

**NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND
TRAINING**



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PROPOSED OCCUPATIONAL STANDARDS

**OCCUPATION: WATER CONSERVANCY AND HYDROPOWER ENGINEERING
TECHNICIAN**

LEVEL: NTA 4

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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	Hydrological 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 Competence:	The application of knowledge and skills to perform consistently to the standards required in the working context.
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.

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 troubleshooting 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 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. 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 Water Conservancy and Hydropower 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 STANDARDS 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 Water Conservancy and Hydropower 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 also served to engage a wide cross-section of experts in the occupation. Apart from this, the stakeholders' forum was attended by participants from different parts of the country representing various companies.

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

The standards cover a broad range of duties and tasks that can be performed by a Water Conservancy and Hydropower Engineering Technician. However, the occupational standards are not meant to

replace individual job descriptions. Instead, they are to be used for guidance in defining skill levels and knowledge for the technician in specific settings or positions. The Water Conservancy and Hydropower 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 and Hydropower 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 hydrological surveys. Generally, the Water Conservancy and Hydropower Engineering Technician performs the following responsibilities:

- a) Operation of the drilling rig
- b) Identification and selection of earthwork construction machinery (equipment)
- c) Operation and maintenance of earthwork construction machinery (equipment)
- d) Preparation of earthwork construction scheme and offering of onsite guidance
- e) Identification and selection of concrete construction materials and equipment
- f) Concrete construction and finishing
- g) Formulation and check of the concrete construction plan
- h) Steel bar processing, connection, and installation
- i) Preparation of the steel bar construction scheme
- j) Monitoring of the water conservancy project and recording of the data
- k) Detection, inspection and maintenance of water conservancy project monitoring facilities
- l) Routine inspection and maintenance of hydraulic gate operation, abnormality identification and local maintenance, abnormality elimination, and equipment maintenance
- m) Observation and measurement of (test) precipitation, water level, and flow, and reorganization of data
- n) Hydrological survey, groundwater observation, and water quality monitoring
- o) Installation and maintenance of hydrological survey instruments and equipment, and hydrological information prediction

p) Water conservancy and hydropower engineering construction management

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

4.0. VALIDITY PERIOD

Due to the rapid development of technology, the validity period of occupational standards is 3-5 years. The review will proceed in the same manner as the one before it, with new occupational standards being developed based on current trends of the labour market.

