# NATIONAL COUNCIL FOR TECHNICAL EDUCATION

**NOVEMBER 2022**

**PROPOSED OCCUPATIONAL STANDARDS**

**OCCUPATION: CIVIL ENGINEERING TECHNICIAN**

**LEVEL: NTA 5**

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## FOREWORD

The National Council for Technical Education (NACTE) is a corporate body established by the National Council for Technical Education Act, Cap.129. The Act provides a legal framework for the Council to coordinate the provision of technical education and training in Tanzania. The mandate of NACTE is three-fold, namely; Regulatory, Quality Assurance and Policy Advisory.

In discharging its mandate, the Council has been charged with the responsibilities, among others, to:

(a) assist technical institutions in the transmission of knowledge, principles and training in the field of technical education and training for the benefit of the people of Tanzania;
(b) assist technical institutions in the overall development of the quality of education they provide and to promote and to maintain approved academic standards;
(c) establish and make awards in technical education which are consistent in standard and comparable to related awards in Tanzania and internationally; and
(d) ensure that the quality of education required for the awards is met and maintained throughout the duration of the delivery of the course.

In the course of execution of these responsibilities, the Council has been instituting various measures aiming at advancing the quality of training provided in technical institutions in respect of the changing demands of the labour market, both local and international.

To achieve the above obligation, NACTE, under the Ministry of Education, Science and Technology implemented the East Africa Skills for Transformation and Regional Integration Project (EASTRIP), a project aiming at promoting regional integration through supporting the regional corridors and sector markets, developing common standards and qualifications, and promoting mobility of students, faculty, and graduates. The project supports the Government of Tanzania to address shortage of skills in five sectors namely:

(a) Energy;
(b) Construction;
(c) Information and Communication Technology (ICT);
(d) Transportation; and
(e) Agrobusiness.

To address the skills, miss-match and shortage in the five (5) sectors in the country, the project funded, among others, a component of Development of Occupational Standards for Technical and Vocational Education and Training (TVET). In this regard, NACTE endeavoured to identify qualified and highly experienced experts in the five sectors from both the industry and training institutions to carry out the development of Occupational Standards. The exercise was carried out at Morogoro Teachers College – Morogoro from 16$^{th}$ July to 10$^{th}$ August, 2021. The output of the exercise is Occupational Standards for 12occupations. Occupational standards for Civil Engineering Technicians are among the 12 occupational standards which have been developed.

Since Occupational Standards are statements of work performance reflecting the ability to successfully complete the functions required in an occupation, as well as the application of knowledge, skills, attitudes and understanding in an occupation, it is the Council's expectations that the developed standards will form a robust base for decision making and provide explicit guidance to policy makers, curriculum developers, educators, employers and other stakeholders in matters related to manpower planning as well as execution of Technical and Vocational Education and Training undertakings.

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| Prof. J. W. Kondoro | Dar es Salaam |
| **Chairman** | **NOVEMBER 2022** |

## ACKNOWLEDGEMENT

The National Council for Technical Education (NACTE) is charged with the mandate to be the Quality Assurance organ of the Government in matters related to Technical and Vocational Education and Training (TVET) and production of qualified manpower for both local and international labour markets. In order to realize this obligation, NACTE endeavours to institute policies, guidelines and standards and to set the quality benchmarks for training institutions.

However, this is only possible if there is a strong base, linking the training institutions on one hand and the demands of the industry/labour market for relevant manpower on the other hand. Therefore, the Council undertook a step to develop Occupational Standards in sectors considered to be the engine to steer the country's desire to achieve an industrial economy. This exercise would not be a success without the input and support from our stakeholders. I am indebted to acknowledge some of them here.

I wish to acknowledge and appreciate the support from the Ministry of Education, Science and Technology through the East Africa Skills for Transformation and Regional Integration Project (EASTRIP)for the financial support which facilitated the preparation of this document. I wish also to appreciate Mrs Leah Lukindo and Eng. Dr. Simon Bareguand for the tireless efforts and commitment in facilitating and guiding the standards development process, Ms. Eileen Tzamburakis and Ms. Chausiku Yakweli Ibrahim for compiling and type setting the final document; and the NACTE Secretariat for coordinating the whole activity.

In a very special way I wish further to extend my sincere gratitude to this team of wonderful experts who tirelessly dedicated their time and availed their invaluable intellect in the preparation of this document. I would like to recognise the colossal inputs of the following experts:

| S/N | Name | Designation | Organization |
|---|---|---|---|
| 1 | Eng. Emmanuel Taseni | Consulting Engineer | NIMETA Consult (T) Limited |
| 2 | Eng. Josephat Mutembei | Civil Engineer II | Kigamboni Municipal Council |

| | | | |
|---|---|---|---|
| 3 | Eng. George M. Chaula | Civil Engineer I | Tanzania Building Agency (TBA) |
| 4 | Eng. Franco Faustine | Civil Engineer I | Tanzania Building Agency (TBA) |
| 5 | Eng. Godfrey Komba | Civil Engineer | The National Council for Technical Education (NACTE) |
| 6 | Eng. Milton J. Nyerere | Managing Director | Aquifer Construction Limited |
| 7 | Eng. MwiveiMsisili | Principal Civil Engineer | Hinly Company Limited |
| 8 | Dr. JubilyMusagasa | Lecturer | Dar es Salaam Institute of Technology |
| 9 | Cheche Mabiki | Principal Registration Officer | Contractors Registration Board (CRB) |
| 10 | Eng. Fares Washa | Assistant Registrar | Engineers Registration Board (ERB) |
| 11 | Dr. Prosper Mgaya | Deputy Rector ARC | National Institute of Transport (NIT) |

In addition, the Council hopes to further improve the international level of occupational standards, and promote the modernization and internationalization of industrial industries, so as to make Tanzania's occupational standards more in line with the international ones and expand its development potential. Therefore, the Council has invited China & Africa Technical and Vocational Education Cooperation Alliance and China & Africa (Chongqing) Technical and Vocational Education Cooperation Alliance to develop, revise and review vocational standards together with vocational colleges in China. Based on their rich experience in vocational education, as well as China's advanced and complete industrial chain and its position in the international market, they will help Tanzania develop its vocational education and related industries.

Therefore, I would like to express my heartfelt thanks to the team composed of many Chinese colleges and relevant experts, for their hard work and dedication, and for their wisdom and experience in preparing this document. They are listed below:

| S/N | Organization | Name | Title/Field of Expertise |
|---|---|---|---|
| 1 | Chongqing Jianzhu (Architecture) College | Zhang Yinhui | Professor/Structural Engineering |
| 2 | | Wu Xinjie | Associate Professor/ Structural Engineering |
| 3 | | Luo Wenjin | Professor/ Structural Engineering |
| 4 | | Zeng Hong | Associate Professor/ Structural Engineering |
| 5 | | Jiang Shuhui | Professor/Surveying and Mapping Engineering |
| 6 | | Zhong Tao | Senior Engineer/Safety Engineering |
| 7 | | Guo Yingying | Senior Engineer/ Structural Engineering |
| 8 | | Lei Limei | Lecturer/ Structural Engineering |
| 9 | | Yang Bowen | Lecturer/ Structural Engineering |
| 1 | Chongqing Vocational Institute of Engineering | Jiang Bolin | Associate Professor/ Road and Bridge Engineering Technology |
| 2 | | Tang Xianzhi | Senior Engineer/ Municipal Engineering |

| | | | |
|---|---|---|---|
| 3 | | Pi Yingxing | Lecturer/ Road and Bridge Engineering Technology |
| 1 | Chengdu Polytechnic | Yang Min | Associate Professor/ Project Management |
| 2 | | Li Yushu | Professor/ Geotechnical Engineering |
| 3 | | Zhou Yuan | Professor/Solid mechanics |
| 4 | | Wang Xinjun | Associate Professor/ Structural Engineering |

Last, but not least, I would like to acknowledge the enormous inputs from all stakeholders who were consulted during the validation process to provide their expert views and opinions on the validity of the contents and preparation of this document for customers' consumption.

