МИНИСТЕРСТВО ОБРАЗОВАНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ
Белорусский национальный технический университет

Кафедра английского языка № 2

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ГЕОДЕЗИЯ

GEODESY

Пособие для студентов специальности
1-56 02 01 «Геодезия»

Рекомендовано учебно-методическим объединением по образованию в области металлургического оборудования и технологии

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Пособие написано в соответствии с типовой программой по иностранным языкам для неязыковых вузов и состоит из восьми разделов, направленных на развитие коммуникативных умений и навыков в профессиональной сфере.

Материалом пособия послужили оригинальные тексты, которые предназначены как для аудиторного чтения, так и для самостоятельной работы.

Пособие предназначено для студентов специальности 1-56 02 01 «Геодезия», а также для магистрантов и аспирантов при подготовке к сдаче кандидатского экзамена.

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ПРЕДИСЛОВИЕ

Пособие предназначено для студентов специальности 1-56 02 01 «Геодезия», которые имеют общеобразовательную подготовку по английскому языку: владеют определенным объемом лексических единиц и речевых моделей, знакомы с основными грамматическими категориями. Издание подготовлено в соответствии с требованиями типовой программы по иностранным языкам для неязыковых учреждений высшего образования.

Целью пособия является совершенствование и систематизация знаний и умений студентов, обогащение их словарного запаса по предлагаемой тематике, формирование навыков понимания, перевода и реферирования текстов по специальности, развитие навыков монологического высказывания на основе письменного текста, что позволяет сформировать коммуникативную компетентность в различных профессионально ориентированных видах речевой деятельности выпускников специальности «Геодезия».

Пособие имеет оригинальную авторскую структуру и состоит из восьми разделов: «Инженерная геодезия», «История геодезических изысканий», «Пять основных областей работы геодезиста», «Разница между изысканиями на плоскости и трехмерными изысканиями», «Различные типы геодезического оборудования: старое и новое», «Теодолит», «Глобальная система позиционирования», «Будущее профессии геодезиста». Базой для составления пособия послужили оригинальные тексты, для которых в каждом разделе предлагается комплекс упражнений, способствующих активному усвоению профессиональной лексики, правильному употреблению терминов, повторению некоторых аспектов грамматики, а также позволяющих проверить общее понимание прочитанного, стимулировать говорение на базе прочитанного текста. В конце каждого раздела предусмотрены задания на развитие монологической речи, что способствует формированию у студентов навыков самостоятельной деятельности и ведения дискуссии на английском языке.

Авторы выражают благодарность тем, кто способствовал созданию данного пособия.

UNIT I

ENGINEERING GEODESY

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

surveying	terrain
survey	substantiation
surveyor	triangulation
geodesy	traverse
vaastu shastra	layout
curvature	trilateration
precision	theodolite
latitude	sag
longitude	displacement
assessment	

Adjectives

geodetic	thwart
terrestrial	spatial
кectilinear	photogrammetric
planar	

2. Translate the following words and phrases into English using the vocabulary of the text.

Искривление земной поверхности, точная система, точное расположение, широта и долгота, способы измерения, наземный измерительный прибор, современное программное обеспечение, разработка месторождения, предварительные изыс-

кания, аналитические данные, вертикальная разметка, точные радиогеодезические измерения, визирование уклонов, пространственные искажения.

READING TASK

3. Read the text below.

Engineering Geodesy

Geodetic surveying refers to the survey of the earth's surface. Also called geodesy, the branch of earth science makes allowance for the earth's curvature but gives an **accurate** framework for smaller-scale surveys.

Use of Geodetic surveying:

Engineering purposes: The engineers use Geodetic surveying for finding out the exact location of the concerned point or area. Latitudes and longitudes are needed for any engineering constructions.

Construction purposes: The builders use Geodetic surveying for finding out the **direction** of the buildings or their exact location for vaastu shastra.

Land surveying and assessment: The vertical elevation and the horizontal attributes, the latitude and longitudes of the area surveyed are found out through geodetic surveying.

Geodetic surveying is thus considered as an important method of Surveying.

Engineering Geodesy is a subdivision of geodesy that studies the methods of measuring and the instruments used during the surveying and construction of engineering structures. Engineering geodesy is broken down into topographic-geodetic surveying, geodetic-engineering planning, marking out of areas, verification of structures, and observation of the deformations of structures.

What do Surveyors do?

Land surveyors work in the office and in the field – from suits to boots. Out in the field, they use the latest technology such as high order GPS, Robotic Total Stations (Theodolites), and aerial and terrestrial scanners to map an area, making computations and taking photos as evidence.

