

CHAPTER 21: CONSTRUCTION OF ONSITE SANITATION FACILITIES

21.1 Introduction of the Unit of Learning

This unit covers the competencies required to construct onsite sanitation facilities. It involves preparing construction schedule, organizing the construction site and construction of the various onsite sanitation facilities. This standard applies in water Industry.

21.2 Performance Standard

Prepare construction schedule, organize the construction site, and construct the various onsite sanitation facilities based on engineering codes, scope of work, and project specifications.

21.3 Learning Outcomes


21.3.1 List of Learning Outcomes

- a) Prepare construction schedule
- b) Organize the construction Site
- c) Construct the various onsite sanitation facilities

easytvvet.com

21.3.2 Learning Outcome No 1: Prepare Construction Schedule

21.3.2.1 Learning Activities

Learning Outcome No 1: Prepare Construction Schedule	
 Learning Activities	Special Instructions
1.1 Interpret engineering drawings 1.2 Identify <i>construction activities</i> 1.3 Prepare project management timelines	<ul style="list-style-type: none">• Trainer guidance on the application of engineering codes• Use of updated engineering codes

21.3.2.2 Information Sheet No21/LO1: Prepare Construction Schedule



Introduction to learning outcome

This section deals with the necessary steps taken for the construction of the onsite sanitation facilities. Scheduling construction activities involve distributing the construction tasks available over a specified time frame to ensure its timely delivery and a high quality output of the final product. Sanitation has always been neglected during water supply. However, there has been a tremendous development s in the innovation of better and low-cost sanitation facilities. Therefore, preparation of a construction schedule is necessary in realizing an appropriate supply of clean and potable water and sanitary disposal of human wastes towards improvement of the health of the people in the society.

Definition of key terms

Construction activities: involve the tasks that are undertaken during the implementation of the actual building of the structure.

Content/Procedures/Methods/Illustrations

1.1 Interpret engineering drawings based on the engineering codes

Different engineering codes are available for the design of different engineering structures in order to meet certain minimum standards. These codes include but not limited to: Euro codes, British Standard Codes, Kenyan standards among others and are all essential in any engineering design. Interpretation of engineering drawings involve converting them into forms of CAD representation using different forms of softwares for example Auto CAD, Prokon, Revit Technology among others that convey different meanings including representing a 3-D structure. .

There are three levels of interpretation of engineering drawings namely:

- a. Lexical level
- b. Syntactic level
- c. Semantic level

At the syntactic level, there are tasks utilized in generally recognizing annotations and dimensioning in particular. This dimensioning can be in form of linear or angular dimensioning. It is essential to always start by reading and understanding the title block of every drawing as they contain important features including dimensioning units, scales among others. Section views show the hidden features of an object so that the contractor or the site engineer is able to understand that during construction. Reading and understanding different symbols used in the drawings is also key to interpreting the drawing and meeting its demands fully and therefore it is important to understand a few basics of symbols. The most common symbols used are and not limited to rectangles, triangles, circles and polygons. Architectural symbols for instance doors, windows, cars and electrical installations are normally generally notated. Engineering drawings are a graphic representation of a structure/object and produced by the engineer or technician. It is important that they are done according to the specifications of the relevant engineering codes. Any contractor or a site engineer must therefore be able to interpret any technical drawings given to him or her at the site in order to deliver a project that meets the expected design standards and specifications. Consultation in engineering is necessary. At the site, it is essential to consult with other colleagues and especially the engineer that designed and produced the drawing.

1.2 Identify *construction activities* (Surveying, excavation, laying and jointing) based on scope of work.

Different construction activities are all put together chronologically in order to achieve the desired output of the construction. Preliminary surveying for instance for site understanding and easier clearance to pave way for the actual construction is important.

Surveying is the process of analyzing and obtaining the general characteristics of a land area proposed for construction. The most preferred surveying instruments include the theodolite and the total station. There are several categories of surveying namely:

- a. Cadastral surveying
- b. Topographical surveying
- c. Geodetic surveying
- d. Aerial surveying
- e. As Built surveying

Excavation involves the removal of soil or rocks from a site using tools and machinery. Excavation and trenching is common for the construction of all sanitary facilities as they are vital for the construction of deep foundations. However, these methods of foundations differ for foundations, underground openings or slopes. These foundation methods include: bracing excavation methods, zoned excavation among others.

