THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATIONAL STANDARDS

OCCUPATION: WATER CONSERVANCY ENGINEERING TECHNICIAN

LEVEL: NTA LEVEL 4

FEBRUARY 2024

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ABBREVIATIONS

CBET	Competency Based Education and Training
CEC	Concrete Engineering Construction
CRW	Construction of Rebar Works
DRO	Drilling Rig Operation
EC	Earthwork Construction
HGO	Hydraulic Gate Operation
HM	Hydrogeological Monitoring
NACTVET	National Council for Technical and Vocational Education and Training of Tanzania
NOS	National Occupational Standards
OS	Occupational Standards
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
WCPM	Water Conservancy Project Monitoring
WCOCM	Water Conservancy Organization and Construction Management

GLOSSARY OF TERMS

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 programme 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 area:	This is a broad grouping of related jobs. (Example: catering service)
Occupational standards:	Specific requirements of competences people are expected to demonstrate in a particular occupational area, including knowledge and relevant attitudes. They also act as performance tools of assessment of the prescribed 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. Skills are conceived of as a

	composite of three completely interdependent components: cognitive, affective, and psychomotor activities.
Standards:	A set of statements, 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, circumstantial knowledge, attitudes, performance criteria, tools and materials needed, and safety concerns required of employees performing it.
Task:	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:	The crucial knowledge that an individual must acquire in order to perform a given task.
Verification process:	The process of experts reviewing and confirming the statements of tasks (competency) through occupational analysis. Other questions such as the degree of task learning difficulty are also frequently asked. This process is sometimes referred to as validation.
Occupational competence:	The application of knowledge and skills to perform consistently to the standards required in the working context.

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, with a high level of human development. 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 and Vocational Education and Training (NACTVET) has begun the job of drafting Occupational Standards (OS) that will eventually be adopted as National Occupational Standards (NOS) for use in the delivery of TET that meets the needs of the labour market and the country's economic agenda.

Occupational Standards (OS) are performance criteria that are matched with labour market demands. Each of them describes the functions, performance standards, and understanding or knowledge underpinning a given occupation. They combine skills, knowledge, and attitudes to describe best practice. They are useful tools for establishing job roles, personnel recruitment, supervision, and appraisal, as well as TET Standards. They are also helpful for benchmarking and harmonizing job 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 application across all public and private institutions.

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

For the purpose of TET delivery, Tanzania has adopted the Competence 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 training (CBET) programmes. Therefore, it is quite pertinent

for TET institutions to use the relevant occupational standards as a benchmark for formulating their curricula.

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.

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 STANDARDS DEVELOPMENT PROCESS

The process of developing these Occupational Standards involved both local and international expertise. The process began with an examination of major documents that guide Tanzanian skills development including the *10-year National Skills Development Strategy (2016-2026).* NACTVET 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 team of experts in consultation with practitioners developed draft occupational standards. The draft document was used to develop an occupational profile for each occupation (DACUM Chart), which is attached as an **Appendix** to every Occupational Standard.

The occupational standards were validated during the stakeholders' forum held on 22nd and 23rd February 2024 at Morogoro. The information from the stakeholders' forum provides insight from the workplaces, professional bodies, regulatory bodies and sector ministries regarding trends and changes in the profession, including how well graduates are prepared for working in the occupation.

3.0. THE SCOPE AND OVERVIEW OF THE OCCUPATIONAL STANDARDS FOR WATER CONSERVANCY ENGINEERING TECHNICIANS

These standards cover a broad range of duties and tasks that can be performed by a Water Conservancy 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 Water Conservancy 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.

The Water Conservancy Engineering Technician works under the supervision of the engineer, operating the drilling rig to complete drilling construction, and overseeing the construction site, including earthwork and reinforced concrete works. Additionally, they are required to perform water

conservancy project monitoring and maintenance, hydraulic gate operation and maintenance, and Hydrogeological surveys. Generally, the Water Conservancy Engineering Technician performs the following duties:

a) Operate the drilling rig;

b) Identify and select earthwork construction machinery (equipment);

c) Operate and maintain earthwork construction machinery (equipment);

d) Prepare earthwork construction scheme and provide onsite guidance;

e) Identify and select concrete construction materials and equipment;

f) Carry out concrete construction and finishing;