Dr. A. B. Rutayuga
**Executive Secretary**

Dar es Salaam
**NOVEMBER 2022**

## ABBREVIATIONS

| | |
|---|---|
| **NACTE** | National Council of Technical Education |
| **NOS** | National Occupational Standards |
| **OS** | Occupational Standards |
| **TET** | Technical Education and Training |
| **TVET** | Technical and Vocational Education and Training |

## GLOSSARY OF TERMS

| | |
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| **Circumstantial Knowledge:** | Detailed knowledge, which allows the decision-making in regard to different circumstances and cross cutting issues |
| **Competence:** | The ability to use knowledge, understanding, practical and thinking skills to perform effectively to the workplace standards required in employment. |
| **Competency:** | A description of the ability one possesses when able to perform a given occupational task effectively and efficiently. |
| **Competency-Based Education:** | An instructional program that derives its content from validated tasks and bases assessment on the learner's performance |
| **Curriculum:** | A description or composite of statements about "what is to be learned" by the trainee/student in a particular instructional programme; a product that states the "intended learning outcomes". |
| **Educational/Training Programme:** | The complete curriculum and instruction (what and how) that is designed to prepare a person for employment in a job or other particular performance situation. |
| **Occupation:** | A specific position requiring the performance of specific tasks – essentially the same tasks are performed by all employees having the same title. (Example: baker) |
| **Occupational Analysis:** | A process used to identify the tasks that are important to employees in any given occupation |
| **Occupational Area:** | This is a broad grouping of related jobs. Example: food service. |
| **Occupational Competence:** | The application of knowledge and skills to perform consistently to the standards required in the work context. |
| **Occupational Standards:** | Specific requirements of competences people are expected to demonstrate in a particular occupational area, including |

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| | knowledge and relevant attitudes. They also act as performance tool of assessment of the pre – scribed outcomes. |
| **Performance Criteria:** | Indicate the expected end results or outcome in form of evaluative statements. |
| **Skills:** | The ability to perform occupational tasks with a high degree of proficiency within a given occupation. Skill is conceived of as a composite of three completely interdependent components: cognitive, affective, and psychomotor. |
| **Standards:** | It is a set of statement, which if proved true under working conditions, means that an individual is meeting an expected level and type of performance |
| **Task Analysis:** | The process of analysing each task to determine the steps, related knowledge, attitudes, performance standards, tools and materials needed, and safety concerns required of employees performing it. |
| **Tasks:** | A work activity that has a definite beginning and ending, is observable or measurable, consists of two or more definite steps, and leads to a product, service, or decision. |
| **Underpinning Knowledge:** | This is crucial knowledge that an individual must acquire in order to demonstrate competences that are associated in performing a given task. |
| **Verification Process:** | The process of having experts review and conform the importance of the task (competency) statements identified through occupational analysis. Other questions, such as the degree of task learning difficulty are also frequently asked. This process is also sometimes referred to as validation. |

# 1.0. INTRODUCTION

Technical Education and Training (TET) is one of the most important education sub-sectors in Tanzania, responsible for developing a skilled workforce to support the country's industrialization economic agenda. Tanzania's Development Vision 2025 intends to raise the country's economy to a middle-income status. This requires a skilled workforce that is aligned with the needs of the public and private sectors of the economy. The National Council for Technical Education has begun the job of drafting Occupational Standards that will eventually be adopted as National Occupational Standards for TET in order to ensure that it meets the needs of the labour market and the country's economic agenda.

National Occupational Standards (NOS) are performance criteria that are matched with labour market demands. Each National Occupation Standard describes functions, performance standards, and knowledge/understanding for one important function or task. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruiting, supervision, and appraisal, as well as TET standards. They're also helpful for benchmarking and harmonizing qualifications on a national and international level. Standards, in general, provide a solid framework for high-quality TET that is labour market-relevant, current and consistent in delivery across all public and private institutions.

However, it must be noted that, Occupational Standards and Training standards/qualifications standards are different. Occupational standards are defined in terms of activities performed by a person in a selected occupation (e.g., an electrical engineer designs electrical wiring circuits, performs trouble shooting in electrical wiring, etc.) and they are usually defined by employers following procedures agreed upon by all stakeholders. Education and training standards are developed from the activities defined in occupational standards, and they include learning objectives to ensure that the necessary skills and knowledge are developed by a person to enable him or her to function at an agreed level in an occupation. Education and Training standards are used to define curricula in training institutions. It is however critical that there must be a direct link between the occupational standards and the training standards to respond to demands of the labour market.

In TET delivery, Tanzania adopted the Competency-based Education and Training (CBET) approach. The CBET approach focuses on providing learners with the skills and knowledge required to meet the occupational standards. Occupational standards are thus the starting point for developing Competency-based Education and Training (CBET) programs. TET institutions will be required to benchmark their curricula with relevant occupational standards.

Occupational Standards are developed based on a given occupation's current and future demands. As a result, they serve as a means of bridging the gap between the worlds of employment and technical education and training (TET).

The Civil Engineering Technician Occupation has its own set of occupational standards. The document explains how the occupational standards were developed, as well as the scope, the occupational profile in the form of DACUM charts, and the Occupational Standards.

## 2.0. OCCUPATIONAL STANDARD DEVELOPMENT PROCESS

The Occupational standards development process began with an examination of major documents that guide Tanzanian skill development. The 10-year National Skills Development Strategy (2016-2026) was one of the documents reviewed, and it outlined six (6) economic sectors that should be prioritized when developing skills development programmes.

These sectors include: Transport and logistics, Tourism and Hospitality, Agribusiness, Construction, Energy and ICT. NACTE labour market reports were also used in the literature review to determine the skills demand in the Tanzanian labour market as a whole.
After the literature review, a workshop comprised of expert workers and educators with substantial knowledge and experience in the occupation conducted an occupational analysis utilizing the DACUM approach to produce the occupational profile. The analysis resulted in DACUM Charts, which are attached as **Appendix 1** to this document.

The occupational standards were then developed. Experts in Occupational Analysis and the Development of Occupational Standards facilitated the workshop. Interviews, online surveys, and a stakeholder forum were used to validate the occupational standards. Engineers, supervisory technicians on the job, and experienced Civil Engineering technicians were key informants in the survey to discover occupational trends. This information was used to gain insight from the workplaces regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation. A total of ……….. online surveys were completed by experts from the labour market across the country. Apart from the survey aiding in defining the scope for the occupational analysis, they served to engage a wide cross-section of experts in the occupation. The stakeholders' forum was attended by 100 participants from different parts of the country representing various companies.

## 3.0. THE SCOPE AND OVERVIEW OF THE CIVIL ENGINEERING TECHNICIAN OCCUPATION STANDARDS

These standards cover a broad range of duties and tasks that can be performed by a Civil Engineering Technician. However, the occupational standards are not meant to replace individual job descriptions, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Civil Engineering Technician may perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large operations other individuals may be employed or designated to perform specific tasks.

In most cases, civil engineering technicians work under the supervision of licensed civil engineers. They can assist in the design of simple civil engineering infrastructures and provide inputs in the preparation of tender documents. The infrastructure may include buildings, bridges, highways, railways, marine ports, airports, canals, dams, water and wastewater systems, pipelines, processing and re cycling of waste. These technicians also play important roles in the construction industry, from site evaluation to quality control and problem solving during the construction phase. They also perform field and laboratory tests.
The standard has covered the following main duties of a Civil Engineering Technician:

1. Performing basic field and laboratory test for civil engineering materials.
2. Executing site works for construction and maintenance of buildings, roads, ports, airports and railways projects.
3. Performing construction and maintenance of water supply and sanitation works.
4. Performing survey for civil engineering infrastructures.
5. Supervising civil engineering construction projects.
6. Providing inputs in preparation of tender document for construction and maintenance of building and civil works.
7. Designing simple civil engineering infrastructures.

The Occupational standards have been clustered into NTA qualification levels i.e. NTA level 4, 5 and 6.

## 4.0. VALIDITY PERIOD

The occupational standards will be valid for 3-5 years due to the fast-changing nature of technology. The review will proceed in the same manner as the previous one, with new occupational standards being developed based on current labour market information.

## 5.0. OCCUPATIONAL STANDARDS

### 5.1. CCUPATIONAL STANDARDS FOR CIVIL ENGINEERING TECHNICIAN - NTA 5

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | PERFORM FIELD AND LABORATORY TESTS ON SOIL MASS | **DUTY NO.** | 501 |
| **TASK TITLE** | CONDUCT FIELD AND LABORATORY TESTS FOR SOIL | **TASK NO.** | 5011 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to conduct field and laboratory tests on soil as per standards and guidelines approved by a competent authority. | | |
| **RANGE STATEMENT** | The task will be performed in the field and in the laboratory under the supervision of a technician.<br>The following equipment, tools and materials will be needed in performing the task: consolidation test machine, triaxial test equipment, shear box, permeability apparatus, CBR machine, compaction mold, CBR molds,<br>standard spirit sampler, drop hammer, guiding rod, drilling rig, driving head, Drilling tools (auger, core cutter, wash borer), spades, hoe, P.P.E. | | |

**EVIDENCE REQUIREMENTS**

| PRACTICAL PERFORMANCE | UNDERPINNING KNOWLEDGE |
|---|---|
| The person performing this task must be able do the following:<br>1. Identify type of soil test;<br>2. Select right tools, equipment and safety gears for the task;<br>3. Prepare soil samples;<br>4. Carry out (proctor) soil compaction test;<br>5. Carry out shear test;<br>6. Carryout triaxial test;<br>7. Carry out consolidation test;<br>8. Carryout SPT;<br>9. Carry out permeability test;<br>10. Carry out CRB test;<br>11. Observe health and safety when performing the task;<br>12. Record test results for each test;<br>13. Process results for each test;<br>14. Clean equipment;<br>15. Pack the equipment. | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Perform Standard Penetration Test;<br>1.2. Prepare soil samples;<br>1,3, Carry out (proctor) soil compaction test;<br>1.4. Carry out shear test;<br>1.5. Carryout triaxial test;<br>1.6. Carry out consolidation test;<br>1.7. Carry out SPT;<br>1.8. Carry out CRB test;<br>1.9. Carry out permeability test;<br>1.10. Record and process the results.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1. Operating soil tests equipment;<br>2.2. Sample preparation;<br>2.3. Conducting Soil tests.<br><br>**3.0. Theories**<br>The person performing this task must be able to explain:<br>3.1. Soil mechanics;<br>3.2. Types and operation soil test equipment;<br>3.3. Civil engineering materials.<br><br>**4.0. Essential skills:** |