5.0. OCCUPATIONAL STANDARDS

5.1 OCCUPATIONAL STANDARDS FOR WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIANS - NTA 4

OCCUPATION	WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	EXCAVATION OF WATER INTAKE WELLS	DUTY NO.	401
TASK TITLE	OPERATION OF 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 can be performed on the drilling site under the supervision of senior technicians and geological engineers. The tools and equipment to be used include: 1. Hydrological well drilling rig, including drilling tower, drilling rig, motor, mud pump, air compressor; 2. User's manual for drilling equipment; 3. Drilling construction procedures.		
EVIDENCE REQUIREMENT			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able to do the following: 1. Follow safety, quality and environmental protection measures when performing this task; 2. Follow drilling construction procedures when performing this task; 3. Install and inspect the drilling tower; 4. Install and operate the drilling rig; 5. Operate the motor; 6. Operate the mud pump; 7. Operate the air compressor.		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 Principle The person performing this task must be able to explain the following principles: 2.1 Operation methods of drilling equipment. 3.0 Theories The person performing this task must be able to explain the following: 3.1 Installation and operation cautions of the drilling rig; 3.2 Operation cautions of the motor; 3.3 Operation cautions of the mud pump; 3.4 Operation cautions 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	Use the drilling equipment in accordance with 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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	EXCAVATION OF WATER INTAKE WELLS	DUTY NO.	401
TASK TITLE	PREPARATION OF MUD	TASK NO.	4012
PERFORMANCE CRITERIA	The person performing this task must be able to prepare and adjust mud according to drilling work.		
RANGE STATEMENT	The task can be performed on the drilling site under the supervision of senior technicians and geological engineers. The tools and equipment to be used include: 1. Mud mixer; 2. Drill rod; 3. Mud pump; 4. Water and clay.		
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.		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 Principle 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 the following: 3.1 Selection requirements of appropriate mud according to formation characteristics; 3.2 Grouting requirements of cement mortar. 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	Perform mud preparation and grouting.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	EXCAVATION OF WATER INTAKE WELLS	DUTY NO.	401
TASK TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	TASK NO.	4013
PERFORMANCE CRITERIA	The person performing this task must be able to complete drilling and shaft-forming operations in accordance with operating procedures.		
RANGE STATEMENT	The task can be performed on the drilling site under the supervision of senior technicians and geological engineers. The tools and equipment to be used include: 1. Hydrological drilling rig; 2. Mud pump; 3. Drilling tower; 4. Air compressor; 5. Shaft-forming pipes.		
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.		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 Principle The person performing this task must be able to explain the following principles: 2.1 Flushing process of carbon dioxide well. 3.0 Theories The person performing this task must be able to explain the following: 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	Complete drilling and shaft-forming operations.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	SELECTION OF EXCAVATION EQUIPMENT	TASK NO.	4021
PERFORMANCE CRITERIA	The person performing this task must be able to identify, select, and use earthwork excavation equipment according to technical requirements.		
RANGE STATEMENT	The task can be performed on the water conservancy and hydropower construction site under the supervision of senior technicians or water conservancy and hydropower engineers. The tools and equipment to be used include: 1. Bulldozer; 2. Excavator.		
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.		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 Principle The person performing this task must be able to explain the following principles: 2.1 Basic requirements for the operation of earthwork excavation equipment. 3.0 Theories The person performing this task must be able to explain the following: 3.1 Characteristics of different types of excavation equipment; 3.2 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	Select Earthwork excavation equipment properly according to engineering characteristics.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	SELECTION OF THE EARTHWORK TRANSPORTATION EQUIPMENT	TASK NO.	4022
PERFORMANCE CRITERIA	The person performing this task must be able to understand and identify earthwork transportation equipment, and select the earthwork transportation equipment suitable for site construction according to technical requirements.		
RANGE STATEMENT	The task can be performed on the water conservancy and hydropower construction site under the supervision of senior technicians or water conservancy and hydropower engineers. The tools and equipment to be used include: 1. Dump truck; 2. Excavator; 3. Loader.		
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. 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 Principle The person performing this task must be able to explain the following principles: 2.1 Basic operating requirements for common transportation equipment. 3.0 Theories The person performing this task must be able to explain the following: 3.1 Characteristics of different types of transportation equipment; 3.2 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	Select earthwork transportation equipment properly according to engineering characteristics.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. Safety operation of operating tools; 2. Occupational health and safety; 3. Hydrogeological basics; 4. Mechanical basics.

OCCUPATION	WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	SELECTION OF THE EARTHWORK FILLING EQUIPMENT	TASK NO.	4023
PERFORMANCE CRITERIA	The person performing this task must be able to understand and identify earthwork filling equipment, and select the earthwork filling equipment suitable for site construction according to technical requirements.		
RANGE STATEMENT	The task can be performed on the water conservancy and hydropower construction site under the supervision of senior technicians or water conservancy and hydropower engineers. 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.		
EVIDENCE REQUIREMENT			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able to do the following: 1. Identify different types of filling equipment; 2. Operate the required filling equipment according to the engineering needs; 3. Choose the most suitable filling 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 filling equipment; 1.2 Select filling equipment required for different scenarios; 1.3 Drive and operate the filling equipment. 2.0 Principle The person performing this task must be able to explain the following principles: 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 the following: 3.1 Characteristics of different types of filling equipment; 3.2 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	Select earthwork filling equipment properly according to engineering characteristics.
CIRCUMSTANTIAL KNOWLEDGE	Detailed knowledge about: 1. Safety operation of operating tools; 2. Occupational health and safety; 3. Hydrogeological basics; 4. Mechanical basics.

