- To assess economic benefits arising from roads improvements;
- Investigation of various capacity and design problems for both roads and bridges and parking facilities.
- Design and improvement of new/existing junctions;
- Assistance in planning new developments such as roads in a new town, subdivisions, land use, which generally includes shopping centers, hotels, commercial and industrial complexes, service stations and other traffic generators activities;
- Determination of warrants or the need for implementation of traffic improvement and traffic control measures, such as synchronized/coordinated traffic signals, stop signs, one way roads, no entry, etc;
- To study future traffic trends and assisting in predicting traffic flows in the future for a given period;
- To classify roads on their functional basis.

In addition to the above the following are typical specific needs:

- Assessment of pavement performance through traffic surveys and Period monitoring of selected sections;
- Ascertaining appropriate/optimal timings for maintenance interventions and rehabilitation needs of various roads countrywide;
- Establish economic and social implications of design and feasibility studies of all development projects countrywide;

- Establish the use of the road network by vehicles of different categories, traffic distribution, etc.

4. 3.2 Types of Traffic Counts

It is essential to know the magnitude of traffic data required or to be collected, which will then determine its quality and type of vehicle classification to be adopted. Traffic counting falls in two main categories, namely; manual counts and automatic counts. There is no distinct difference between the two methods however; the economic use or selection of an appropriate method of traffic counting is a function of the level of traffic flow and the required data quality. This difference can be deduced from the discussions of the respective methods below.

Manual Counts

The most common method of collecting traffic flow data is the manual method, which consists of assigning a person to record traffic as it passes. This method of data collection can be expensive in terms of manpower, but it is nonetheless necessary in most cases where vehicles are to be classified with a number of movements recorded separately, such as at intersections.

Automatic Counts

The detection of vehicular presence and road occupancies has historically been performed primarily on or near the surface of the road. The exploitation of new electromagnetic spectra and wireless communication media in recent year, has allowed traffic detection to occur in a non-intrusive fashion, at locations above or to the side of the roadway. Pavement-based traffic detection currently relatively in expensive, will be met with fierce competition in the coming years from detectors that are liberated from the road surface.

4. 3 Notification and communication

There may be a range of stakeholders that will need to be communicated with regarding traffic impacts associated with the event. A number of stakeholder groups and potential forms of communication relevant to each are outlined in the following sections.

4. 3.1 Road users and residents

Consideration should be given to what notification is required based on the level of traffic impacts associated with the event. Types of communication that may be appropriate include:

- letter drops (for local residents and businesses who require access)
- media advertisements (for example, TV, radio, social media and newspapers)
- local online message boards (for example, community pages)
- stakeholder email alerts
- traffic management center notices, and
- pre-event traffic signage (for example, variable message signs (VMSs)

4. 3.2 Road authority

The relevant road authorities may need to be involved in a detailed consultation process depending on the scale and complexity of the event in order to agree on details and grant necessary approvals.

Through this process these parties may require the designer to provide details of:

- community notification strategy
- detour and advance warning strategy
- traffic signal operations strategy, and
- traffic management arrangements.

4. 3.3 Public transport

Events may have impacts on public transport operations, from both a network perspective (stop or road closures) and a demand perspective (particularly high-attendance events in major urban environments). The relevant public transport operator and authority should be consulted to determine the appropriate responsibilities and processes for:

- detour arrangements (both major and minor diversions)
- service delays
- additional public transport services to cater for demands associated with the event, and

4. 3.4 Emergency services

Emergency services are key stakeholders that use public roads to perform a critical community function. Where an event affects potential emergency vehicle routes, the relevant emergency services should be consulted to advice on any specific impacts or alternative arrangements.

In addition, emergency services should be advised where access arrangements are in place specifically for the event (particularly if the event has high risks of participant injury or a large number of participants).

4. 3.5 Security

While security arrangements are typically outside the scope of traffic management for an event, designers should note that event security and / or the Queensland Police Service (QPS) may have requirements that impact on traffic management arrangements. In these cases, consultation with the relevant stakeholders should be conducted to ensure that such requirements can be identified early in the planning process.

4. 4 Signage in the area of planned road works

Advance warning signs are used to inform the road user of changed road conditions ahead. To ensure that traffic management arrangements are credible to road users, advance warning signage selected for use should reasonably reflect the nature of the occurrence that road users will encounter (for example, the use of ROADWORK AHEAD signs in advance of an event where road works are not present is misleading). In the context of events, it is important that advance warning signs distinguish the activities taking place from those that would typically be associated with road construction or maintenance works.

For events, advance warning signs may be required to advise road users of:

- presence of event participants / spectators on or adjacent to the road
- reduced number of lanes or changes in lane priority
- road closures
- detours

- restrictions on lane use for event traffic, and\
- Direction to parking areas of spectators.
-

Associated intermediate advance signage and signage at the end of the event area (and any traffic arrangements associated with the event) should also be relevant to events.

4. 4.1 Traffic Signs and Their Meanings

Whether you are studying for your driver's exam or saw an unusual sign that you do not remember, it is always a good idea to familiarize yourself with it. Recognizing traffic signs and knowing their meanings can help drivers make safe driving decisions faster and more easily.

Animal Crossing Signs

This road warning sign is not an opportunity to ask why the animal crossed the road. Animal crossing sign alerts drivers to areas where the population of animal is active and may enter the roadway.

Seeing animals of this size on the road is a very serious situation, and as a warning, animal crossing signs can help drivers pass safely through these areas.

Emergency Vehicle Warning Signs

Possibly the least frequently seen warning sign on the list of traffic signs and their meanings, the emergency vehicle warning sign is one of the most important.

Similar to the animal crossing signs in shape and design, emergency vehicle warning signs alert drivers to upcoming fire departments, ambulance stations, and other areas where emergency vehicles could be entering the roadway with limited warning to drivers.

Drivers should also refrain from pulling over in these areas to keep it clear for emergency vehicles to pull in and out of the station.

Keep Right Sign

When a road narrows, due to dividers or other obstructions, drivers need to be made aware of the change in the path of the roadway.

Keep right or left signs are the "keep right" and "keep left" versions of the same obstruction warning. These regulatory traffic signs aid in the flow of vehicles when these slight obstacles are present.

Men at Work Signs

It is a temporary warning sign used to alert drivers of upcoming road work. When driving through work zones, safe driving is at its highest premium. Men at work signs are generally accompanied by other temporary warning signs, such as “road work ahead” signs and “detour” signs.

No Bicycle Signs

Bicycle riders are subject to many of the same traffic control signs that drivers are on the roadways. No bicycle signs prohibit bicycle traffic from entering a roadway or facility. If used at a facility, these signs should be posted at the entrances. It is closed to bicycles.

No U and left Turn Signs

With the curved arrow showing a U-turn and bold prohibition symbol over it, this standard design is understood to express areas where drivers cannot change the direction of their vehicle into the opposite direction. In addition the same for no left and right turn signs.

Pedestrian Crossing Signs

There are a few versions of pedestrian crossing signs that are posted near crosswalks and intersections. This sign indicates close to Pedestrian ethiopian trafic sign.

Speed Limit Signs

Speed limit signs are essential traffic control signs, and can vary in the limit depending on the specific state that you are driving though.

Stop Signs

Stop signs are likely the most iconic of all traffic signs. Both the shape and color are important to how a stop sign is recognized and understood. Stop signs alert drivers to intersections and other areas where traffic may be traveling in opposite or crossing directions.

Self-check 4	**Written test**

Direction choose the best answer (2 point each)

1. One of the following is factors that affect traffic risk
   A. Traffic volume C. age of participants and spectators
   B. Traffic speed D. weather conditions
   E. All
2. Traffic flow data is needed for the following **except**
   A. Planning prioritization

B. Project design.

C. Planning maintenance.

D. Traffic Control

E. None

3. principles that apply to planning and designing traffic management

   A. ensure the protection of event

   B. provide adequate advance warning

   C. plan to minimize impacts to all relevant stakeholders

   D. Ensure adequate documentation and data is prepared about proposed traffic arrangements

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information sheet-5	**Establishing and Outlining Work Schedules, Required Equipment, Resources, Materials and Optimum Timing to Complete Works**

5.1. Introduction

Good project management in construction must vigorously pursue the efficient utilization of labor, material and equipment. Improvement of labor productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and

innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of the mainstream of construction activities.

Project Management is a process of estimating individual activity resource need or cost and then this only works if the activities and resources are similar. You're never going to have the complete resource picture until you have finished building the schedule.

Project management is the fundamental knowledge you need for managing a project, categorized into 10 knowledge areas:

Managing integration: Projects have all types of activities going on and there is a need to keep the "whole" thing moving collectively – integrating all of the dynamics that take place. Managing integration is about developing the project charter, scope statement, and plan to direct, manage, monitor, and control project change.

Managing scope: Projects need to have a defined parameter or scope, and this must be broken down and managed through a work breakdown structure. Managing scope is about planning, definition, work breakdown structure creation, verification, and control.

Managing time/schedule: Projects have a definite beginning and a definite ending date. Therefore, there is a need to manage the budgeted time according to a project schedule. Managing time/schedule is about definition, sequencing, resource and duration estimating, schedule development, and schedule control.

Managing costs: Projects consume resources, and therefore, there is a need to manage the investment with the realization of creating value (i.e., the benefits derived exceed the amount spent). Managing costs is about resource planning, cost estimating, budgeting, and control.

Managing quality: Projects involve specific deliverables or work products. These deliverables need to meet project objectives and performance standards. Managing quality is about quality planning, quality assurance, and quality control.

Managing human resources: Projects consist of teams and you need to manage project team(s) during the life cycle of the project. Finding the right people, managing their outputs, and keeping them on schedule are a big part of managing a project. Managing

human resources is about human resources planning, hiring, and developing and managing a project team.

Managing communication: Projects invariably touch lots of people, not just the end users (customers) who benefit directly from the project outcomes. This can include project participants, managers who oversee the project and external stakeholders who have an interest in the success of the project. Managing communication is about communications planning, information distribution, performance reporting, and stakeholder management.

Managing risk: Projects are a discovery-driven process, often uncovering new customer needs and identifying critical issues not previously disclosed. Projects also encounter unexpected events, such as project team members resigning, budgeted resources suddenly changing, the organization becoming unstable, and newer technologies being introduced. There is a real need to properly identify various risks and manage these risks. Managing risk is about risk planning and identification, risk analysis (qualitative and quantitative), risk response (action) planning, and risk monitoring and control.

Managing procurement: Projects procure the services of outside vendors and contractors, including the purchase of equipment. There is a need to manage how vendors are selected and managed within the project life cycle. Managing procurement is about acquisition and contracting plans, sellers' responses and selections, contract administration, and contract closure.

Managing stakeholders: Every project impacts people and organizations and is impacted by people and organizations. Identifying these stakeholders early, and as they arise and change throughout the project, is a key success factor. Managing stakeholders is about identifying stakeholders, their interest level, and their potential to influence the project; and managing and controlling the relationships and communications between stakeholders and the project.

In organizational studies, resource management is the efficient and effective development of an organization's resources when they are needed. Such resources may include the financial resources, inventory, human skills, production resources, or information technology (IT) and natural resources.

5.2. Project Schedule and Time Management

The definition of project success often includes completing the project on time. The development and management of a project schedule that will complete the project on time is a primary responsibility of the project manager, and completing the project on time requires the development of a realistic plan and the effective management of the plan. On smaller projects, project managers may lead the development of the project plan and build a schedule to meet that plan. On larger and more complex projects, a project controls team that focuses on both costs and schedule planning and controlling functions will assist the project management team in developing the plan and tracking progress against the plan.

To develop the project schedule, the project team does an analysis of the project scope, contract, and other information that helps the team define the project deliverables. Based on this information, the project team develops a milestone schedule. The milestone schedule establishes key dates throughout the life of a project that must be met for the project to finish on time. The key dates are often established to meet contractual obligations or established intervals that will reflect appropriate progress for the project. For less complex projects, a milestone schedule may be sufficient for tracking the progress of the project. For more complex projects, a more detailed schedule is required.

To develop a more detailed schedule, the project team first develops a work breakdown structure (WBS)—a description of tasks arranged in layers of detail. After the project team identifies the activities, the team sequences the activities according to the order in which the activities are to be accomplished. An outcome from the work process is the project logic diagram. The logic diagram represents the logical sequence of the activities needed to complete the project. The next step in the planning process is to develop an estimation of the time it will take to accomplish each activity or the activity duration. Some activities must be done sequentially, and some activities can be done concurrently. The planning process creates a project schedule by scheduling activities in a way that effectively and efficiently uses project resources and completes the project in the shortest time.

To successfully manage a project, the project manager must also know how to accelerate a schedule to compensate for unanticipated events that delay critical activities. During the life of the project, scheduling conflicts often occur, and the project manager is responsible for reducing these conflicts while maintaining project quality and meeting cost goals.

5.3. Materials Management

Materials management is an important element in project planning and control. Materials represent a major expense in construction, so minimizing procurement or purchase costs presents important opportunities for reducing costs. Poor materials management can also result in large and avoidable costs during construction. First, if materials are purchased early, capital may be tied up and interest charges incurred on the excess inventory of materials. Even worse, materials may deteriorate during storage or be stolen unless special care is taken. For example, cement often must be stored in waterproof and dry locations.

Materials management is not just a concern during the monitoring stage in which construction is taking place. Decisions about material procurement may also be required during the initial planning and scheduling stages. The availability of materials may greatly influence the schedule in projects with a fast track or very tight time schedule: sufficient time for obtaining the necessary materials must be allowed.

Materials ordering problems lend themselves particularly well to computer based systems to insure the consistency and completeness of the purchasing process. In the manufacturing realm, the use of automated materials requirements planning systems is common.

Information to be collected on construction materials can be categorized by one of two basic types, project specific or general. Project specific information is that collected specifically for a current project.

General information is existing information that may have been collected for another project but is also currently applicable. General information may be collected during what is commonly referred to as a "Desk-study" phase, whilst project specific, or new,

information may be recovered during the project exploration and ground investigation phases.

The principal objective in acquiring information about road construction materials is to identify geotechnical materials that are capable of meeting the engineering, economic and environmental requirements of the project. Information relevant to this objective may be generally grouped as listed below:

- Source locations
- Geological environment
- Geotechnical character
- Volumes of material
- Project specifications
- Economic factors
- Environmental factors

5.3.1. Aggregate Materials

Aggregates are broken pieces of stone, obtained by blasting and crushing a parent rock or stone boulders in a designated size; or by screening suitable gravels from natural sources. However, coarse aggregates obtained from natural sources are sometimes polished or weathered due to formation and transportation modes. Therefore, natural sources may be ideal for fine aggregate (natural sand) than coarse aggregates.

Aggregate is used in a concrete mix as an extender (bulking material) to reduce cost and control shrinkage, in pavement layers as base course material (CRS and CRR), as chipping for surface dressing and it takes up about 95% of asphalt mixes. Additionally, graded aggregate is used to improve the strength (CBR) of weak soils (known as ‘mechanical stabilization’).

However, before being used in any mix, aggregate should be clean and strong enough to resist forces (e.g. crushing, abrasion, impact, etc.) and durable under exposure conditions (e.g. heat, chemical attack, etc.). Soft aggregate (e.g., limestone, sandstone, etc.) should

not be used where high strength is required (unless it is the only option and design modification is made to accommodate such weak aggregate).

Aggregate particles should have angular shape to form tight interlock and rough enough to produce frictional resistance in a mix. Flaky or elongated aggregates should be avoided, as they break and do not pack tightly during compaction. For aggregate to produce adequate density and stability during compaction, it should contain a wide range of particle sizes (from fine to course) that can fill the mix matrix.