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| | 4.1 Team work skills;<br>4.2. Communication skills;<br>4.3. Mathematics skills in logarithms, algebra;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Laboratory and field Tests are performed as per standards and guidelines approved by a competent authority. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health;<br>4. Waste disposal methods. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS</td><td>DUTY NO.</td><td>501</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM CONCRETE TESTS.</td><td>TASK NO.</td><td>5012</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out concrete tests as per standards and guidelines approved by a competent authority.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed on construction site and in the laboratory under the supervision of technician.<br>The following equipment, tools and materials will be needed in performing the task: slump cone, tapping rods, slump test base, slump cone filling funnel, ruler, straight edge, scoop, brushes, measuring tape, compressive machine, capping pads, cube mold, cylinder mold and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Select right tools, equipment and safety gears for the task;<br>2. Prepare the sample for concrete tests;<br>3. Carry out Slump test;<br>4. Carry out Compressive strength test for cubical samples;<br>5. Carry out Compressive strength test for cylindrical samples;<br>6. Perform rebound hammer test;<br>7. Perform penetration resistance test;<br>8. Perform permeability test on hardened concrete;<br>9. Records results for each test;<br>10. Process the results for each test;<br>11. Present report to supervisor;<br>12. Observe health and safety precautions when performing the task;<br>13. Clean the equipment, tools and working area;<br>14. Store tools, equipment and safety gear;<br>15. Dispose wastes.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Perform Slump test;<br>1.2. Perform Compressive strength test for cubical samples;<br>1.3. Perform Compressive strength test for cylindrical samples;<br>1.4. Perform rebound hammer test;<br>1.5. Perform penetration resistance test;<br>1.6. Perform permeability test on harden concrete.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Conducting laboratory test;<br>2.3. Sample preparation;<br>2.4. Cube/cylinder sampling;<br>2.5. Cube/cylinder casting;<br>2.6. Cube/cylinder curing.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Concrete technology;<br>3.2. Types and operation of testing equipment;<br>3.3. Basic applied mechanics.<br><br>4.0. Essential skills</td></tr>
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| | 4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills (spreadsheet). |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Concrete tests are performed as per approved standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal Methods;<br>4. Occupational safety and health. |

<table>
<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS</td><td>DUTY NO.</td><td>501</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM AGGREGATE TESTS FOR CONCRETE</td><td>TASK NO.</td><td>5013</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out aggregate test as per standards and guidelines approved by a competent authority.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the laboratory under the supervision of technician.<br>The following equipment, tools and materials will be needed in performing the task:<br>Cylinder molds, plunger, base plate, tapping rod, weigh balance, standard sieve, oven, gauge trowels, thickness gauge, crushing machine, elongation gauge, P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Select tools, equipment and safety gears;<br>2. Prepare the sample for aggregate tests;<br>3. Carry out Ten Percent Fine Value test;<br>4. Carry out Aggregate Crushing Value test;<br>5. Carry out Flakiness Index test;<br>6. Carry out Elongation test;<br>7. Carry out Abrasion tests;<br>8. Record results for each test;<br>9. Process the results for each test;<br>10. Present results to supervisor;<br>11. Observe health and safety precautions when performing the task;<br>12. Clean the equipment, tools and working area;<br>13. Store tools, equipment and safety gear;<br>14. Dispose wastes.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Ten Percent Fine Value test;<br>1.2. Aggregate Crushing Value test;<br>1.3. Flakiness Index test;<br>1.4. Elongation test;<br>1.5. Abrasion tests.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Conducting laboratory test;<br>2.3. Sample preparation.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Basic Civil engineering Materials;<br>3.2. Aggregate properties;<br>3.3. Reasons of carrying out the different types of tests to be performed on aggregates;<br>3.4. Types and operation of testing equipment.<br><br>4.0. Essential skills<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Mathematics skills in coordinate geometry;</td></tr>
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| | 4.4. Computer application skills (spreadsheet). |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | All Aggregate tests are performed as per approved standards. |
| **CIRCUMSTANTIAL KNOWLEDGE:** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools.<br>2. Extent of responsibility;<br>3. Waste disposal methods;<br>4. Occupational safety and health. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS</td><td>DUTY NO.</td><td>501</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM BOREHOLE LOGGING</td><td>TASK NO.</td><td>5014</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out borehole logging as per standards and guidelines approved by a competent authority.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the laboratory under the supervision of technician.<br>The following equipment, tools and materials will be needed in performing the task: soil colour chart, core box and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Identify the required tools and equipment required for the task;<br>2. Identify different soil layers;<br>3. Locate depth to take sample for both undisturbed and disturbed sample;<br>4. Identify type of soil where field tests are required;<br>5. Record all the information in borehole log;<br>6. Record results of field test;<br>7. Process the results;<br>8. Present results to supervisor;<br>9. Observe health and safety precautions when performing the task;<br>10. Clean tools and equipment;<br>11. Store tools and equipment.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Visually classify soil;<br>1.2. Decide where to take samples;<br>1.3. Record collected information in borehole.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Logging and numbering;<br>2.3. Sample preparation.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Soil mechanics;<br>3.2. Types and operation of testing equipment.<br><br>4.0. Essential skills<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills (spreadsheet);<br>4.4. Numeracy;<br>4.5. Work ethic;<br>4.6. Adaptability;<br>4.7. Time management.</td></tr>
<tr><td colspan="2">DESCRIPTION OF END PRODUCTS/SERVICE</td><td colspan="2">Borehole rock core logging is performed as per approved standards.</td></tr>
<tr><td colspan="2">CIRCUMSTANTIAL KNOWLEDGE</td><td colspan="2">Detailed knowledge about:<br>1. Safe handling of equipment and tools;</td></tr>
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| | 2. Extent of responsibility;<br>3. Waste disposal methods;<br>4. Occupational safety and health. |

<table>
<tr><td>OCCUPATION</td><td colspan="2">CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td colspan="2">PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS</td><td>DUTY NO.</td><td>501</td></tr>
<tr><td>TASK TITLE</td><td colspan="2">PERFORM SOIL CLASSIFICATION</td><td>TASK NO.</td><td>5015</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="4">The person performing this task must be able to classify different type of soil as per standards and guidelines approved by a competent authority.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="4">The task will be performed in the laboratory under the supervision of a technician.<br>The following materials will be needed in performing the task: laboratory test results, stationery, classification charts and P.P.E.</td></tr>
<tr><td colspan="5" align="center">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="3">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Obtain laboratory test results;<br>2. Analyse the results;<br>3. Interpret results for soil classification;<br>4. Prepare soil classification report.</td><td colspan="3">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Classify soil;<br>1.2. Interpret soil test results;<br>1.3. Analyse soil test results;<br>1.4. Interpret soil classification standards;<br>1.5. Technical report.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Soil classification;<br>2.2. Soil test;<br>2.3. Operating test equipment and tools.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Soil mechanics.<br><br>4.0. Essential skills<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Mathematics skills in coordinate geometry;<br>4.4. Computer application skills (spreadsheet);<br>4.5. Work ethic;<br>4.6. Adaptability;<br>4.7. Time management;<br>4.8. Respect;<br>4.9. Writing skills.</td></tr>
<tr><td colspan="2">DESCRIPTION OF END PRODUCTS/SERVICE</td><td colspan="3">Soil classification is performed as per approved standards.</td></tr>
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| **CIRCUMSTANTIAL KNOWLEDGE:** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal methods;<br>4. Occupational safety and health. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS</td><td>DUTY NO.</td><td>501</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM LABORATORY TEST ON BITUMINOUS MATERIALS</td><td>TASK NO.</td><td>5016</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out laboratory test on bitumen materials as per standards and guidelines approved by a competent authority.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the laboratory under the supervision of technician.<br>The following equipment, tools and materials will be needed in performing the task:<br>oven, ductility test machine, viscometer, ring and ball apparatus, standard penetrometer, Cleveland open cup, distillation apparatus, breaking value of cationic emulsion test set, and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
</table>