In the office, Surveyors then use sophisticated software, such as Auto-cad to draft plans and map the onsite measurements. Surveyors work on a **diverse** variety of projects from land subdivision and mining exploration, to tunnel building and major construction, which means no two days are the same. They are experts in determining land size and measurement. They also give advice and provide information to guide the work of engineers, architects and developers.

Preliminary surveys of the routes of linear structures are made using topographical maps and materials from aerial photography. The final survey is done by laying the route out in the field. **Optimal** alternatives for routes and sites are chosen by means of computers, using numerical models of the terrain. Geodetic-engineering planning consists of preparing the topographical base for the project (plans, profiles), analytic data, vertical **layout** of the sites, analytic preparation for the project, and so on.

To transfer the project layout to the terrain a layout network of geodetic control points is set up in the form of tunnel, hydro-engineering, or bridge triangulation, in the form of a construction grid (at industrial sites), traverse grids (in cities), or **precise** trilateration (for high-rise and unique structures). Using the layout network, one transfers the principal axes of the structures to the physical site and all the construction axes and transverse lines are marked off in detail.

A check survey is made on completed structures. The height of structural elements is controlled using geometric and hydrostatic leveling or microleveling. When observing the deformation of structures, one determines sag and planar displacement of fixed points (marks). Sag is measured by high-precision leveling that is

done periodically according to a strictly established program. Electronic hydrostatic systems with automatic recording of readings are also used. During this work special attention is paid to the stability of the planar and elevation geodetic base.

So why become a Surveyor?

Surveying provides a great diversity of indoor and outdoor work, meaning you won't be chained to a desk.

There is job variety; you can choose to work in many different industries from IT to Archaeology.

The high demand for Surveyors means it's easy to get a job, 95 % of students find work within 4 months after graduating.

The salaries are excellent.

Surveyors have access to the latest technology and equipment.

Surveyors can work for themselves, in private firms or in government departments.

COMPREHENSION CHECK

4. Answer the following questions.

1. What is Geodetic surveying?
2. Name purposes of geodetic surveying.
3. Give a definition of Engineering Geodesy.
4. What are subdivisions of Engineering Geodesy?
5. Where do Land surveyors work?
6. What does Geodetic-engineering planning consist of?
7. How are preliminary surveys made?
8. What methods are used for plan verifying?
9. What are the main advantages of becoming a Surveyor?

5. Choose the contextual meanings of the words written in bold in the Text.

1. **Accurate**

a) правильный
c) определенный
b) меткий
d) точный

2. **Direction**

a) направление
c) руководство
b) управление
d) сторона

3. **Diverse**

a) отличный
c) несходный
b) иной
d) различный

4. **Optimal**

a) экстремальный
c) наилучший
b) благоприятный
d) наивыгоднейший

5. **Layout**

a) разметка
c) формат
b) разработка
d) оборудование

6. **Precise**

a) определенный
c) ясный
b) аккуратный
d) точный

6. Match the synonyms.

1) accurate	6) method	*a) aim*	*f) bending*
2) curvature	7) variety	*b)instrument*	*g) position*
3) location	8) expert	*c) technique*	*h) part*
4) purpose	9)equipment	*d) specialist*	*i) observe*
5) measure	10) detail	*e) precise*	*j) diversity*

7. Fill in the table with the derivatives.

Noun	Verb	Adjective
1)	to transfer	
2) construction		
3)		optimal
4)	to measure	
5) determination		

Noun	Verb	Adjective
6)		building
7)	to analyze	
8) surveyor		
9)		automatic
10)	to stabilize	

8. Fill in the correct prepositions and translate the phrases.

1) to refer …; 2) the direction … the buildings; 3) to find out … Geodetic surveying; 4) to need … engineering constructions; 5) to work … a diverse variety … projects; 6) to lay the route … … the field; 7) … the form … tunnel; 8) base … the project; 9) to measure … high-precision leveling; 10) according … an established program.

9. Translate into English.

Инженерные изыскания являются одним из важнейших видов строительной деятельности, с них начинается любой процесс строительства и эксплуатации объектов. Комплексный подход, объединяющий различные виды инженерных изысканий, позволяет проводить разностороннее и своевременное обследование строительных площадок, зданий и сооружений.