g) Formulate and check the concrete construction plan;

h) Perform steel bar processing, connection, and installation;

i) Prepare the steel bar construction scheme;

j) Monitor the water conservancy project and record the data;

k) Detect, inspect and maintain water conservancy project monitoring facilities;

l) Perform routine inspection and maintenance of hydraulic gate operation, abnormality identification and local maintenance, abnormality elimination, and equipment maintenance;

m) Observe and measure (test) precipitation, water level, and flow, and reorganize data;

n) Carry out Hydrogeological survey, groundwater observation, water quality monitoring;

o) Install and maintain Hydrogeological survey instruments and equipment, and perform Hydrogeological information prediction;

p) Carry out Water Conservancy engineering construction management.

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 OCCUPATIONAL STANDARDS FOR WATER CONSERVANCY ENGINEERING TECHNICIANS - NTA LEVEL 4

OCCUPATION	**WATER CONSERVANCY ENGINEERING TECHNICIAN**	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELL	**DUTY NO.**	401
TASK TITLE	OPERATE DRILLING EQUIPMENT	**TASK NO.**	4011
PERFORMANCE CRITERIA	The person performing this task must be able to operate the drilling equipment in accordance with technical requirements.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Senior Technician and Geological Engineer. The tools and equipment to be used include: 1. Hydrogeological well drilling rig, including drilling tower, drilling rig, motor, mud pump, air compressor; 2. User's manual for drilling equipment; 3. Drilling construction procedures. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Comply with safety, quality and environmental protection measures when performing this task; 2. Comply with drilling construction procedures when performing this task; 3. Install and inspect the drilling tower; 4. Install and operate the drilling rig;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Install and inspect the drilling tower; 1.2 Install and operate the drilling rig; 1.3 Operate the motor; 1.4 Operate the mud pump; 1.5 Operate the air compressor. **2.0 Principles** The person performing this task must be able to explain the following principles:

5. Operate the motor; 6. Operate the mud pump; 7. Operate the air compressor. 8. Observe health, occupational and environmental safety rules and regulations.	2.1 Operation of drilling equipment. **3.0 Theories** The person performing this task must be able to explain: 4.1 Installation and operation of the drilling rig; 4.2 Operation of the motor; 4.3 Operation of the mud pump; 4.4 Operation of the air compressor. **4.0 Essential skills** 4.1 Communication skills; 4.2 Computer operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The drilling equipment is operated in accordance with approved operating procedures.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of operating tools; 2. Occupational health and safety; 3. Hydrogeological basics; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	**WATER CONSERVANCY ENGINEERING TECHNICIAN**	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELL	**DUTY NO.**	401
TASK TITLE	PREPARE AND ADJUST MUD	**TASK NO.**	4012
PERFORMANCE CRITERIA	The person performing this task must be able to prepare and adjust mud according to the drilling work.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Senior Technician and Geological Engineer. The tools and equipment to be used include: 1. Mud mixer; 2. Drill rod; 3. Mud pump; 4. Water and clay. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Select appropriate mud according to formation characteristics under guidance; 2. Calculate the mud ratio; 3. Prepare mud through mechanical mixing; 4. Prepare cement mortar; 5. Use the mud pump; 6. Test the mud. 7. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select mud type; 1.2 Calculate the mud ratio. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Adjustment of the mud performance in accordance with the drilling process. **3.0 Theories** The person performing this task must be able to explain: 3.1 Selection of appropriate mud according to formation characteristics;

	3.2 Grouting of cement mortar. **4.0 Essential skills** 5.1 Communication skills; 5.2 Computer operation skills; 5.3 Customer service skills; 5.4 Teamwork skills; 5.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The mud is prepared and adjusted according to approved mud preparation conditions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of operating tools; 2. Occupational health and safety; 3. Hydrogeological basics; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	**WATER CONSERVANCY ENGINEERING TECHNICIAN**	**OCCUPATION CODE**	
DUTY TITLE	EXCAVATE WATER INTAKE WELL	**DUTY NO.**	401
TASK TITLE	PERFORM DRILLING AND SHAFT-FORMING OPERATIONS	**TASK NO.**	4013
PERFORMANCE CRITERIA	The person performing this task must be able to perform drilling and shaft-forming operations in accordance with standard operating procedures.		
RANGE STATEMENT	The task may be executed on the drilling site under the supervision of a Senior Technician and Geological Engineer. The tools and equipment to be used include: 1. Hydrogeological drilling rig; 2. Mud pump; 3. Drilling tower; 4. Air compressor; 5. Shaft-forming pipes. 6. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Operate the drilling rig; 2. Operate the mud pump; 3. Operate the air compressor; 4. Install the well casing; 5. Use carbon dioxide to flush the well. 6. Observe health, occupational and environmental safety rules and regulations.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Lift drilling tools; 1.2 Carry out hole opening, bit replacement and reaming; 1.3 Perform drill pipe casing. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Carbon dioxide well flushing. **3.0 Theories**