Some of the common tests used to examine the quality of aggregate are;

- Grading also known as sieve analysis or particle size distribution.
- Shape test comprise flakiness index (FI) and elongation index (EI).
- Aggregate Crushing Value (ACV) Some aggregate particles resist crushing while some crush during rolling (due to the effect of weathering process or micro-fractures developed by blasting or crushing operations). Crushing of aggregates during construction process affects the grading, density and strength of a mix or layer made with such aggregate.
- Ten percent Fines Value (TFV) it is also measures the resistance of aggregate to crushing.
- Aggregate Impact Value (AIV) The AIV test is used to measure resistance of aggregate to impact.

5.3.2. Construction material Record Keeping

Records of material usage are an essential part of efficient construction materials management. Records concerning the actual use of materials during a project should be maintained during the course of a project and stored following completion. Ongoing maintenance and pavement evaluation records should also be added for further reference. Records that need to be kept, which can be used to construct "as built" haulage diagrams:

- Actual source of materials used to construct each section of road.
- Characteristics of each material used per section of road
- Actual costs of materials

- Estimate of residual volumes left at each utilized source.

The benefits of being able to access as built records are:

- Identification of resource deficiencies in terms of quantity for future use.
- Identification of any construction problems with particular materials; enables a crosscheck on, for example, assumptions regarding the relationship between in-situ, as-dug and service performance.
- Identification of in service performance deficiencies, which will allow amended processing requirements to be identified for future works.

Processing of as-excavated resource is undertaken to produce construction materials that meet required specifications by means of either mechanical alteration or physical selection. In general terms, materials utilized for common fill, would normally require no processing in contrast to high quality hard-rock aggregates which can be subjected to several phases of crushing and sorting. The amount of processing required is a function of the relationship between the as-extracted character and the required mechanical, chemical and physical properties.

Processing plants can be fixed or mobile.. Fixed plant is more common in large, established quarries, while semi-mobile plant is more appropriate for major construction projects where the life of the quarry is directly related to the duration of the project. Sometimes very light mobile plant is utilized in small-scale operations where minimal amounts of processing are required.

Processing is used to:

- reduce the excavated material to suitable sizes of aggregate
- group the sizes together where required into appropriate grading
- remove unwanted fines
- reduce oversize

5.4. Human Resources

Staffing the project with the right skills, at the right place, and at the right time is an important responsibility of the project management team. The project usually has two types of team members: functional managers and process managers. The functional

managers and team focus on the technology of the project. On a construction project, the functional managers would include the engineering manager and construction superintendents. The project management team also includes project process managers. The project controls team would include process managers who have expertise in estimating, cost tracking, planning, and scheduling. The project manager needs functional and process expertise to plan and execute a successful project.

Because projects are temporary, the staffing plan for a project typically reflects both the long-term goals of skilled team members needed for the project and short-term commitment that reflects the nature of the project. Exact start and end dates for team members are often negotiated to best meet the needs of individuals and the project. The staffing plan is also determined by the different phases of the project. Team members needed in the early or conceptual phases of the project are often not needed during the later phases or project closeout phases. Team members needed during the implementation phase are often not needed during the conceptual or closeout phases. Each phase has staffing requirements, and the staffing of a complex project requires detailed planning to have the right skills, at the right place, at the right time.

5.5. Construction Equipment

The selection of the appropriate type and size of construction equipment often affects the required amount of time and effort and thus the job-site productivity of a project. It is therefore important for site managers and construction planners to be familiar with the characteristics of the major types of equipment most commonly used in construction.

Typically, construction equipment is used to perform essentially repetitive operations, and can be broadly classified according to two basic functions: (1) operators such as cranes, graders, etc. which stay within the confines of the construction site, and (2) haulers such as dump trucks, ready mixed concrete truck, etc. which transport materials to and from the site. In both cases, the cycle of a piece of equipment is a sequence of tasks which is repeated to produce a unit of output. For example, the sequence of tasks for a crane might be to fit and install a wall panel (or a package of eight wall panels) on the side of a building; similarly, the sequence of tasks of a ready mixed concrete truck might be to load, haul and unload two cubic yards (or one truck load) of fresh concrete.

In order to increase job-site productivity, it is beneficial to select equipment with proper characteristics and a size most suitable for the work conditions at a construction site. In road construction, for examples, factors that could affect the selection of excavators include:

- Size of the job
- Activity time constraints
- Availability of equipment
- Cost of transportation of equipment
- Type of excavation
- Soil characteristics
- Geometric characteristics of elements to be excavated
- Space constraints
- Characteristics of haul
- Location of dumping areas
- Weather and temperature

Self-check 5	Written test

Choose the best answer (2 points each)

1. One of the following is may not necessarily manage by construction manager

A. Material management C. Human resource management

B. Natural resource management D. Time management

2. To select appropriate type of construction equipment engineers should consider

A. Weather and temperature C. Volume of work

B. Countries government rule D. Soil characteristics

3. Records of material usage by construction work are used to

A. Actual source of materials used to construct each section of road.

B. Characteristics of each material used per section of road

C. Estimate Actual costs of materials

D. Estimate of residual volumes left at each utilized source

E. None

4. Tests used to examine the quality of aggregate **except**

A. Grading Aggregate C. Crushing Value

B. Tensile strength test D. Shape test

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____
4. _____

Information sheet-6	Referring Appropriate Plans, Specifications or Drawings to Ensure Quality Assurance

5.1. Introduction

The preparation of plans, specifications, and estimates (PS&E) for highway and bridge construction projects is essential in order to facilitate construction, provide contract control, estimate construction costs, and provide a uniform basis for bidding purposes.

Design documentation is prepared to a level that allows the works to be constructed accurately. The design documentation includes design drawings, bill of quantities and technical specifications.

Design drawings are developed to a level of detail necessary to prepare a clear, coordinated visual depiction of all aspects of the works. Major project elements including overall layout, earthworks equipment, mechanical, electrical, structural, and water supply systems are designed and depicted through coordinated scale drawings and detailed elevations and plans.

Technical specifications are prepared to provide consistency and to instruct construction contractors on how the works are to be carried out, the quality of the workmanship and methods of quality assurance for the construction. Technical specifications describe the project design and construction practices, technical standards, specifications and principles to be followed during construction.

Objectives

The objectives of the design drawings and technical specifications are to

- provide a detailed record of the design of the project
- set standards for the technical aspects required in the construction
- set standards for the execution of the construction
- Set standards for documenting the design, tendering and construction process.

5.2. Design documents

Design documents relate to the design, construction and commissioning of the project works. Typically, the documents should include

- design drawings
- construction specifications

5.2.1. Design drawings

Design drawings for construction contain all the information necessary for the construction contractor to bid on and build a particular project. Typically, the preparation of design drawings provides a detailed record of the design and structural requirements of the works. A contract or tender document often references design drawings.

Design drawings should show details on layout, measurements, plan, cross-sectional and vertical profiles. This information is prepared as scale drawings of the works to be constructed.

Design drawings should be presented in such a way that

- the project can easily be understood
- they visually communicate the concept to the lot feeder and the construction contractor
- they are legible
- They include all information from previous revisions and updates.

The design drawings should include the following aspects

- site layout and the location of the works to be constructed
- plan views
- detailed designs and cross-sectional profiles of the works
- dimensions and units gradients
- titles and scales that meet the required standards and units
- adequate labeling
- elevations that are referenced to meters Australian Height Datum (m AHD)
- Be dated and signed by the designer.

Preparation of detailed drawings

To prepare drawings based on detailed investigations and designs, the following should be noted:

- To ensure the most economic solutions and to avoid any delay in construction as a result of shortage of materials, the structures and any buildings should be generally designed with available local materials
- To ensure durability of structures and buildings, etc., the best quality materials and workmanship must be used
- To maintain a high quality of construction, standard local construction techniques should be taken into account when the facilities are designed, and in particular when the measurements of earth works are determined.

Requirements of detailed drawings

(i) Location, boundary, contour and land maps

(ii) Layout plan

This plan is depending on the size of the project area. The layout plan must show the contour lines if those are not provided on a separate contour map and all the establishments found at the site such as the existing roads, electric and telephonic lines, rivers and drains or other channels, buildings, underground pipelines, boundary lines.

(iii) Setting out plan

In order to ensure the accurate marking-out of all the earthworks of the road, the reference line including the TBMs, all the measurements of the boundary, as well as drainage canal, including the location and numbering of the cross sections required to peg out the center lines and the channels must be illustrated. The elevations of the TBMs and other data needed for setting out the facilities should also be given in this plan. The TBMs should be established in such positions that they cannot be destroyed by the machines during the construction period. The scale of this plan is the same, or less, than that used for the layout plan.

(iv) Cross and longitudinal sections of earthworks

Road width, feeder and drainage channels should be given in the detailed plans with appropriate scale. Two types of cross-sections should be noted as follows.

5.3. Technical specifications

A contract or tender document often references technical specifications about the specific requirements and construction standards for various elements of a project. This includes how the work will be done, the quality of workmanship and methods of testing. Typically, construction projects require construction of various elements and use of various materials. More than one technical specification may be required for the whole project. For example, a construction project may require individual technical specifications for

- earthworks
- erosion and sediment controls
- concrete works
- fencing
- building works
- roads
- electrical systems
- Water reticulation systems.

For small projects, the material and construction specifications may be documented in the form of notes on the design drawings. For larger projects, a separate specification document is more practical.

The following are common types of specification.

- Requirement Specifications
- Design Specifications
- Material Specifications
- Standard Specifications
- Interface Specifications
- Test Specifications
- Performance Specifications
- Quality Specifications

Specifications describe the products, materials and work required by a construction contract. They do not include cost, quantity or drawn information, and so need to be read alongside other information such as quantities, schedules and drawings.

Outline specification an outline specification is a brief description of the main components to be used in construction. They should be described in sufficient detail to allow the cost consultant to prepare some approximate quantities.

5.3.1. Necessity of specification to construction work

The main reasons why the specification is so important to the construction process:

- It provides clear instructions on the intent, performance and construction of the project.
- It can reference the quality and standards which should be applied.
- Materials and manufacturers' products can be clearly defined.
- The requirements for installation, testing and handover can be identified.
- Classification in the specification can be used to support handover and running of the asset.
- The drawing or model does not need to be overloaded with detailed information, which can sometimes be difficult to identify.
- It can be used to support the costing of a project: not only the materials and products but also the performance and workmanship
- The specification forms part of the contractual documents, along with the drawings, and therefore can help minimize project risk and provide support should there be any legal disputes.
- It supports the interpretation of the client brief and gives the client assurance that the asset which they commissioned is being delivered.
- It is not only essential for the construction phase but also used as part of the soft landing process, subsequent asset management and the lifecycle plan.
- By being clear and concise and containing all the information, it saves the project team, the client and the contractor time and money by providing answers to many of the on-site construction questions.
- There is the option for the design team to build a suite of office masters, which would improve efficiency, provide quality assurance and project consistency.
- The specification should be used by all the project team throughout the construction phase; it should be a living document and not stop being used at the design phase.

- The specification and any variations or value engineering can also be used for the project audit trail and should form part of the handover documents. It will then form the basis for the running of the asset by the asset management team

Self-check 6	**Written test**

Direction Choose the best answer (2 points each)

1. ------is type of specification used to control erosion problems
   A. earthworks
   B. erosion and sediment controls
   C. concrete works
   D. fencing
2. deals about specific requirements and construction standards for various elements of a project

A. material specification
B. technical specification
C. design specification
D. performance specification

3. The objectives of the design drawings and technical specifications are to

A. provide a detailed record of the design of the project

B. set standards for the technical aspects required in the construction

C. set standards for the execution of the construction

D. Set standards for documenting the design E. All

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Operation sheet 1	**Receiving and prioritizing Requests for road works**

Step 1: Read and understand the detail design and drawing of road work

Step 2: Carry out reconnaissance survey

Step 3: Carry out preliminary location survey

Step 4: Cary out final location survey

Step 5: Identify temporary works required to road construction work

Step 6: Identify location for campus used to staff housing, equipment storing etc.

Step 7: Provide required materials equipment etc.

Operation sheet 2	**Assessing Site of road works and cause of defect to determine required materials, resources and safety precautions**

Step 1: Go to the road where assessment is needed and assess the defected road

Step 2: Investigate the cause, volume and type of deterioration

Step 3: List out list and amount of material, equipment and other resources used to maintain the defect

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 3day.

1. Receive and prioritize requirements for road works?
2. Assess site of works and cause of defects to determine required material, resource and safety precautions?

Instruction Sheet	Learning Guide 17: Evaluate Road Construction Materials

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Determining and delivering type and quantity of construction or repair materials to site is arranged in accordance with established work schedule.
- Identifying required pre-mix and hot-mix materials to suit job requirements.
- Identifying and recording impurities in raw and processed materials in accordance with council and quality assurance requirements.
- Recommending appropriate type of repair and repair material for defective road surfaces.
- Conducting and recording manufacture and testing of all materials in accordance with appropriate Ethiopian standards.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Determining and delivering type and quantity of construction or repair materials to site is arranged in accordance with established work schedule.
- Identifying required pre-mix and hot-mix materials to suit job requirements
- Identifying and recording impurities in raw and processed materials in accordance with council and quality assurance requirements

- Recommending appropriate type of repair and repair material for defective road surfaces
- Conducting and recording manufacture and testing of all materials in accordance with appropriate Ethiopian standards

Learning Instructions:

1) Read the specific objectives of this Learning Guide.
2) Follow the instructions described below
3) Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4) Accomplish the “Self-checks”.in each information sheets.
5) Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6) If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7) After You accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result;
8) Then proceed to the next LG

Information sheet-1	Determining and delivering type and quantity of construction or repair materials

1.1 Introduction

There are many types of building materials used in construction such as Concrete, Steel, Wood and masonry and paved materials such as tarmac dam. Each material has different properties such as weight, strength, durability and cost which makes it suitable for certain types of applications. The choice of materials for construction is based on cost and effectiveness to resisting the loads and stresses acting on the structure. As a structural engineer, I work with my clients to decide on the type of materials used in each project depending on the size and use of the building.

Although majority of the road failures developed in Ethiopia is normally due to the use of substandard materials and poor construction techniques rather than over-loading and environmental influences. This brings views that, for a road project to achieve quality product that would fulfill the functional and structural requirement with high degree of confidence it must have appropriate and effective quality system, which screens out substandard materials and put a stop to poor construction techniques. In order to be appropriate and effective, quality system should comprise the knowledgeable staff, proper testing plan and equipment. It should also focus on the materials quality before being used to a permanent work and monitor closely the processing and finishing techniques. Durability of pavement is not judged instantly by the appearance of final product, but is guaranteed by proper design, good quality of materials and proper construction techniques. Specifications alone are not enough to produce a durable road if quality of the applicable materials is not accurately revealed and cared for.

Quality control requires not only a good knowledge of materials characteristics, but also being confident in handling and testing the materials, correct interpretation of the test results, timely delivery of the test results and familiarity with the construction techniques.

1.2 The acquisition and utilization of road construction materials information

Information to be collected on construction materials can be categorized by one of two basic types,

1. project specific or
2. General

Project specific information is that collected specifically for a current project.

General information is existing information that may have been collected for another project but is also currently applicable. General information may be collected during what is commonly referred to as "Desk-study" phase, whilst project specific, or new, information may be recovered during the project exploration and ground investigation phases.