GRAMMAR FOCUS

10. Translate the following sentences paying attention to the functions of the verb "to be".

1. Latitudes and longitudes are needed for any engineering constructions. 2. Engineering Geodesy is a subdivision of geodesy that studies the methods of measuring and the instruments used during the surveying and construction of engineering structures. 3. Surveyors are experts in determining land size and measurement. 4. Geodetic substantiation is constructed in the form of triangulation,

traverse, and leveling grids. 5. It is reasonable to measure spatial deformations by the ground stereo-photogrammetric survey method. 6. During this work special attention is paid to the stability of the planar and elevation geodetic base. 7. Surveying provides a great diversity of indoor and outdoor work, meaning you won't be chained to a desk. 8. The high demand for Surveyors means it's easy to get a job.

11. Make all types of questions to the sentence below in written form.

Surveyors can work for themselves, in private firms or in government departments.

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. What geodetic surveying is and where it is used.
2. The definition of Engineering Geodesy.
3. What Surveyors do.
4. The stages of surveying.
5. Advantages of being a surveyor.

UNIT II

THE HISTORY OF LAND SURVEYING

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

boundary	theodolite
evidence	GPS
accuracy	EDM
cadastre	total station
inability	

Verbs	**Adjectives**
to redraw	significant
to advance	lacking
to ensure	enthusiastic
	built-up
	precise

2. Match the words from the two columns to make phrases.

land	areas
international	part
significant	work
boundary	lines
surveying	surveying
built-up	device
horizontal	techniques
measurement	angles

3. Match the words with their definitions.

1. Boundary	a) the condition or quality of being true, correct, or exact; freedom from error or defect.
2. Built-up	b) a precision instrument having a telescopic sight for establishing horizontal and sometimes vertical angles.
3. Inability	c) something that indicates limits; a limiting line.
4. Accuracy	d) a global system of U.S. navigational satellites developed to provide precise positional and velocity data and global time synchronization for air, sea, and land travel.
5. To advance	e) lack of power, capacity, or means
6. Theodolite	f) an official register of the ownership, extent, and value of real property in a given area, used as a basis of taxation.
7. GPS	g) to improve or make progress.
8. To ensure	h) (of an area) filled in with houses, as an urban region.
9. Cadastre	i) having or expressing a meaning; indicative; suggestive.
10. Significant	j) to make sure or certain.

READING TASK

4. Read the text carefully and do the tasks that follow.

The History of Land Surveying

The history of land surveying is very interesting and diverse and it is in fact one of the oldest professions in the world.

Land surveying is the process by which land is surveyed and measured using mathematical means.

The history of land surveying dates back thousands of years and forms of land surveying have been around since ancient man in all major civilizations across the globe.

Ownership of land has and still is a very significant part of the lives of everyone in the world. Whether it was finding out which tribe owned which forest or the boundaries of major cities, the history of land surveying is incredibly interesting.

The first examples in the history of land surveying date back to the ancient Egyptians during the building of the Great Pyramid at Giza in 2700 BC. There is evidence of the Egyptians using basic geometry to redraw boundary lines when the Nile overflowed its banks.

The Romans were the next civilization to advance on the initial land surveying techniques of the Egyptians. Historical evidence shows that the Roman Empire was the first civilization to **employ** an official land surveyor within their Empire. They used simple tools to create straight lines and angles. The land surveyors had a **range** of jobs in the Empire and some of their work is still evident today.

The Domesday Book (кадастровая книга), created by William the Conquerer in 1086 in England is another early example of the history of land surveying. The **amount** of information about the land was very impressive for the time, however the quality of land surveying was very poor and accuracy was lacking.

Possibly one of the best known characters in land surveying history was Napoleon Bonaparte – who was very **enthusiastic**

about accurate land surveying. He always ensured that he had very precise maps, which were obviously very important when he was trying to conquer the world. He had maps produced that were drawn down to scale both at 1:2500 and 1:1250. The cadastres he had were used widely and spread quickly, however problems were encountered in built-up areas where things changed quite rapidly.

As new technology and theories have become available, the techniques and methods used in land surveying have evolved.

Hundreds of years ago land surveyors would use all sorts of means for measuring distances – such as using **chains** with links that have a certain known length for example. Additionally land surveyors have to measure horizontal angles which in most cases was done using some form of compass. The quality and accuracy of compasses have increased as time has gone by.

In the past land surveying results were a lot less accurate – not due to the inabilities of the land surveyors themselves – but due to the inaccuracy of the tools that they had access to. These days land surveyors have access to much more accurate tools such as GPS (global positioning systems).

As time has gone by, land surveying tools and **techniques** have advanced and the role of land surveyors is much broader than it was in the past.

Although the fundamentals of land surveying haven't changed, and the purpose is still the same – the techniques and methods have evolved drastically since the beginning of the history of land surveying.