	The person performing this task must be able to explain: 3.1 Drilling techniques; 3.2 Shaft-forming technology. **4.0 Essential skills** 4.1 Communication skills; 4.2 Computer operation skills; 4.3 Customer service skills; 4.4 Teamwork skills; 4.5 Report writing skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Drilling and shaft-forming operations are performed according to approved procedures.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety operation of operating tools; 2. Occupational health and safety; 3. Hydrogeological basics; 4. Mechanical basics; 5. Electrical engineering basics; 6. Electrical welding.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	IDENTIFY AND SELECT THE EARTHWORK EXCAVATION EQUIPMENT	**TASK NO.**	4021
PERFORMANCE CRITERIA	The person performing this task must be able to identify and select, the earthwork excavation equipment according to approved technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Bulldozer; 2. Excavator. 3. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Identify different types of machinery; 2. Select the required machinery according to the engineering needs; 3. Operate the selected machinery according to engineering needs. 4. Operate the operating tools according to safety and occupation health rules and regulations	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Identify different types of excavation equipment; 1.2 Select excavation equipment required for different scenarios. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Basic requirements for the operation of earthwork excavation equipment.

5. Observe health, occupational and environmental safety rules and regulations.	**3.0 Theories** The person performing this task must be able to explain: 5.1 Characteristics of different types of excavation equipment; 5.2 Applicable scenarios of different types of excavation equipment. **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The earthwork excavation equipment is selected according to engineering standards.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Selection of appropriate excavation equipment and performance of correct construction operations based on construction scenario requirements.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	IDENTIFY AND SELECT THE EARTHWORK TRANSPORTATION EQUIPMENT	**TASK NO.**	4022
PERFORMANCE CRITERIA	The person performing this task must be able to identify and select the suitable earthwork transportation equipment for site construction according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Dump truck; 2. Excavator; 3. Loader. 4. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Identify different types of transportation equipment; 2. Learn to operate the required transportation equipment according to the engineering needs; 3. Choose the most suitable transportation equipment according to the engineering needs.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Identify different types of transportation equipment; 1.2 Select transportation equipment required for different scenarios; 1.3 Drive and operate the transportation equipment. **2.0 Principles** The person performing this task must be able to explain the following principles:

4. Observe health, occupational and environmental safety rules and regulations.	2.1 Basic operating requirements for common transportation equipment. **3.0 Theories** The person performing this task must be able to explain: 4.1 Characteristics of different types of transportation equipment; 4.2 Applicable scenarios of different types of transportation equipment. **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The suitable earthwork transportation equipment is selected according to the engineering standards.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Selection of appropriate transportation equipment and performance of correct construction operations based on construction scenario requirements. 2. Safety operation of operating tools. 3. Occupation health and safety.