General Objectives

The principal objective in acquiring information about road construction materials is to identify geotechnical materials that are capable of meeting the engineering, economic and environmental requirements of the project. Information relevant to this objective may be generally grouped as listed below:

- Source locations
- Geological environment
- Geotechnical character
- Volumes of material
- Project specifications
- Economic factors
- Environmental factors

The acquisition of materials information may be viewed as a process of gradually increasing the certainty by which decisions can be made regarding construction materials within the project area and how best to utilize them.

1.3 Materials Used for the Construction of Road Layers and Road Pavement

A wide variety of materials are used in the construction of roads these are soils (naturally occurring or processed), aggregates (fine aggregates or coarse aggregates obtained from rocks), binders like lime, bituminous materials, and cement, and miscellaneous materials used as admixtures for improved performance of roads under heavy loads and traffic.

Soil constitutes the primary material for the foundation, subgrade, or even the pavement (for low-cost roads with low traffic in rural areas). When the highway is constructed on an embankment at the desired level, soil constitutes the primary embankment material; further, since all structures have to ultimately rest on and transmit loads to 'mother earth', soil and rock also serve as foundation materials.

The manufacturing of building materials is a well-established and standardized industry capable of providing a reliable supply of high-quality materials for our structures. The production of structural-grade building materials is subject to quality control procedures that involve inspection and testing according to national standards and scientific testing methods.

Part of the structural engineer's responsibilities is to prepare the project specifications including all building materials and applicable standards and provision to comply with. This is a crucial part of any project to specify the quality and properties of materials to be used. Building materials can generally be divided into two categories:

- Natural building materials such as stone and wood, and
- Man-made building materials such as pavement materials, concrete and steel.

Both categories usually require a certain level of preparation or treatment before the use in a structural application. Below is the list of materials I used the most in engineering consulting projects.

A detailed study of their properties is therefore essential. Binder materials such as bitumen and cement mixed with appropriate types and proportions of aggregates are used for the construction of superior types of roads that are characterized by their durability and load-carrying capacity. Thus, base courses, sub-base courses and even the surface or wearing courses require the use of these materials.

1. Soil

Soils can be studied effectively if they are classified according to certain principles into a definite system. A soil classification system may be defined as a fundamental division of the various types of soil into groups according to certain parameters such as its physical properties, constituents or texture, field performance under load, presence of water and so on. A classification system is usually evolved with a view to assessing the suitability of a soil for specific use as a construction material or as a foundation material.

2. Stone Aggregates

Stone aggregate, or mineral aggregate, as it is called, is the most important component of the materials used in the construction of roads. These aggregates are derived from rocks, which are formed by the cementation of minerals by the forces of nature.

Stone aggregates are invariably derived by breaking the naturally occurring rocks to the required sizes. They are used for granular bases, sub-bases, as part of bituminous mixes and cement concrete; they are also the primary component of a relatively cheaper road, called water-bound macadam.

A study of the types of aggregates, their properties, and the tests to determine their suitability for a specific purpose is of utmost importance to a highway engineer. Properties such as strength and durability of aggregates are generally influenced by their origin of occurrence, mineral constituents and the nature of the bond between the constituents.

3. Bituminous Materials

Bitumen was used as a bonding and water-proofing agent thousands of years ago. However, the use of bitumen for road-making picked up only in the nineteenth century. As the quest for fuels like petroleum to run automobiles grew and the distillation of crude oil emerged as a major refining industry, the residues known as bitumen and tar found increasing use in constructing bituminous surfaces, which provided superior riding surface.

4. Cement, Cement Mortar and Cement Concrete

Cement concrete is a versatile material which has revolutionized civil engineering construction during the twentieth century. A fresh cement concrete mix consists of cement, mineral aggregates (coarse aggregate and fine aggregate), and water.

A well-designed cement concrete mix sets and hardens due to the binding property of the cements, forms a mix with minimum void space and on curing with water, provides a

strong, stable and durable pavement for a highway, resisting repetitive impact from wheel loads and also withstanding adverse environmental conditions.

Self-check 1	**Written test**

Choose the best answer (2 points each)

1. Information about road construction materials is used to identify

   A. Source locations C. Geotechnical character

B. Volumes of material D. Geological environment

2. Which one of the following is man-made construction material

A. Concrete C. Soil

B. Wood D. Aggregate

Note: **Satisfactory rating – 2 points** **Unsatisfactory - below 2 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____

Information Sheet-2	**Identifying Required Pre-Mix and Hot-Mix Materials to Suit Job Requirements**

3.1 Introduction

Asphalt is a black, cementing material that varies widely in consistency from solid to semisolid (soft solid) at normal air temperatures. When heated sufficiently, asphalt softens

and becomes a liquid, which allows the material to coat the aggregate particles during HMA production.

Paving asphalt, commonly called binder, is a highly viscous (thick), sticky material. It adheres readily to aggregate particles and is therefore excellent cement for binding together aggregate particles in HMA. The binder is an excellent waterproofing material and is resistant to most acids, alkalis (bases) and salts. This means that a properly constructed HMA pavement is waterproof and resistant to many types of chemical damage.

3.2 Components of a mix material

The coarse aggregates used for making premix should be produced by crushing sound, un-weathered rock or natural gravel. The specifications for the aggregates are similar to those for granular road bases. The aggregate must be clean and free of clay and organic material. To obtain good mechanical interlock and good compaction the particles should be angular and not flaky. Rough-textured material is preferable. Gravel should be crushed to produce at least two fractured faces on each particle. The aggregate must be strong enough to resist crushing during mixing and lying as well as in service. Aggregates which are exposed to traffic must also be resistant to abrasion and polishing. Highly absorptive aggregates are wasteful of bitumen and give rise to problems in mix design. They should be avoided where possible but if there is no choice, the absorption of bitumen must be taken into account in the mix design procedure. Hydrophilic aggregates which have a poor affinity for bitumen in the presence of water should also be avoided. They may be acceptable only where protection from water can be guaranteed.

The fine aggregate can be crushed rock or natural sand and should also be clean and free from organic impurities. The filler (material passing the 0.075 mm sieve) can be crushed rock fines, Portland cement or hydrated lime Portland cement or hydrated lime is often added to natural filler (1-2 percent by mass of total mix) to assist the adhesion of the bitumen to the aggregate. Fresh hydrated lime can help reduce the rate of hardening of bitumen in surface dressings and may have a similar effect in premixes.

Hot Mix Asphalt (HMA) is a combination of approximately 95% stone, sand, or gravel bound together by asphalt cement a product of crude oil. Asphalt cement is heated aggregate, combined, and mixed with the aggregate at an HMA facility.

Hot mix asphalt (HMA) consists of a combination of aggregate uniformly mixed and coated with asphalt cement. To dry the aggregates and to obtain sufficient fluidity of asphalt cement for proper mixing and workability, both the aggregate and asphalt must be heated prior to mixing—hence the term “hot mix.”

Aggregates and asphalt are combined in a mixing facility in which all of the constituent materials are heated, proportioned and mixed to produce the desired paving mixture. After plant mixing is complete, the hot mix is transported to the paving site and spread with a paving machine in a loosely compacted layer to a uniform, even surface. While the paving mixture is still hot, the material is further compacted by heavy motor-driven rollers to produce a smooth, well-consolidated pavement layer.

Hot mix asphalt paving mixtures may be produced from a wide range of aggregate combinations, each having its own particular characteristics suited to specific design and construction uses. In addition to the amount and grade of asphalt used, the principal characterizes of the mix are determined by the relative amounts of course aggregate, fine aggregate and mineral filler.

The most critical layer of the pavement is the bituminous surfacing, and the highest quality material is necessary for this layer. Where thick bituminous surfacing are required, they are normally constructed with a wearing course laid on a base course (sometimes called a binder course) which can be made to slightly less stringent specifications. To perform satisfactorily as road surfacing, bitumen aggregate mixes need to possess the following characteristics:-

- High resistance to deformation
- High resistance to fatigue and the ability to withstand high strains i.e they need to be flexible.

- Sufficient stiffness to reduce the stresses transmitted to the underlying pavement layers
- High resistance to environmental degradation i e. good durability
- Low permeability to prevent the ingress of water and air
- Good workability to allow adequate compaction to be obtained during construction

The requirements of a mix which will ensure each of these characteristics are often conflicting In temperate climates it has proved possible to design mixes which possess an acceptable balance of properties giving long service lives under a range of loading and climatic conditions. In the tropics, higher temperatures and high axle loads produce an environment which is more severe thereby making the mix requirements more critical and an overall balance of properties more difficult to obtain. The operation of asphalt batch mix plant starts from feeding the aggregates into the feeder bins. The operation ends when hot mix asphalt is discharged into the truck.

- The first step is to feed unheated-raw aggregates into different bins of the cold aggregate feeder. This feeding has to be as per their sizes. There are cold feeder gates on individual bins which will control the aggregates flow.
- The aggregates are then transferred to drying drum. A charging conveyor will transfer the aggregates to the drum.
- The drying drum comes fitted with a burner. Burner heats-dries the aggregates effectively.
- Most of the hot mix plants are equipped with a primary dust collector. It is for settling heavy dust particles.
- The primary dust collector works best with secondary dust collector. This secondary dust collector is a bag filter.
- Once the heating of aggregates is done in the drum, they are transferred to the tower unit. A bucket elevator is used to transfer the aggregates.
- On top of the tower unit we have the screening unit. It is multiple layered. As the hot aggregates pass through the screens they get treated to screening effect. They will get separated and stored into different bins based on their sizes.
- Separate hot bins are there. These help to separately store each type of aggregates.

- Aggregates are then weighed. After weighing these aggregates will be discharged in to the mixing unit. In the mixer, aggregates will be mixed with bitumen and filler material.
- Bitumen tanks heats and stores bitumen. It is equipped with a pumping station. Bitumen is pumped to the weighing hopper prior to discharge. This bucket weighs it before addition into the mixer. Filler material is added in a separate container and it is pumped to its weighing hopper. Only after weighing the filler material it is discharged into the mixing unit.
- After mixing for a fixed time, the hot mix asphalt is ready to discharge into waiting trucks. In some cases it is transferred to storage silos for storing the same temporarily.
- A control panel is for using/controlling the plant.

Self-check 3	**Written Test**

Direction choose the best answer (2 points each)

1. Bitumen aggregate mixes is necessarily apply to
    A. High resistance to deformation
    B. High resistance to fatigue and the ability to withstand high strains
    C. High resistance to environmental degradation
    D. Good workability to allow adequate compaction
    E. All
2. Hot mix asphalt (HMA) consists of a combination of
    A. Cement and aggregate C. Asphalt and cement
    B. Cement and sand D. Aggregate and asphalt
3. Which one of the following is similar with fine aggregate

A. Mortar
C. Concrete
B. Crushed rock
D. River sand

4. Mortar is a mixture of

A. Aggregate, sand and cement
C. Aggregate and cement
B. Sand and cement
D. None

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____
4. _____

Information sheet 3	**Identifying and recording impurities in raw and processed materials**

3.1 Introduction

The appropriate selection of construction methods to be used during the execution of a construction project is a major determinant of high productivity, but sometimes this selection process is performed without the care and the systematic approach that it deserves, bringing negative consequences. Materials management is a process for planning, executing and controlling field and office activities in construction.

The goal of materials management is to insure that construction materials are available at their point of use when needed. The materials management system attempts to insure that the right quality and quantity of materials are appropriately selected, purchased, delivered

and handled on site in a timely manner and at a reasonable cost. Materials management is the system for planning and controlling all of the efforts necessary to ensure that the correct quality and quantity of materials are properly specified in a timely manner, are obtained at a reasonable cost and most importantly are available at the point of use when required.

Thus Materials management is an important element in project management. Materials represent a major expense in construction, so minimizing procurement costs improves opportunities for reducing the overall project costs.

The Specifications contain requirements for all concrete materials. Inspect all materials used in the construction of concrete work at their source, on the job, or both. The Engineers and Inspectors must inspect all materials to assure they meet all requirements prior to incorporation into the work.

3.2 Construction acceptance criteria

Construction acceptance criteria for materials qualifications, inspection, and testing are established by technical specifications as illustrated in the QC document included in materials qualifications, inspection and testing. Criteria for materials and equipment have been set by the Engineer of Record in accordance with the applicable codes and standards, and by manufacturers' recommendations. Contractor submittals are to document conformance with acceptance criteria as detailed in their CQCP (control, verification, and acceptance testing plan).

3.3 Cause of deleterious of construction material

Deleterious materials in aggregate are those substances which detrimentally affect the fresh and hardened properties of concrete for instance strength, workability, and long-term performance of the concrete in which such are used.

Deleterious materials and highly undesirable constituents

Organic impurities: clay, silt and crushed dust, salts, unsound particles, and alkali aggregate reactions are some of organic impurities. An adverse effect of deleterious

materials on concrete includes the increase of water demand in concrete, impair bond strength between cement and aggregate, reduce durability, result in concrete pop-outs, and impair wear resistance.

There are tests such as colorimetric test recommended by ASTM which are used to determine aggregate organic content. The colorimetric test does not show the adverse effect of deleterious materials in aggregate. This is because high aggregate deleterious substance content does not infer that the aggregate is not fit for utilization that is why strength test based on ASTM is recommended for mortars with questionable sand.

1. Organic Impurities

- Organic impurities interfere with the hydration reaction.
- Frequently, it is found in sand and consists of products of decay of vegetable matter.
- Organic matter may be removed from sand by washing.
- Colorimetric test recommended by ASTM can be used to determine aggregate organic content.
- The colorimetric test does not show the adverse effect of the organic impurity since high organic content does not necessarily mean that the aggregate is not fit for use in concrete.
- For this reason, strength test on mortar with questionable sand as per ASTM is recommended.
- This strength has to be compared with the strength of mortar with washed sand

2. Clay

Clay may coat the surface of aggregates which impair bond strength between aggregate and cement paste. Consequently clay adversely affects the strength and durability of concrete. It is necessary to control the amount of clay in aggregate since no test is available to determine separately the clay content, the limits of fine materials are prescribed in terms of the percentage of material passing sieve No. 200.

3. Silt and crusher dust

Silt and dust owing to their fineness, increase the surface area and therefore increase the amount of water necessary to wet all the particles in the mix.

- Impair wear resistance
- Reduce durability

- They may result pop-outs

It is necessary to control the amount of silt and fine dust in aggregate. Since no test is available to determine separately the silt and dust, the limits of fine materials are prescribed in terms of the percentage of material passing sieve No. 200

4. Salts

Salts are present in certain types of aggregates such as Sand from seashore, sand and coarse aggregate dredged from the sea or a river estuary, and desert sand. Salts coming through aggregates cause reinforcement corrosion and also absorb moisture from the air and cause efflorescence.

5. Unsound Particles

Two major classes of unsound particles are materials fail to maintain their integrity, and substances lead to disruptive expansion on freezing or even on exposure to water.

Shale, particles with low density, clay lumps, wood, coal, mica, gypsum, and iron pyrites are examples of unsound particles.

Unsound particles if present in large quantities (over 2 to 5% of the mass of the aggregate) may adversely affect the strength of concrete. These materials should not be allowed in concrete which is exposed to abrasion.

6. Alkali- Aggregate Reactions

Reaction between alkali from cement and silica or carbonate from aggregate is called “alkali- aggregate reaction”. The most common reaction is that between the active silica constituents of the aggregate and those alkalis in cement, called as “alkali-silica reaction.”

The contractors QC Technicians perform the following functions

- Inspect all materials, construction, plant, and equipment for conformance with the technical specifications; and
- Perform all QC tests as required by the technical specifications.