OCCUPATION	WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	CONCRETE WEIGHING AND MIXING	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 can be performed on the water conservancy and hydropower construction site under the supervision of senior technicians or water conservancy and hydropower engineers. The tools and equipment to be used include: 1. Standard sieve; 2. Balance; 3. Mixer.		
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; 5. Calculate the amount of concrete raw materials and accurately weigh them 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 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 Principle The person performing this task must be able to explain the following principles: 2.1 Quality requirements for concrete raw materials; 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 the following: 3.1 Characteristics and requirements of concrete raw materials; 3.2 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	Select the type and specification of concrete raw materials and calculate their quantities 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.

OCCUPATION	WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	SELECTION, INSTALLATION, AND REMOVAL OF CONCRETE FORMWORK	TASK NO.	4025
PERFORMANCE CRITERIA	The person performing this task must be able to select, configure, install, and remove the formwork according to technical requirements.		
RANGE STATEMENT	The task can be performed on the water conservancy and hydropower construction site under the supervision of senior technicians or water conservancy and hydropower engineers. The tools and equipment to be used include: 1. Ink fountain; 2. Cutting machine; 3. Hammer.		
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; 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.		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 Principle The person performing this task must be able to explain the following principles: 2.1 Formwork quality requirements; 2.2 Basic safety requirements for formwork construction site. 3.0 Theories The person performing this task must be able to explain the following: 3.1 Characteristics and requirements of different types of formworks; 3.2 Sequence of formwork installation and removal; 3.3 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	Select simple formworks appropriately for installation, removal and maintenance as per 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.

OCCUPATI ON	WATER CONSERVANCY AND HYDROPO WER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITL E	DRILLING AND SHAFT-FORMING OPERAT IONS	DUTY NO.	402
TASK TITL E	CONCRETE PLACEMENT, CURING AND D EFFECT REMEDY	TASK NO.	4026
PERFORM ANCE CRI TERIA	The person performing this task must be able to carry out concrete placement, as well as maintenance, defect remedy and other quality control steps.		
RANGE ST ATEMENT	The task can be performed on the water conservancy and hydropower constructio n site under the supervision of senior technicians or water conservancy and hydro power engineers. The tools and equipment to be used include: 1. Concrete placing plant; 2. Concrete vibrator; 3. Concrete power trowel.		
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 cond ition; 4. Cast concrete for ordinary structures or members; 5. Operate the concrete vibrator for vibratio n; 6. Finish and trowel the surface of poured c oncrete; 7. Determine the initial and final setting of concrete; 8. Perform ordinary concrete curing; 9 Protect the edges and corners of the pour ed concrete members and repair the voids and pits.		Detailed knowledge about: 1.0 Methods The person performing this task must be able to e xplain how to: 1.1 Prepare before concrete placement; 1.2 Perform concrete vibration and finishing duri ng concrete placement; 1.3 Carry out maintenance and repair after concr ete placement. 2.0 Principle The person performing this task must be able to e xplain the following principles: 2.1 Quality requirements for casting concrete; 2.2 Safety requirements for construction machin ery. 3.0 Theories The person performing this task must be able to e xplain the following: 3.1 Use methods and operating procedures of co nstruction machinery; 3.2 Water absorption characteristics of formwork s of different materials; 3.3 Concrete compaction requirements for constr uction 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	Meet the technical requirements for the poured concrete members in shape, size, and strength.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	PREPARATION OF REINFORCEMENT WORK SITE, MATERIALS, AND EQUIPMENT	TASK NO.	4027
PERFORMANCE CRITERIA	The person performing this task must be able to prepare the working site, materials, and machines and tools according to technical requirements.		
RANGE STATEMENT	The task can be performed on the water conservancy and hydropower construction site under the supervision of water conservancy and hydropower engineers or civil engineers. 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.		
EVIDENCE REQUIREMENT			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able to do the following: 1. Wear personal safety protective equipment; 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.;		Detailed knowledge about: 1.0 Methods The person performing this task must be able to explain how to: 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 Principle The person performing this task must be able to explain the following principles: 2.1 Occupational health, work safety, and civilized construction;	