One of the key changes in land surveying is the accuracy of the tools that are available to land surveyors. While in the past (up until the early 1900's) most land surveyors had access to little more than a level, tape measure and a theodolite – modern land surveyors have access to some of the most **advanced** tools in the world.

Total Stations are very commonly used in modern land surveying. These include an EDM (electronic distance measurement device) which allows for more precise land surveying.

COMPREHENSION CHECK

5. Decide whether the following statements are true or false according to the text.

1. Land surveying is exciting and varied as it is one of the latest professions in the world.
2. Land possession is a vital part of everyone's life.
3. The Egyptians redrew boundary lines when the Nile overflowed its banks.
4. In order to create straight lines the Romans used sophisticated tools.
5. The amount of information about the land was poor, however the quality of land surveying was at the high level.
6. Napoleon Bonaparte was very passionate about precise land surveying.
7. There were no problems with cadastres which spread widely and quickly.
8. Surveying results were a lot less accurate in the past due to the inabilities of land surveyors.
9. Nowadays a surveyor's range of jobs is much broader than it was in the past.
10. The fundamentals as well as the purposes of land surveying have changed a lot.

6. Answer the following questions.

1. What is land surveying?
2. How old is the history of land surveying?
3. Who was land surveying initially used by?
4. Who were the first to employ an official land surveyor?
5. What is the Domesday Book?
6. Why were precise maps important for Napoleon Bonaparte?
7. How were distances measured hundreds of years ago?
8. What purpose were compasses used for?
9. Why were land surveying results a lot less accurate in the past?

10. Have the fundamentals and the purposes of land surveying changed a lot?

11. What are the key changes?

12. What are the tools land surveyors used in the past and use today?

7. Choose the contextual meanings of the words written in bold.

1. Employ

a) использовать
c) обратить
b) нанимать
d) загружать работой

2. Range

a) ряд
c) гамма
b) диапазон
d) цепь (гор и т.п.)

3. Amount

a) объем
c) степень
b) доза
d) коэффициент

4. Enthusiastic

a) мотивированный
c) усердный
b) ревностный
d) увлеченный

5. Chain

a) горный хребет
c) вереница
b) мерная цепь
d) конвейер

6. Technique

a) техническое мастерство
c) метод
b) последовательность
d) формулировка

7. Advanced

a) современный
c) сложный
b) выдвинутый вперед
d) перспективный

8. Match the synonyms.

1) to employ — *a) extension*
2) due to — *b) easy*

3) to evolve	*c) unbelievably*
4) widely	*d) varied*
5) accurate	*e) to hire*
6) technique	*f) possess*
7) quickly	*g) major*
8) length	*h) admission*
9) simple	*i) owing to*
10) poor	*j) rapidly*
11) incredibly	*k) broadly*
12) boundary	*l) limit*
13) diverse	*m) scarce*
14) own	*n) precise*
15) main	*o) method*
16) access	*p) to develop*

9. Match the antonyms.

1) ancient	*a) to decrease*
2) more	*b) to destroy*
3) simple	*c) meaningless*
4) to increase	*d) to part*
5) rapidly	*e) vague*
6) to create	*f) narrow*
7) to encounter	*g) inability*
8) significant	*h) final*
9) accurate	*i) less*
10) evolving	*j) uniform*
11) broad	*k) abundant*
12) initial	*l) stagnant*
13) ability	*m) modern*
14) lacking	*n) slowly*
15) diverse	*o) sophisticated*

10. Arrange the words according to their parts of speech:

Surveying, ancient, the globe, incredibly, boundaries, major, advance, simple, straight, significant, ownership, employ, surveyor, range, evident, accuracy, redraw, scale, widely, encounter, precise, rapidly, available, evolve, means, length, increase, inabilities, access, technique, broad, measure, purpose, drastically, level, commonly.

Verb	Noun	Adj.

11. Fill in the prepositions then choose any three items and make sentences.

1) A range … jobs; 2) to be enthusiastic … accurate land surveying; 3) maps drawn … to scale … 1:2500; 4) problems encountered … built-up areas; 5) hundreds … years ago; 6) means … measuring distances; 7) to have access … accurate tools; 8) the quality … compasses; 9) … most cases; 10) due … the inability; 11) to allow … more precise land surveying; 12) to advance … the initial land surveying.

12. Translate the sentences from Russian into English.

1. Как известно, геодезия возникла в древние времена как прикладная инженерная наука. С ее помощью построены уникальные древние сооружения: пирамиды, храмы, маяки, высота которых достигала 150–200 м. Эти сооружения свидетельствуют о достаточно высоком уровне геодезических работ.