3.4 Record construction work activities

1.4.1. Daily record keeping

Project documents will be managed through a combination of a secure document filing and storage system and a computerized document tracking system. Sufficient records shall be prepared and maintained as work is performed to furnish documentary evidence

of the quality of construction and laboratory analysis and of activities affecting quality. Each contractor QC technician shall maintain a daily log of all inspections performed for both contractor and subcontractor operations on a form acceptable to the CM.

The Daily Inspection and Daily Test reports shall be signed by the responsible QC technician and the QCM. The CM shall be provided at least one copy of each daily inspection and test report on the work day following the day of record.

1.4.2. Daily construction report

A daily construction report will be prepared and signed by each FE and FI. The report will include a summary of the contractor's daily construction activities. Supporting inspection data sheets will be attached to the daily report where needed. At a minimum, the daily construction report will include the following information:

- Date, project name, location, and other identification
- Description of weather conditions, including temperature, cloud cover, and precipitation
- Reports on any meetings held and their results
- Record of visitors to site
- Locations of construction underway during that day
- Equipment and personnel working in each activity, including subcontractors
- Descriptions of work being inspected
- Decisions made regarding approval of units of material or of work, and corrective actions to be taken
- Description of problems or delays and resolution
- Communications with contractor staff
- Construction activities completed and/or in progress
- Progress photos, where applicable
- Signature of the report preparer

To fulfill all these objectives, it is necessary to establish harmony and good co-ordination between all the employees of material management department and this department

should have good co-ordination with the other departments of the organization to serve all production centers.

Self-check 3	Written test

Direction choose the best answer (2 points each)

1. Organic impurities which affects concrete strength
   A. Clay C. Unsound particles
   B. Silt and crushed dust D. Salt E. All
2. daily construction report will include **except**

A. weather conditions
B. Descriptions of work being inspected
C. Description of problems or delays and resolution
D. material specification

3. material management is used to
   A. insure appropriate quality of material is deliver in the site
   B. insure appropriate quantity of material is deliver in the site
   C. control material utilization in the site
   D. Manage human resource activity E. all except D

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information Sheet 3	Recommending appropriate type of repair and repair material for defective road surfaces

3.1 Introduction

Road surfaces will deteriorate because of two main factors, though – traffc and weather. The greater number (and weight) of vehicles using a road, the faster the road surface wears out – particularly those of a 'flexible' nature (i.e. containing bitumen as the binder that holds the road stones together in a fairly stable structure). Over time, this flexibility diminishes and the surface essentially snaps – by cracking and crazing. This deterioration is exacerbated by both hot and cold weather extremes. The high temperatures this summer have had an impact on that bitumen, either evident through rutting or roads seemingly melting. But sub-surface geological conditions can also make certain roads susceptible to drought and shrinkage, often exacerbated by roadside trees and vegetation extracting moisture from below the bound road surfaces. This results in movement of the road surface and, in particular, transverse and longitudinal cracking.

3.2 Possible road defects

3.2.1 Potholes

Potholes are voids in the roadway surface where pieces of the pavement have become dislodged. Areas in which many potholes occur become suspect for fundamental problems such as inadequate drainage, pavement strength, or base/subgrade problems. Single or infrequent potholes may be the only pavement distress to occur in an area, and beyond the treatment of the individual pothole no other pavement repair work may be required.

3.2.2 Longitudinal Cracking

A longitudinal crack follows a course approximately parallel to the centerline. These are typically resultants of natural causes or traffic loading.

3.2.3 Transverse Cracking

Transverse cracks run roughly perpendicular to the roadway centerline. They may be due to surface shrinkage caused by low temperatures, hardening of the asphalt, or cracks in underlying pavement layers such as PCC slabs. They may extend partially or fully across the roadway.

3.2.4 Sags and Humps

Sags and humps are localized depressions or elevated areas of the pavement that result from settlement, pavement shoving, displacement due to sub grade swelling, or displacement due to tree roots. The deficiency usually occurs in isolated areas of the roadway surface.

3.2.5 Edge Raveling

Edge raveling occurs when the pavement edge breaks and is most commonly found on those roadways that were constructed without curbs or paved shoulders.

3.2.6 Flushing

Flushing (or bleeding) is free asphalt on the surface of the pavement caused by, too many fines in the mix, too few voids, too much asphalt in patches, or a chip seal that has lost its rock. This type of distress often shows as a shiny, glass-like reflective surface. It is inherent to unstable mixes and often results in other roadway surface distresses if not corrected.

3.2.7 Raveling and Pitting

Raveling and pitting distresses are characterized by the loss or dislodgment of surface aggregate particles. Oxidized asphalt binder is often the cause of raveling and pitting.

It could also be caused by poor compaction, letting the mix get cold when paving, dirty aggregate, not enough asphalt in the mix, overheating the mix during manufacture, or aging. Routine maintenance repairs are made to raveled or pitted surfaces is made as soon as conditions permit and/or materials are available.

3.3 Pavement Maintenance Techniques

3.2.1 Patching

All flexible pavements require patching at some time during their service life. Surface patching should be performed to a standard commensurate with resource availability and the objective of retaining a smooth ride as long as possible. Since patching materials is one of the larger material costs a high quality patch is one of the most cost effective means of utilizing available resources.

There are two principal methods of repairing asphalt pavements:

1. Remove and replace the defective pavement and surfacing or base material.
2. Cover the defective area with an overlay of a suitable material to renew the surface, seal the defective area, and stabilize the affected pavement.

These repairs can be called ‘dig-outs’ or ‘overlays’ according to the method used.

3.3.1 Patching With Base Repair

“Dig-out patches” are used for making permanent repairs to the pavement. Defective pavement and unstable surfacing materials are removed down to a stable base. This may mean removal of some of the sub grade material. After the cut is made and the defective pavement and/or base material is removed, level and compact the base material. This will make an adequate foundation for the new asphalt concrete material. Surfacing materials (gravel base, crushed surfacing) and pavement must always be replaced in depths at least equal to the original design.

3.3.2 Overlay Patches

Overlay patches are generally applied when an area is too large to be economically repaired by hand with a small crew. The overlay patch, with hot plant-mix asphalt, also has

the advantage of setting quickly. It does, however, commit a considerable investment in labor, equipment, and materials.

Typically, overlay patches are applied in areas of pavement failure or wear problems rather than areas with a base or subgrade problem. Ruts, raveling, pitting, minor cracking, and oxidation are typical failures where overlay can be effective in quickly and permanently restoring the surface.

3.3.3 Rolling Hot Mix Patches

It is always desirable to use the most effective tools for the job at hand, including asphalt work. The use of a finish lute person on the patching crew is highly desirable. The quality and ride of the patch is often much better due to their expertise.

3.3.4 Surface dressing

Surface dressing is a road treatment that extends the life of a road, protects it from water damage and enhances the skid resistance of the road surface – improving road safety. We surface dress roads where the structure is sound but the surface has started to deteriorate– treating them now means we can stop them getting any worse and needing a much more expensive repair in the future. We carry out surface dressing in the summer as the materials we use work better in warm weather.

Self-check	**Written test**

Direction choose the best answer (2 points each)

1. ------- are voids in the roadway surface where pieces of the pavement have become dislodged

A. Flushing C. Potholing

B. Edge Raveling D. Cracking

2. --------applied when an area is too large to be economically repaired

A. Patching with base repair C. Dressing

B. Overlay patching D. Rolling

3. Factors that affect road deterioration

A. Weather C. Construction management

B. Traffic D. A and C E. A and B

4. Write principal methods of repairing asphalt pavements. (4 point)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____
4. _____

_____

_____

_____

Information Sheet 5	**Conducting and Recording Manufacture and Testing Of All Materials in Accordance with Appropriate Ethiopian Standards**

5.1 Introduction

Construction Materials Testing (CMT) primarily involves testing structural materials used to build new projects from the ground up, materials and components used to construct new additions or new components being added to an existing facility.

This standard test procedure defines a process that can be used to design, coordinate and analyze an inter laboratory testing program on a specific test procedure. This standard test procedure is used to determine precision statements for the testing procedures involved in the inter-laboratory testing program.

Material designates anything with a property that can be measured. Different materials having the same property may be expected to have different property levels, meaning higher or lower values of the same property. For example, an asphalt concrete mix is a material that has properties, such as asphalt content, that can be measured. Different asphalt concrete mixes can have the same property, asphalt content, at different levels, low asphalt content or high asphalt content.

The materials involved in the inter-laboratory testing program should differ primarily only in the level of the property being measured by the test procedure. If it is known or suspected that different classes of materials will exhibit different levels of precision when tested by the test procedure, consideration should be given to conducting a separate inter-laboratory testing program for each class of material.

5.2 The Importance of Construction Materials Testing

A building's structure is much more than floors, walls and a foundation. Virtually all buildings rely on a variety of support materials, including layers of soil and cement, to maintain long-term stability. Construction materials testing (CMT) is a vital process that helps builders and site owners identify potential problems before committing resources to the project. Testing is also essential for keeping the structure in line with applicable legal requirements, including occupational safety and environmental regulations.

Comprehensive materials testing solutions that include field examinations, laboratory tests and special inspections are essential to improve the construction industry in Ethiopia.

Materials testing and engineering ensures that the structural materials used during construction meet all necessary quality benchmarks. Construction experts control the risks associated with building construction through the testing of earthworks, soils, concrete, masonry, asphalt, reinforcing steel, structural steel, and roof materials.

5.2.1 Why Construction Materials Testing Matters

In the construction industry, the term “materials testing” can refer to the evaluation of almost any kind of building material that impacts the project at hand. This includes aspects of the local terrain, including soil quality and composition, as well as potential impact on nearby structures. It also encompasses testing of concrete, steel, masonry and woodwork elements throughout the structure.

The testing process is important because it allows inspectors and builders to identify faults before an actual stress test, where personal and environmental safety is at risk. Even detailed inspections aren’t completely foolproof, but they are still extremely cost-effective and helpful throughout the construction process. Material testing helps avoid expensive repair or renovation work to correct faults and mitigate risks to other people and property. Various inspections and proof of materials quality is also required by law depending on the location and type of structure.

5.2.2 Planning, Development, and Site Evaluation

In many building projects, materials testing begin before the construction team even starts excavating to make room for a foundation. The preconstruction planning and design development services help clients start on the right foot so they can take control of the project from beginning to end. This phase often includes a comprehensive examination of in-place materials, like soil, aggregates and asphalt, as well as an evaluation of potential impact on surrounding terrain and structures. The soil is tested for chemistry and composition so it can be properly stabilized or treated to better support a building.

5.2.3 Building Materials and Structural Testing

Observation and monitoring of foundation installation is another essential component of materials testing since faulty material or implementation can yield chronic and potentially disastrous consequences. Testers also conduct periodic evaluations at certain points throughout the construction process to ensure that all materials meet the minimum standards. This includes evaluation of reinforcing steel, fireproofing and building envelope quality assurance.

Self-check	

Direction short answer (3 points each)

1. What is material testing?
2. Write the advantage of material testing?

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____

2. _____

Operation sheet 1	**Identifying and recording impurities in raw and processed materials in accordance with council and quality assurance requirements.**

In order to test for silt content of fine aggregate we should follow the following steps:

Step1: Fill a measuring cylinder with a representative sand (fine aggregate) sample up to 100 ml mark and add clean water up to 150 ml.

Step2: Shake the sample vigorously for one minute and the last few shakes being in a side wise direction to level of the sand.

Step3: Allow the cylinder to stand for three hours during which time any silt present will settle in a layer on the top of the sand and its thickness can be read off on the cylinder itself. The sand shall not contain more than 8% of silt.

Operation sheet 2	**Recommending appropriate type of repair and repair material for defective road surfaces**

In order to maintain defected road (Pothole repair in Asphalt Concrete (AC) by Plant Hot Mix) follow the following steps:

step1. Mark out the defected area in a rectangular shape

step2. Used cutter machine and manual excavation

step3. Remove debris from defected area

step4. Excavate to remove all bad materials until firm material is found

step5. Backfilling the hole with M30 aggregate as base material

step6. Apply Asphalt Concrete (AC) by Plant Hot Mix.

Step7. Compact the patch area with vibrating roller, vibrating plate or a rammer.

Step8. Traffic can resume after completing the work.

Operation sheet 3	**Conducting and recording manufacture and testing of all materials in accordance with appropriate Ethiopian standards**

In order to test the aggregate particle size distribution sieve analysis (Grading) is apply using the following producer.

Step1. Obtain a test sample by quartering or riffling the material.

Step2. Dry the sample in oven (at 105 – 110 0 C) and allow it to cool.

Step3. Record the weight of test sample after cooling (m1).

Step4. Arrange the specified sieves with a receiver at the bottom side.

Step5. Pour sample in the topmost sieve and cover it, then shake until no more material passes through each sieve.

Step6. Weigh (either individually or cumulatively) the material retained on each sieve (m2)

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 3day.

1. Identifying and recording impurities in raw and processed materials in accordance with council and quality assurance requirements.
2. Recommend appropriate type of repair and repair material for defective road surfaces.
3. Conduct and record manufacture and testing of all materials in accordance with appropriate Ethiopian standards.

Instruction Sheet	Learning Guide 18: Supervise Road Construction and Repair Work

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Selecting and scheduling appropriately skilled workforce to conduct roadwork
- Communicating job specifications and required tasks to scheduled workforce
- Monitoring road construction or repair work to ensure it satisfies quality assurance requirements and relevant legislation
- Monitoring and observing on-site Occupational Health and Safety (OHS) requirements at all times
- Using emergency equipment in working order and made available at the work site.
- Managing contingencies to ensure quality of road works
- Completing work within agreed timeframes

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Selecting and scheduling appropriately skilled workforce to conduct roadwork
- Communicating job specifications and required tasks effectively to scheduled workforce
- Monitoring road construction or repair work to ensure it satisfies quality assurance requirements and relevant legislation.

- Monitoring and observing on-site Occupational Health and Safety (OHS) requirements at all times
- Using emergency equipment in working order and made available at the work site.
- Managing contingencies to ensure quality of road works
- Completing work within agreed timeframes

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks”.in each information sheets.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After You accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result;
8. Then proceed to the next LG

Information sheet-1	Selecting and Scheduling Appropriately Skilled Workforce to Conduct Roadwork

2.1 Introduction

Improvements in project performance due to enhancements in labor skills have been highly demanding in the construction sector for a long time. It is widely acknowledged that project performance is based on the skills of the labors during the execution of the project, whose skills and abilities can affect the project's progress to a greater or lesser extent. This is mostly the case for construction projects. Normally the project is managed and supervised by the project manager, assistant project manager, construction engineer, project architect, contractors, or subcontractors and tasks are performed by involving physical labor at a construction site.

Results of many studies conducted on impact of manpower on project performance revealed that unskilled labor has a significant negative impact on project performance during the construction phase, whereas the results confirmed that skilled labors have a significant positive impact on project performance in enhancing the success rate of the project in the public construction industry.

2.2 Scheduling appropriate workforce

Workforce scheduling is a balancing act that requires managers to take into account a number of factors. Among those factors are the many issues involving employees, including their availability, their abilities, their desire to work, and the cost of their labor.

Many projects suffers time and cost overruns due to improper planning, scheduling and execution works that results in several issues like delay in providing facilities, development, reduction in quality of construction and making the project more expensive. A little consideration shows that the time required to complete the project is inversely proportional to the supply of manpower. As the manpower is increased, the completion time of the project is decreased and on the other hand if the manpower is decreased, the completion time of the project is increased.