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<tr><td>PRACTICAL PERFORMANCE</td><td>UNDERPINNING KNOWLEDGE</td></tr>
<tr><td>The person performing this task must be able do the following:<br>1. Select right tools, equipment and safety gears for the task;<br>2. Prepare the sample for bituminous tests;<br>3. Carry out consistency tests;<br>4. Carry out composition tests;<br>5. Carry out functional tests;<br>6. Carry out special tests;<br>7. Carry out bituminous mixture tests;<br>8. Record results for each test;<br>9. Process the results for each test;<br>10. Submit results to supervisor;<br>11. Observe health and safety precautions when performing the task;<br>12. Clean the equipment, tools and working area;<br>13. Store tools, equipment and safety gears;<br>14. Dispose wastes.</td><td>Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Carryout consistence test;<br>1.2. Carryout composition test;<br>1.3. Carryout functional test;<br>1.4. Carryout special test.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Conducting laboratory test;<br>2.3. Sample preparation;<br>2.4. Processing data.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Types of bituminous tests;<br>3.2. Operation of laboratory test equipment for bitumen.<br><br>4.0. Essential skills<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Mathematics skills in coordinate geometry;<br>4.4. Computer application skills (spreadsheet).</td></tr>
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| **DESCRIPTION OF END PRODUCTS/SERVICE** | All bituminous tests are performed as per approved standards. |
| **CIRCUMSTANTIAL KNOWLEDGE:** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal methods;<br>4. Occupational safety and health. |

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | PERFORM FIELD AND LABORATORY TEST FOR CIVIL ENGINEERING MATERIALS | **DUTY NO.** | 501 |
| **TASK TITLE** | PERFORM LABORATORY TEST ON STEEL | **TASK NO.** | 5017 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to carry out laboratory test on steel reinforcement bar as per standards and guidelines approved by a competent authority. | | |
| **RANGE STATEMENT** | The task will be performed in the laboratory under the supervision of technician.<br>The following equipment, tools and materials will be needed in performing the task:<br>tensile testing machine, Vernier calliper, cupping machine, punching tools P.P. E. | | |
| **EVIDENCE REQUIREMENTS** | | | |

| **PRACTICAL PERFORMANCE** | **UNDERPINNING KNOWLEDGE** |
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| The person performing this task must be able do the following:<br>1. Select right tools, equipment and safety gears for the task;<br>2. Prepare steel specimen;<br>3. Carry out tensile tests;<br>4. Carry out bending tests;<br>5. Carry out torsional tests;<br>6. Records results for each test;<br>7. Process the results for each test;<br>8. Submit results to supervisor;<br>9. Observe health and safety precautions when performing the task;<br>10. Clean the equipment, tools and working area;<br>11. Store tools, equipment and safety gears;<br>12. Dispose wastes. | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Carryout consistence test;<br>1.2. Carryout composition test;<br>1.3. Carryout functional test;<br>1.4. Carryout special test.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Conducting laboratory test;<br>2.3. Sample preparation;<br>2.4. Processing data.<br><br>**3.0. Theories**<br>The person must be able to explain:<br>3.1. Types of bituminous tests;<br>3.2. Operation of laboratory tests equipment for bitumen.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Mathematics skills in coordinate geometry;<br>4.4. Computer application skills (spreadsheet). |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | All steel reinforcement bar tests are performed as per approved standards. |

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| **CIRCUMSTANTIAL KNOWLEDGE:** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal methods;<br>4. Occupational safety and health. |

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | PERFOM SITE WORKS ON PORT, AIRPORT AND RAILWAYS | **DUTY NO.** | 502 |
| **TASK TITLE** | PERFORM SETTING OUT OF DIFFERENT INFRASTRUCTURE ON PORT, AIRPORT AND RAILWAYS | **TASK NO.** | 5021 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to carry out setting out of different infrastructures as per approved working drawings. | | |
| **RANGE STATEMENT** | The task will be performed on field or construction site under the supervision of a technician.<br>The following equipment, tools and materials will be required in performing the task: total station and its auxiliary equipment, level gauge and its auxiliary equipment, builder's square, pipe level, motor grader, rope peg, hoe and P.P.E. | | |

**EVIDENCE REQUIREMENTS**

| PRACTICAL PERFORMANCE | UNDERPINNING KNOWLEDGE |
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| The person performing this task must be able do the following:<br>1. Clear Site;<br>2. Interpret drawings;<br>3. Select right tools, equipment and safety gears for the task;<br>4. Prepare materials for setting out;<br>5. Determine proper setting-out method according to various kinds of infrastructure;<br>6. Prepare the drawings and data needed for setting-out and mark the setting-out points;<br>7. Use proper survey equipment and auxiliary tools for setting-out of foundation contour points;<br>8. Check the foundation contour shape;<br>9. Set the foundation axis extension control peg;<br>10. Restore the axes of the parts of foundation;<br>11. Setting-out for foundation elevation;<br>12. Observe health and safety precautions when performing the task;<br>13. Clean the equipment and tools; | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Set out the different infrastructure at port, airport and railway;<br>1.2. Use setting out equipment;<br>1.3. Calculate the setting-out data for the setting-out methods such as polar coordinate method, rectangular coordinate method, angle 5intersection method and distance intersection method;<br>1.4. Use survey equipment;<br>1.5 Operation procedure for the setting-out methods such as polar coordinate method, rectangular coordinate method, angle intersection method and distance intersection method;<br>1.6 Use peg and rope to mark the foundation feature points and contour line;<br>1.7 Foundation elevation setting-out method;<br>1.8 Restore the foundation axis by using foundation axis extension control peg.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1. "Whole to part" survey principle;<br>2.2. Pythagoras theorem;<br>2.3 Foundation location and axis setting out; |

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| 14. Pack the equipment and tools. | 2.4. Levelling.<br><br>**3.0. Theories**<br>The person must be able to explain:<br>3.1. Types and operation of setting out equipment;<br>3.2. Mathematics skills in Pythagoras theorem;<br>3.3 The principles of the setting-out methods such as polar coordinate method, rectangular coordinate method, angle intersection method and distance intersection method;<br>3.4 Known elevation laying-off principle.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect;<br>4.8. Confidence;<br>4.9. Assertiveness;<br>4.10. Work effectively;<br>4.11. Logical thinking;<br>4,12. Independent work. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Setting out of different infrastructure on port, airport and railways is performed as per the approved working drawings. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFOM SITE WORKS ON PORT, AIRPORT AND RAILWAYS</td><td>DUTY NO.</td><td>502</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM CONSTRUCTION OF DIFFERENT INFRASTRUCTURE ON PORT, AIRPORT AND RAILWAYS</td><td>TASK NO.</td><td>5022</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out construction of different infrastructure at ports, airports and railways as per approved documents.</td></tr>
<tr><td>RANGE STATEMENTs</td><td colspan="3">The task will be performed at the construction site under supervision of a technician.<br>The following equipment, tools and material will be required in performing the task: earthwork machinery, concrete construction machinery, steel machining tools, construction pump, transportation and lifting machinery, various small construction machinery and tools, building materials, PPE and auxiliary transportation and communication equipment.</td></tr>
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<table>
<tr><td colspan="2">EVIDENCE REQUIREMENTS</td></tr>
<tr><td>PRACTICAL PERFORMANCE</td><td>UNDERPINNING KNOWLEDGE</td></tr>
<tr><td>The person performing this task must be able do the following:<br>1. Interpret approved construction documents;<br>2. Interpret the program of works;<br>3. Prepare construction materials for different work according to the approved schedule of the material provided;<br>4. Carry out or guide the personnel to carry out the construction of infrastructure at ports, airports and railways;<br>5. Perform test for quality control and monitoring;<br>6. Observe safety regulations when performing the task to ensure work safety during the construction.</td><td>Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Monitor and control quality of construction;<br>1.2. Interpret drawings and documents;<br>1.3. Interpret program of work;<br>1.4. Use equipment and tools;<br>1.5. Perform or guide the personnel to perform earthwork;<br>1.6. Construct or guide the personnel to construct different infrastructure for railway, ports and airports.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating test equipment and tools;<br>2.2. Sample preparation;<br>2.3. construction technology surveying;<br>2.4 Construction process flow.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Components of port, airport and railway;<br>3.2. Railway's construction;<br>3.3. Port construction;</td></tr>
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| | 3.4. Airport construction;<br>3.5. Survey;<br>3.6. Occupation safety and health;<br>3.7. How to use different types of earthmoving equipment and tools.<br><br>**4.0. Essential skills:**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect;<br>4.8. To work under pressure;<br>4.9. Confidence;<br>4.10. Assertiveness;<br>4.11. Work effectively;<br>4.12. Logical thinking;<br>4.13. Independent work. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Construction of different infrastructure in port, airport and railways is done as per approved design documents. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal methods. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFOM SITE WORKS ON PORT, AIRPORT AND RAILWAYS</td><td>DUTY NO.</td><td>502</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM MAINTANANCE OF DIFFERENT INFRASTRUCTURE ON PORT, AIRPORT AND RAILWAYS</td><td>TASK NO.</td><td>5023</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out maintenance of different infrastructure at ports, airports and railways as per maintenance needs assessment report and relevant standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the field under supervision of a technician.<br>The following equipment, tools and material will be required in performing the task: survey equipment, construction machinery, concrete machinery, steel machining machinery, small construction machinery and tools, building materials, personal protective equipment (PPE) and transportation and communication equipment.</td></tr>
<tr><td colspan="4" align="center">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Interpret approved maintenance needs assessment report;<br>2. Interpret maintenance plan;<br>3. Interpret program of works;<br>4. Interpret working drawings;<br>5. Inspect area to be maintained;<br>6. Properly perform technical disclosure and safety measures disclosure;<br>7. Observe safety regulations when performing the task to ensure work safety during construction;<br>8. Prepare construction materials for maintenance works;<br>9. Carry out maintenance works;<br>10. Perform quality inspection and acceptance properly;<br>11. Clean the equipment and working area.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Interpret drawings;<br>1.2. Interpret program of work;<br>1.3. Use equipment;<br>1.4. Perform maintenance works for ports, railways and airports.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating equipment and tools as per the safe operation procedure;<br>2.2. Construction;<br>2.3. Surveying;<br>2.4. Performing maintenance works for ports, airport and railways.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Construction Technology, construction organization and management;<br>3.2. Components of port, airport and railway;<br>3.3. Railway's construction;</td></tr>
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| | 3.4. Port construction;<br>3.5. Airport construction;<br>3.6. Survey;<br>3.7. Occupation safety and health.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect;<br>4.8. To work under pressure;<br>4.9. Confidence;<br>4.10. Assertiveness;<br>4.11. Work effectively;<br>4.12. Logical thinking;<br>4.13. Independent work. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Maintenance of different infrastructure in ports, airports and railways is performed as per approved maintenance needs assessment report and relevant approved standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Waste disposal methods. |

