THE NATIONAL COUNCIL FOR TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

OCCUPATION: SURVEYING AND MAPPING TECHNICIAN

LEVEL: NTA LEVEL 6

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ABBREVIATIONS

CAD	Computer Aided Design
CBET	Competency Based Education and Training
CORS	Continuously Operating Reference Station
DEM	Digital Elevation Model
DLG	Digital Line Graph
DOM	Digital Orthophoto Map
DRG	Digital Raster Graphic
EDM	Electromagnetic Distance Measurement
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ISO	International Organization for Standardization
NACTVET	National Council for Technical and Vocational Education and Training of Tanzania
NOS	National Occupational Standards
OS	Occupational Standards
RTK	Real Time Kinematic
TET	Technical Education and Training
TVET	Technical and Vocational Education and Training
UAV	Unmanned Aerial Vehicle

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 analyzing 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 STANDARD 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 workplace, 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 SURVEYING AND MAPPING TECHNICIANS

These standards cover a broad range of duties and tasks that can be performed by a Surveying and Mapping 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 Surveying and Mapping Technician may perform tasks in a number of key areas of the occupational standards, but not necessarily in all areas. For example, in large construction operations, other individuals may be employed or designated to perform specific tasks.

The Surveying and Mapping Technician works under the supervision of a Surveying and Mapping Engineer to prepare data and instruments and equipment; conduct field surveying and mapping according to field operation process; conduct calculation and mapping with measuring instruments, software and professional measuring software; conduct construction engineering survey and other specialized engineering surveying based on professional knowledge; analyze the surveying data, assess the measurement result and prepare the analysis report; and be responsible for periodically checking and maintaining measuring instruments and equipment. Generally, the Surveying and Mapping Technician performs the following duties:

a) Collect data and conduct field survey;
b) Prepare relevant data and instruments;
c) Survey engineering control network;
d) Conduct specialized engineering surveying;
e) Survey engineering surveying elements;
f) Survey and map UAV;

g) Conduct surveying and section measurement;
h) Perform and calculate the engineering surveying data;
i) Process the observed data;
j) Reconnaissance the current situation of land and survey and map the cadastral feature;
k) Store and sort out the cadastral achievements;
l) Check the quality of result;
m) Check and maintain the instruments and equipment.

The Occupational Standards have been clustered into NTA qualification levels, i.e. NTA Levels 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 SURVEYING AND MAPPING TECHNICIANS – NTA LEVEL 6

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SURVEY ENGINEERING CONTROL NETWORK	**DUTY NO.**	601
TASK TITLE	CONDUCT GNSS CONTROL NETWORK SURVEYING	**TASK NO.**	6011
PERFORMANCE CRITERIA	The person performing this task must be able to survey GNSS control networks in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. GNSS receiver; 2. Tripod, centering rod, and drawing board; 3. Crowbar, shovel, and walkie-talkie; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations; 3. Design GNSS control network;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Set up the GNSS control network according to the project requirements; 1.2 Calculate the GNSS baselines;

4. Select sites, and place survey markers; 5. Draw the survey mark description; 6. Develop the work plan; 7. Configure the parameters of the GNSS receiver; 8. Observe and record GNSS data; 9. Download and calculate GNSS observed data; 10. Check the quality of GNSS achievements; 11. Operate the GNSS receiver; 12. Record surveying data; 13. Clean tools, equipment and the workplace; 14. Store tools, equipment and safety gear; 15. Observe health, occupational and environmental safety rules and regulations.	1.3 Adjust the GNSS control network. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of pseudoarrange distance measurement; 2.2 Principles of space distance resection; 2.3 Technical requirements for the GNSS control network. **3.0 Theories** The person performing this task must be able to explain: 3.1 GNSS surveying methodology; 3.2 GNSS control network design; 3.3 GNSS control surveying scheduling; 3.4 Cross control adjustment. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence; 4.6 Adaptive capacity. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The GNSS control network surveying and calculation are completed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Safety operation of measuring instruments; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SURVEY ENGINEERING CONTROL NETWORK	**DUTY NO.**	601
TASK TITLE	CONDUCT TOTAL STATION CONTROL NETWORK SURVEYING	**TASK NO.**	6012
PERFORMANCE CRITERIA	The person performing this task must be able to conduct total station control network surveying in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station; 2. Tripod, prism, and centering rod; 3. Scientific calculator, and drawing pad; 4. Crowbar and shovel. 5. Safety gear		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Design the control network; 4. Select sites and place survey markers; 5. Observe and record horizontal angles with the total station; 6. Observe and record vertical angles with the total station; 7. Observe and record distances with the total station; 8. Sort out and calculate the observation data; 9. Check the quality of the control network achievements; 10. Operate the total station 11. Record surveying data 12. Clean tools, equipment and the workplace 13. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Set up the traverse network; 1.2 Calculate and adjust the total station traverse network. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Technical requirements for traverse surveying. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Total station control network layout; 3.2 Total station distance measurement; 3.3 Total station angle measurement. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Total station control network surveying is performed in accordance with the surveying and mapping standards and specifications approved by the competent authority, and the achievement data is submitted.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SURVEY ENGINEERING CONTROL NETWORK	**DUTY NO.**	601
TASK TITLE	SURVEY LEVELLING CONTROL NETWORK	**TASK NO.**	6013
PERFORMANCE CRITERIA	The person performing this task must be able to set up and measure the levelling control network in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Level gauge; 2. Tripod, levelling ruler and staff plate; 3. Engineering calculator, and drawing board; 4. Crowbar and shovel; 5. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations; 3. Design the levelling network; 4. Select sites, and place survey markers; 5. Observe and record the levelling network; 6. Sort out and calculate the observation data; 7. Check the quality of levelling achievements; 8. Maintain the level gauge; 9. Record surveying data; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Set up the levelling network; 1.2 Perform levelling network adjustment. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of levelling survey; 2.2 Technical requirements for levelling survey. **3.0 Theories** The person performing this task must be able to explain: 3.1 Levelling line design; 3.2 Levelling line layout; 3.3 Levelling line observation;

	3.4 Station data verification. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence; 4.6 Adaptive capacity. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation.
DESCRIPTION OF THE END PRODUCT / SERVICE	The levelling control network is set up and surveyed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SURVEY ENGINEERING CONTROL NETWORK	**DUTY NO.**	601
TASK TITLE	SURVEY UNDERGROUND ENGINEERING TRAVERSE	**TASK NO.**	6014
PERFORMANCE CRITERIA	The person performing this task must be able to survey the underground engineering traverse in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, and gyro total station; 2. Tripod, prism, and steel ruler; 3. Lighting fixture, wood pile, survey nail, small hammer, paint, and drawing board; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Inspect the coordinates of the starting point and the orientation of the starting side; 4. Set up construction traverse points based on excavation progress; 5. Install surveying marks for construction traverse point; 6. Observe and record horizontal angles with the total station; 7. Observe and record vertical angles with the total station; 8. Observe and record distances with the total station; 9. Sort out and calculate the observation data; 10. Check the quality of the traverse achievements; 11. Record surveying data; 12. Clean tools, equipment and the workplace; 13. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use a gyro total station to check the azimuthal side; 1.2 Set up traverse points based on the characteristics of the underground engineering; 1.3 Conduct underground traverse adjustment. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principle of least square method; 2.4 Principle of gyro orientation; 2.5 Technical requirements for underground traverse surveying.