<table>
<tr><td>OCCUPATION</td><td>WATER CONSERVANCY ENGINEERING TECHNICIAN</td><td>OCCUPATION CODE</td><td></td></tr>
<tr><td>DUTY TITLE</td><td>CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION</td><td>DUTY NO.</td><td>402</td></tr>
<tr><td>TASK TITLE</td><td>IDENTIFY AND SELECT THE EARTHWORK FILLING EQUIPMENT</td><td>TASK NO.</td><td>4023</td></tr>
<tr><td>PERFORMANCE CRITERIA</td><td colspan="3">The person performing this task must be able to identify and select the earthwork filling equipment suitable for site construction according to technical requirements.</td></tr>
<tr><td>RANGE STATEMENT</td><td colspan="3">The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer.
The tools and equipment to be used include:
1. Smooth-wheel roller;
2. Ribbed roller or sheep-foot roller;
3. Vibratory roller;
4. Pneumatic tired roller;
5. Rammer.
6. Safety gear</td></tr>
<tr><td colspan="4">EVIDENCE REQUIREMENT</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 to do the following:
1. Identify different types of filling equipment;
2. Learn to operate the required filling equipment according to the engineering needs;
3. Choose the most suitable filling equipment according to the engineering needs.</td><td colspan="2">Detailed knowledge about:
1.0 Methods
The person performing this task must be able to explain how to:
1.1 Identify different types of filling equipment;
1.2 Select filling equipment required for different scenarios;
1.3 Drive and operate the filling equipment.
2.0 Principles
The person performing this task must be able to explain the following principles:</td></tr>
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4. Observe health, occupational and environmental safety rules and regulations.	2.1 Selection basis of filling equipment; 2.2 Applicable conditions of filling equipment; 2.3 Precautions for filling equipment operation. **3.0 Theories** The person performing this task must be able to explain: 4.1 Characteristics of different types of filling equipment; 4.2 Applicable scenarios of different types of filling equipment. **4.0 Essential skills** 4.1 Communication skills; 4.2 Operation skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The earthwork filling equipment is identified and selected according to the engineering standards.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Selection of appropriate filling equipment and performance of correct construction operations based on construction scenario requirements

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	WEIGH AND MIX CONCRETE	**TASK NO.**	4024
PERFORMANCE CRITERIA	The person performing this task must be able to weigh and mix concrete according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Standard sieve; 2. Balance; 3. Mixer. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Identify different types of cement and master their properties; 2. Identify different admixtures and master their properties; 3. Identify coarse and fine aggregates and master their properties and technical indexes; 4. Select concrete raw materials (e.g. water, cement, coarse aggregate, fine aggregate, and admixtures) that meet the requirements based on engineering requirements;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select the type and specification of concrete raw materials; 1.2 Determine the strength grade and durability of concrete based on engineering requirements; 1.3 Determine the quantity of concrete raw materials based on engineering requirements. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Quality requirements for concrete raw materials;

5. Calculate the amount of concrete raw materials and accurately weigh them according to the engineering needs. 6. Observe health, occupational and environmental safety rules and regulations.	2.2 Basic safety requirements for the construction site of concrete raw materials. **3.0 Theories** The person performing this task must be able to explain: 4.1 Characteristics and requirements of concrete raw materials; 4.2 Basis for selecting concrete raw materials. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills; 4.4 Calculation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The concrete raw materials are weighed according to their quantities calculated as per construction drawings.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Properties of concrete raw materials and their indexes; 2. Raw material quality determination methods and their practical operations; 3. Environmental and occupational health. 4. Safety operation of operating tools.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	SELECT, INSTALL, AND REMOVE CONCRETE FORMWORK	**TASK NO.**	4025
PERFORMANCE CRITERIA	The person performing this task must be able to select, install, and remove the formwork according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Ink fountain; 2. Cutting machine; 3. Hammer. 4. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Identify different types of formworks; 2. Choose the type of formwork according to the engineering needs; 3. Read simple plans and elevations; 4. Read simple sectional and detailed drawings; 5. Perform wooden formwork cutting and blanking according to the drawings;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Select formwork material, shape, and quantity; 1.2 Install and remove the formwork according to its position and shape. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Formwork quality requirements;