Planning, scheduling is an important part of the construction management. Planning and scheduling of construction activities helps engineers to complete the project in time and within the budget.

Scheduling techniques help to align the timeline, the scope and your resources. A schedule has to fit a specified timeframe and use available resources with the right skills Keep planning and organizing work activities simple in order maximize effectiveness.

- Determine Specific Tasks. Brainstorm all required tasks throughout the day.
- Prioritize and Sequence Tasks. Group tasks together.
- Set Realistic Timetables.
- Remove Potential Distractions.

2.3 Overview of Workforce Scheduling

Most workforce-scheduling routines use one of two classic frameworks.

Scheduling criteria Workforce scheduling routines usually seek either to minimize the cost of the schedule (subject to constraints that ensure some level of staffing) or to maximize the schedule's overall benefit to the organization. Managers also try to draw up a schedule that will make the employees reasonably satisfied with the number and timing of their work hours. Unfortunately, developing a schedule that meets the goal of minimum cost or maximum benefit can conflict with employee preferences.

2.4 Job analysis

Job analysis (also known as work analysis is a family of procedures to identify the content of a job in terms of activities involved and attributes or job requirements needed to perform the activities. Job analysis provides information of organizations which helps to determine which employees are best fit for specific jobs. Through job analysis, the analyst needs to understand what the important tasks of the job are, how they are carried out, and the necessary human qualities needed to complete the job successfully.

The process of job analysis involves the analyst describing the duties of the incumbent, then the nature and conditions of work, and finally some basic qualifications. After this, the job analyst has completed a form called a job psychograph, which displays the mental requirements of the job. The measure of a sound job analysis is a valid task list. This list contains the functional or duty areas of a position, the related tasks, and the basic training recommendations. Subject matter experts (incumbents) and supervisors for the position being analyzed need to validate this final list in order to validate the job analysis.

Job analysis is crucial for first, helping individuals develop their careers, and also for helping organizations develop their employees in order to maximize talent. The outcomes of job analysis are key influences in designing learning, developing performance interventions, and improving processes. The application of job analysis techniques makes the implicit assumption that information about a job as it presently exists may be used to develop programs to recruit, select, train, and appraise people for the job as it will exist in the future.

Self-check	Written test

Direction short answer (3 point each)

1. Write importance of work scheduling?
2. What is job analysis and its advantage?

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
   _____
   _____
   _____
   _____
2. _____
   _____
   _____
   _____

Information Sheet-2	Communicating Job Specifications and Required Tasks to Scheduled Workforce

2.1 Job and task analysis

An important part of quality management is quality communication, because effective communication plays a vital role in your project. You should provide a common contact list and arrange a scheduled meeting to maintain a healthy working environment. Because of these required tasks, you need provide safe environment to assist and provides an effective communication platform and allows you to export all the all data and statistics as a report. This way you've solved three of your biggest challenges, defects ticketing, documentation, and communication.

A Project Plan is prepared which is defined as a management summary document that describes the essentials of a project in terms of its objectives, justification and how the objectives are to be achieved. It describes how all of the major activities under each project management function are to be accomplished, including that of overall project control. The project plan will evolve through successive stages of the project life cycle.

One of the main purposes of conducting job analysis is to prepare job descriptions and job specifications which in turn help hire the right quality of workforce into an organization. The general purpose of job analysis is to document the requirements of a job and the work performed. Job and task analysis is performed as a basis for later improvements, including: definition of a job domain; description of a job; development of performance appraisals, personnel selection, selection systems, promotion criteria, training needs assessment, legal defense of selection processes, and compensation plans. The human performance improvement industry uses job analysis to make sure training and development activities are focused and effective. In the fields of human resources (HR) and industrial psychology, job analysis is often used to gather information for use in personnel selection, training, classification, and/or compensation.

Industrial psychologists use job analysis to determine the physical requirements of a job to determine whether an individual who has suffered some diminished capacity is capable of performing the job with, or without, some accommodation. When a job analysis is

conducted for the purpose of valuing the job (i.e., determining the appropriate compensation for incumbents) this is called "job evaluation."

2.2 Purpose of workforce analyst

Workforce analysts interpret, analyze, rate, and make recommendations to improve the workforce in order to reduce overheads and increase customer satisfaction and experience. Their job description entails gathering and reviewing a lot of information related to staff performance and customer issues with the goal of determining ways to improve operations through effective staffing decisions and increase customer satisfaction and productivity.

They are responsible for preparing and managing staffing and scheduling to ensure that a sufficient amount of staff is available to perform all required tasks. They are responsible for assessing staffing levels daily, and monitoring attendance and schedule adherence.

The workforce analyst role also involves producing daily reports of staff members' attendance and performance for the human resources department, which is being used to determine whether employees are effectively utilized, or to develop strategies to recruit qualified staff.

It also includes generating regular and ad-hoc reports, including daily agent statistics and skill group/call type statistics; analyzing data to identify trends, issues, and opportunities, and uncovering levers impacting these issues, and developing recommendations for improvement.

Workforce analysts are responsible for providing periodic reports: real time and historical reports containing performance data to support operations management. They also communicate with the operations, management and human resources teams to be sure that all departments are abiding by company standards.

They are also responsible for appropriately responding to service level variations by working with client and operations to match staff to demand and/or reallocate call volumes.

They serve as the real-time monitor for the operations team by providing direction, guidelines, and performance updates to hit service level goals. The workforce analyst work description entails analyzing schedule performance, forecast accuracy, and underlying assumptions, as well as historical trends, and making continuous adjustments and improvements to the forecasting, headcount planning, and scheduling process to make sure both service levels and profitability goals are met.

Self-check	**Written test**

Direction choose the best answer (2 points each)

1. Workforce analysts is
   A. Interpret work
   B. Prepare detail drawing of the project
   C. make recommendation
   D. Analyze work process
2. Effective communication in the project is used to
   A. Complete within specified time schedule
   C. improve project quality

B. Effective resource management D. All

Note: **Satisfactory rating – 2 points** **Unsatisfactory - below 2 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____

Information Sheet-3	**Monitoring Road Construction or Repair Work to Ensure It Satisfies Quality Assurance Requirements and Relevant Legislation**

3.1. Introduction

Project monitoring is an integral part of life cycle management. A regular structural and environmental forcing monitoring program enables structures to be evaluated for safety, condition and functionality. This process also allows for timely planning of repair and replacement activities and can provide an adequate understanding of failure mechanisms and damage trends. The performance of a structure is assessed by comparing measures

of its condition and performance at a number of points in time. Such a monitoring program should, ideally, be designed at the time of the structure design but this is often not the case. Techniques used should be repeatable when following a clearly defined specification as well as tolerant of slight operator or procedural variations.

The monitoring plan should outline pre-failure symptoms and, if possible, indicate how to quantify the changes. Some identified failure modes may give no warning of impending collapse.

3.2. Guidelines for developing a monitoring program

A successful construction project is the one which can achieve a balance between cost, time, and quality. Quality control is branched from the quality management sector as the responsible party to ensure that products and facilities comply with requirements and established standards.

The strategy set by the management model is used to design the monitoring program.
Monitoring principally measures:

- functional performance
- structural condition
- environmental loading conditions
- The structure's impact on the local environment.

When developing a monitoring program, identify monitoring objectives and assess every component suggested for the monitoring program based on quality should be assured. Only include monitoring elements that support the goals review the project planning and design information to identify the physical processes that affect the structure. Rank these in order of importance with respect to the monitoring goals. For example, if the cross-sectional profile of a structure is to be monitored, it is necessary to establish the profile relative to known control points at the start of the monitoring period. The as-built drawings often serve as part of the baseline survey information for structure condition monitoring. It is recommended that as-built drawings based on after-construction surveys be prepared, but in their absence the original design drawings may have to serve as baseline

information develop a plan to obtain pre-construction bathymetry and measurements of the physical parameters that are likely to be affected by the structure.

3.3. Monitor quality of work

The common way of controlling quality is the inspection of finished parts of a product. The quality control engineers' main purpose is to minimize the chance of defects before the project delivery to the owner or his consultancy. Supervision of a construction project is not just as simple as marking in your construction punch list. Controlling quality means monitoring if the work practices are going as planned or not, examining the quality of the current construction tasks, and provides reports daily for any unsatisfactory work output.

In order to be appropriate and effective, quality system should comprise the knowledgeable staff, proper testing plan and equipment. It should also focus on the materials quality before being used to a permanent work and monitor closely the processing and finishing techniques.

Quality Control is a common terminology in most construction sites and is frequently used by the laboratory personnel; however, its meaning might not be clearly known by everyone. The term contains two words, quality (which means standards) and control (which means regulate or monitor). Therefore, Quality Control may be defined as the organized operations (inspections, sampling and testing) necessary for regulating or monitoring the work standards.

The main objectives of quality control in a road project are;

- To screen-out and prevent the use of substandard materials in the project by conducting preliminary and routine testing.
- To inspect the production process and enable quick corrections whenever production deviates from the project standards.
- To weigh up and grade the final product for acceptance.

Quality control takes account of materials properties (beneficial and detrimental behavior), application methods (workmanship) and the value of final product.

Self-check	Written test

Direction choose the best answer (2 points each)

1. Monitoring project is helps to
   A. timely planning of repair
   B. provide an adequate understanding of failure
   C. conduct replacement and repair activities timely
   D. All
2. Monitoring principally **not** measures:
   A. functional performance
   B. structural condition
   C. environmental loading conditions
   D. Countries rule and regulation
3. The main objectives of quality control in a road project are;
   A. To screen-out and prevent the use of substandard materials
   B. To inspect the production process and enable quick corrections
   C. To weigh up and grade the final product for acceptance
   D. All

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information Sheet-4	**Monitoring and observing on-site Occupational Health and Safety (OHS) requirements at all times**

4.1. Occupation health and safety at workplace

Ensuring safety regulations is essential need during both construction and maintenance works to adhere to protect workers and passengers during working time. This applies to both equipment and workers on site as well as in relation to third parties such as traffic passing on the road and people and property in the vicinity of the work sites. Workers on site need to be instructed about potential hazards and issued the necessary protective gear thereby reducing the risks of accidents.

Many road operations are potentially dangerous both to the workers and to the road users. There is clear evidence that accident rates increase on road sections where works are taking place, as compared to when the road is in good order and free from any obstructing work activities. To reduce the risk of accidents where road works take place, it is necessary to install adequate safety measures.

There is considerable scope for improving safety practices on road works sites and this also applies when maintenance is carried out on rural roads. Most measures to improve safety at work sites are inexpensive to implement and are often a matter of setting minimum standards and enforcing these.

A key to improving safety therefore lies with the client and its supervisory staff and introducing appropriate procedures for enforcing standard safety measures as part of the regular inspection routines.

The person in charge of a work site needs to ensure that all risks are minimized by:

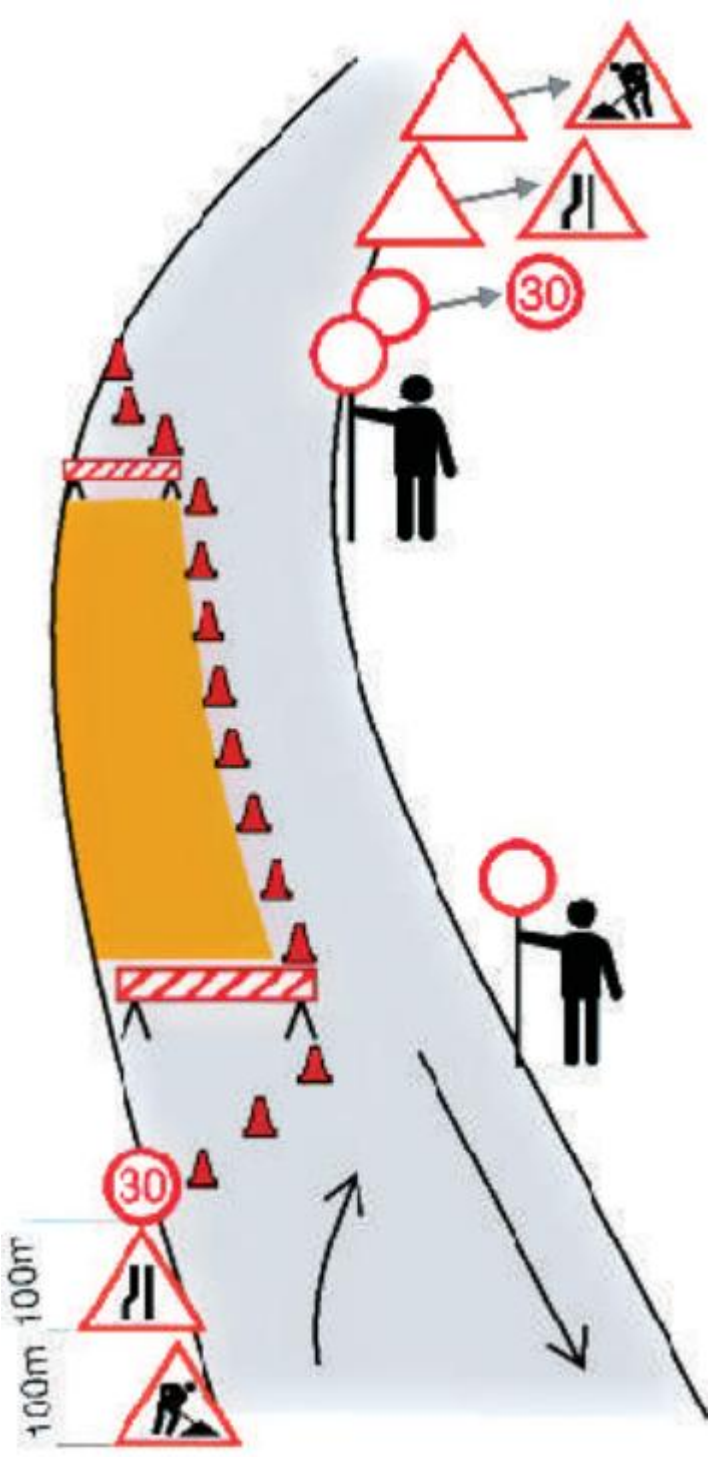
- Providing adequate traffic signs and protection at the location where works are taking place. Where necessary, traffic should be stopped during the placement or removal of temporary signs;
- arranging for safety vests and appropriate protective equipment to be worn by the workers;
- ensuring that all plant and vehicles are parked off the carriageway or behind protective barriers and signs, when not in use;
- ensuring that no materials are left in a dangerous location and that the road adjacent to the worksite is kept clean and swept of any debris arising from the maintenance work;
- taking proper precautions when handling dangerous substances e.g. hot bitumen, corrosive or poisonous substances;
- protecting all excavations for the benefit of all road users, equipment and workers;
- ensuring that all operators are trained in the correct operation of their equipment;
- informing operators and laborers alike of the potential risks of and procedures for working with or close to machinery;
- making sure that traffic control operations are properly organized and that road users are not unnecessarily delayed;
- ensuring all ladders or scaffolding used in bridge construction and maintenance are securely fixed;
- placing proper warning signs and taking appropriate measures to protect unfinished work on the carriageway or shoulder;
- Ensuring that all sites are left tidy and cleared of debris when the work is completed.