	3.0 Theories The person performing this task must be able to explain: 3.1 Underground engineering traverse design; 3.2 Underground engineering traverse layout; 3.3 Underground engineering traverse observation; 3.4 Observation data sorting and calculation for underground engineering traverse. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The underground engineering traverse is surveyed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SURVEY ENGINEERING CONTROL NETWORK	**DUTY NO.**	601
TASK TITLE	CONDUCT SHAFT CONNECTION SURVEYING	**TASK NO.**	6015
PERFORMANCE CRITERIA	The person performing this task must be able to conduct shaft connection surveying in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, gyro total station, plumb bob, and level gauge; 2. Tripod, prism, steel ruler, staff plate, and levelling rod; 3. Lighting fixture, wood pile, survey nail, small hammer, paint, and drawing board; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Determine the gyro azimuth of a known side; 4. Measure the coordinates of the target point; 5. Measure the gyro azimuth of the underground directional side; 6. Re-determine the gyro azimuth of a known side; 7. Calculate the coordinates and azimuth of the underground directional side; 8. Hang a steel ruler in the middle of the shaft; 9. Measure the readings on the levelling ruler and steel ruler both above and below the shaft; 10. Check the quality of the achievements; 11. Record surveying data; 12. Clean tools, instruments, equipment and the workplace; 13. Store tools, instruments, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Use a gyro total station to measure the azimuth; 1.2 Implement ground-to-underground coordinate transmission; 1.3 Implement ground-to-underground elevation transmission. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of gyro orientation; 2.2 Principle of laser pointing; 2.3 Principle of angle measurement; 2.4 Principles of electromagnetic distance measurement; 2.5 Principles of levelling survey; 2.6 Technical requirements for shaft connection surveying.

	3.0 Theories The person performing this task must be able to explain: 3.1 Combined measurement using gyro total station and plumb bob; 3.2 Elevation transmission surveying method; 3.3 Analysis of accuracy in shaft connection surveying. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Shaft connection surveying is performed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT TOPOGRAPHIC SURVEYING AND MAPPING	**DUTY NO.**	602
TASK TITLE	SURVEY AND MAP USING UAV	**TASK NO.**	6021
PERFORMANCE CRITERIA	The person performing this task must be able to conduct UAV surveying and mapping according to approved industry standards and regulations.		
RANGE STATEMENT	The task may be executed on the survey/mapping site or in the data processing room under the supervision of a Surveying and Mapping Engineer. The tools and equipment to be used include: 1. GNSS receiver; 2. Photogrammetry system, and UAV aerial photography system; 3. Computer; 4. Plotter; 5. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Collect relevant data, and conduct field surveys; 4. Prepare the technical design document for UAV surveying and mapping; 5. Apply for conducting flight operations within designated airspace; 6. Plan the flight routes; 7. Perform aerial photogrammetry using UAVs; 8. Utilize images for control surveying; 9. Employ aerial triangulation techniques; 10. Generate digital orthophotos; 11. Collect digital line graphs; 12. Conduct mapping and supplementary surveying; 13. Produce topographic maps; 14. Check the quality of the achievements, and submit them; 15. Record surveying data; 16. Clean tools, instruments, equipment and the workplace;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Plan the flight route according to the project; 1.2 Set up ground control points based on terrain; 1.3 Create digital orthoimage using photogrammetry workstation; 1.4 Collect and create digital line graph. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of central projection; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of space distance resection; 2.4 Principle of least square method; 2.5 Technical requirements for UAV photogrammetry.

17. Store tools, equipment and safety gear.	**3.0 Theories** The person performing this task must be able to explain: 3.1 UAV control; 3.2 GNSS RTK surveying; 3.3 Collinearity condition equation; 3.4 Aerial triangulation; 3.5 Digital orthophoto map; 3.6 Digital line graph. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Communication skills; 4.3 Computer application skills; 4.4 Analysis competence; 4.5 Writing ability. **5.0 Mathematical skills** 5.1 Matrix operation skills; 5.2 Geometric operation skills; 5.3 Calculus operation.
DESCRIPTION OF THE END PRODUCT / SERVICE	The UAV surveying and mapping is conducted according to approved industry standards, regulations, specifications, and project technical plans.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Airspace management laws and regulations; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	MEASURE AND RECORD GRID AXIS SURVEYING AND PLANNING CORRECTION OF ENGINEERING BUILDINGS (CONSTRUCTIONS)	**TASK NO.**	6031
PERFORMANCE CRITERIA	The person performing this task must be able to carry out various measurements and recordings of grid axis surveying and planning correction of engineering buildings (constructions) in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station; 2. Tripod, prism, and centering rod; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations 3. Survey the positions of grid axis points for engineering buildings (constructions); 4. Measure angles and sides; 5. Calculate surveying parameters; 6. Adjust the positions of grid axis points via a total station; 7. Plan and correct various grid systems for engineering buildings (constructions); 8. Check the quality of building grid achievements; 9. Maintain the total station; 10. Record surveying data; 11. Clean tools, equipment and the workplace; 12. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Survey the grid points for engineering buildings (constructions); 1.2 Plan and correct the grid axis for engineering buildings (constructions). **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Technical requirements for building grid.