Laying and jointing is done especially for pipes for instance concrete pipes or plastic pipes. Pipes are generally laid below the ground or even sometimes on the ground. These pipes are laid in the following ways:

- a. Initially prepare a detailed map showing the topographical features of the area including lanes, roads among others.
- b. The Centre line of the proposed pipework be transferred from the map to the actual ground and marked in equal intervals.
- c. Excavation of the trenches commences.
- d. Pipes are laid on the ground by use of derricks for heavy pipes or manually for lighter pipes.
- e. Testing of these pipes for leakage and pressure begin immediately after the pipes are laid in position.
- f. After it has passed the above immediate test, backfilling using soil or rock is done.

1.3 Prepare project management timelines based on project specifications

The success of a project often is also defined by completing the project within the budgeted timeframe. This will be achieved by developing a realistic and working plan and effective management of the created plan. Different construction activities and stages will be given specified time limits to which they should be completed for example site clearance, excavation, setting out works, actual construction to completion and official handing over will be given different dates in the same order. This is also made possible through the work breakdown structure. The following steps are to be followed in order to develop or prepare project management timelines:

- a. Write the scope of the project for instance for the construction of a 3-bedroom house that will occupy an area of 20 sq. feet.
- b. Develop a work breakdown structure. This will help in breaking down the construction of the house into small sub-units for example construction of foundation, exterior walls, partition walls, partition walls, roofing.
- c. Each work package is broken down into tasks
- d. The total time required for each task is estimated. Sufficient time for curing is given for concrete works.
- e. Identify the available resources required to be input into the specific works and allocate them appropriately.
- f. Using all the above gathered information, assemble them to obtain the final project management timeline

Conclusion

This learning outcome covered the preliminary construction techniques, scheduling and management of the onsite sanitation facilities.

Further Reading



Read more on the project cycle and methods of excavation

21.3.2.3 Self-Assessment



Written Assessment

1. Which is the most applicable engineering code in any design by engineers
 - a) British standards
 - b) Kenyan standards
 - c) Euro codes
2. Onsite sanitation facilities include the following except one, identify
 - a) Aqua-privy
 - b) Pit latrine
 - c) Swamp
3. Which one of the following is not a construction activity
 - a) Surveying
 - b) Excavation
 - c) Trenching
 - d) Playing
4. Do poor waste disposal pollute groundwater
5. Is provision of clean water the solution to the problem of poor sanitation
6. Which is the most common form of waste disposal in Kenya
7. Is waste segregation at the production site important in controlling pollution
8. Is project plan important in ensuring a timely delivery of the project

Essay question

Scheduling of work is important in ensuring the completion of the project in time, discuss

Oral Assessment

Why is excavation one of the most important stage in onsite sanitation facilities construction?

Are low-cost construction techniques the solution to the problem to the deficiency of sanitation facilities in third world countries?

Case Study Assessment

Malawi has made great improvements in ensuring an improved water supply rates to its citizens (56.3%). However, like other sub-Saharan countries, continue to suffer under the burden of an increasing population and hence a higher demand for more sanitation facilities. Using this knowledge, discuss what the government should do to improve the livelihoods of the people in your area.

Oral Assessment

What are the likelihoods that improved sanitation will impact positively on the improvement of the health of the people of the society?

Project Assessment

Conduct a research (questionnaire) on how poor maintenance of sanitation facilities lead to the poor sustainability of the already established facilities

21.3.2.4 Tools, Equipment, Supplies and Materials

- Computers
- Stationery
- Standard operating procedures
- Ordinary Portland Cement
- Surveying instruments
- Laying pipes
- Wheelbarrow
- Excavators

21.3.2.5 References




Strande, L. (2014). The global situation (pp. 1-18). IWA Publishing, London.

Harada, H., Strande, L., & Fujii, S. (2016). Challenges and oppotuneits of faecal sludge management for global sanitation. Towards future earth: challenges and progress of global environmental studies. Tokyo (Japan): Kaisei Publishing, 81-100.

Tiimub, B. M., Forson, M. A., Obiri-Danso, K., & Rahaman, I. A. (2009, May). Pointed gaps in the provision, quality, patronage and management of toilet facilities in Bawku East District. In Water, Sanitation and Hygiene: Sustainable Development and Multisectoral Approaches, Proceedings of the 34th WEDC International Conference, United Nations Conference Centre, Addis Ababa, Ethiopia (pp. 18-22).