6. Select the composite formwork specifications according to the drawings; 7. Determine the size of the formwork; 8. Determine the position and elevation of the formwork; 9. Install the formworks in the correct sequence and ensure safety; 10. Reinforce simple formworks; 11. Remove the formworks in the correct sequence and ensure safety; 12. Protect the finished concrete product during formwork removal. 13. Observe health, occupational and environmental safety rules and regulations.	2.2 Basic safety requirements for formwork construction site. **3.0 Theories** The person performing this task must be able to explain: 4.1 Characteristics and requirements of different types of formworks; 4.2 Sequence of formwork installation and removal; 4.3 Reinforcement methods for formwork. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The formworks are selected, installed and removed according to construction drawings.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Properties of materials such as concrete and steel; 2. Filling in of formwork maintenance and storage related record forms; 3. Environmental and occupational health. 4. Safety operation of operating tools.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	CARRY OUT CONCRETE PLACEMENT, CURING AND DEFECT REMEDY	**TASK NO.**	4026
PERFORMANCE CRITERIA	The person performing this task must be able to carry out concrete placement, curing and defect remedy and other quality control steps according to civil concrete building guidelines.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Senior Technician or Water Conservancy Engineer. The tools and equipment to be used include: 1. Concrete placing plant; 2. Concrete vibrator; 3. Concrete power trowel. 4. Safety gear		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Clean the debris on the original concrete joint face and placement surface; 2. Wet the formwork or cushion layer; 3. Check whether the concrete placing plant and machines and tools are in good condition; 4. Cast concrete for ordinary structures or members; 5. Operate the concrete vibrator for vibration; 6. Finish and trowel the surface of poured concrete;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Know the preparations before concrete placement; 1.2 Perform concrete vibration and finishing during concrete placement; 1.3 Carry out maintenance and repair after concrete placement. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Quality requirements for casting concrete;

7. Determine the initial and final setting of concrete; 8. Perform ordinary concrete curing; 9 Protect the edges and corners of the poured concrete members and repair the voids and pits. 10 Observe health, occupational and environmental safety rules and regulations.	2.2 Safety requirements for construction machinery. **3.0 Theories** The person performing this task must be able to explain: 3.1 Use methods and operating procedures of construction machinery; 3.2 Water absorption characteristics of formworks of different materials; 3.3 Concrete compaction requirements for construction joints of common structures; 3.4 Curing requirements and methods of ordinary concrete. **4.0 Essential skills** 4.1 Communication skills; 4.2 Management skills; 4.3 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The concrete placement, curing and defect remedy are carried out according to civil concrete building guidelines.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Representation method of member codes; 2. Stressing features of different members; 3. Occupational health, safety and construction environment protection.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	PREPARE REINFORCEMENT WORKING SITE, MATERIALS, AND MACHINES AND TOOLS	**TASK NO.**	4027
PERFORMANCE CRITERIA	The person performing this task must be able to prepare the reinforcement working site, materials, and machines and tools according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Steel bar processing machine: used for cutting, bending, and cold machining of steel bars; 2. Electric welding machine, used for welding steel bars; 3. Measuring tools, such as tape and protractor, used for measuring and marking steel bars; 4. Hand tools, such as hammers, pliers and wrenches, used for holding and fixing steel bars during processing and splicing; 5. Protective equipment, such as gloves, goggles and masks, used for protecting the safety and health of workers; 6. Vehicle-mounted lifting equipment, used for transporting and handling large steel bars. 7. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Wear personal safety protective equipment;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to:

2. Use safe operating platform and small mechanical equipment; 3. Clean and prepare the working site according to the construction conditions and requirements; 4. Understand and comply with occupational health, work safety, and civilized construction requirements; 5. Understand the technical disclosure on quality and safety, and follow relevant requirements on the construction site; 6. Perform basic medical first aid for electric shock, heatstroke, etc.; 7. Be familiar with the basic knowledge of medical rescue for common safety accidents on construction sites; 8. Use on-site firefighting equipment; 9. Handle, select, and inspect the main and auxiliary materials of reinforcement according to the material list, and classify and label them; 10. Acquire and prepare materials and operate according to relevant procedures; 11. Select, clean, arrange, and inspect steel bar processing machines and tools; 12. Be familiar with the installation, operation methods, and safety	1.1 Perform safety operation, including wearing personal safety protective equipment, using safe operating platform and small mechanical equipment, and correctly using on-site firefighting equipment; 1.2 Carry out construction operations, including cleaning and preparing the working site; acquiring and preparing materials; and selecting, cleaning, arranging, and inspecting steel bar processing machines and tools. **2.0 Principles** The person performing this task must be able to explain the following principles: 3.1 Occupational health, work safety, and civilized construction; 3.2 Principles and requirements of the safety technical operating procedures for bar setters, including basic first aid for electric shock and heatstroke, as well as on-site fire safety related knowledge. **3.0 Theories** The person performing this task must be able to explain: 3.1 Selection, inspection, requisition, and preparation of main and auxiliary materials of reinforcement; 3.2 Installation, operation methods, and safety procedures of common simple steel bar processing and forming machines and tools; and stacking, handling, and protection of formed steel bars and frameworks. **4.0 Essential skills** 4.1 Communication skills;