	3.0 Theories The person performing this task must be able to explain: 3.1 Standard for the grid layout of engineering buildings (constructions); 3.2 Standard for the grid axis surveying of engineering buildings (constructions); 3.3 Standard for the grid point surveying of engineering buildings (constructions); 3.4 Method for planning and correcting grid point measurements; 3.5 Construction coordinate system switching method. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Communication skills; 4.3 Computer application skills; 4.4 Analysis competence; 4.5 Writing ability. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	GRID AXIS SURVEYING AND PLANNING CORRECTION OF ENGINEERING BUILDINGS are conducted in accordance with approved industry standards and specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	CONDUCT CENTER LINE SURVEYING, VERIFICATION, AND ADJUSTMENT IN LINE ENGINEERING.	**TASK NO.**	6032
PERFORMANCE CRITERIA	The person performing this task must be able to check surveying data, verify the center line deviation in line engineering, and conduct on-site verification in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station and GNSS receiver; 2. Prism, centering rod, tripod, and steel ruler; 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations; 3. Select appropriate survey station points and backsight points; 4. Use a total station to survey the coordinates of the center line in line engineering; 5. Operate GNSS RTK to survey the coordinates of the center line in line engineering; 6. Check the center line deviation in line engineering; 7. Adjust the center line in line engineering; 8. Record surveying data; 9. Clean tools, equipment and the workplace 10. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Calibrate the coordinates of the center line points in the surveyed route; 1.2 Adjust the calibrated center line points in the surveyed route. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of space distance resection; 2.4 Technical requirements for center line surveying. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Calculation method for surveying data of the center line in line engineering; 3.2 Calculation method for surveying elements using polar coordinate system; 3.3 Real-time differential positioning method using GNSS; 3.4 Measurement method for verifying the center line in line engineering; 3.5 Coordinate system switching method. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Communication skills; 4.3 Computer application skills; 4.4 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Center line surveying, verification, and adjustment is performed in accordance with approved industry standards and specifications.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	OBSERVE AND RECORD DEFORMATION SURVEYING	**TASK NO.**	6033
PERFORMANCE CRITERIA	The person performing this task must be able to observe and record the deformation surveying in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, and level gauge; 2. Tripod, steel ruler, levelling rod, prism, and centering rod; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations; 3. Set up a deformation surveying reference network, working base point, and monitoring point; 4. Verify height differences, and calculate the elevation of monitoring points; 5. Record the elevation of monitoring points; 6. Measure angles; 7. Record the angle of monitoring points; 8. Measure distances; 9. Record the distance of monitoring points; 10. Measure coordinates; 11. Record the coordinates of monitoring points; 12. Check the quality of observation achievements; 13. Clean tools, equipment and the workplace; 14. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Set up deformation reference and monitoring points; 1.2 Determine the method used for deformation monitoring; 1.3 Determine the observation period for deformation monitoring. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of levelling survey; 2.4 Technical requirements for deformation monitoring. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Design standards for deformation surveying reference network; 3.2 Methods for setting up a deformation surveying reference network; 3.3 Methods for measuring a deformation surveying reference network; 3.4 Adjustment methods for a deformation surveying reference network. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Communication skills; 4.3 Computer application skills; 4.4 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	The quality of deformation surveying observations and records are checked in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	CONDUCT FIELD TRACING AND RECORDING OF URBAN UNDERGROUND PIPELINES	**TASK NO.**	6034
PERFORMANCE CRITERIA	The person performing this task must be able to complete field tracing and recording of urban underground pipelines in accordance with the approved industry standards and specifications.		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Pipeline detector, and GNSS receiver; 2. Crowbar, shovel, measuring rod, and steel ruler; 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe the health and safety regulations; 3. Collect data such as control point achievements, topographic maps, pipeline maps, as-built drawings, etc., for the survey area; 4. Conduct field surveys of the topography, geology, transportation, and pipelines for the survey area; 5. Inspect the selected instruments and equipment; 6. Establish the conversion relationship between the coordinate system of the pipeline survey control network and the local urban coordinate system; 7. Map the current status of the pipelines, and carry out pipeline control surveying; 8. Conduct on-site investigations and measurements of prominent underground pipeline points; 9. Trace concealed underground pipeline points; 10. Measure pipeline points and cross	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Inspect the technical indexes of the pipeline detector; 1.2 Map the current status of the pipelines, and conduct control surveying; 1.3 Use GNSS RTK to measure prominent underground pipeline points; 1.4 Use a pipeline detector to detect concealed underground pipeline points. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of electromagnetic distance measurement; 2.2 Principles of space distance resection; 2.3 Electro-magnetic induction principle; 2.4 Technical requirements for underground pipeline detection.

sections; 11. Check the quality of observation achievements; 12. Clean tools, equipment and the workplace; 13. Store tools, equipment and safety gear.	**3.0 Theories** The person performing this task must be able to explain: 3.1 Classification and content of urban underground pipelines; 3.2 Theoretical knowledge of coordinate systems; 3.3 Basic theories related to plane coordinate system transfer; 3.4 Content, methods, and technical requirements of urban underground pipeline surveying; 3.5 Classification and application of pipeline detectors; 3.6 Theoretical knowledge, instruments and equipment, and operating methods for urban underground pipeline detection. **4.0 Essential skills** 4.1 Teamwork skills; 4.2 Communication skills; 4.3 Computer application skills; 4.4 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	The field tracing and recording of urban underground pipelines are completed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	CONDUCT COMPLETION PLANNING AND VERIFICATION SURVEYING FOR URBAN CONSTRUCTION PROJECTS	**TASK NO.**	6035
PERFORMANCE CRITERIA	The person performing this task must be able to conduct the completion planning and verification surveying for urban construction projects in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, GNSS receiver, and distance measuring instrument; 2. Tripod, and steel ruler; 3. Prism and centering rod; 4. Camera 5. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Collect control point achievements, completion topographic maps, etc.; 4. Measure point coordinates using a total station; 5. Measure point coordinates via GNSS RTK; 6. Measure distances using a distance measuring instrument or steel ruler; 7. Capture the current status of buildings and related facilities through photography; 8. Create on-site sketches of measurements; 9. Check the quality of the achievement data; 10. Record surveying data; 11. Clean tools, equipment and the	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Determine the completion plan for urban construction projects, and verify the surveying requirements. **2.0 Principle** The person performing this task must be able to explain the following principles: 3.1 Principle of angle measurement; 3.2 Principles of electromagnetic distance measurement; 3.3 Principles of space distance resection; 3.4 Technical requirements for acceptance surveying. **3.0 Theories** The person performing this task must be able to

workplace; 12. Store tools, equipment and safety gear.	explain: 4.1 Verification standards of GNSS static control network; 4.2 Verification standards of total station angle, distance, and coordinate; 4.3 Reading and application methods of engineering drawings. **4.0 Essential skills** 5.1 Communication skills; 5.2 Teamwork skills; 5.3 Computer application skills; 5.4 Learning ability; 5.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	The completion planning and verification surveying for urban construction projects is completed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	CONDUCT GEOLOGICAL EXPLORATION ENGINEERING SURVEYING	**TASK NO.**	6036
PERFORMANCE CRITERIA	The person performing this task must be able to CONDUCT GEOLOGICAL EXPLORATION ENGINEERING SURVEYING in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. GNSS receiver, and total station; 2. Tripod, and steel ruler; 3. prism and centering rod; 4. Surveying and mapping software; 5. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe health and safety regulations; 3. Collect data such as control point achievements and topographic maps in the survey area; 4. Conduct field surveys of the topography, geology, and transportation in the exploration area; 5. Inspect the selected instruments and equipment; 6. Establish the conversion relationship between the coordinate system of the exploration area control network and the local urban coordinate system; 7. Perform control surveying in the exploration area; 8. Operate UAVs to capture image data; 9. Complete drilling, geological point determination, and mining area boundary survey; 10. Check the quality of the achievement data;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Perform geological exploration control surveying using a total station; 1.2 Conduct geological exploration control surveying using a GNSS receiver; 1.3 Acquire UAV image data according to geological exploration requirements; 1.4 Operate measuring instrument for boundary surveys. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of space distance resection; 2.4 Technical requirements for UAV photogrammetry;