7. Operate 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. Install and operate common simple steel bar processing and forming machines and tools; 13. Stack, handle, and protect formed steel bars and frameworks.	2.2 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 the following: 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; 4.2 Teamwork skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Meet safety, quality, environmental protection and other requirements for all tools and equipment used, ensure the safety of workers and the quality of the project.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	MACHINING OF 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 can be performed on the water conservancy and hydropower construction site under the supervision of water conservancy and hydropower engineers or civil engineers. 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.		
EVIDENCE REQUIREMENT			
PRACTICAL PERFORMANCE		UNDERPINNING KNOWLEDGE	
The person performing this task must be able to do the following: 1. Inspect visually appearance defects of steel bars; 2. Perform steel bar cleaning, rust removal, straightening, and other operations; 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.		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; 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 Principle 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 the following: 3.1 Knowledge about steel bar appearance quality inspection; 3.2 Use of measurement tools and steel measurement methods; 3.3 General knowledge about steel bar processing and framework forming. 4.0 Essential Skills 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety consciousness.
DESCRIPTION OF THE END PRODUCT / SERVICE	Meet the requirements for quality, safety, and civilized construction, with no obvious defects in appearance; and meet customer requirements for dimensions and mechanical performance.
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 AND HYDROPOWER ENGINEERING TECHNICIAN	OCCUPATION CODE	
DUTY TITLE	DRILLING AND SHAFT-FORMING OPERATIONS	DUTY NO.	402
TASK TITLE	POSITIONING AND SPLICING OF 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 can be performed on the water conservancy and hydropower construction site under the supervision of water conservancy and hydropower engineers or civil engineers. 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.		
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, calipers, and level gauges to measure and position accurately; 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.		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. 2.0 Principle 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 the following: 3.1 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; 3.2 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 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Safety consciousness.
DESCRIPTION OF THE END PRODUCT / SERVICE	Form the framework structure following processing, positioning, connecting and protecting steel bars in accordance with drawing and technical requirements, providing support and reinforcement for subsequent concrete placement.
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.

TABLE 1: DACUM CHARTS FOR WATER CONSERVANCY AND HYDROPOWER ENGINEERING TECHNICIAN - NTA4

DUTIES	TASKS	ENABLERS
1.0 Excavation of water intake wells	1.1 Operation of drilling equipment	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 Requirements for employees - Teamwork spirit - Integrity - Safety consciousness - Quality consciousness
	1.2 Preparation of mud	
	1.3 Drilling and shaft-forming operations	
2.0 Drilling and shaft-forming operations	2.1 Selection of the earthwork excavation equipment	Generic skills and knowledge - Communication and cooperation skills - Interpretation of simple technical drawings - Basic building materials science - Basic construction machinery operation skills - Construction organization
	2.2 Positioning and splicing of steel bars. Selection of the earthwork transportation equipment	
	2.3 Selection of the earthwork filling equipment	
	2.4 Concrete weighing and mixing	

DUTIES	TASKS	ENABLERS
	2.5 Selection, installation, and removal of concrete form work	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 • 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 Requirements for employees • Relevant construction experience; be familiar with construction techniques and processes • Good physical strength and endurance, and be able to adapt to physical labour during construction operations • Skills in operating and maintaining relevant tools and equipment • Safety consciousness, and the ability to use personal protective equipment properly and comply with construction safety codes.
	2.6 Concrete placement, curing and defect remedy	
	2.7 Preparation of reinforcement work site, materials, and equipment	
	2.8 Machining of steel bars with a steel bar processing machine	
	2.9 Positioning and splicing of steel bars	

DUTIES	TASKS	ENABLERS
		• Teamwork spirit and cooperation with other construction personnel