4.2. Signs and Safety Equipment

When working on the roadside or carriageway, traffic from both directions must be alerted. The following signs and barriers are useful for this purpose:

- Reversible 'Stop / Go' signs
- Speed limit signs (30 km/hr)
- 'Men working' signs
- 'No overtaking' signs
- 'Road narrows' sign
- 'End of restriction' signs
- Lane closure barriers and
- Traffic cones

These signs should be available as many as required. In addition to reflective vests, workers should be issued with various personal protective equipment depending on the work being undertaken such as; gloves, helmets, boots, overalls, dust masks, goggles and ear muffs.



4.2. Temporary Signposting

Temporary signs should be placed well ahead of the site from both directions to warn traffic and reduce the speed, both for work on the roadside and in the carriageway. It is important to install sufficient measures to ensure that the speed of traffic is reduced before it arrives at the work site.

At the work site, all damages to the road which pose a danger to the traffic should be properly marked so that the traffic is guided away at a safe distance. Equally, the traffic should be properly separated from where works take place. The work site needs to be

protected so that the traffic does not pose any danger to the workers, materials or equipment. Simple and inexpensive safety equipment such as traffic cones can improve safety for both the road users as well as the maintenance workers.

Cones are useful for:

(i) alerting the traffic of road works ahead,

(ii) guiding the traffic into diversions and

(iii) Keeping traffic at a safe distance from the work site.

Cones are easy to place and can be quickly moved when the works progress to another location.

Self-check 4	**Written test**

Direction short answer

1. List at list 5 Signs and Safety Equipment When working on the roadside or carriageway to assure workers safety. (5 point)
2. Write 3 advantages of Simple and inexpensive safety Cones in road work. (3 point)

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 4 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
   _____
   _____
   _____
2. _____
   _____
   _____
   _____
   _____

Information sheet-5	**Using Emergency Equipment in Working Order and Made Available At the Work Site**

5.1. Introduction

The National Institute for Occupational Safety and Health (NIOSH) reports that roughly 20,000 construction workers are injured each year in highway and street construction accidents. According to the Bureau of Labor and Statistics, approximately 100 construction workers are killed each year.

You must ensure that the work equipment you provide meets the requirements of standard. You should ensure that it is:

- **suitable** for use, and for the purpose and conditions in which it is to be used;
- **maintained** in a safe condition for use so that people's health and safety is not at risk; and
- **Inspected,** in certain circumstances, to ensure that it is and continues to be safe for use. Any inspection should be carried out by a competent person (this could be an employee if they have the necessary skills, knowledge and experience to perform the task) and a record kept until the next inspection.

5.2. Safety standards for highway & construction sites

The Occupational Safety & Health Administration (OSHA) developed standards to improve workplace safety and health. OSHA addresses safety concerns for construction sites, specifically the use of danger signs, caution signs, exit signs, directional signs and traffic signs. The following requirements are only a few examples:

- Construction sites shall be posted with legible traffic signs at points of hazard.
- All traffic control signs or devices used for the protection of construction workers shall conform to standards.
- Accident prevention tags shall be used as a temporary means of warning employees of an existing hazard, such as defective tools, equipment, etc.
- Signaling by flaggers and the use of flaggers shall conform to standards.

The improvement of safety, health and working conditions depends ultimately upon people working together, whether governments, employers or workers. Safety management involves the functions of planning, identifying problem areas, coordinating, controlling and

directing the safety activities at the work site, all aimed at the prevention of accidents and ill health. The following are the most common tips that should be consider by the employer to fulfill to assure the safety of the employee.

5.2.1 Firefighting equipment

Fires on construction sites arise from the misuse of compressed gases and highly flammable liquids, from the ignition of waste material, wood shavings and cellular plastic materials, and from the failure to recognize that adhesives and some floor and wall coatings are highly flammable.

Every individual on site should be aware of the fire risk, and should know the precautions to prevent a fire and the action to be taken if fire does break out. If fire breaks out, get someone to call the fire brigade. Do not continue trying to fight the blaze yourself if large quantities of fumes are being emitted in a closed space. Get out as fast as possible.

Fires are sometimes caused by carelessness in drying wet clothes. Heaters for this purpose, gas, oil or electric, should be mounted on and backed with non-flammable material, and enclosed in a stout wire mesh with effective air space to prevent clothing being placed directly upon them.

If you have to use a blow lamp or torch, or welding or burning equipment in the course of your work, first make sure that there is no fire risk to adjacent materials such as roof timbers. Many fires with disastrous consequences start from this source. Sparks can travel a long distance.

Everyone on site should be trained to:

- know of two unobstructed ways off the site if there is a fire or other emergency;
- know how to raise the alarm;
- know where firefighting appliances are kept;
- Be able to use the firefighting appliances; and be able to select the correct type of portable fire extinguisher for specific types of fire.

5.2.2 First Aid equipment and training

Your employer should provide sufficient aid equipment, training and information about first-aid treatment. Construction sites are dangerous places, and first-aid and rescue equipment should always be available. What is needed will depend on the size of the site and the numbers employed, but there should be at least a stocked first-aid box and a stretcher and blanket – the stretcher should be of a type which can be raised and lowered to and from upper floors. On large sites, and always where more than 200 people are employed, there should be a properly equipped first-aid room or hut.

On any construction site of size, at least one person on every shift should have been trained in first aid to a nationally recognized standard.

When there is an accident on site and someone is hurt, you can help by:

- calling for help from someone on site trained in first aid, or in cases of severe injury by calling an ambulance;
- preventing others (including yourself) from being injured from the same cause;
- providing life-saving first aid, even if you are not a trained first-aider;
- Reporting the accident at once to your supervisor.

5.2.3 Personal protective clothing and equipment (PPE)

The working conditions in construction are in most cases such that, despite all preventive measures in project planning and work design, some personal protective equipment (PPE), such as a helmet, hearing and eye protection, boots and gloves, is needed to protect workers.

OSHA regulates employers to provide construction employees with proper personal protective equipment (PPE), used to supplement administrative and engineering safety controls. OSHA standards provide criteria for personal protective equipment, including protection for the head, feet, eyes, face, hearing and respiration. It could be the last defense between a worker and a possible injury.

However, many injuries occur not because employees don't have protective gear but because they choose not to wear it. This means that employers not only need to provide the PPE, but must require employees to always use it.

A risk assessment will determine what personal protective measures work best at a given construction site. Such an assessment will require some, if not all, of the following.

Head Protection – Hard hats protect against impacts from fixed and falling objects. Some hard hats may come equipped with face shields or ear muffs. Helmets should fit properly and never be altered. They should also be replaced after any heavy blow. Be sure to inspect them periodically for cracks or deterioration.

Eye and Face Protection – Hard hats don't protect the face, which makes safety goggles or face shields very important. When it comes to cutting, grinding, welding, or nailing, eye protection is essential. They should also be worn when working with concrete or harmful chemicals, or when exposed to electrical hazards. Goggles might be tinted and some offer side shields.

Foot Protection – Steel-toed boots will prevent toes from being crushed due to falling objects. Construction workers should also wear slip-resistant, puncture-resistant soles.

Respiratory Protection– When employees work with paint or are exposed to toxic airborne substances, respiratory protection is vital. Respiratory protection can protect against pesticides, paint spray, fumes and even dust. Respirators must also be cleaned to remain effective.

Hearing Protection–Be sure to use earplugs or earmuffs in work areas with high noise levels especially if there is no sound barrier.

Hand Protection–Workers will need heavy-duty rubber gloves for concrete work and welding gloves for welding. Electrical hazards require insulated gloves and sleeves. Be sure to keep gloves snug.

High-Visibility Clothing–When visibility may be impaired, reflective clothing will be necessary.

Self Check 5	Written Test

Direction I: Give short answer to the following questions

1. List out at list 5 personal protective equipment and its advantage. (5 point)
2. What action will take as a first aid when there is an accident on site and someone is hurt? (4 point)
3. What are safety standards for highway construction that should be fulfill to assure safety of the worker. (3 point)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
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   _____
   _____
3. _____
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   _____
   _____

Information sheet-6	**Managing contingencies to ensure quality of road works and completed within agreed time frames**

6.1. Introduction

Contingency planning is the act of assessing work risk in various areas and developing primary plans and alternate plans for handling unpredictable situations. Road work contingency plans typically address everything from natural disasters that strike activities to drastic downward shifts in the construction process that significantly impact earnings. Contingency planning allows a business to develop workable solutions and directives should a feared event occur.

6.2. Weather change

Climate is defined as the regular weather conditions for an area. Weather is the day to day manifestation of this climate. Climate has a large influence on pavement construction and maintenance. Currently, the past climate is used to plan construction and maintenance activities. However, changes in the climate mean that practices currently used may not be appropriate for the future climate and therefore for the full life of the pavement.

The weather has always been one of the primary factors that affect the performance of both carriageways and footways. However, the extent to which climate affects the pavement also depends on many other factors such as the characteristics of the pavement (materials, structure and condition), traffic, underlying geology, geography and topography. Each of these may in themselves present a hazard to the pavement. In general the consequences of these hazards are deterioration of the surface, underlying layers and structure of the pavement and occasionally, in the event of extreme hazards, such as weather or traffic loading, catastrophic failure.

Highways are designed based on historic climate, however during their design life they could well be subjected to a very different climate. The cost of not taking this into consideration could be vast in terms of disruption to traffic, public safety and infrastructure repairs.

Adverse climatic conditions are a major factor affecting the economic vitality of the construction industry. The climatic conditions that most often affect construction work are precipitation, temperature, and wind. These conditions occur alone or in combinations. Rain, snow, or sleet that falls when the temperature is low and the wind velocity is high causes conditions that have the greatest effect on the comfort and safety of the worker, the quality of work, production, operating costs, and equipment wear.

6.2.1. Actions to reduce weather problems

The change in seasons may affect the conditions under which maintenance activities are undertaken, both with regard to the effect on the pavement and to avoid health and safety

issues for workers as a result of temperatures, storms and winds. Actions which may help minimize potential problems include:

- Prolonged dry periods leading to loss of skid resistance;
- laying deformation resistant asphalt mixes in thin layers in hot weather;
- Restricting laying periods to the cooler part of the day to allow materials to cool;
- Restricting laying periods to the cooler part of the day to reduce the effect of extreme temperatures on the work-force and;
- Protecting the surface of rigid pavements when lying during excessively wet weather.

The evidence provided by local authorities who have already experienced extremes of weather has demonstrated that each network is unique with its own particular vulnerabilities and that damage caused by the weather can be extremely expensive and disruptive. However, some adaptation to control road network defect due to sever climate change is already taking place including:

- Monitoring ground water levels
- Changes in asphalt standards
- Long term program for locating and assessing the adequacy and condition of current drainage
- Programs of drainage improvements
- changing the aggregate they use to one less prone to stripping;
- Trialing of reinforcement of roads to reduce subsidence

6.3. Work erinjuries or illness

The Occupational Health and Safety Act require that the constructor shall establish Emergency Response Procedures for every project. Emergency preparedness helps to minimize the human suffering and economic losses that can result from emergencies.

It should be understood that the size and complexity of projects, as well as their access and location, have a bearing on the degree of planning necessary for emergencies. It is therefore strongly recommended that the constructor ensure that a member of staff on site assist in developing the emergency response plan.

Planning shall begin before any work commences on the project. Although there may be little time between the award of the contract and the start of the project, a good emergency response plan can be generic and, with some minor changes, can be easily adapted to specific sites and readily implemented. This is especially the case where a constructor specializes in similar types of projects.

Development should include the following considerations:

- hazard identification/assessment
- emergency resources
- communication systems
- administration of the plan
- emergency response procedure
- communication of the procedure

A workplace emergency is an unforeseen situation that threatens your employees, customers, or the public; disrupts or shuts down your operations; or causes physical or environmental damage. Emergencies may be natural or manmade and include the following:

- Floods,
- Fires,
- Toxic gas releases,
- Chemical spills,
- Radiological accidents,
- Explosions,
- Civil disturbances, and
- Workplace violence resulting in bodily harm and trauma etc.

An emergency action plan covers designated actions employers and employees must take to ensure employee safety from fire and other emergencies.

6.4. Worker absences

Virtually all organizations now have absence management policies in place but it is still clear that absence may continue to cost a construction project by a million. A successful

absence management policy must recognize and take into account the different causes of absence and develop appropriate policies. It is also vital to recognize and accept that employees do take time off from work because they are genuinely ill.

Construction downtime can cause additional expenses and worse, a huge profit loss to clients and vendors. Poor management is a big impediment to the successful execution of a construction project. Management is the foundation of the project. If the foundation is shaky, then the building will surely collapse.

Good management starts with good communication. The team working on a project should maintain good communication, especially when things do not go well on the ground. The management should create conducive environment where everyone feels comfortable to talk about the plan, to send reports, and to ask questions from the first day of the project. Most importantly, it should ensure everyone is present when discussions about the project are taking place.

6.5. Supply breakdowns and Machinery failures

Construction equipment can be a very high expenditure for contractors. Thus, proper management is required for the optimal return on investment. Downtime due to equipment damage can result in discontented customers and difficulty winning future projects. Therefore, it is important to execute effective strategies to extend the life of your construction equipment and optimize its productivity.

Equipment breakdowns are not just inefficient for a construction schedule, either. They're stressful for the operator, aggravating for the supervisor and a pain for the entire construction crew who are interdependent on all the machinery on the job to function properly as a team. The following are some of the major causes of construction downtime that can be avoided to ensure a successful and timely project execution.

Lack of proper equipment

Using the wrong machinery for the wrong job does not only cause a waste of time and low productivity, but also compromises the limitations and longevity of the heavy equipment. Therefore, before heavy machinery gets crushed, invest in the right equipment.

Break down of machinery

When heavy equipment or the attachments reach their limitations, they become prone to damage and wear out, and to make matters worse, they break down. Machinery failures are costly. Although regular preventive maintenance helps ensure that machine works 100%, investing in reliable equipment saves a lot of time, money, and effort.

Waiting for new attachments

Waiting time obviously causes delays in finishing projects. If a new attachment is needed in the middle of the project, purchasing or renting new equipment is the only option. Waiting for new attachments puts things on hold because it may take some time before attachment suppliers can supply.

When it comes to buying new equipment, make sure to contact trusted manufacturers who can deliver high quality products quickly and on time.

Equipment certifications

Ensure that every heavy equipment, excavator attachment, and construction machinery pass certification or comply with legislation. This will ensure that there are no stoppages arising from legal issues with regards to the machines.

6.5.1. Cause of equipment breakdown

Most of the causes of equipment breakdown come from ten issues surrounding the overall operation of machinery. These ten preventable problems account for well over half of field breakdowns:

- Untrained personnel operating equipment
- Ignoring warning signals
- Failure to read the owner manual
- Overrunning the machine's capability
- Not replacing worn parts when needed
- Component misalignment
- Improper maintenance
- Improper equipment storage
- Improper weather-related use
- Poor electrical connections

Self-check	Written test

1. List at list 5 causes of equipment breakdown in road construction project. (5 point)
2. Write down causes of construction downtime that can be avoided to ensure a successful and timely project execution. (4 point)
3. List actions which may help minimize potential weather problems road construction industry. (3 point)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
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3. _____
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   _____

Operation sheet 1	**Monitoring road construction or repair work to ensure it satisfies quality assurance requirements and relevant legislation**

To ensure road works satisfy quality assurance requirements monitoring is required according to the following procedure.

Step1. Identify road under construction or repair which requires monitoring

Step2. Schedule in order to inspect work activity in the working site

Step3. Go to the field and observe each activities performing in the work site

Step4. Identify the work process performing comparing with quality assurance

Step5. Make recommendation to assure quality required if there is gap between actual work and quality standard.