2. Геодезист – профессия людей, умеющих принимать решения и нести ответственность за выполняемую ими работу. Любое невнимательное отношение к выполняемой работе влечет за собой ошибки, которые могут потребовать значительных затрат времени и средств на их устранение.

3. Сейчас геодезические исследования наиболее востребованы в сфере строительства, а также для определения точных

координат и размеров земельных участков при проведении кадастровых мероприятий.

GRAMMAR FOCUS

13. Translate the following sentences paying attention to the functions of the verb "to have".

1. The land surveyors had a range of jobs in the Empire and some of their work is still evident today. 2. He always ensured that he had very precise maps. 3. The cadastres he had were used widely and spread quickly. 4. As new technology and theories have become available, the techniques and methods used in land surveying have evolved. 5. Chains with links that have a certain known length were used hundreds of years ago. 6. Additionally land surveyors have to measure horizontal angles. 7. The quality and accuracy of compasses have increased. 8. These days land surveyors have access to much more accurate tools. 9. Land surveying tools and techniques have advanced. 10. The fundamentals of land surveying haven't changed though the techniques and methods have evolved drastically.

14. Put all types of questions to the sentences below.

1. The history of land surveying dates back thousands of years.
2. They used simple tools to create straight lines and angles.

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. About Land Surveying History:
   Egypt;
   Rome;
   Bonaparte.
2. Historical Land Surveying Techniques.
3. Modern Land Surveying.

UNIT III

THE FIVE MAIN AREAS OF THE SURVEYOR'S WORK

START HERE

1. Match the terms with their definitions.

a) surveying	*d) equipment*	*g) calculations*
b) surface	*e) acquisition*	*h) representation*
c) satellite	*f) measurements*	*i) accuracy*

1) a set of tools, devices, kit, etc, assembled for a specific purpose;
2) an amount, extent, or size determined by measuring;
3) the study or practice of measuring altitudes, angles, and distances on the land surface so that they can be accurately plotted on a map;
4) the act, process, or result of calculating;
5) a man-made device orbiting around the earth, moon, or another planet transmitting to earth scientific information or used for communication;
6) faithful measurement or representation of the truth; correctness; precision;
7) the act or an instance of representing or the state of being represented;
8) the process of locating a spacecraft, satellite, etc, esp by radar, in order to gather tracking and telemetric information
9) the uppermost level of the land or sea.

2. Choose the right word.

1. Today, technology like satellites and global positioning systems (GPS) allow geodesists and other scientists to make extremely approximate/accurate measurements. 2. Uncommon/conventional measuring instruments with a telescope can neither be operated nor retrofitted with this device. 3. Maps based on observations and

measurements were an indispensable/needless aid for journeys and voyages, and were thus highly valued.

ACTIVE VOCABULARY

3. Give Russian equivalents of the following words and phrases. Try to memorize them.

Nouns and noun phrases

acquisition	chart	defense
plat	accuracy	

Verbs and verbal phrases

to be regarded	to process	to portray
to encompass	to evolve	to delineate
to gather	to plot	

Adjectives

conventional
indispensable

4. Combine the words from the column on the left with the suitable nouns from the column on the right. Translate them into Russian.

1) relative	*a) methods*
2) general	*b) processing*
3) physical	*c) sense*
4) surveying	*d) program*
5) space	*e) operation*
6) research	*f) positions*
7) data	*g) analysis*
8) construction	*h) environment*

5. Match the English and Russian equivalents.

1) relative positions	*a) установление точек*
2) establishing points	*b) размещение углов*
3) processing information	*c) сбор данных*
4) research analysis	*d) полевые работы*
5) corner locations	*e) замеры участка земли*
6) field work	*f) обработка сведений*
7) data acquisition	*g) анализ изысканий*
8) plotting measurements	*h) относительное положение*

6. Fill in the table with appropriate derivatives if possible.

Noun	Verb	Adjective
	to define	
information		
decision		
	to measure	
		indispensable
accuracy		

READING TASK

7. Read the text.

The Five Main Areas of the Surveyor's Work

Surveying has traditionally been defined as the science and art of determining relative positions of points above, on, or beneath the surface of the earth, or establishing such points. In a more general sense, however, surveying can be regarded as that discipline which encompasses all methods of gathering and processing information

about the physical earth and environment. Conventional ground systems are now supplemented by aerial and satellite surveying methods, which evolved through the defense and space programs.

In general, the work of a surveyor can be divided into five parts:

1. Research analysis and decision making. Selecting the survey method, equipment, most likely corner locations, and so on.

2. Field work or data acquisition. Making measurements and recording data in the field.

3. Computing or data processing. Performing calculations based on the recorded data to determine locations, areas, volumes, and so on.