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | EXECUTE CONSTRUCTION AND MAINTANANCE WORKS OF ROADS PROJECTS | **DUTY NO.** | 503 |
| **TASK TITLE** | PERFORM EARTHWORK OPERATIONS | **TASK NO.** | 5031 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to perform road earthwork operations as per approved drawings and standards. | | |
| **RANGE STATEMENT** | The task will be completed at the construction site under the supervision of technician.<br>The following equipment, tools, machines and materials will be required in performing the task: boning rods, line levels, tape measure, water bowsers, bulldozer, tractor, shovel, excavator with backhoe, crane, trucks and wagons, motor grader, steel-wheeled roller vibratory compactor, pneumatic-tired roller, sheep-foot roller, hand compactor, earth filling materials, chemical stabilizers, and P.P.E. | | |

| **EVIDENCE REQUIREMENTS** | |
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| **PRACTICAL PERFORMANCE** | **UNDERPINNING KNOWLEDGE** |
| The person performing this task must be able do the following:<br>1. Interpret drawings, familiarize with the geological and hydrological data of soil layers;<br>2. Prepare the plan for site levelling, excavation and backfilling;<br>3. Select proper tools, equipment and PPE for the task;<br>4. Clear the site and level the ground<br>5. Perform setting out the road;<br>6. Select materials and equipment to be used;<br>7. Identify source of materials;<br>8. Perform road formation;<br>9. Perform soil stabilization;<br>10. Compact the prepared subgrade to specified density;<br>11. Prepare road pavements layers (subgrade, subbase and base course);<br>12. Observe health and safety precautions when performing the task;<br>13. Clean equipment and tools;<br>14. Clean working area;<br>15. Pack the equipment and tools; | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Interpret drawings to create an item or components;<br>1.2. Surveying and setting out;<br>1.3. Operate hands and power tools;<br>1.4. Perform all road earthwork operations.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1 Survey;<br>2.2. Excavation;<br>2.3. Spreading of earthwork materials;<br>2.4. Soil compaction;<br>2.5. Operating different earthwork tools, equipment, and machines.<br><br>**3.0. Theories**<br>The person must be able to explain:<br>3.1. Soil mechanics;<br>3..2. Road construction;<br>3.3. Engineering drawings;<br>3.4. Mathematics skills in geometry and trigonometry;<br>3.5. Land survey; |

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| 16. Store tools, equipment and safety gear. | 3.6. Civil engineering materials.<br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic and craftsmanship spirit;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect;<br>4.8 Instrument and equipment operation skills. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Road earthworks is performed as per approved working drawings and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Maintenance of hand and power tools;<br>3. Extent of responsibility;<br>4. Occupational safety and health;<br>5. Waste disposal Methods. |

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | EXECUTE CONSTRUCTION AND MAINTANANCE WORKS OF ROADS PROJECTS | **DUTY NO.** | 503 |
| **TASK TITLE** | PERFORM CONSTRUCTION OF ROAD DRAINAGE WORKS | **TASK NO.** | 5032 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to perform road drainage works as per approved drawings and standards. | | |
| **RANGE STATEMENT** | The task will be completed at the construction site under the supervision of technician.<br>The following equipment, tools, machines and materials will be required in performing the task: coarse aggregates, fine aggregates, cement, water, reinforcing steel bars, precast pipe culverts, side drain precast concrete panels, pitching stones, boning rods, line levels, tape measure, concrete mixers, poker vibrator, formworks, shovel, and P.P.E. | | |

**EVIDENCE REQUIREMENTS**

| PRACTICAL PERFORMANCE | UNDERPINNING KNOWLEDGE |
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| The person performing this task must be able do the following:<br>1. Interpret drawings;<br>2. Select and prepare right tools, equipment and safety gears for the task;<br>3. Prepare the plan for water drainage works;<br>4. Set out side drain;<br>5. Excavate side drain;<br>6. Construct side drain as per approved specification;<br>7. Set out culvert and drift;<br>8. Excavate for culvert and drift;<br>9. Construct for culvert and drift as per approved specification;<br>10. Observe health and safety precautions when performing the task;<br>11. Clean equipment and tools;<br>12. Clean working area;<br>13. Pack the equipment and tools<br>Store tools, equipment and safety gear. | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Interpret drawings to create an item or components;<br>1.2 Surveying and setting out;<br>1.3. Operate hands and power tools;<br>1.4. Perform all road drainage works.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1 Survey;<br>2.2. Excavation;<br>2.3. Spreading of earthwork materials;<br>2.4 Jointing of prefabricated pipes and culverts;<br>2.5 Construction of cast-in-situ concrete;<br>2.6. Soil compaction;<br>2.7. Operating different earthwork tools, equipment, and machines.<br><br>**3.0. Theories**<br>The person must be able to explain:<br>3.1. Soil mechanics;<br>3.2. Road construction;<br>3.3. Drainage construction;<br>3.4. Engineering drawings;<br>3.5. Mathematics skills in geometry and trigonometry;<br>3.6. Civil engineering materials; |

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| | 3.7. Maintenance of hand and power tools.<br><br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic and craftsmanship spirit;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect;<br>4.8 Instrument and equipment operation skills. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Road drainage works is performed as per approved working drawings and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health;<br>4. Waste disposal Methods. |

<table>
<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>EXECUTE SITE WORKS FOR CONSTRUCTION AND MAINTANANCE OF ROADS PROJECTS.</td><td>DUTY NO.</td><td>503</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM ROAD PAVING OPERATIONS</td><td>TASK NO.</td><td>5033</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to perform road paving operations as per approved drawings and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed at the asphalt plant and construction site under the supervision of technician.<br>The following equipment, tools, machines and materials will be required in performing the task: asphalt cement, asphalt emulsions, cutback asphalt, asphalt modifiers, aggregates, fillers, asphalt plant, dump trucks, temperature preserving coverings, thermometers, asphalt distributors, asphalt pavers, Portland cement concrete (PCC) pavers, rakes, dipsticks, steel-wheeled rollers, pneumatic-tired rollers, hand compactor, tipper, dozer, compressor and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Interpret drawings;<br>2. Select right tools, equipment and safety gears for the task. Prepare layout for existing components or items;<br>3. Select materials to be used;<br>4. Prepare base course prior to paving;<br>5. Prepare asphalt/ Portland cement concrete (PCC) paver for paving;<br>6. Prepare asphalt mixture / Portland cement concrete (PCC) for paving as per specifications;<br>7. Pour the paving mixture on the road to specified layer thickness<br>(Mixture can be paved manually or mechanically, hot-mix asphalt mixture will be paved mechanically, the material must be spread evenly, slowly and continuously);<br>8. Compact the paving mixture on the road to specified layer thickness;<br>8.1 First compaction will be done by using steel roller. During rolling, the driving wheel will face the paver.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Interpret drawings to create an item or components;<br>1.2. Operate hands and power tools;<br>1.3. Perform all road paving operations.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Asphalt paving operations;<br>2.2. Portland cement concrete paving operations;<br>2.3. Operating different paving tools, equipment, and machines;<br>2.4. Transportation of asphalt mixture or Portland cement concrete paving operations;<br>2.5. Quality control.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Highway engineering materials;<br>3.2. Road construction process;<br>3.3. Engineering drawings;<br>3.4. Mathematics skills in geometry and trigonometry;<br>3.5. Civil engineering materials;</td></tr>
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| After first compaction, inspect the flatness and road camber, and make adjustment if necessary;<br>8.2 Second compaction will be done by using heavy-duty pneumatic tyred roller and final compaction by smooth steel roller. The number of rolling passes of various rollers will be determined by tests;<br>9. Joint treatment: The construction joints of bituminous pavement (including longitudinal joint and transverse joint) must be dense and smooth;<br>10. Control mix temperature asphalt;<br>11. Perform test for quality control and monitoring;<br>12. Observe health and safety precautions when performing the task;<br>13. Clean equipment and tools;<br>14. Clean working area;<br>15. Store tools, equipment and safety gear;<br>16. Pack the equipment and tools. | 3.6. Maintenance of hand and power tools.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Road paving operations is performed as per approved working drawings and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health;<br>4. Waste disposal Methods. |