21.3.3 Learning Outcome No 2: Organize the Construction Site

21.3.3.1 Learning Activities

Learning Outcome No 2: Organize the Construction Site	
 Learning Activities	Special Instructions
2.1 Clear and secure site 2.2 Identify and mobilize human resource, construction plant and equipment 2.3 Put in place <i>onsite infrastructure</i>	<ul style="list-style-type: none"> • Strict and transparent bidding and tendering process • All measurements adhered to

21.3.3.2 Information Sheet No21/LO2 Organize the Construction Site



Introduction to learning outcome

This is a very important and the most crucial step towards implementation of the proposed facility. Visiting the actual site and mobilizing the human resource to provide labour and providing the necessary equipment for the actual construction is essential.

Definition of key terms

Onsite infrastructure: This can be defined as the supporting infrastructure that is provided within the specified perimeter of a project site and is directly or indirectly related to the same project. Examples include, but not limited to, onsite sanitation units, administrative offices, roads, residences, and power substations

Content/Procedures/Methods/Illustrations

2.1 Clear and secure site based on the contract document.

The procedure of clearing and securing the site varies depending on several factors, such as project size and how remote the site is. The procedure for clearing the site should be clearly highlighted in the contract document. In most cases, this is done by the contractor. The first step is usually grubbing and standard clearing. The works included in this step are removing any existing tree stumps, bushes, buildings, and any other obstruction to site preparation. The terrain is then leveled to the surveyor's specifications using the surveyor's instruments. The ground beyond the site is also leveled to facilitate future works of maintenance. The trees and shrubs that stand on the right of way of the project are also trimmed as per the contract document.

Grubbing is done in all areas where deep excavation is to be done. Note that all tree clearances and excavations are done according to the engineer's specifications, as stipulated in the contract drawings. At this stage, it's easier to design the onsite facilities depending on the orientation of the cleared site.

2.2 Identify and mobilize human resource, construction plant and equipment based on the contract document.

This step is carried out by the contractor before work commencement, and once the site is ready for work. According to the Fidic Redbook, the contractor shall carry out all the manufacture of the plant, the production of materials, and all other executions of the stipulated work. Depending on the nature of work, the contractor should be able to identify the type of labour that is needed for the execution of the works and also the equipment. These are organized and arranged on site. Examples of human resources needed in a site are masons, technicians, supervisors, and plumbers. Examples of equipment that should be availed to the site are wheelbarrows, excavators, pipes, and trowels. Identify the available labour and compare with what is needed. If there is a need for more, then more mobilization is paramount.

2.3 Put in place onsite infrastructure (stores, site offices, fences) based on contract document and legal requirements.

The contract document should indicate the necessary onsite infrastructure that is to be built. Once site clearance and mobilization of equipment are complete, then this step can commence. The first thing to do is appropriately fence the site as per the contract document. The administrative offices can then be constructed so as to accommodate the administrative staff that is crucial for project management. The stores are then constructed. These are important in facilitating the movement of material and equipment. Stores are also important in safeguarding materials such as cement. On completion of this step, the site should be ready for the commencement of the main works

Conclusion

This learning outcome covered the full organization of the construction site in order for the actual construction works to commence.

Further Reading



Discuss other ways which the suitable alternatives can be utilized to replace onsite sanitation facilities.

21.3.3.3 Self-Assessment



Written Assessment

1. Which one of the following is not an onsite infrastructure facility?
 - a) Toilet
 - b) Wheelbarrow
 - c) Pavement
 - d) Power substation
2. Which one of the following is not an activity in site clearing?
 - a) Design of culverts
 - b) Tree cutting
 - c) Demolitions
3. Identify the human resource that is involved in site clearance
 - a) Painters
 - b) Drivers
 - c) Masons
 - d) Excavator operators

Oral Assessment

1. Identify and explain two documents that are necessary in putting into place onsite infrastructure.
2. Explain, in detail, the process from site clearing to commencement of the main works

Case Study Assessment

Organize with your lecturer, and visit a nearby construction site. Request for entry and identify all the existing onsite infrastructures. Draw sketches of the site outline that capture the infrastructure.

21.3.3.4 Tools, Equipment, Supplies and Materials

- Computers
- Stationery
- Standard operating procedures
- Ordinary Portland Cement
- Surveying instruments
- Laying pipes
- Wheelbarrow
- Excavators
- GPS

21.3.3.5 References



Bunni, N. G., & Bunni, N. G. (2005). The FIDIC forms of contract (Vol. 284). Oxford: Blackwell Publishing.