11. Record surveying data; 12. Clean tools, equipment and the workplace; 13. Store tools, equipment and safety gear.	2.5 Technical requirements for geological exploration survey. **3.0 Theories** The person performing this task must be able to explain: 3.1 Design standards for geological exploration control networks; 3.2 Methods for laying out geological exploration control networks; 3.3 Methods for measuring geological exploration control networks; 3.4 Reading and application methods of geologic drawings. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	The geological exploration engineering surveying is performed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT SPECIALIZED ENGINEERING SURVEYING	**DUTY NO.**	603
TASK TITLE	PERFORM BREAKTHROUGH SURVEYING, AND ADJUST BREAKTHROUGH ERRORS	**TASK NO.**	6037
PERFORMANCE CRITERIA	The person performing this task must be able to carry out breakthrough surveying and adjust breakthrough errors in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, and level gauge; 2. Prism, centering rod, tripod, levelling rod, staff plate, and steel ruler; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Calculate surveying elements of the breakthrough tunnel (roadway); 4. Conduct on-site calibration of the center line and median lines of the through tunnel (roadway); 5. Adjust the center line and median lines of the through tunnel (roadway); 6. Calculate the actual breakthrough deviation; 7. Determine the closure errors; 8. Analyze and assess the accuracy; 9. Record surveying data; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Calculate surveying elements of the breakthrough tunnel (roadway); 1.2 Conduct on-site calibration of the center line and median lines of the through tunnel (roadway); 1.3 Calculate the breakthrough deviation, and make adjustments. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of levelling survey; 2.4 Principle of error distribution. **3.0 Theories** The person performing this task must be able to explain:

	3.1 Center line method for planar breakthrough surveying; 3.2 Traversing method for planar breakthrough surveying; 3.3 Elevation breakthrough surveying method; 3.4 Control and adjustment method for breakthrough error. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	The breakthrough surveying is carried out, and breakthrough errors adjusted in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK AND SORT OUT OBSERVATION DATA FOR ENGINEERING CONSTRUCTION CONTROL NETWORK	**TASK NO.**	6041
PERFORMANCE CRITERIA	The person performing this task must be able to check and sort out the raw observation data of various engineering construction control networks in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Engineering calculator; 2. Computer with accessories; 3. Data processing software; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe the health and safety regulations; 3. Check field records of levelling observations; 4. Check field records of traverse observations; 5. Check field records of GNSS static observations; 6. Import field observation data into data processing software; 7. Check the quality of levelling observation data; 8. Check the quality of traverse observation data; 9. Check the quality of GNSS static observation data; 10. Sort out the observation achievements 11. Record surveying data; 12. Clean tools, equipment and the	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check field records of various control network observations; 1.2 Check the quality of observation data for various control networks. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of least square method; 2.2 Technical requirements for construction control networks. **3.0 Theories** The person performing this task must be able to explain: 3.1 Technical process of levelling survey; 3.2 Technical process of traverse surveying;

workplace; 13. Store tools, equipment and safety gear.	3.3 Technical process requirements for GNSS static measurement; 3.4 Standards for management of engineering construction control network data. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Observation data for engineering construction control network is sorted out in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK AND SORT OUT ENGINEERING CONSTRUCTION CONTROL NETWORK AXIS SURVEYING AND PLANNING CORRECTION SURVEYING ACHIEVEMENTS	**TASK NO.**	6042
PERFORMANCE CRITERIA	The person performing this task must be able to check and sort out engineering construction control network axis surveying and planning correction surveying achievements in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, and level gauge; 2. Tripod, levelling rod, prism, and centering rod; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Check the engineering construction control network axis; 4. Measure angles and sides; 5. Measure the coordinates of control points; 6. Measure the elevations of control points; 7. Calculate angular errors and relative side errors; 8. Calculate the mean square errors of control point positions; 9. Verify control points; 10. Check and sort out the achievements of observation and calculation; 11. Record surveying data; 12. Clean tools, equipment and the	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the planar positions of control points in the engineering construction control network; 1.2 Check the elevations of control points in the engineering construction control network. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of levelling survey; 2.4 Technical requirements for construction control networks. **3.0 Theories** The person performing this task must be able to

workplace; 13. Store tools, equipment and safety gear.	explain: 3.1 Methods for verifying the elevations of grid points in the engineering construction control network; 3.2 Methods for verifying the plane coordinates of grid points in the engineering construction control network; 3.3 Standard for management of surveying achievement data in axis line surveying and planning correction. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computing skills 4.4 Learning ability; 4.5 Analysis competence; 4.6 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	Engineering construction control network axis surveying and planning correction surveying achievements are checked and sorted out in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK AND SORT OUT THE SURVEYING VERIFICATION AND ADJUST THE CENTER LINE IN LINE ENGINEERING	**TASK NO.**	6043
PERFORMANCE CRITERIA	The person performing this task must be able to inspect the surveying data of detailed engineering points, verify the center line deviation of the engineering, and conduct on-site verification in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station and GNSS receiver; 2. Prism, centering rod, tripod, and steel ruler; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Set up the total station and GNSS RTK; 4. Use a total station to set out the coordinates of the center line in line engineering; 5. Operate GNSS RTK to set out the coordinates of the center line in line engineering; 6. Verify the quality of center line coordinates in line engineering; 7. Determine the center line deviation in line engineering; 8. Check the quality of the observed and verified achievements; 9. Record surveying data; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Conduct on-site inspections of the center line in line engineering; 1.2 Sort out the surveying data of the center line in line engineering. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of angle measurement; 2.2 Principles of electromagnetic distance measurement; 2.3 Principles of space distance resection; 2.4 Technical requirements for center line surveying.