<table>
<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>EXECUTE SITE WORKS FOR CONSTRUCTION AND MAINTANANCE OF ROADS PROJECTS</td><td>DUTY NO.</td><td>503</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM MAINTENANCE OF ROAD WORKS</td><td>TASK NO.</td><td>5034</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to perform maintenance of roadworks as per approved drawings and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed at the construction site under the supervision of technician.<br>The following equipment, tools, machines and materials will be required in performing the task: coarse aggregates, fine aggregates, cement, water, reinforcing steel bars, precast pipe culverts, side drain, bitumen, bitumen distributors, wheelbarrow, hand compactor, hand roller compactor, pneumatic wheeled roller, patch works, steel rollers, precast concrete panels, pitching stones, boning rods, line levels, tape measure, concrete mixers, poker vibrator, formworks, shovel, and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Identify areas that need maintenance and repair of roads;<br>2. Identify maintenance needs for roads;<br>2.1 Road service conditions investigation and performance assessment;<br>2.2 Road maintenance plan design;<br>3. Select right tools, equipment and safety gears for the task;<br>4. Select maintenance materials;<br>5. Repair and maintain road defects;<br>6. Clean equipment, tools and working area;<br>7. Pack the equipment and tools;<br>8. Store tools, equipment and safety gears.</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Establish maintenance requirement;<br>1.2. Repair and maintain road defects.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Repair road defects;<br>2.2. Operating and handling tool and equipment for maintenance roads maintenance;<br>2.3 Construction organization.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Soil mechanics;<br>3.2. Road construction;<br>3.3. Drainage construction;<br>3.4. Engineering drawings;<br>3.5. Civil engineering materials;<br>3.6. Highway engineering materials.<br><br>4.0. Essential skills<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Numeracy;<br>4.4. Work ethic;</td></tr>
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| | 4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Road maintenance works is performed as per approved working drawings and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Maintenance of hand and power tools;<br>3. Extent of responsibility;<br>4. Occupational safety and health;<br>5. Waste disposal Methods. |

<table>
<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM CONSTRUCTION AND MAINTENANCE OF WATER SUPPLY AND SANITATION WORKS.</td><td>DUTY NO.</td><td>504</td></tr>
<tr><td>TASK TITLE</td><td>INSTALL WATER SUPPLY AND WASTEWATER SYSTEM IN BUILDINGS</td><td>TASK NO.</td><td>5041</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to install water supply and wastewater systems in buildings as per approved working drawing and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the constructed super structure of a building under the supervision of technician.<br>The following equipment, tools and materials will be required in performing the task: pipes, pipe connectors, drilling equipment, pipe valves, sanitary ware, tape measure, plumb bob, dumpy level and P.P.E.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Interpret construction drawings for water supply/drainage pipe system of the building;<br>2. Correctly use construction equipment, tools, measuring equipment and personal protective equipment;<br>3. Select proper setting-out equipment;<br>4. Proficiently perform connection and installation of pipes and fabrication and installation of pipe supports and hangers;<br>5. Perform installation of automatic sprinkling fire-fighting system pipes and fittings and testing and installation of common valves;<br>6. Perform pressure test, washing and disinfection of water supply and drainage pipes of building;<br>7. Perform independent inspection on pipe installation quality, and check for leakage;<br>8. Perform routine maintenance of pipes and common valves and installation of safety valves;<br>9. Proficiently install sanitary ware;<br>10. Install accessories and</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Interpret pipeline construction drawings;<br>1.2. Make and install pipe supports and hangers;<br>1.3. Install building water supply and drainage pipes;<br>1.4. Clean and disinfect indoor water supply and drainage pipes;<br>1.5. Test indoor water supply and drainage pipe system;<br>1.6. Use and maintain common construction equipment and measuring equipment<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Automatic sprinkling fire-fighting system;<br>2.2. Water supply/drainage system drawing;<br>2.3. Fire protection system drawing;<br>2.4. Pipe and valve tests.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Basic knowledge on pipe system and common pipe fittings;<br>3.2. Basic knowledge on fluid mechanics and materials mechanics;</td></tr>
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| instruments. | 3.3. Basic knowledge on water quality safety and protection;<br>3.4 Common defects in pipe construction quality and the preventive and corrective measures.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | The water supply and wastewater systems installation are performed as per approved working drawing and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

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<tr><td>OCCUPATION</td><td colspan="2">CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td colspan="2">PERFORM CONSTRUCTION AND MAINTENANCE OF WATER SUPPLY AND SANITATION WORKS</td><td>DUTY NO.</td><td>504</td></tr>
<tr><td>TASK TITLE</td><td colspan="2">PERFORM CONSTRUCTION OF WATER SUPPLY SYSTEM</td><td>TASK NO.</td><td>5042</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="4">The person performing this task must be able to carry out construction works for water transmission and distribution networks as per approved design documents and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="4">The task will be performed along the surveyed route for water transmission and distribution networks under the supervision of technician.<br>The following equipment, tools and materials will be required in performing the task: surveying equipment and tools, pipes, pipe connectors, excavation tools and equipment, pipe valves, tape measure, plumb bob, damp level and P.P.E.</td></tr>
<tr><td colspan="5">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="3">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br><br>1. Understand pipe construction drawing, and draft rough drawing;<br>2. Properly use common construction machinery, tools and surveying equipment, and properly use personal protective equipment for necessary work protection;<br>3. Complete trench excavation, installation of pipes and auxiliary equipment and backfilling of trench according to the construction drawing;<br>4. Perform independent quality inspection according to the quality acceptance requirements and fill out the acceptance certificate;<br>5. Perform pipe pressure test, washing and disinfection according to regulations;<br>6. Perform installation, maintenance or replacement of pipes, valves and water meters.</td><td colspan="3">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1 Interpret pipe construction drawing, pipe fitting drawing and setting out;<br>1.2 Pipeline installation construction;<br>1.3 Test functions of installed pipe.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. The types, structure and operating principle of common valves of pipes;<br>2.2. The quality inspection standards for various pipes and pipe fittings;<br>2.3. The principles and requirements for pipe laying.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Forms of pipe connectors and the types, specifications and operation requirements of materials;<br>3.2. Purposes and specifications of pipe network facilities;<br>3.3. Knowledge on engineering mechanics and hydromechanics and the knowledge on quality inspection<br>3.4. Names of the common pipe construction</td></tr>
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| | equipment, tools and surveying equipment, functions and purposes;<br>3.5 Water pressure in pipes and the vulnerabilities of pipe network (areas of frequent accidents etc.).<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | The water transmission, distribution network and domestics water points installation are performed as per approved working drawing and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health;<br>4. Waste disposal methods. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM CONSTRUCTION AND MAINTENANCE OF WATER SUPPLY AND SANITATION WORKS</td><td>DUTY NO.</td><td>504</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM CONSTRUCTION OF DOMESTIC SANITATION SYSTEM</td><td>TASK NO.</td><td>5043</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out construction works for domestic sanitation system as per approved working drawings and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed along the surveyed area or route for construction of sanitation system under the supervision of technician. The following equipment, tools and materials will be required in performing the task: surveying equipment and tools, pipes, pipe connectors, excavation tools and equipment, pipe valves, tape measure, plumb bob, damp level and P.P.E and construction materials.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br><br>1. Interpret water drainage pipe construction;<br>2. Properly use common construction machinery, tools and surveying equipment, and properly use personal protective equipment for necessary work protection;<br>3. Perform the works including excavation and backfilling, trench support, bottom treatment, pipe laying and connection in trenching construction;<br>4. Perform the works including equipment installation, section-by-section jacking, testing and deviation correction, connection and pit closure and quality inspection in pipe-jacking construction;<br>5. Perform the works including levelling, chalk line, plastering, masonry unit placement, opening, pointing and quality inspection in pipe laying construction with masonry method and assembly method;<br>6. Perform the works including steel</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Interpret of pipe construction drawing;<br>1.2. Be Familiar with water drainage pipe installation process;<br>1.3. Use and keep safe the equipment and materials for water drainage pipelines.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. The urban water drainage system and the final destination of rainwater and sewage;<br>2.2. The principle for discharge by gravity flow;<br>2.3. How toxic and harmful gases are generated in urban water drainage system.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. The functions of urban water drainage system, drainage methods and drainage facilities;<br>3.2. The basic knowledge on fluid mechanics and water chemistry;<br>3.3. The classification, grading, composition and structure of water drainage pipelines;<br>3.4. The basic knowledge on sewage interception and rainwater runoff pollution control in the mixed flow system;</td></tr>
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| binding, formwork erection, concrete pouring and vibration in trench construction with cast-in-situ method. | 3.5. The knowledge on identification and prevention of common sources of hazard.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | The construction of domestic sanitation system is performed as per approved working drawings and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health;<br>4. Waste disposal methods. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM CONSTRUCTION AND MAINTENANCE OF WATER SUPPLY AND SANITATION WORKS.</td><td>DUTY NO.</td><td>504</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM MAINTENANCE AND REPAIR OF WATER SUPPLY AND SANITATION SYSTEMS</td><td>TASK NO.</td><td>5044</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out maintenance works for domestic water supply and sanitation systems as per approved working drawings and standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in buildings and along the existing water supply and sanitation systems under the supervision of technician. The following equipment, tools and materials will be required in performing the task: pipe connectors, excavation tools and equipment, pipe valves, P.P.E. and construction materials.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Identify the areas needing maintenance and repair in the water supply and sanitation systems;<br>2. Determine the maintenance requirements for water supply and drainage systems;<br>3. Operate and maintain the operation and control equipment;<br>4. Use various leakage detectors and pipe locators to identify the pipe leakage points and analyse the cause of leakage;<br>5. Perform replacement of water supply pipe and water meter and repair of valves;<br>6. Perform the site works including water drainage pipe clearing and sludge thickening, washing and sieving;<br>7. Perform sludge removal and minor revamp of the auxiliary structures such as inspection well and gutter inlet;<br>8. Perform interception and control of mixed flow of sewage and initial rainwater;</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Use and keep safe the tools, appliances and materials for maintenance of water supply and drainage pipes;<br>1.2. Operate and maintain the operation monitoring equipment for water supply and drainage pipe network;<br>1.3. Operate and maintain the equipment for maintenance of water supply and drainage pipes;<br>1.4 Use common methods to clear water drainage pipes;<br>1.5 Use common methods to sove plugging, water diversion, local repair and local replacement of water drainage pipe.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. The working principles of water supply and drainage pipes;<br>2.2. The operation procedure and safety precautions for operation and maintenance of water supply and drainage pipes;<br>2.3. The types, characteristics, classification and response requirements of drainage pipe network;<br>2.4 The basic approaches for urban flood control and</td></tr>
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| 9. Organize fast backup service and onsite emergency response for medium or small units of drainage pipe network that need emergency rescue;<br>10. Perform temporary plugging and water diversion of water drainage pipe;<br>11. Repair the defects of water drainage pipe such as leakage and rupture. | emergency drainage and the principle for selecting the approaches.<br><br>**3.0. Theories**<br>The person must be able to explain:<br>3.1. The basic knowledge on fluid mechanics and water chemistry;<br>3.2. The basic knowledge on pipe inspection and leakage detection technology;<br>3.3. The safety knowledge regarding toxic and harmful gases and inflammable and explosive spaces in urban drainage system;<br>3.4 The safety knowledge regarding work in confined space, road-occupying works and flood control and drainage;<br>3.5 The knowledge on testing and assessment of the functional and structural conditions of drainage pipes.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Work ethic;<br>4.5. Adaptability;<br>4.6. Time management;<br>4.7. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | The maintenance of water supply and sanitation systems is performed as per approved standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