Totterdill, B. W. (2001). FIDIC User's Guide: A Practical Guide to the 1999 Red Book. Thomas Telford.

<https://www.fdot.gov/docs/default-source/programmanagement/implemented/specbooks/january2016/files/110-116.pdf>

easytvvet.com

21.3.4 Learning No 3: Construct the Various Onsite Sanitation Facilities

21.3.4.1 Learning Activities

Learning Outcome No 3: Construct the Various Onsite Sanitation Facilities	
 Learning Activities	Special Instructions
3.1 Source and mobilize <i>construction materials</i> 3.2 Set out onsite sanitation facilities 3.3 Construct <i>onsite sanitation facility units</i> 3.4 Do labour payments 3.5 Prepare and submit as-built drawings 3.6 Prepare substantial completion certificate 3.7 Prepare payment certificate 3.8 Prepare completion certificate	<ul style="list-style-type: none"> • A correct bill of quantities • Construction done according to the approved engineering drawings

21.3.4.2 Information Sheet No21/LO3: Construct the Various Onsite Sanitation Facilities



Introduction to learning outcome

Onsite sanitation facilities will be constructed using several methods for instance the “project cycle” approach in order to improve on sanitation standards in the society. This approach seeks to address all the project complexities through all its stages and, at the same time, maintaining the alignment with the objectives and strategies. The construction phase is a very important one in project management.

Definition of key terms

Construction materials: These are items or supplies, most of which are naturally occurring that are used to form the components of the structure. Naturally occurring materials include stones, sand, and timber. Some materials are made in the factory from naturally occurring minerals. A good example is cement.

Onsite sanitation facility units: are units designed and constructed to handle, store, and treat the waste generated within the same property that produces it. In most cases, the onsite treatment facilities are used in areas that are not yet covered with public sewers. A typical example is the septic tank.

3.1 Source and mobilize construction materials (cement, bricks, stones) based on the bill of quantities.

Before the commencement of the project, there is proper documentation that specifies all the materials to be used in the necessary quantities. This document is called the bill of quantities. The contractor uses this document to know and decide on the best way of acquiring the materials. The document specifies the number of bags of cement that are required for each construction stage. Bricks and stones are measured in terms of kilograms or tons. In that case, the contractor will be able to interpret the document and order the required amount of the same. Preferably, these materials should be sourced from closer sources to save on the cost of construction. For example, the stones and bricks could be sourced from a nearby quarry. Once these have been obtained, the construction of the facilities can commence. Read and understand the bill of quantities, on the materials section. Make or organize how orders of the same materials will be made. Also, organize for delivery of the same to the site. Identify the ordered materials on arrival, and perform a thorough inspection to check on quantity and quality. Write a report on the same. Also, document this in the invoice and sign the delivery documentation. Lastly, organize how the delivered materials shall be stored. This is to make sure they are protected from quantity and quality manipulation.

3.2 Set out onsite sanitation facilities based on the engineering drawings.

Setting out is a very important stage in construction. It is the stage that determines the orientation of the construction and whether the plan will be followed accordingly. For this step, the engineers or surveyors may make use of sophisticated instruments. Examples are GPS, computers, and surveyors' equipment. The setting out is done following the drawings. Centerlines of the structures are interpreted from the drawings and transferred to the ground. Excavation lines are also plotted on the ground during setting out. . Interpreted the drawings, and draw the appropriate centerlines. Mark them using a visible marker, preferably a string. This shall aid in accurate excavation.

3.3 Construct onsite sanitation facility units (Septic tanks, bio-digesters, soak pits) based on the design drawings

Septic tanks. The drawings will determine whether the tank will be a single or two-compartment tank. The excavation is also done following the setting out procedure. The best materials to use for the floors and walls of the septic tank are concrete and plastic. The floor should have a slight slope towards the outlet. All these details are specified in the structural drawings. Bio-digesters. These are facilities fed with generated organic waste, and in return, create useful gases such as methane. This is the right way of recycling waste. Just as in the septic tanks, the specifications are well illustrated in the structural drawings provided in the contract document. Soak pits. These are covered holes, whose walls are made of porous materials to allow fed in waste to soak into the soil slowly. In most cases, the soak pit is connected to the septic tank. Its design is a bit easier. The depth of the soak pit, the position of the inlet, and the material to be used should be specified in the drawings. The details should be followed keenly.