procedures of common simple steel bar processing and forming machines and tools; 13. Stack, handle, and protect formed steel bars and frameworks. 14. Observe health, occupational and environmental safety rules and regulations.	4.2 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The reinforcement working site, materials and machine tools are prepared according to safety, environmental rules and regulations and civil instructions.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety technical operating procedures for bar setters; 2. Requirements for occupational health, work safety, and civilized construction; 3. Construction site operating conditions and requirements; 4. Medical rescue for common safety accidents on construction sites; 5. Construction site fire safety.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	MACHINE STEEL BARS WITH A STEEL BAR PROCESSING MACHINE	**TASK NO.**	4028
PERFORMANCE CRITERIA	The person performing this task must be able to machine steel bars with a steel bar processing machine according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Steel bar processing machine, used for cutting, bending, and cold machining of steel bars; 2. Electric welding machine, used for welding steel bars; 3. Measuring tools, such as tape and protractor, used for measuring and marking steel bars; 4. Hand tools, such as hammers, pliers and wrenches, used for holding and fixing steel bars during processing and splicing; 5. Protective equipment, such as gloves, goggles and masks, used for protecting the safety and health of workers; 6. Vehicle-mounted lifting equipment, used for transporting and handling large steel bars. 7. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Visually inspect appearance defects of steel bars; 2. Perform steel bar cleaning, rust removal, straightening, and other operations;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use safe operating platform and small mechanical equipment; 1.2 Check appearance defects of steel bars;

3. Use steel bar processing machines and tools for blanking according to the material list; 4. Use steel bar forming machines and tools for steel bar processing and framework forming. 5. Observe health, occupational and environmental safety rules and regulations.	1.3 Perform steel bar cleaning, rust removal, straightening, and other operations; 1.4 Use steel bar processing machines and tools; 1.5 Use steel bar forming machines and tools. **2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Knowledge about steel bar appearance quality inspection; 2.2 General knowledge about steel bar processing and framework forming. **3.0 Theories** The person performing this task must be able to explain: 4.1 Knowledge about steel bar appearance quality inspection; 4.2 Use of measurement tools and steel measurement methods; 4.3 General knowledge about steel bar processing and framework forming. **4.0 Essential skills** 5.1 Communication skills; 5.2 Teamwork skills; 5.3 Safety consciousness.
DESCRIPTION OF THE END PRODUCT / SERVICE	The steel bars are machined according to standard mechanical operations and customer requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety technical operating procedures for bar setters; 2. Requirements for occupational health, work safety, and civilized construction;

	3. Construction site operating conditions and requirements; 4. Medical rescue for common safety accidents on construction sites; 5. Construction site fire safety.

OCCUPATION	WATER CONSERVANCY ENGINEERING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CARRY OUT WATER CONSERVANCY PROJECT CONSTRUCTION	**DUTY NO.**	402
TASK TITLE	POSITION AND SPLICE STEEL BARS	**TASK NO.**	4029
PERFORMANCE CRITERIA	The person performing this task must be able to position and splice steel bars according to technical requirements.		
RANGE STATEMENT	The task may be executed on the Water Conservancy construction site under the supervision of a Water Conservancy Engineer or Civil Engineer. The tools and equipment to be used include: 1. Steel bar processing machine, used for cutting, bending, and cold machining of steel bars; 2. Electric welding machine, used for welding steel bars; 3. Measuring tools, such as tape and protractor, used for measuring and marking steel bars; 4. Hand tools, such as hammers, pliers and wrenches, used for holding and fixing steel bars during processing and splicing; 5. Protective equipment, such as gloves, goggles and masks, used for protecting the safety and health of workers; 6. Vehicle-mounted lifting equipment, used for transporting and handling large steel bars. 7. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to do the following: 1. Use measuring tools such as marks, callipers, and level gauges to measure and position accurately;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Position and temporarily secure steel bars; 1.2 Splice steel bars.