4. Mapping or data representation. Plotting measurements or computed values to produce a map, plat, or chart, or portraying the data in numerical or computer format.

5. Stakeout. Setting monuments and stakes to delineate boundaries or guide construction operations.

Surveying is one of the oldest and most important arts practiced by man because from the earliest times it has been necessary to mark boundaries and divide land. Surveying has now become indispensable to our modern way of life.

Surveying continues to play an extremely important role in many branches of engineering. For example, surveys are required to plan, construct, and maintain highways, railroads, buildings, bridges, tunnels, canals, land subdivisions, sewerage systems, pipelines, etc. All engineers must know the limits of accuracy possible in construction.

COMPREHENSION CHECK

8. Answer the following questions and give examples.

1. What is a traditional definition of surveying?
2. What is Surveying in a more general sense?
3. What are conventional systems supplemented by?
4. How many main parts are there in surveyor’s work?

5. Surveying is one of the modern arts practiced by man, isn't it?
6. Does surveying play an important part in engineering?
7. What spheres surveying is needed in?

9. Translate into Russian in written form.

Виды геодезических исследований и их состав

Геодезические изыскания – это целый комплекс работ по исследованию местности, который включает в себя следующие мероприятия:

1. Сбор, анализ и обработка материалов изысканий прошлых лет. Здесь обрабатываются данные аэрофотографических, картографических, топографических и топографо-геодезических съемок.

2. Визуальные наблюдения за территорией. На этом этапе исследований площадка строительства оценивается с точки зрения близлежащих строений и возможности вписать объект проектирования в существующую инфраструктуру. Выявляются и сложные геологические условия (овраги, реки, оползни).

3. Создание комплекса планово-высотной и опорной геодезических сетей

4. Проведение наземной топографической съемки. Если возникает необходимость, то возможно проведение аэро- и стереофотографических съемок объектов или акватории

5. Перенесение проекта в натуру с дальнейшей привязкой объекта на местности.

6. Камеральная обработка материалов исследований и составление технического отчета по геодезическим изысканиям.

7. Наружные обмеры зданий и координирование их элементов в период подготовки их к ликвидации.

Все исследования в области геодезических изысканий необходимо проводить в строгом соответствии с нормативными

документами, учитывая привязку объектов к пунктам существующей геодезической сети. По проведению работ есть возможность дать комплексную оценку площадки застройки, выполнить схему сетей территории и обосновать экономическую целесообразность строительства конкретного объекта на конкретном участке.

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. General determination of Surveying.
2. Five parts of Surveyer's work.
3. Surveying role in branches of engineering.

UNIT IV

DIFFERENCE BETWEEN PLANE SURVEYING AND GEODETIC SURVEYING

START HERE

1. Form the nouns from the following verbs.

to determine →…	to classify →…
to produce →…	to irrigate→…
to measure→…	to correlate→…
to result →…	to ignore→…

2. Fill in the correct prepositions, translate the phrases, then choose any five items and make up the sentences of your own.

_ order to determine points; 2) to use _ civil engineering; 3) construction _ irrigation projects; 4) to be based _ different factors; 5) field _ survey; 6) to consider _ plane surface; 7) the curvature _ earth; 8) to be categorized _ the method; 9) to take _ account; 10) to be used _ the purpose; 11) to compare___ smth; 12) to locate points _ earth.

ACTIVE VOCABULARY

3. Give Russian equivalents of the following words and phrases. Try to memorize them.

Nouns and noun phrases

reservoir	extent
irrigation	curvature
triangulation	chain
trilateration	

Verbs and verbal phrases

to plot	to categorize
to correlate	to neglect

Adjectives

marine
photogrammetric
precise

Adjectives

conventional
indispensable

READING TASK

4. Read the text.

Difference between Plane Surveying and Geodetic Surveying

Surveying can simply be defined as the process or technology of making measurement in a scientific manner on, above, or below the earth's surface in order to determine points to produce a plan or map. When the area of surveying is small, and the scale to which its **result** plotted is large, then it is known as plan, and the vice versa of this is Map. Surveying is widely used in almost all civil engineering projects such as construction of building, bridges, reservoirs, dams, railways, roads, irrigation projects etc. Surveying can be classified based on different factors such as field of survey (like land survey, marine survey, photogrammetric, etc), object of surveys (like Engineering purpose, military purpose, etc), method of survey (like Triangulation, Trilateration, etc), and instruments used (Like chain surveying, theodolite surveying, levelling, etc). However the prime classification of surveying is plane surveying and geodetic surveying.