	3.0 Theories The person performing this task must be able to explain: 3.1 Technical process for verifying the center line in line engineering; 3.2 Standards for management of the surveying data of the center line in line engineering. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The surveying verification and adjustment of the center line in line engineering are checked and sorted out in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK, SORT OUT, AND CALCULATE DEFORMATION SURVEYING DATA	**TASK NO.**	6044
PERFORMANCE CRITERIA	The person performing this task must be able to check, sort out, and calculate deformation surveying data in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room or on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Total station, and level gauge; 2. Tripod, levelling rod, prism, centering rod, and steel ruler; 3. Engineering calculator; 4. Computer with accessories; 5. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Check the quality of monitoring point observation data; 4. Verify the calculation of deformation observation value; 5. Verify the accuracy of deformation observation data; 6. Calculate the changes between consecutive observations; 7. Create deformation process lines and deformation distribution maps; 8. Sort out the deformation observation achievements; 9. Record surveying data; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the quality of observation data; 1.2 Calculate the deformation; 1.3 Plot the deformation trend chart. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of coordinate determination; 2.2 Principles of levelling survey; 2.3 Technical requirements for deformation monitoring. **3.0 Theories** The person performing this task must be able to explain: 3.1 Technical process of settlement observation;

	3.2 Technical process of horizontal displacement monitoring; 3.3 Standards for management of deformation surveying data; 3.4 Methods for analysis of deformation trends. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The deformation surveying data is checked, sorted out, and calculated in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Safety operation of measuring instruments; 5. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK AND SORT OUT URBAN UNDERGROUND PIPELINE TRACING DATA	**TASK NO.**	6045
PERFORMANCE CRITERIA	The person performing this task must be able to check and sort out urban underground pipeline tracing data in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Pipeline mapping software, adjustment software, and commonly used office software; 2. Computer with accessories; 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations 3. Inspect, sort out and map pipeline status adjustment drawings; 4. Check the quality of field observation data for pipeline control surveying, perform adjustment calculations, and assess the accuracy; 5. Check and evaluate the quality and accuracy of measurement observation data for pipeline points; 6. Enter and check data via pipeline mapping software; 7. Map and edit pipelines via pipeline mapping software; 8. Check the completeness of data achievements, graphical data, attribute data, and logical errors; 9. Sort out underground pipeline tracing data achievements; 10. Record surveying data; 11. Clean tools, equipment and the workplace;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the quality of field observation data; 1.2 Perform adjustment calculations for field observation data; 1.3 Check the quality of data achievements. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for underground pipeline detection. **3.0 Theories** The person performing this task must be able to explain: 3.1 Classification and content of urban underground pipelines; 3.2 Technical requirements and adjustment theory for grade control surveying; 3.3 Technical process of urban underground pipeline survey;

12. Store tools, equipment and safety gear.	3.4 Workflow of digital surveying and mapping for urban underground pipelines; 3.5 Requirements for urban underground pipeline map compilation; 3.6 Requirements for sorting out urban underground pipeline detection data. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The urban underground pipeline tracing data is checked and sorted out in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK AND SORT OUT COMPLETION PLANNING AND VERIFICATION SURVEYING DATA FOR URBAN CONSTRUCTION PROJECTS	**TASK NO.**	6046
PERFORMANCE CRITERIA	The person performing this task must be able to check and sort out completion planning and verification surveying data for urban construction projects in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Mapping software; 2. Data quality control software; 3. Computer with accessories; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe the health and safety regulations; 3. Check the acceptance surveying data of urban construction projects; 4. Use mapping software to complete the indoor mapping; 5. Use data quality control software to perform quality checks on the achievements; 6. Prepare a written report on the achievements; 7. Sort out the achievements of urban construction projects; 8. Record surveying data; 9. Clean tools, equipment and the workplace; 10. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Draw as-built drawings; 1.2 Use quality control software for quality inspection; 1.3 Prepare completion verification report. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for acceptance surveying. **3.0 Theories** The person performing this task must be able to explain: 3.1 Requirements for completion verification of urban construction projects;

	3.2 Requirements for completion verification of urban construction projects; 3.3 Requirements for completion verification of urban road projects; 3.4 Requirements for completion verification of urban greening projects. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The completion planning and verification surveying data for urban construction projects are checked and sorted out in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK, SORT OUT, AND MAP GEOLOGICAL EXPLORATION ENGINEERING SURVEYING DATA	**TASK NO.**	6047
PERFORMANCE CRITERIA	The person performing this task must be able to check, sort out, and map geological exploration engineering surveying data in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Surveying and mapping software, and commonly used office software; 2. Computer with accessories; 3. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Check the quality of field observation data for control surveying in the exploration area; 4. Check the quality of aerial photography data captured by UAVs; 5. Process UAV aerial surveying data to generate Digital Elevation Models (DEMs) and Digital Orthophoto Maps (DOM); 6. Use surveying and mapping software to create a simplified topographic map; 7. Use surveying and mapping software to display and plot the design exploration network, and calculate the coordinates of exploration network points; 8. Check the quality of data and graphical achievements; 9. Record surveying data; 10. Clean tools, equipment and the	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check the field observation data for control surveying; 1.2 Check the aerial photography data captured by UAVs; 1.3 Generate DEMs, DOMs, and simplified topographic maps based on geological exploration requirements. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Technical requirements for geological exploration surveying. **3.0 Theories** The person performing this task must be able to explain: 3.1 Technical process of geological exploration engineering surveying;

workplace; 11. Store tools, equipment and safety gear.	3.2 Criteria for selecting projection surfaces; 3.3 Workflow for producing DEMs and DOMs; 3.4 Application of topographic maps in geological exploration. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The geological exploration engineering surveying data is checked, sorted out, and mapped in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CHECK, SORT OUT, AND CALCULATE BREAKTHROUGH SURVEYING DATA	**TASK NO.**	6048
PERFORMANCE CRITERIA	The person performing this task must be able to check, sort out, and calculate breakthrough surveying data in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Commonly used office software, and adjustment software; 2. Computer; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe the health and safety regulations; 3. Check field observation records for breakthrough surveying; 4. Sort out breakthrough surveying data; 5. Calculate longitudinal error of breakthrough points; 6. Calculate lateral error of breakthrough points; 7. Calculate elevation error of breakthrough points; 8. Make accuracy assessment; 9. Compile achievement data, and conduct quality inspection; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Check and sort out breakthrough surveying data; 1.2 Calculate and allocate longitudinal error of breakthrough points; 1.3 Calculate and allocate elevation error of breakthrough points. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of error distribution; 2.2 Technical requirements for breakthrough surveying. **3.0 Theories** The person performing this task must be able to explain: 3.1 Criteria for selecting projection surfaces; 3.2 Technical process of breakthrough surveying;