Operation sheet 2	**Monitoring and observing on-site Occupational Health and Safety (OHS) requirements at all times**

In order to protect safety of workers in road work monitoring is essential.

Step1. Arrange time schedule to monitor site activity

Step2. Observe site work activities and Occupational Health and Safety (OHS) implementation in the working site.

Step3. Investigate OHS requirements which are should be provided

Step4. Make recommendation to fulfill OHS requirements

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 3day.

1. Monitor road construction or repair work to ensure it satisfies quality assurance requirements and relevant legislation.
2. Monitor and observe on-site Occupational Health and Safety (OHS) requirements at all times.

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Assessing site drainage requirements in accordance with legislative requirements
- Monitoring quality of drainage water and run-off from the site to ensure compliance with legislation
- Identifying issues relating to damage from environmental impact and processes are implemented to prevent or minimize impact.
- Planning and carrying out reinstatement of the surrounding environment i in accordance with relevant legislation.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Assessing site drainage requirements in accordance with legislative requirements
- Monitoring quality of drainage water and run-off from the site to ensure compliance with legislation
- Identifying issues relating to damage from environmental impact and processes are implemented to prevent or minimize impact.
- Planning and carrying out reinstatement of the surrounding environment i in accordance with relevant legislation.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” in each information sheets.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).

6. If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After You accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result;
8. Then proceed to the next LG

Information Sheet 1	**Assessing site drainage requirements in accordance with legislative requirements**

2.1 Introduction

One of the most important factors in building a road is drainage. If every other aspect of highway design and construction is done perfectly but the drainage does not work well, the road will fail quickly. Excess water, which is precipitated as rain, hail, snow or sleet, is the enemy of earthwork foundations, pavements and traffic. Consequently, proper surface drainage design is an essential and integral part of economic road design.

Roads cut across and obstruct natural drainage paths and, hence, there may be locations where flood waters have the power, if given the opportunity, to destroy a roadway by force or to hold up traffic by flooding a carriageway. The barrier effects of new roads can result in blockages on existing local drainage channels which cause redirection and redistribution of stream flows and alter local catchment areas and boundaries. Thus, good drainage design begins with good route location, and roads that avoid poorly-drained areas, unstable foundation soils, frequently flooded areas, and unnecessary stream crossings greatly reduce the costs and dangers associated with these aspects of road drainage. Good location may also make it more economical to relocate stream channels rather than provide bridges, major culverts and/or other expensive drainage features to accommodate them – assuming that the impacts of the proposed channel changes upon the environment are acceptable to the public.

Water on a road always poses potential danger to moving vehicles, due to the longer distances required to stop under wet conditions. Surface drainage must be provided to drain precipitation away from the pavement structure. In a simple example, cross slope directs water to the shoulder where it flows into a ditch, then down the ditch to a culvert and finally into an existing natural drainage.

1.1.1. Side drainage assessment

The design of surface drainage system has two phases

- Hydrologic analysis - to determine amount of water
- Hydraulic analysis - to design the drainage facility

Hydrologic Analysis

Several methods for estimating runoff are available. Two commonly used methods applicable to available data for Ethiopia are

- rational method and
- SCS Synthetic Unit Hydrograph.

Rational Method

The Rational Method is most accurate method for estimating the design storm peak runoff for areas up to 50 hectares (0.5 km^2). This method, while first introduced in 1889, is still widely used. Even though it has come under frequent criticism for its simplistic approach, no other drainage design method has achieved such widespread use.

The rational formula estimates the peak rate of runoff at any location in a catchment area as a function of the catchment area, runoff coefficient, and means rainfall intensity for duration equal to the time of concentration.

The rational formula is expressed as:

$Q = CIA$

Where:

Q = maximum rate of runoff, m^3/s

C = runoff coefficient representing a ratio of runoff to rainfall

I = average rainfall intensity, mm/sec

A = catchment (drainage) area tributary to the design location, in km^2

The various factors affecting the runoff are rate of rainfall, type of soil and moisture condition, topography of the area, type of ground cover like vegetation etc.

Runoff Coefficient, C

The runoff coefficient, C, is the ratio of runoff to rainfall for the drainage area. The runoff coefficient depends on the type of ground cover, the slope of the drainage area, storm duration, prior wetting, and the slope of the ground.

Basic Hydraulic Analysis

There are two types of flow in open channels, steady flow and unsteady flow. For steady flow, the flowdepth at a given cross section does not change; it can be assumed to remain constant during the timeinterval under consideration. With unsteady flow, the depth of flow at a given cross section changes with time. Steady flow is uniform if the depth of flow is the same at every section along the length of the channel. Steady, uniform flow is an ideal condition which seldom occurs in natural channels.

However, for many practical applications, changes in width, depth or direction are sufficiently small so that uniform flow can be assumed. Assuming uniform, steady flow in a channel, the mean velocity may be computed using the Manning equation as:

$$v = \frac{1}{n} R^{2/3} S^{1/2}$$

Where:

v = average velocity (m/sec).

R = A/P = Hydraulic radius (m).

A = area of cross-sectional flow (m^2).

P = wetted perimeter (m).

S = slope of total head line (m/m).

n = manning's roughness coefficient.

The wetted perimeter of the channel is the perimeter of the channel in contact with water. Discharge from the channel is given as:

$$Q = Av$$

$$Q = Av = \frac{1}{n} AR^{2/3} S^{1/2}$$

Best hydraulic sections

- Semi-circular cross section - is the best hydraulic section
    - For a given Q, S, and n smallest A and P
    - For a given A, S, and n max. Q and min. P
- Rectangular cross section
- Trapezoidal cross-section
- V – shape cross section
- Circular cross-section

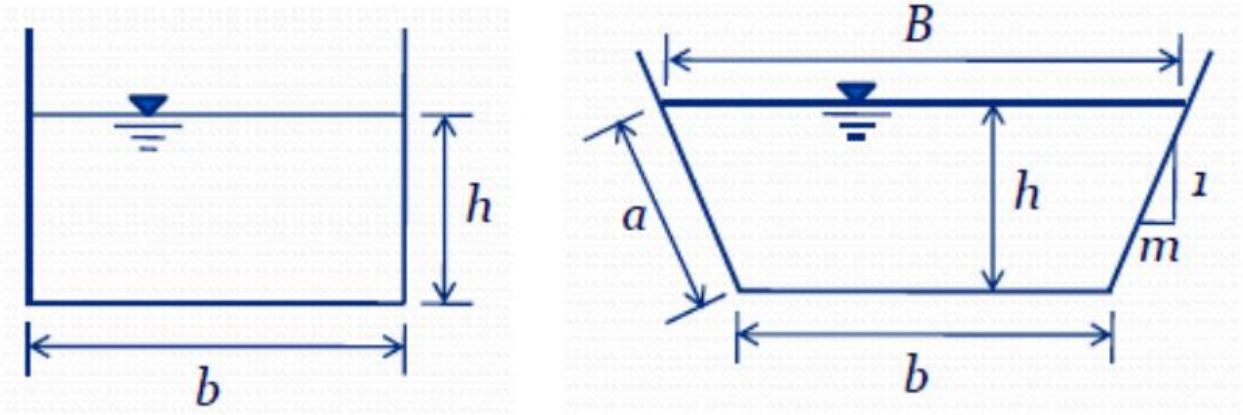

Figure 9: Rectangular and trapezoidal drainage canals

Self-check	**Written test**

Direction choose the best answer (2 points each)

1. Which one of the following cross-section is best hydraulic cross-section?

A. Triangular cross-section
B. Rectangular cross-section
C. Trapezoidal cross-section
D. Semi-circular cross-section

2. Best hydraulic sections means
   A. For a given Q, S, and n smallest A and P
   B. For a given A, S, and n min. Q and min. P
   C. For a given Q, S, and n max. A and P
   D. None

Short answer

3. Write two methods of estimating surface runoff. (2 point)

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information Sheet 2	**Monitoring Quality of Drainage Water and Run-Off from the Site to Ensure Compliance with Legislation**

2.1 Introduction

Highway design uses a combination of surface and subsurface drainage solutions. Subsurface drainage problems often lead directly to pavement failure. They may also lead

to slope failures, particularly when fills are constructed on existing slopes or when roads are constructed through steep cuts. There are many sources of subsurface water and just as many solutions. For example, longitudinal and transverse drains used in conjunction with drainage blankets can remove groundwater and water melting from ice lenses.

2.2 Consideration of Highway Drainage System

Highways by their nature cut across natural drainage ways and stream; and as a result adequate and economical drainage is absolutely essential for the protection of the environment and safeguarding the lives of the persons using the highway.

Problems resulting from poor drainage system in highway include

- Standing water on pavements is a danger to traffic safety
- Seepage water into pavement and subgrade leads to deform road network
- Development of soft spots & breakup of the surfacing
- Streams have the power to damage road and road protection structures
- Destroy roadways by force & holdup traffic by flooding

Therefore the requirements of highway drainage system to alleviate such problems include

- Surface water from carriageway and shoulder should effectively be drained
- Surface water from adjoining land should be prevented from entering the roadway
- Flow of surface water across the road and shoulders and along slopes shouldn't cause formation of cross ruts or erosion

- Seepage and other sources of underground water should be drained off by the subsurface drainage system
- In water logged areas special precautions should be taken

Figure 10: Slope failure in Highway due to improper drainage system

Factors to be considered in drainage design include

- Size of the area to be drained
- Expected maximum rainfall
- Slope of the surrounding terrain / possible rate of runoff
- Characteristics of the soil (incl.: permeability, tendency to erode)
- Presence of springs or other underground water
- General elevation of the ground water level
- Minimum depth of cover required to protect pipes from traffic loads

Self-check	Written test

Direction choose the best answer (2 points each)

1. Poor drainage system in highway leads to?
   A. Standing water on pavements improve pavement quality
   B. Seepage water into pavement increase road foundation
   C. Streams have the power to damage road and road protection structures
   D. Increase the life of road structure
2. Requirements of highway drainage system to alleviate such problems include
   A. Surface water from carriageway and shoulder should effectively be drained
   B. Surface water from the land should be encouraged to entering to the roadway

C. Encourage flow of surface water across the road to depose soil on and along the road

D. In water logged areas special precautions should not be taken

3. Factors to be considered in drainage design include

A. Size of the area to be drained

B. Expected maximum rainfall

C. Slope of the surrounding terrain / possible rate of runoff

D. All

Note: **Satisfactory rating – 6 points** **Unsatisfactory - below 6 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
2. _____
3. _____

Information Sheet 3	**Identifying and Processing Issues Relating to Damage from Environmental Impact Are Implemented to Prevent Or Minimize Impact**

3.1 Introduction

Highway and traffic have earned the dubious distinction of being the worst defilers of the environment. They have a direct impact on social and community values, the environment and the ecology. In view of the growing awareness of the community and the government to preserve and enhance the environmental values, highway engineers have to plan, construct and maintain highways with this special requirement in mind.

Before the highway engineer prepares any scheme, he should prepare an environmental impact statement. The environmental impact statement containing an assessment of the anticipated significantly effects that the proposed action may have on the quality of the environment. The purpose of the environmental impact statement is to ensure that careful attention is given to environmental matters and that such matters are appropriately considered in the highway agency's decision.

3.2 Environmental impact of road

Roads can have both positive and negative influences on people and the environment. On the positive side roads provide the opportunity of mobility and transport for people and goods. On the negative side roads occupy land resources and form barriers to animals. They can also cause adverse impacts on natural water resources and discharge areas.

The three most damaging effects of road construction and management are **noise, dust** and **vibrations**. Noise mainly occurs during road construction phases but it can also occur to a lesser degree during maintenance operations. Dust is created during the construction of gravel roads and unbound aggregate layers. Excess dust production can be treated by a range of means such as watering, the use of alternative materials, and by using dust binders near houses. Vibration can be caused by uneven road surfaces and can pose significant impacts and problems to houses close to the source.

Noise is defined as a sound that is undesirable to the listener. The level of the disturbance caused by sound will depend on its extent and intensity, and on the sensitivity of the persons affected. The condition of roads has an effect on noise level. For example if a road is in poor condition and cars are traveling fast, this can cause more noise than if the road is in good condition. Greater consideration must therefore be given if road works are likely to create noise. Noise disturbances may cause irritation as well as agitation and stress to livestock.

A simple but fairly effective measure to manage the effects of noise is to notify the persons likely to be affected that work is about to start. This can be done by delivering information leaflets through letterboxes and/or by posting notices on notice boards. For major work, it

may be sensible to convene an information meeting. If people are notified, their acceptance of the disturbance is usually higher. It is wise to work within normal working hours as much as possible. Where this is impossible, the persons affected should be given special notification. There are only limited ways of reducing the noise level. Noise can obviously be reduced by noise fences or similar structures, but these are often impracticable on roadwork sites, particularly for minor works of short duration.

A general piece of advice that applies to noise is to use modern equipment wherever possible. Such equipment normally has better noise and vibration attenuation than older machines. Modern machinery also offers other benefits, such as reduced emissions, etc.

Vibrations disturb people close to roads but they may also cause damage to buildings and sensitive equipment. Vibrations, and also noise, can affect local fauna. Moreover, vibrations can cause damage to geological and archaeological objects. Major sources of vibrations to surrounding households are uneven roads with potholes and differential frost heave. Vibration levels can be different in winter when the ground is frozen compared to summer. Vibrations caused by poor road conditions can be also a risk to the health of drivers.

If vibrations are likely to be caused by road works, greater consideration should be given to when the work should be done. As with the noise problems a simple and effective measure is to notify the persons about the planned road works so that they can be informed of their reason and expected duration.

Unnecessary high vibration sources, such as compaction with heavy vibration rollers or bedrock blasting, should be avoided or minimized in built-up areas. Heavy vibrations can cause damage to buildings and installations, which can give rise to damage claims. Methods and equipment that minimize vibrations should therefore be employed.

Dust is an almost inevitable consequence of roadwork. Gravel and crushed gravel and hard rock aggregates always contain a proportion of fines, and if the material is dry, a fairly

heavy dust cloud can be raised when it is mobilized. The resulting dust can disturb both the population and the local environment.

Dust from local geological material should not be inherently environmentally harmful to the local landscape whether it is deposited either naturally or by the next rain shower. However, it should be kept in mind that if the dust is spread to watercourses and lakes, it may cause cloudiness in the water affecting aquatic life. Great care should therefore be taken in such cases.

Dust incidences can be treated by watering, alternative material choices or using dust binders near houses. If dust binders are used they should be used with care especially when they could affect the local groundwater.

Waste is defined as "any substance or object which the holder discards, intends to discard, or is required to discard". Note that this may include unexpected materials, such as excavated soil that cannot be re-used.
Waste may arise in different ways:

- Packaging material
- Residual road structure material
- Dangerous waste, oil from machines, etc

Good handling of materials can enable most residual materials to be put to use in one way or another. If the quality of material is too poor to use in the road structure, it can usually be employed as landscaping material, e.g. to level out steep slopes. Some waste will of course always occur, e.g. packaging material, oil residues and the like, but these should be minimized.

Contents of an environmental impact statement:

- Description of the proposed action and alternatives considered
  - ✓ Location, type, and length of facility, termini, number of lanes, right-of-way width.
  - ✓ Other design features such as general horizontal and vertical alignment, structures, etc.