Plane Surveying

Plane surveying is a branch of surveying in which the surface of the earth is **considered** as plane surface. This is the most commonly

practicing form of surveying. This is used when the extent of the area to be surveyed is small (area less than 260 square km) as this method **neglects** the curvature of earth. In order to make calculations, normally triangles are formed on the ground and these triangles are also assumed as plane triangles and the rules of plane triangles are used to do the computations. The area to be surveyed, and the error associated to the survey results are positively correlated that is more the area more the error. So, this method is not suitable for more accurate or precise large area surveying. Normally Plane surveying is useful for engineering projects. Normally, survey for location and construction of railroads, highway, cannel, and landing fields are categorized under this method.

Geodetic Surveying

Geodetic surveying is another branch of surveying in which the curvature of the earth is considered when taking measurements on earth's surface. That is the actual spherical shape of earth is taken into account. This is also known as trigonometrical surveying. The triangles formed are spherical triangles and calculations are made using spherical trigonometry. In this method, measurements are taken using high precision instruments. This method is used to determine or establish control **points** for other surveys, and to long lines and areas. The position of each geodetic station is expressed using longitude and latitude and Global Positioning System (GPS) is normally used for this purpose.

What is the difference between Plane Surveying and Geodetic Surveying?

Though, both plane surveying and geodetic surveying are the methods of making measurement on earth, they are having some distinguishing **features**.

1. Mainly, plane surveying ignores the curvature of the earth, while geodetic surveying considers it.

2. Plane surveying is suitable for small areas, whereas Geodetic surveying suits for surveying of large area.

3. Geodetic surveying is more accurate than plane surveying.

4. Triangles formed in plane surveying are plane triangles, but triangles formed in geodetic surveying are spherical triangles.

5. Geodetic stations are in huge distance compared to stations formed in plane surveying.

6. Moreover plane surveying uses normal instruments like chain, measuring tape, theodolite, etc. to locate points on earth, while geodetic surveying uses more precise instruments and modern technology like GPS.

COMPREHENSION CHECK

5. Choose the contextual meanings of the words written in bold in Text 1.

1. Result

a) итог
b) следствие
c) исход
d) вывод

2. Consider

a) учитывать
b) обдумывать
c) полагать
d) рассматривать

3. Neglect

a) упускать
b) пренебрегать
c) игнорировать
d) забрасывать

4. Point

a) отметка
b) пункт
c) место
d) точка

5. Feature

a) свойство
b) подробность
c) функция
d) черта

6. Complete the following sentences according to the text.

1. Surveying serves to produce … .
2. Surveying is widely used in … .
3. Objects of surveys are … .
4. Methods of survey are ... .

5. The most commonly practicing form of surveying is ... .
6. … is not suitable for accurate or precise large area surveying.
7. Global Positioning System is normally used for … .

7. Correct the following statements if necessary.

1. When the area of surveying is small, and the scale to which its result plotted is large, then it is known as Map.
2. The broad classification of surveying is plane surveying and geodetic surveying.
3. Plane surveying is a branch of surveying in which the curvature of the earth is considered.
4. Geodetic surveying neglects the curvature of earth.
5. Plane surveying is suitable for more accurate or precise large area surveying.
6. In geodetic surveying, measurements are taken using high precision instruments.

8. Answer the following questions and give examples.

1. How can surveying be defined?
2. Where is surveying widely used?
3. What is surveying classification based on?
4. What is the prime classification of surveying?
5. What is plane surveying?
6. What is geodetic surveying?
7. What is the main difference between Plane Surveying and Geodetic Surveying?

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. The prime classification of Surveying.
2. Definition of Plane surveying.
3. Definition of Geodetic surveying.
4. Six distinguishing features of Plane Surveying and Geodetic Surveying.

UNIT V

DIFFERENT TYPES OF SURVEYING EQUIPMENT: OLD AND NEW

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

planimeter	measuring wheel	lifting level
automatic level	a tripod stand	self-leveling level

Adjectives

asymmetrical	tilting
precise	drastic

2. Translate the following international words in Russian with no dictionary.

Market, parameter, specific, distance, compass, horizontal, instrument, metallic, technology, vertical, asymmetrical, calculations, global, telescope, total, ultra-modern.

3. Match the English and Russian equivalents.

1) short duration of time	*a) набор инструментальных средств, инструментарий*
2) measuring of angles	*b) различные поворотные возможности*
3) asymmetrical land areas	*c) измерение углов*
4) attached over axis	*d) несимметричные участки земли*
5) surveying tool kit	*e) радикальное изменение технологии*
6) different rotating capabilities	
7) satellite systems	

8) drastic change of technology

f) прикрепленный над осью
g) короткая продолжительность времени
h) спутниковые системы

READING TASK

4. Read the text below. What old and new surveying equipment can you name?

Different Types of Surveying Equipment: Old and New

by: Raunekk

A surveyor depends on their equipment for acquiring accurate measurements quickly and easily. The article describes the various types of surveying equipment, both ancient and modern, that are available in the market today.