	3.3 Requirements for sorting out breakthrough surveying data. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The breakthrough surveying data is checked, sorted out, and calculated in accordance with the surveying and mapping standards and specifications approved by the competent authority
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	SORT OUT AND CALCULATE SPECIALIZED ENGINEERING SURVEYING DATA	**DUTY NO.**	604
TASK TITLE	CONDUCT ADJUSTMENT CALCULATION AND ACCURACY ASSESSMENT OF TRAVERSE NETWORK AND LEVELLING NETWORK	**TASK NO.**	6049
PERFORMANCE CRITERIA	The person performing this task must be able to perform adjustment calculations and accuracy assessments of traverse network and levelling network in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Computer with accessories; 2. Adjustment software; 3. Engineering calculator; 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools, equipment and safety gear; 2. Observe the health and safety regulations; 3. Utilize adjustment software to perform traverse network adjustment calculations; 4. Assess the accuracy of the traverse network; 5. Utilize adjustment software to perform levelling network adjustment calculations; 6. Assess the accuracy of the levelling network; 7. Perform quality checks on data achievements; 8. Record surveying data; 9. Clean tools, equipment and the workplace; 10. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Perform traverse network adjustment; 1.2 Assess the accuracy of the traverse network; 1.3 Perform levelling network adjustment; 1.4 Assess the accuracy of the levelling network. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principle of least square method; 2.2 Technical requirements for traverse network; 2.3 Technical requirements for levelling network. **3.0 Theories** The person performing this task must be able to explain: 3.1 Basic knowledge of Gauss projection;

	3.2 Measurement of the accuracy of surveying achievements; 3.3 Error handling methods for traverse networks; 3.4 Error handling methods for levelling networks. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Learning ability; 4.4 Analysis competence; 4.5 Computer application skills. **5.0 Mathematical skills** 5.1 Trigonometric function calculation; 5.2 Matrix operation; 5.3 Geometric operation skills.
DESCRIPTION OF THE END PRODUCT / SERVICE	The adjustment calculations and accuracy assessments of traverse network and levelling network are performed in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	CONDUCT LAND UTILIZATION STATUS SURVEY BASED ON REMOTE SENSING IMAGES	**TASK NO.**	6051
PERFORMANCE CRITERIA	The person performing this task must be able to conduct land utilization status using remote sensing images in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed on the survey/mapping site under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Remote sensing image processing software, and GIS software; 2. Computer with accessories; 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Collect, sort out, and analyze the required remote sensing images, topographic maps, etc.; 4. Map administrative boundaries, land ownership boundaries, land cover mapping, and linear features; 5. Calculate the total area of each land ownership unit and the area of each land category; 6. Compile the current land utilization map and the divided land ownership boundary map; 7. Prepare a report on land utilization survey findings and an explanatory document for the land utilization survey; 8. Review and validate the survey achievements; 9. Record surveying data;	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Interpret remote sensing images; 1.2 Map boundaries, land cover, and linear features; 1.3 Calculate the area of different land categories; 1.4 Compile the current land utilization map and the divided land ownership boundary map; 1.5 Prepare a report and document on land utilization survey findings. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of remote sensing detection; 2.2 Principles of interpreting remote sensing images; 2.3 Principles of achievement archiving. **3.0 Theories** The person performing this task must be able to explain: 3.1 Remote sensing image processing method; 3.2 Remote sensing image interpretation method;

10. Archive and preserve the survey achievements; 11. Clean tools, equipment and the workplace; 12. Store tools, equipment and safety gear.	3.3 Use method of remote sensing image processing software; 3.4 Use method of GIS mapping software; 3.5 Method for conducting land utilization surveys; 3.6 Procedure for achievement acceptance. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Land utilization status survey based on remote sensing images is conducted in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	PLOT BOUNDARIES, BOUNDARY MARKERS, AND BOUNDARY POINTS	**TASK NO.**	6052
PERFORMANCE CRITERIA	The person performing this task must be able to plot boundaries, boundary markers, and boundary points on topographic maps in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Computer with accessories; 2. Mapping software; 3. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Choose a working base map; 4. Refer to survey forms and boundary agreements; 5. Calculate plotting parameters; 6. Mark the positions of boundary points, boundary markers, and turning points of boundaries; 7. Connect all turning points; 8. Inspect the quality of the documents; 9. Record surveying data; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read topographic maps, cadastral maps, and image maps; 1.2 Calculate plotting parameters; 1.3 Plot all turning points. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Map reading principles; 2.2 Principles of plotting turning points. **3.0 Theories** The person performing this task must be able to explain: 3.1 Interpretation and application of topographic maps, cadastral maps, and image maps; 3.2 Cadastral features; 3.3 Requirements for determining the content of ownership survey forms and boundary agreements;

	3.4 Land laws and regulations. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Boundaries, boundary markers, and boundary points are plotted in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	MEASURE BOUNDARY POINT COORDINATES AND ELEVATIONS ON THE MAP	**TASK NO.**	6053
PERFORMANCE CRITERIA	The person performing this task must be able to extract the coordinates and elevations of boundary points from the map in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Computer with accessories; 2. Millimeter ruler, calculator, etc.; 3. Surveying and mapping software; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Identify boundary points on a working base map; 4. Identify the surrounding coordinate grids and plane coordinate values of the target boundary points; 5. Calculate the coordinates of the target boundary points using graphical methods; 6. Read the contours and elevations near the target boundary points; 7. Determine the elevation of the target boundary points using interpolation or estimation methods; 8. Use surveying and mapping software to quickly measure the coordinates and elevations of the points; 9. Perform quality checks on data documents; 10. Record surveying data; 11. Clean tools, equipment and the	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read topographic maps, cadastral maps, and image maps; 1.2 Measure the coordinates of boundary points on the map using graphical method; 1.3 Measure the elevation of boundary points on the map using interpolation method; 1.4 Measure the 3D coordinates of points using surveying and mapping software. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Linear interpolation principles; 2.2 Map reading principles. **3.0 Theories** The person performing this task must be able to explain:

workplace; 12. Store tools, equipment and safety gear.	3.1 Methods and accuracy requirements for elevation interpolation; 3.2 Methods and accuracy requirements for graphical coordinate determination. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence. **5.0 Mathematical skills** 5.1 Geometric operation skills; 5.2 Trigonometric function calculation.
DESCRIPTION OF THE END PRODUCT / SERVICE	The coordinates and elevations of boundary points on the map are measured in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Use of engineering calculator; 4. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	PREPARE A BOUNDARY AGREEMENT	**TASK NO.**	6054
PERFORMANCE CRITERIA	The person performing this task must be able to prepare boundary agreements in accordance with the surveying and mapping standards and specifications approved by the competent authority		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Computer with accessories; 2. Office software; 3. Surveying and mapping software; 4. Safety gear.		