3.4 Do labour payments based on the progress report and attendance list.

Unless stated otherwise, it's the responsibility of the contractor to mobilize and pay for labour. The easiest way is to have a complete list of all the involved labour. In such a case, an attendance list is necessary to make sure everyone is paid for what he/she has worked for. It is important to observe the regulations that have been set for rates of wages and working conditions. Organize the labourers on the payroll into manageable groups. This is if the payments are to be made in cash. Have group heads to help in distributing their dues. Organize them to sign a document on receiving the payment. Lastly, write a report and submit to the management.

3.5 Prepare and submit as-built drawings based on the actual construction works.

These drawings are prepared based on what is going on on the ground. They are very important as they cater to the changes that might have occurred during the construction. Changes in construction might be a result of various forces such as nature, politics, and financial constraints. Built drawings as necessary in making further construction plans. This can be done by the use of computer software such as AutoCAD. These drawings are then submitted to the relevant authorities for approval before construction commences. They have to meet certain minimum criteria in terms of design.

3.6 Prepare substantial completion certificate based on FIDIC regulations.

A substantial completion certificate is a document between the owner of an ongoing construction and a contractor. This certificate is prepared upon completion of the initially proposed work when the contractor has handed over the structure to the owner and the owner now becomes liable for anything that happens to the structure. The Fidic Redbook states that reporting of progress of works shall continue until the respective contractor has completed all the planned works. Before total completion, the contractor should submit relevant results that capture a description of the progress of works at each stage of design. This can be done via charts, graphs, photos, and videos. A certificate is then offered for completion of a stage

3.7 Prepare payment certificate based on progress report.

The payment certificate captures the amount that the contractor is entitled to and it depicts the importance of cash flows in determining the success of a project. This will depend on the amount of progress on the works. The report of progress should be accompanied by supporting documents that will validate the necessity of payment being demanded. These payments can therefore be set periodic payments or stage payments. Any variations from the contract price should be clearly indicated. If all is clear, the payment certificate is issued

Table 59: payment certificate based on progress report

Type	Cost (Kshs)
Preliminaries	5 000 000
Foundation	23 000 000
Internal works	30 000 000
External works	15 000 000
Total	73 000 000

3.8 Prepare completion certificate based on the legal requirements.

The completion certificate is issued once whole works or sections (if any) have been completed within the agreed time of completion. Once the progress has been agreed on, taking over certificate application is issued by the engineer to the employer. At that point, the contractor ceases to be responsible for any works ongoing on the site.

Conclusion

Constructing a public sewer is quite expensive. On-site sanitation facilities are, therefore, important for the improvement of sanitation standards of a society. More importantly, in areas where there is no access to a public sewer. There is, therefore, a need to construct more onsite sanitation facilities. However, the performance of these facilities will depend on how well the construction is done. For the best results, proper design and construction procedures are paramount.

Further Reading



Read more on the construction of septic tanks

21.3.4.3 Self-Assessment



Written Assessment

- Which of the following is not a certificate captured in the Fidic Redbook?
 - Certificate of completion
 - Payment certificate
 - Structural drawings
 - Taking over certificate

2. Which one of the following is not a part of a contract?
 - a) Contractor
 - b) Employer
 - c) Engineer
 - d) Politician
3. Which one of the following is not an onsite treatment facility?
 - a) Septic tank
 - b) Soak pit
 - c) Bio digester
 - d) Waste stabilization pond

Oral Assessment

1. Explain your choices of onsite treatment methods
2. Briefly describe five documents captured in the Fidic Redbook.

Case Study Assessment

Visit any public institution and identify the present onsite treatment facilities and give detailed report on their management and sustainability of these facilities

Practical Assessment

Draw and label a simple septic tank. Use your own dimensions and if possible, draw a connected soak pit

21.3.4.4 Tools, Equipment, Supplies and Materials

- Computers
- Stationery
- Standard operating procedures
- Ordinary Portland Cement
- Surveying instruments
- Laying pipes
- Wheelbarrow
- Excavators
- Trowels
- Tape measure

21.3.4.5 References



Glover, J., & Hughes, S. (2011). Understanding the FIDIC Red Book: A Clause by Clause Commentary. Sweet & Maxwell.

easytvvet.com