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| **OCCUPATION** | CIVIL ENGINEERING TECHNICIAN | **OCCUPATION CODE** | |
| **DUTY TITLE** | PERFORM LAND SURVEY FOR CIVIL ENGINEERING INFRASTRUCTURES | **DUTY NO.** | 505 |
| **TASK TITLE** | PERFORM TRAVERSE SURVEY FOR CIVIL ENGINEERING INFRASTRUCTURES (CONTROL SURVEY) | **TASK NO.** | 5051 |
| **PERFORMANCE CRITERIA** | The person performing this task must be able to carry out traverse survey (control survey) and prepare survey plan as per approved standards. | | |
| **RANGE STATEMENT** | The task will be performed in the field under the supervision of technician.<br>The following equipment, tools and materials will be required in performing the task: total station, prism set, tripod, 5m measuring tape, level gauge, levelling staff, staff plate, gaging board, walkie-talkie and PPE. | | |

| **EVIDENCE REQUIREMENTS** | |
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| **PRACTICAL PERFORMANCE** | **UNDERPINNING KNOWLEDGE** |
| The person performing this task must be able do the following:<br>1. Prepare the technical design specification for control survey;<br>2. Conduct site reconnaissance (arrange the traverse control points and elevation control points according to the site conditions);<br>3. Select right tools, equipment and safety gears for the task;<br>4. Establish the coordinate system and survey area reference points;<br>5.Measure the traverse horizontal angle and side length by using the total station;<br>6. Measure the elevation difference between points by using the total station or level gauge;<br>7. Record the observation data;<br>8. Determine whether the survey results are satisfactory according to the engineering accuracy requirements;<br>9. Process the traverse survey data;<br>10. Process the elevation survey data;<br>11. Prepare the technical report on control survey;<br>12. Observe health and safety precautions when performing the | **Detailed knowledge about:**<br>**1.0. Methods**<br>This person performing this task must be able to explain how to:<br>1.1. Methods for embedment of traverse control point and elevation control point;<br>1.2. Methods for use of total station and level gauge;<br>1.3. Methods for measurement of horizontal angle and horizontal distance of traverses;<br>1.4. Methods for measurement of elevation difference between elevation control points;<br>1.5 Methods for recording traverse survey data;<br>1.6 Methods for recording elevation survey data;<br>1.7 Traverse survey data accuracy assessment and treatment;<br>1.8 Elevation survey data accuracy assessment and processing.<br><br>**2.0. Principles**<br>The person must be able to explain the principles of:<br>2.1. Principle for placement of traverse control points and elevation control points;<br>2.2. Angle survey;<br>2.3. Distance survey;<br>2.4. Elevation difference survey;<br>2.5. Data resurvey.<br><br>**3.0. Theories**<br>The person must be able to explain: |

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| task;<br>13. Clean the equipment, tools and working area;<br>14. Store tools, equipment and safety gear. | 3.1. Traverse survey error processing;<br>3.2. Elevation survey error processing;<br>3.3 Triangulated elevation survey principle.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Mathematics skills in Trigonometry, Coordinate Geometry, Geometry;<br>4.5 Work ethic;<br>4.6. Adaptability;<br>4.7. Time management;<br>4.8. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Traverse survey for civil engineering infrastructures is performed with all details as per approved surveying standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

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<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM LAND SURVEY FOR CIVIL ENGINEERING INFRASTRUCTURES</td><td>DUTY NO.</td><td>505</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM BASIC TOPOGRAPHIC SURVEY FOR CIVIL ENGINEERING INFRASTRUCTURES</td><td>TASK NO.</td><td>5052</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to carry out basic topographic survey as per approved standards.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed in the field under the supervision of technician.<br>The following equipment, tools and materials will be required in performing the task: total station, ranging prism bar, tripod, 5m measuring tape, gaging board, walkie-talkie and PPE.</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENTS</td></tr>
<tr><td colspan="2">PRACTICAL PERFORMANCE</td><td colspan="2">UNDERPINNING KNOWLEDGE</td></tr>
<tr><td colspan="2">The person performing this task must be able do the following:<br>1. Prepare the technical design specification for topographic survey;<br>2. Conduct site reconnaissance;<br>3. Select right tools, equipment and safety gears for the task;<br>4. Recheck the accuracy of the coordinates and elevation of the known control points in the survey area;<br>5. Survey station setting, reference direction setting and survey station checking;<br>6. Determine the surface features and landforms to be represented on the topographic map;<br>7. Survey the characteristic points of surface features and landforms;<br>8. Survey data storage and transmission, and format conversion;<br>9. Draw the topographic map indicating the selected topographic features;<br>10. Prepare the technical report on topographic survey;<br>11. Observe health and safety precautions when performing the task;<br>12. Clean the equipment, tools and working area;</td><td colspan="2">Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Perform site reconnaissance;<br>1.2. Use topographic map surveying instruments and accessories;<br>1.3. Determine the location and scope of topographic map;<br>1.4. The methods for survey of surface features and landforms;<br>1.5. Methods for symbolic representation of surface features and landforms;<br>1.6 Map the surface features and landforms by using mapping software;<br>1.7 Graphic texts and modifications of topographic map.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Operating survey equipment;<br>2.2. Survey principle of characteristic points of surface features and landforms;<br>2.3. Principle of symbolic representation of surface features and landforms;<br>2.4. Principle to choose landforms when drawing a map.<br><br>3.0. Theories<br>The person must be able to explain:<br>3.1. Theory of topographic survey;</td></tr>
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| 13. Store tools, equipment and safety gear. | 3.2. Theory of topographic mapping.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Mathematics skills in Trigonometry, Coordinate Geometry, Geometry;<br>4.5. Work ethic;<br>4.6. Adaptability;<br>4.7. Time management;<br>4.8. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Basic topographic survey for civil engineering infrastructures is performed as per approved surveying standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