- ✓ Deficiencies of existing facilities, anticipated benefits
- Land use planning: description of planning processes for the area
- Probable impact of proposed action on the environment
  - ✓ Natural, ecological, scenic resource impacts
  - ✓ Relocation of individuals and families
  - ✓ Social impacts
  - ✓ Air quality impacts
  - ✓ Noise impacts
  - ✓ Water quality impacts
  - ✓ Construction impacts
- Alternatives to the proposed action
- Probable adverse environmental effects that cannot be avoided.
- The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity.
- Irreversible and irretrievable commitments of resources.
- The impact on properties and sites of historic and cultural significance

Self-check	Written test

Direction choose the best answer (2 points each)

1. ----- can cause damage to geological and archaeological objects
   A. Noise
   B. Vibration
   C. Dust
   D. None
2. **-------** is any substance or object which the holder discards, intends to discard, or is required to discard
   A. Waste
   B. Vibration
   C. Noise
   D. Dust
3. Waste may arise in
   A. Packaging material
   B. Reuse residual road structure material for landscape
   C. Effectivly remove or resuse dangerous waste
   D. All
4. Which one of the following is **not** Contents of an environmental impact statement
   A. Description of the proposed action and alternatives considered
   B. Land use planning, description of planning processes for the area
   C. Probable impact of proposed action on the environment
   D. Alternatives to the proposed action
   E. History and culture of Community

Note: **Satisfactory rating – 4 points** **Unsatisfactory - below 6 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____ 3. _____
2. _____ 4. _____

Information Sheet 4	**Planning and Carrying Out Reinstatement of the Surrounding Environment in Accordance with Relevant Legislation**

4.1 Introduction

Ethiopia set a target to restore 15 million hectares of degraded and deforested land into productivity by 2025 – that's one-sixth of the country's total land area. A growing population – and with that, an increased demand for land for food production led to the loss of nearly 97% of Ethiopia's native forests. Economic losses caused by soil degradation are estimated to be greater than USD 1 billion in the 1980s, the widespread loss of trees and soil, compounded by drought, led to the disastrous famine of 1984-1985, which killed nearly one million people. Over the past 30 years Ethiopia began rehabilitating these extremely degraded lands.

Tigray is one example of how restoration can improve lands and livelihoods in Ethiopia. For more than 10 years, villagers of Tigray contributed up to 40 days per year of voluntary labour to dig infiltration pits or construct terraces, stonewalls, and other conservation works. Severely degraded land was set aside for tree planting and to allow natural regeneration to occur.

The systemic ecosystem management helped recharge groundwater levels in the valleys below. The area under irrigation increased with a factor six from almost 5,000 hectares in 2000 to 30,000 hectares in 2008. This helped expand agricultural production even in drought years, providing food security and steady incomes.

Road ecology is the study of the ecological effects (both positive and negative) of roads and highways (public roads). These effects may include local effects, such as on noise, water pollution, habitat destruction/disturbance and local air quality; and wider effects such as habitat fragmentation, ecosystem degradation, and climate change from vehicle emissions.

The design, construction and management of roads, parking and other related facilities as well as the design and regulation of vehicles can change their effect. Roads are known to cause significant damage to forests, prairies, streams and wetlands. Besides the direct habitat loss due to the road itself, and the road-kill of animal species, roads alter water-flow patterns, increase noise, water, and air pollution, create disturbance that alters the species composition of nearby vegetation thereby reducing habitat for local native animals, and act as barriers to animal movements. Roads are a form of linear infrastructure intrusion that has some effects similar to infrastructure such as railroads, power lines, and canals, particularly in tropical forests. Road ecology is practiced as a field of inquiry by a variety of ecologists, biologists, hydrologists, engineers, and other scientists.

4.2 Environmental disturbance

Disturbance is a change in environmental conditions that disrupt the functioning of an ecosystem. Disturbance can occur at a variety of spatial and temporal scales, and is a natural component of many communities. For example, many forest and grassland restorations implement fire as a natural disturbance regime. However the severity and scope of anthropogenic impact has grown in the last few centuries. Differentiating between human-caused and naturally occurring disturbances is important if we are to understand how to restore natural processes and minimize anthropogenic impacts on the ecosystems.

4.3 Restoring environment

Restoration ecology is the scientific study supporting the practice of ecological restoration, which is the practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment by active human intervention and action.

Effective restoration requires an explicit goal or policy, preferably an unambiguous one that is articulated, accepted, and codified.

Natural ecosystems provide ecosystem services in the form of resources such as food, fuel, and timber; the purification of air and water; the detoxification and decomposition of wastes; the regulation of climate; the regeneration of soil fertility; and the pollination of crops. These ecosystem processes have been estimated to be worth trillions of dollars annually. There is consensus in the scientific community that the current environmental degradation and destruction of many of the Earth's biota are taking place on a "catastrophically short timescale.

Restoration ecology is the academic study of the process, whereas ecological restoration is the actual project or process by restoration practitioners. The Society for Ecological Restoration defines "ecological restoration" as an "intentional activity that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability". Ecological restoration includes a wide scope of projects including:

- erosion control,
- reforestation,
- removal of non-native species and weeds,
- re-vegetation of disturbed areas,
- day-lighting streams,
- the reintroduction of native species (preferably native species that have local adaptation), and
- Habitat and range improvement for targeted species.

For lots of researchers, the ecological restoration must include the local communities: they call this process the "social-ecological restoration". Restoration is used as a tool for reducing the spread of invasive plant species many ways. The first method views restoration primarily as a means to reduce the presence of invasive species and limit their spread.

Restoration projects are also used as a way to better understand what makes an ecological community resistant to invasion. As restoration projects have a broad range of

implementation strategies and methods used to control invasive species, they can be used by ecologists to test theories about invasion. Restoration projects have been used to understand how the diversity of the species introduced in the restoration affects invasion. We know that generally higher diversity prairies have lower levels of invasion. The incorporation of functional ecology has shown that more functionally diverse restorations have lower levels of invasion. Furthermore, studies have shown that using native species functionally similar to invasive species are better able to compete with invasive species. Restoration ecologists have also used a variety of strategies employed at different restoration sites to better understand the most successful management techniques to control invasion.

4.4 Environment restoration Succession

Ecological succession is the process by which a community changes over time, especially following a disturbance. In many instances, an ecosystem will change from a simple level of organization with a few dominant pioneer species to an increasingly complex community with many interdependent species. Restoration often consists of initiating, assisting, or accelerating ecological succession processes, depending on the severity of the disturbance. Following mild to moderate natural and anthropogenic disturbances, restoration in these systems involves hastening natural successional trajectories through careful management. However, in a system that has experienced a more severe disturbance (such as in urban ecosystems), restoration may require intensive efforts to recreate environmental conditions that favor natural successional processes.

Self-check	Written test

Direction short answer

1. Define Environmental disturbance.(3 point)
2. What is Restoring environment (3 point)
3. List out at list 4 scopes considering helps to restoring ecology of the environment (4 points)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
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   _____
2. _____
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   _____
3. _____
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   _____
   _____

Operation Sheet 1	Assessing Site Drainage Requirements in Accordance

	With Legislative Requirements to Drain Drainage Water and Run-Off Compliance with Legislation

In order to effectively drain runoff from work site, site observation and collect necessary data is needed.

Step1. Collect all necessary hydro-meteorological data from the field meteorology station or office

Step2. Analyze the hydro-meteorological data

Step3. Calculate the effective runoff may generate

Step4. Design effective and most economical structures used to drain runoff

Step5. Construct structure accordingly

Operation sheet 2	**Identifying and processing issues relating to damage from environmental impact are implemented to prevent or minimize impact**

To protect environment degradation due to road construction we should implement environmental impact assessment according to the following procedure.

Step1. Inspect and observe work site and environmental conditions

Step2. Identify possible potential environmental impacts may occur during or after construction

Step3. Identify possible mitigation measures to protect, restore or compensate the negative impact

Step4. Make recommendation and implement possible mitigation solutions already designed

LAP Test	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 3day.

1. Assess site drainage requirements in accordance with legislative requirements to drain drainage water and run-off compliance with legislation
2. Identify and process issues relating to damage from environmental impact are implemented to prevent or minimize impact

Instruction Sheet	Learning Guide 20: Report the Outcomes of Road Constructing and Maintenance Supervision

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- Analyzing, recording and reporting monitoring and supervision data according to organizational procedures and statutory requirements
- Identifying and reporting current or potential problems

-

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

- Analyzing, recording and reporting monitoring and supervision data according to organizational procedures and statutory requirements
- Identifying and reporting current or potential problems

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” in each information sheets.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets and LAP Tests if any”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity.
7. After You accomplish Operation sheets and LAP Tests, ensure you have a formative assessment and get a satisfactory result;
8. Then proceed to the next LG

Information Sheet 1	**Analyzing, Recording and Reporting Monitoring and Supervision Data to Organizational Procedures and Statutory Requirements**

1.1 Data Collection, Analysis and Reporting

1.1.1. Determining what information to collect

The general purpose of data recording is to set in writing and assure the preservation of the data collected in the course of field or laboratory studies. The experimental design of

each study determines the types of data to be collected in terms of the objectives and resources available for the study. Whatever the nature of the types of data, however, there is need for suitable forms or questionnaires to record the information to be gathered. It is often convenient to prepare these forms or questionnaires by discipline or type of data. The use of pre-coded forms or questionnaires that permit the direct registry of data is to be preferred, since with proper training, their use often results in fewer errors. Additionally, only one protocol or set of forms will be used to collect and code the information to be recorded in the field or in the laboratory for each unit of study.

Deciding what data to collect will depend on the phase of the project: the conceptual, design, production, or maintenance phase. In any case, data should include failures due to equipment failure and human error.

- The conceptual phase will require the use of data from similar products.
- The design phase will require research or actual test data for the specific product.
- The production phase requires the use of a more historical type data derived sometimes from the design stages.
- The maintenance phase requires the use of actual failure data that may have been acquired with various failure analysis techniques.

Five basic steps are outlined below that will help determine what data to collect:

- Find out what happened, and be as specific as possible. At what level in the overall system, product, or process was the event discovered?
- Method of detection. Internally? Externally?
- Find out when the event happened. During testing? During production run?
- Find out if there is a similar event in historical records. If the answer is "yes," it could save time by eliminating some data collection.
- Find out if there have been any recent changes. Check vendor materials, test conditions, etc.

1.1.2. How will data be collected and reported

Data may be collected by either manual or automatic means. Most test results or observations are recorded manually on forms customized to collect specific information

then input into a computer database. Data is sometimes taken automatically through the use of electronic devices that send information directly to a database. The automatic data information gathering technique is usually desirable where continuous monitoring is necessary.

There are no standards for how to record or store data. When data is input into a computer, manually or automatically, both retrieval and use become obviously enhanced. There are many software packages on the market that can be readily tailored to fit specific needs for data analysis and reporting.

1.1.3. Who will collect the information

Data collection can be initiated when the personnel responsible for data collection have been properly trained and have reached a satisfactory level of standardization. In addition, forms, questionnaires and coding manuals must be considered operational. The description of recording forms, and the techniques and procedures to be employed should be integrated into a standard operating protocol (SOP) for the evaluation. In the course of long term studies, changes in procedure may be mandatory. Accordingly, it is advisable to produce the SOP in a loose leaf form for ease of insertions as may be required. In this connection, however, it is essential that all changes introduced in the course of the evaluation be fully documented in terms of justification, nature of the change and date of implementation.

Several types of errors may arise during the data collection stages which may produce biases affecting the interpretation of results. These errors are generally associated with failure to complete interviews, missing data, interviewer mistakes, and conceptual misunderstandings, lack of knowledge, and intentional misrepresentations of truth by the respondents. To minimize the effects of these factors or conditions, special attention must be given to proper supervision throughout the data collection stages.

Deciding who will collect the information depends on who will use the data, the accuracy needed, and time and cost constraints. Keep in mind that the person who collects data is not necessarily the one who will use it.

1.1.4. What level of accuracy is needed

Accuracy will depend on the product and its intended use. For example, a cook may only need to take time and temperature data at so many minutes and degrees, while a race car designer may want time and temperature in tenths of seconds and degrees. For another example, if someone is asked their age 10 days before their 40th birthday, they may reply 39 or 40. Which is more accurate? Which is accurate enough? It could be important enough to require an answer like: 39 years, 355 days, 12 hours, and 15 minutes. Of course, estimating age usually will not require that much detail, but when asking how long a verified equipment problem has persisted, details do become important.

The program outlined below will help assure that accurate and complete data is collected which meets the objectives for data collecting, identifying, reporting, verifying, analyzing, and correcting problems.

1.2 Reporting of analyzed data

A report should be initiated at the occurrence of each problem or failure of hardware, software, or equipment. The report should contain the information required to permit determination of the origin and correction of failures. The following information should be included in the report.

1.3 Corrective-action and follow-up

When the cause of a failure has been determined, a corrective-action shall be developed to eliminate or reduce the recurrence of the failure. The procuring activity should review the corrective-actions at scheduled status reviews prior to implementation. In all cases, the failure analysis and the resulting corrective-actions should be documented. The effectiveness of the corrective-action should be demonstrated by restarting the test at the beginning of the cycle in which the original failure occurred.

1.4 Who will use the information?

Deciding who will use the data is probably of less concern than what data to use. Usually everyone involved in the project will use some portion of the information. Assuring that collected information is available to all through data analysis and reporting, and making it easily accessible, is the key.

Self-check	**Written test**

Direction written test

1. Write and discuss in detail about definition and necessity of data collection, analyze and report. (10 point)

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____
   _____
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Information Sheet 2	**Identifying and Reporting Current or Potential Problems**

2.1 Identifying and reporting problems related to construction industry

The construction industry everywhere faces problems and challenges. However, in the developing countries, these difficulties and challenges are present alongside a general situation of socio-economic stress, chronic resource shortages, institutional weaknesses and a general inability to deal with the key issues. There is also evidence that the problems have become greater in extent and severity in recent years.

Construction industry is a highly risky process mostly because of its long life duration and unique product as a result of construction, and also many different professions are involved in one project. Generally, risks in construction industry should be controlled and reduced during design, procurement and construction phase, and the most important activities are define risk management plan from the very beginning and to assign risks to different project members and to manage their execution. In this paper risks on a project in initial phase will be presented, cost and duration risks and complete contingency for the

previously defined budget will be described. Statistical data for one project in design phase will be analyzed and general comments and recommendations will be proposed. Also, general method for calculating risks will be presented.

A risk assessment is simply a record of the health and safety risks to which you and others are exposed to on a construction site, and the precautions to protect you all. Risk management in construction is designed to plan, monitor and control those measures needed to prevent exposure to risk. To do this it is necessary to identify the hazard, assess the extent of the risk, provide measures to control the risk and manage any residual risks.

A construction risk can be defined as any exposure to possible loss. ... To ensure the success of a project, a contractor starting on a construction project must be able to recognize and assess those risks.

Common risks include:

- Safety hazards that lead to worker accidents and injuries.
- Managing change orders.
- Incomplete drawings and poorly defined scope.
- Unknown site conditions.
- Poorly written contracts.
- Unexpected increases in material costs.
- Labor shortages.
- Damage or theft to equipment and tools.

Self-check	Written test

Direction short answer

1. How to identify potential problems in construction industry? (6 point)

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Answer sheet

1. _____

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Operation sheet 1	Identifying and reporting current or potential problems

In order to identify and report potential problems the following steps should be undertaken

Step 1: Assess the work site activities

Step2: Identify hazards, i.e. anything that may cause harm.

Step 3: Decide who may be harmed, and how.

Step 4: Assess the risks and take action.

Step 5: Make a record of the findings.

Step 6: Review the risk assessment.

Step 7: reporting to concerned body.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 3day.

1. Identify and report current or potential problems that may occur?

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