EVIDENCE REQUIREMENT	
PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Read the topographic map and boundary survey working map; 4. Identify the cadastral boundaries, boundary markers, and boundary points; 5. Prepare the boundary agreement and its attached drawings based on the topographic map and revised boundary survey working map; 6. Prepare an explanation of the boundary point locations; 7. Prepare an explanation of the boundary directions; 8. Prepare the boundary agreement; 9. Inspect the quality of the achievements; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Read the topographic map and boundary survey working map; 1.2 Prepare attached drawings of the boundary agreement; 1.3 Prepare boundary point and line descriptions; 1.4 Prepare a boundary agreement. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of preparing a boundary agreement. **3.0 Theories** The person performing this task must be able to explain: 3.1 Purpose and tasks of cadastral boundary surveying and mapping; 3.2 Accuracy requirements for boundary surveying and mapping;

	3.3 Requirements for selecting boundary marker locations; 3.4 Content requirements for describing boundary point locations; 3.5 Content requirements for describing boundary directions; 3.6 Content requirements for preparing attached drawings of the boundary agreement; 3.7 Content requirements for preparing a boundary agreement. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence; 4.6 4.6 Adaptive capacity.
DESCRIPTION OF THE END PRODUCT / SERVICE	The boundary agreement is prepared in accordance with the surveying and mapping standards and specifications approved by the competent authority.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENTS COMPILATION	**DUTY NO.**	605
TASK TITLE	STORE SURVEY DOCUMENTS	**TASK NO.**	6055
PERFORMANCE CRITERIA	The person performing this task must be able to store survey documents in accordance with industry regulations and technical requirements		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Database software; 2. Computer with accessories; 3. Data input-output devices (such as scanners, plotters, and printers); 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Import basic geographic feature data; 4. Import land utilization feature data; 5. Import basic farmland feature data; 6. Import raster feature data; 7. Import other land feature data; 8. Import independent feature data; 9. Check the quality of data documents; 10. Archive the data documents; 11. Clean tools, equipment and the workplace; 12. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Operate the database software to store feature data. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of data storage. **3.0 Theories** The person performing this task must be able to explain: 3.1 Cadastral features; 3.2 Cadastral achievements; 3.3 Data editing and processing methods; 3.4 Import and export methods for data exchange formats; 3.5 Requirements for achievement statistics and summary; 3.6 Requirements for achievement production and output; 3.7 Database system maintenance methods. **4.0 Essential skills**

	4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Survey documents are imported and stored in accordance with industry regulations and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL DOCUMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	SORT OUT CADASTRAL SURVEY DOCUMENTS	**TASK NO.**	6056
PERFORMANCE CRITERIA	The person performing this task must be able to sort out the documents of cadastral surveys, feature surveys, and administrative boundary surveys.		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Office software; 2. Computer with accessories; 3. Data input-output devices (such as scanners, plotters, and printers); 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe the health and safety regulations; 3. Sort out and archive the original cadastral map data; 4. Sort out and archive the cadastral parcel sketch data; 5. Sort out and archive data of schematic diagrams of boundary disputes; 6. Sort out cadastral survey questionnaires; 7. Sort out survey archives; 8. Inspect the sorting or archiving of documents 9. Clean tools, equipment and the workplace; 10. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Sort out and archive data of original cadastral maps, cadastral parcel sketches, and schematic diagrams of boundary disputes; 1.2 Sort out and archive data of cadastral survey questionnaires and other achievement data. **2.0 Principle** The person performing this task must be able to explain the following principles: 2.1 Principles of achievement archiving. **3.0 Theories** The person performing this task must be able to explain: 3.1 Requirements for organizing cadastral surveying data; 3.2 Requirements for organizing element surveying data; 3.3 Requirements for organizing administrative boundary surveying data.

	4.0 Essential skills 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Standardized cadastral survey maps, forms, and registers are established in accordance with industry regulations and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Knowledge of measurement errors.

OCCUPATION	SURVEYING AND MAPPING TECHNICIAN	**OCCUPATION CODE**	
DUTY TITLE	CONDUCT LAND STATUS SURVEY AND CADASTRAL ACHIEVEMENT COMPILATION	**DUTY NO.**	605
TASK TITLE	SORT OUT CADASTRAL SURVEYING AND MAPPING DOCUMENTS	**TASK NO.**	6057
PERFORMANCE	The person performing this task must be able to classify and sort out measurement raw data, surveying calculation documents, and charts and tables		
RANGE STATEMENT	The task may be executed in the surveying and mapping data processing room under the supervision of a Professional Surveyor/Geomatician. The tools and equipment to be used include: 1. Office software; 2. Computer with accessories; 3. Data input-output devices (such as scanners, plotters, and printers); 4. Safety gear.		

EVIDENCE REQUIREMENT

PRACTICAL PERFORMANCE	**UNDERPINNING KNOWLEDGE**
The person performing this task must be able to: 1. Select tools equipment and safety gear; 2. Observe health and safety regulations; 3. Sort out control point coordinate data in tables; 4. Sort out boundary point coordinate data in tables; 5. Sort out and archive the cadastral map data; 6. Sort out and archive the cadastral parcel plan data; 7. Compile and summarize land classification area statistics in tables; 8. Sort out surveying and mapping archives; 9. Inspect the sorting or archiving of documents; 10. Clean tools, equipment and the workplace; 11. Store tools, equipment and safety gear.	**Detailed knowledge about:** **1.0 Methods** The person performing this task must be able to explain how to: 1.1 Sort out coordinate data in tables; 1.2 Archive cadastral maps and cadastral parcel plans; 1.3 Compile and summarize land classification area statistics in tables; 1.4 Sort out surveying and mapping archives. **3.0 Principle** The person performing this task must be able to explain the following principles: 3.1 Principles of achievement archiving. **4.0 Theories** The person performing this task must be able to explain: 4.1 Requirements for sorting out boundary surveying data; 4.2 Requirements for sorting out cadastral map surveying data;

	4.3 Requirements for sorting out cadastral parcel plan production data; 4.4 Requirements for sorting out land area calculation data. **4.0 Essential skills** 4.1 Communication skills; 4.2 Teamwork skills; 4.3 Computer application skills; 4.4 Learning ability; 4.5 Analysis competence.
DESCRIPTION OF THE END PRODUCT / SERVICE	Standardized cadastral surveying and mapping maps, forms, and registers are established in accordance with industry regulations and technical requirements.
CIRCUMSTANTIAL KNOWLEDGE	**Detailed knowledge about:** 1. Environmental management knowledge; 2. Occupational health and safety protection; 3. Knowledge of measurement errors.