<table>
<tr><td>OCCUPATION</td><td>CIVIL ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>PERFORM LAND SURVEY FOR CIVIL ENGINEERING INFRASTRUCTURES.</td><td>DUTY NO.</td><td>505</td></tr>
<tr><td>TASK TITLE</td><td>PERFORM SETTING OUT OF CIVIL ENGINEERING INFRASTRUCTURES.</td><td>TASK NO.</td><td>505<br>3</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to set out civil engineering infrastructures for construction as per approved working drawings.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task will be performed at a construction site ~~under~~ the supervision of technician.<br>The following equipment, tools and materials will be required in performing the task: total station, prism set, tripod, 5m measuring tape, level gauge, levelling staff, staff plate, builder’s square, gaging board, walkie-talkie, rope, peg, hoe and PPE.</td></tr>
<tr><td colspan="4" align="center">EVIDENCE REQUIREMENTS</td></tr>
</table>

<table>
<tr><td>PRACTICAL PERFORMANCE</td><td>UNDERPINNING KNOWLEDGE</td></tr>
<tr><td>The person performing this task must be able do the following:<br>1. Conduct site reconnaissance;<br>2. Select proper survey tools and equipment, and select safety gears;<br>3. Establish control/reference point, or recheck the accuracy of the coordinates and elevation of the known control points in the survey area;<br>4. Interpret working drawings for setting out;<br>5. Select proper setting-out method;<br>6. Set out the planimetric position and detailed axis position of infrastructure, and set axis control peg;<br>7. Set out the excavation depth reference point of infrastructure;<br>8. Check the planimetric position, size and excavation depth reference point of foundation;<br>9. Observe health and safety precautions when performing the task;<br>10. Clean the equipment, tools and working area;<br>11. Store tools, equipment and safety gears.</td><td>Detailed knowledge about:<br>1.0. Methods<br>This person performing this task must be able to explain how to:<br>1.1. Use survey equipment and tools to set out civil engineering infrastructure;<br>1.2. Set out surveying equipment;<br>1.3 Calculate the setting-out data of the setting-out methods such as polar coordinate method, rectangular coordinate method, angle intersection method and distance intersection method;<br>1.4 Operation process of the setting-out methods such as polar coordinate method, rectangular coordinate method, angle intersection method and distance intersection method;<br>1.5 Demarcate the characteristic points and contour lines of foundation by using peg and rope;<br>1.6 Method for foundation elevation setting out;<br>1.7 Method for restoring foundation axis according to foundation axis extension.<br><br>2.0. Principles<br>The person must be able to explain the principles of:<br>2.1. Site reconnaissance;<br>2.2. Operating survey equipment;<br>2.3. Foundation location and axis setting out;<br>2.4. Levelling.<br><br>3.0. Theories<br>The person must be able to explain:</td></tr>
</table>

| | |
|---|---|
| | 3.1. Setting out procedure;<br>3.2. Errors associated with setting out of civil engineering infrastructure;<br>3.3. Principles of the setting-out methods such as polar coordinate method, rectangular coordinate method, angle intersection method and distance intersection method;<br>3.4 Known elevation laying-off principle.<br><br>**4.0. Essential skills**<br>4.1. Team work skills;<br>4.2. Communication skills;<br>4.3. Computer application skills;<br>4.4. Mathematics skills in Trigonometry, Coordinate Geometry, Geometry;<br>4.5. Work ethic;<br>4.6. Adaptability;<br>4.7. Time management;<br>4.8. Respect. |
| **DESCRIPTION OF END PRODUCTS/SERVICE** | Civil engineering infrastructures is set out for construction as per approved working drawing and standards. |
| **CIRCUMSTANTIAL KNOWLEDGE** | **Detailed knowledge about:**<br>1. Safe handling of equipment and tools;<br>2. Extent of responsibility;<br>3. Occupational safety and health. |

**TABLE 1: DACUM CHARTS FOR CIVILIENGINEERING TECHNICIAN NTA 5**

| S/No | DUTIES | TASKS | ENABLERS |
|---|---|---|---|
| 01 | Perform field and laboratory test for civil engineering materials. | 1.1 Conduct field and laboratory tests for soil.<br>1.2 Perform concrete tests.<br>1.3 Perform aggregate tests for concrete.<br>1.4 Perform borehole logging.<br>1.5 Perform soil classification.<br>1.6 Perform laboratory test on bituminous materials.<br>1.7 Perform laboratory test on steel. | **Generic skills and knowledge**<br>• Using communication skills to work with others, reporting to superiors<br>• Skills and knowledge on Taking measurements & measuring units.<br>• Machine elements<br>• Civil Engineering Materials<br>• Soil mechanics<br>•<br>**Tools and Equipment**<br>• PPE such as Safety Shoes, Glasses, Gloves, Hard Hats.<br>• consolidation test machine, triaxial test equipment, shear box, permeability apparatus, CBR machine, compaction mold, CBR molds, standard spirit sampler, drop hammer, guiding rod, drilling rig, driving head, Drilling tools (auger, core cutter, wash borer), spades, hoe etc.<br>**Worker behaviours**<br>Team spirit, trustworthy, time management, commitment, Work ethic, Adaptability and Respect |
| 02 | Perform site works on port, airport and railways. | 2.1 Perform setting out of different infrastructure on port, airport and railways.<br>2.2 Perform construction of different infrastructure on port, airport and railways.<br>2.3 Perform maintenance of different infrastructure on port, | **Generic skills and knowledge**<br>• Using communication skills to work with others, reporting to superiors<br>• Skills and knowledge on Taking measurements & measuring units.<br>• Machine elements<br>• Civil Engineering Materials<br>• Soil mechanics<br>• Engineering survey |

| S/No | DUTIES | TASKS | ENABLERS |
|---|---|---|---|
| | | airport and railways. | **Tools and Equipment**<br>• PPE such as Safety Shoes, Glasses, Gloves, Hard Hats.<br>• levelling machine, rope, land survey equipment, builder's square, water level, pipe level, hoe etc.<br><br>**Worker behaviours**<br>Team spirit, trustworthy, time management, commitment, Work ethic, Adaptability and Respect |
| 03 | Execute site works for construction and maintenance of roads projects. | 3.1 Perform earthwork operations.<br>3.2 Perform construction of road drainage works.<br>3.3 Perform road paving operations.<br>3.4 Perform maintenance of road works. | **Generic skills and knowledge**<br>• Using communication skills to work with others, reporting to superiors<br>• Skills and knowledge on Taking measurements & measuring units.<br>• Machine elements<br>• Civil Engineering Materials<br>• Soil mechanics<br>• Engineering survey<br><br>**Tools and Equipment**<br>• PPE such as Safety Shoes, Glasses, Gloves, Hard Hats.<br>• levelling machine, rope, land survey equipment, builder's square, water level, pipe level, Bulldozer, wheel loader, excavator, vibrator compactor, roller, road paver, dumping truck, concrete mixer, water bowser, motor grader, tipper, wheel barrow hoe etc.<br><br>**Worker behaviours**<br>Team spirit, trustworthy, time management, commitment, |

| S/No | DUTIES | TASKS | ENABLERS |
|---|---|---|---|
| | | | Work ethic, Adaptability and Respect |
| 04 | Perform construction and maintenance of water supply and sanitation works. | 4.1 Install water supply and waste water system in buildings.<br>4.2 Perform construction of water supply system.<br>4.3 Perform construction of domestic sanitation system.<br>4.4 Perform maintenance and repair of water supply and sanitation systems. | **Generic skills and knowledge**<br>• Using communication skills to work with others, reporting to superiors<br>• Skills and knowledge on Taking measurements & measuring units.<br>• Machine elements<br>• Civil Engineering Materials<br>• Fluid mechanics<br>• Engineering survey<br>**Tools and Equipment**<br>• PPE such as Safety Shoes, Glasses, Gloves, Hard Hats.<br>• surveying equipment and tools, pipes, pipe connectors, excavation tools and equipment, pipe valves, tape measure, plumb bob, damp level etc.<br>**Worker behaviours**<br>Team spirit, trustworthy, time management, commitment, Work ethic, Adaptability and Respect |
| 05 | Perform land survey for civil engineering infrastructures. | 5.1 Perform traverse survey for civil engineering infrastructures.<br>5.2 Perform basic topographic survey for civil engineering infrastructures.<br>5.3 Perform setting out of civil engineering infrastructures. | **Generic skills and knowledge**<br>• Using communication skills to work with others, reporting to superiors<br>• Use of manufacturer's manual<br>• Skills and knowledge on Taking measurements & measuring units.<br>• Machine elements<br>• Interpretation of technical drawing<br>• Engineering Survey<br>**Tools and Equipment** |

| S/No | DUTIES | TASKS | ENABLERS |
|---|---|---|---|
| | | | • PPE such as Safety Shoes, Glasses, Gloves, Hard Hats.<br>• measuring tape, Theodolite, ranging poles, levelling staff, level machine and/or total station, prism targets<br><br>**Worker behaviours**<br><br>Team spirit, trustworthy, time management, commitment, Work ethic, Adaptability and Respect |