2. Use temporary fixing tools such as steel hooks and supports to secure the steel bars in the designated position and connect them using cross lap joint method; 3. Connect steel bars using the direct lap joint method; 4. Connect steel bars using the bent lap joint method. 5. Observe health, occupational and environmental safety rules and regulations.	**2.0 Principles** The person performing this task must be able to explain the following principles: 2.1 Steel bar positioning, such as ensuring the thickness of the protective layer between steel bars and concrete, the cohesion and friction between steel bars and concrete, and the geometric position and positional accuracy of steel bars; 2.2 Steel bar splicing, such as ensuring the connection strength and stability of steel bars, the position and accuracy of the connection point, and the thickness of the protective layer between the connection point and the concrete. **3.0 Theories** The person performing this task must be able to explain: 4.1 Theoretical knowledge of steel bar positioning and temporary fixation, such as design requirements for the position, quantity, size, and spacing of steel bars in concrete structures, as well as the mechanical properties and principles of steel bars in concrete structures; 4.2 Theoretical knowledge of steel bar splicing, such as the design principles of splicing length, the relationship between splicing length and steel bar diameter, the mechanical properties and principles of steel bar splicing. **4.0 Essential skills** 5.1 Communication skills; 5.2 Teamwork skills; 5.3 Safety consciousness.

DESCRIPTION OF THE END PRODUCT / SERVICE	The steel bars are positioned and spliced in accordance with standard mechanical drawing and customer requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Safety technical operating procedures for bar setters; 2. Requirements for occupational health, work safety, and civilized construction; 3. Construction site operating conditions and requirements; 4. Medical rescue for common safety accidents on construction sites; 5. Construction site fire safety.

APPENDIX: DACUM CHARTS FOR WATER CONSERVANCY ENGINEERING TECHNICIAN – NTA LEVEL 4

DUTIES	TASKS	ENABLERS
1.0 Excavate water intake wells	1.1 Operate drilling equipment. 1.2 Prepare and adjust mud. 1.3 Perform drilling and shaft-forming operations.	**Generic skills and knowledge** · Cooperating with others using communication skills and reporting to the superiors · Operation of drilling equipment · Mud making · Drilling and shaft-forming operations · Knowledge of safety, quality and environmental protection · Interpretation of construction drawings · Occupational safety and health **Tools and equipment** · Safety helmet, safety belt, work clothes, work shoes, gloves and other personal protective equipment · Fire safety equipment · Work safety signs · Lightning rod, drilling tower shed rope, hoist protection device, faucet guide rope, lifter protective screen and other safety protection facilities **Materials** · Water and mud

DUTIES	TASKS	ENABLERS
		Worker behaviours · Teamwork spirit · Integrity · Safety consciousness · Quality consciousness
2.0 Carry out water conservancy project construction	2.1 Identify and select the earthwork excavation equipment. 2.2 Identify and select the earthwork transportation equipment. 2.3 Identify and select the earthwork filling equipment. 2.4 Weigh and mix concrete. 2.5 Select, install, and remove concrete formwork. 2.6 Carry out concrete placement, curing and defect remedy. 2.7 Prepare reinforcement work site, materials, and equipment. 2.8 Machine steel bars with a steel bar processing machine. 2.9 Position and splice steel bars.	**Generic skills and knowledge** · Communication and cooperation skills · Interpretation of simple technical drawings · Basic building materials science · Basic construction machinery operation skills · Construction organization **Tools and equipment** · Bulldozer · Excavator · Loader · Dump Truck · Smooth-wheel roller · Ribbed roller or sheep-foot roller · Vibratory roller · Pneumatic tired roller · Rammer · Woodworking tools · Standard sieve · Concrete pump · Cutting machine · Shovel · Mixer

DUTIES	TASKS	ENABLERS
		· Vibrator · Steel bar cutting machine · Steel bar bender · Steel bar welding equipment · Measuring tools · Handheld power tools · Personal safety equipment **Materials** · Steel bar · Rebar coupler · Rebar protective material · Wood · Formwork · Cement · Sand · Stone · Admixture **Worker behaviors** · Have relevant construction experience; be familiar with construction techniques and processes · Have good physical strength and endurance, and be able to adapt to physical labour during construction operations · Possess skills in operating and maintaining relevant tools and equipment

DUTIES	TASKS	ENABLERS
		· Possess safety consciousness, and be able to use personal protective equipment properly and comply with construction safety codes. · Possess teamwork spirit and be able to cooperate with other construction personnel