APPENDIX: DACUM CHARTS FOR SURVEYING AND MAPPING TECHNICIAN – NTA 6

DUTIES	TASKS	ENABLERS
1.0 Survey engineering control network	1.1 Conduct GNSS control network surveying. 1.2 Conduct total station control network surveying. 1.3 Survey levelling control network. 1.4 Conduct underground engineering traverse surveying. 1.5 Conduct shaft connection surveying.	**Generic skills and knowledge** · Cooperating with others using communication skills and reporting to the superiors · Application skills of mathematics and computer · Application of operation instructions of instruments · Application of industrial standards and technical requirements · Skills and knowledge in control surveying · Observation methods and technical requirements for shaft connection surveying · Skills and knowledge of measuring instrument · Fundamentals of surveying **Tools and equipment** · Personal protective equipment such as vehicles, reflective vests, and safety helmets, as well as necessary tools · Gyro total station, centering rod, support, prism, level gauge, levelling rod, staff plate, staff brace, GNSS receiver, data recorder, surveying robot, compass, laser plumb, tripod, measuring rope, steel ruler, calculator, and other instruments and equipment **Materials** · Wood pile, survey nail, hammer, marking pen□, paint, brush, recording board, pencil/pen, etc. **Worker behaviors**

DUTIES	TASKS	ENABLERS
		· Hardworking, teamwork, preciseness, seriousness, time management, honesty and trustworthiness, adaptability and respect
2.0 Conduct Topographic surveying and mapping	2.1 Survey and map using UAV.	**Generic skills and knowledge□□** · Cooperating with others using communication skills and reporting to the superiors · Application skills of mathematics and computer · Application of operation instructions of instruments · Application of industrial standards and technical requirements · Skills and knowledge in UAV photogrammetry · Skills and knowledge of measuring instrument · Reading of topographic map · Fundamentals of surveying **Tools and equipment** · Personal protective equipment such as safety helmet and reflective vest · Total station, support, prism, tripod, GNSS receiver, centering rod, data recorder, computer, mapping software, and other instruments and equipment **Materials** · Wood pile, survey nail, hammer, marking pen, paint, brush, recording board, pencil/pen, etc. **Worker behaviors** · Hardworking, teamwork, preciseness, seriousness, time management, honesty and trustworthiness, adaptability and respect

DUTIES	TASKS	ENABLERS
3.0 Conduct specialized engineering surveying (choose two based on different professional directions)	3.1 Measure and record grid axis surveying and planning correction of engineering buildings (constructions). 3.2 Conduct center line surveying, verification, and adjustment in line engineering. 3.3 Observe and record deformation surveying. 3.4 Conduct field tracing and recording of urban underground pipelines. 3.5 Conduct completion planning and verification surveying for urban construction projects. 3.6 Conduct geological exploration engineering surveying. 3.7 Perform breakthrough surveying, and adjust breakthrough errors.	**Generic skills and knowledge** · Cooperating with others using communication skills and reporting to the superiors · Application skills of mathematics and computer · Application of operation instructions of instruments · Application of industrial standards and technical requirements · Skills and knowledge of engineering surveying · Skills and knowledge in mine surveying · Skills and knowledge of cadastral survey · Skills and knowledge in civil engineering · Skills and knowledge of measuring instrument · Reading of topographic maps and engineering drawings · Fundamentals of surveying **Tools and equipment** · Personal protective equipment such as safety helmet and reflective vest · Gyro total station, support, prism, level gauge, levelling rod, staff plate, staff brace, GNSS receiver, centering rod, data recorder, surveying robot, compass, pipeline detector, laser plumb, 3D laser scanner, tripod, steel ruler, calculator, and other instruments and equipment **Materials** · Wood pile, survey nail, hammer, marking pen□, paint, brush, recording board, pencil/pen, etc.

DUTIES	TASKS	ENABLERS
		Worker behaviors · Hardworking, willingness to take on responsibilities, teamwork, craftsmanship, honesty and trustworthiness, professional ethics, adaptability, and respect
4.0 Sort out and calculate specialized engineering surveying data (choose two based on different professional directions)	4.1 Check and sort out observation data for engineering construction control network. 4.2 Check and sort out engineering construction control network axis surveying and planning correction. surveying documents. 4.3 Check and sort out the surveying, verification, and adjustment of the center line in line engineering 4.4 Check, sort out, and calculate deformation surveying data 4.5 Check and sort out urban underground pipeline tracing data 4.6 Check and sort out completion planning and verification surveying data for urban construction projects 4.7 Check, sort out, and map geological	**Generic skills and knowledge** · Cooperating with others using communication skills and reporting to the superiors · Application skills of mathematics and computer · Application of operation instructions of instruments · Application of industrial standards and technical requirements · Skills and knowledge in surveying data processing · Skills and knowledge in civil engineering · Skills and knowledge of measuring instrument · Reading of topographic maps and engineering drawings · Fundamentals of surveying **Tools and equipment** · Personal protective equipment such as safety helmet and reflective vest · Calculator, computer, adjustment calculation software, and stationery **Materials** · Recording board, pencil/pen, etc. **Worker behaviors**

DUTIES	TASKS	ENABLERS
	exploration engineering surveying data 4.8 Check, sort out, and calculate breakthrough surveying data 4.9 Conduct adjustment calculation and accuracy assessment of traverse network and levelling network	· Hardworking, teamwork, preciseness, seriousness, time management, honesty and trustworthiness, adaptability and respect
5.0 Conduct land status survey and cadastral documents compilation	5.1 Conduct land utilization status survey based on remote sensing images 5.2 Plot boundaries, boundary markers, and boundary points 5.3 Measure boundary point coordinates and elevations on the map 5.4 Prepare a boundary agreement 5.5 Store surveying documents 5.6 Sort out cadastral survey documents 5.7 Sort out cadastral surveying and mapping documents	**Generic skills and knowledge□□** · Cooperating with others using communication skills and reporting to the superiors · Application skills of mathematics and computer · Application of operation instructions of instruments · Application of industrial standards and technical requirements · Knowledge of land utilization and laws · Skills and knowledge in remote sensing · Skills and knowledge of cadastral survey · Skills and knowledge in database management · Skills and knowledge in land information systems · Skills and knowledge of measuring instrument · Reading of topographic maps and cadastral maps · Fundamentals of surveying **Tools and equipment**

DUTIES	TASKS	ENABLERS
		· Personal protective equipment such as safety helmet and reflective vest · Total station, distance measuring instrument, GNSS receiver, tripod, support, prism, centering rod, steel ruler, and stationery · Computer, database software, cadastral mapping software, etc. **Materials** · Wood pile, survey nail, hammer, marking pen□, paint, brush, recording board, pencil/pen, etc. **Worker behaviors** · Hardworking, teamwork, preciseness, seriousness, time management, honesty and trustworthiness, adaptability and respect