Many kinds of surveying equipment have been used in the past and present to help a surveyor measure various parameters of a land area. Each of these parameters is measured by a specific type of measuring equipment. In this article we will learn about the importance of the main types of surveying equipments, both old and new.

Old

In ancient times surveying equipment included chains, compass, solar compass, transit, theodolite and more. Chains with equal size links were used to measure distance between two required points. A compass was used to measure the direction of a line that was being surveyed. A Solar Compass was used for measuring both the direction and latitude of a particular point with the help of sun and stars. A Solar Compass could also measure horizontal angles and the "true north" of a particular place. A metallic measuring tape was used to measure shorter distances.

As technology gradually advanced with time, instruments used for surveying also improved. Horizontal and vertical angles were measured using a simple theodolite whereas different heights were

measured by a basic level. Measuring wheels were also initially used by surveyors to measure long distances in a short duration of time. Measuring wheels came in two types: mechanical and electrical, and both worked on the same principle of rolling the wheel from the start to the end point.

In the early 1900s, surveyors started to use surveying equipment such as planimeters, theodolites, automatic levels and measuring wheels. A planimeter is the best known tool for measuring asymmetrical land areas as they eliminate the need for charts or manual calculations; whereas a theodolite allows measuring of horizontal and vertical angles. A theodolite consists of a movable telescope attached over perpendicular axis. It provides precise measurement of angles and is an integral part of every surveying tool kit. A transit is a type of theodolite but has less precision.

An auto level or a dumpy level is also a type of surveying equipment used for measuring horizontal levels. It consists of a telescope like device fitted on a tripod stand. Auto level, tilting level, and self-leveling level are all types of leveling instruments, each providing different rotating capabilities. Most surveying instruments are fixed on a tripod, which acts as a support. As the name suggests, tripods have three legs with length varying capability. Many of these equipments are still used by surveyors around the world.

New

Recent development in technology has provided some of the finest surveying equipments present today. Moreover, with the introduction of global positioning system, the methods of surveying have also totally changed. GPS has not only made surveying faster but has increased the accuracy to amazing heights. GPS works with the help of satellite systems which provide accurate data directly on the computer screen. Various types of GPS equipment is available, from basic to highly advanced. Some GPS equipment even has night vision which facilitates surveying during the night time. However, it is said that though GPS helps in acquiring the

exact position of the land; it does not provide good results in dense forest areas or concrete constructions. For this reason, an instrument known as total station is used along with the GPS.

Total station is a theodolite with an Electronic Distance Measurement Device. Total station has also been one of the reasons behind the drastic change of technology in the surveying field. EDMD shifted the surveying technology from optical mechanical devices to digital electronic devices. In spite of just being distance measuring equipment, total station can also be used for leveling when adjusted in a horizontal plane. Most of the ultra-modern surveying devices are a combination of one or more of these devices. There is a long list of surveying equipment available in the market today. The selection of particular equipment depends on the type of application and accuracy required.

Though all these equipment provide a wide range of options to surveyors, it is advisable to have a thorough knowledge of both, the equipment and the desired survey. This would not only help in bringing accuracy to the work but would also save considerable time and money.

COMPREHENSION CHECK

5. Answer the following questions.

1. What does a surveyor depend on for acquiring accurate measurements quickly and easily?
2. What did surveying equipment include in ancient times?
3. What was used to measure distance between two required points?
4. What could a Solar Compass measure?
5. How were measuring wheels used?
6. When did surveyors start to use planimeters, theodolites and automatic levels?
7. What is planimeter?
8. A theodolite allows measuring of horizontal levels, doesn't it?
9. What does an auto level consist of?

10. What surveying equipment uses satellite systems?

11. Does GPS provide good results in dense forest areas or concrete constructions?

12. What is used along with the GPS?

6. Fill in the table with old and new equipment.

Chains, global positioning system, solar compass, transit, theodolite, metallic measuring tape, total station, planimeters, automatic levels, measuring wheels.

EQUIPMENT	
Old	New

7. Match the surveying instruments with their descriptions.

1) planimeter	a) was used for measuring both the direction and latitude of a particular point with the help of sun and stars
2) tripod	b) mechanical and electrical, worked on the principle of rolling the wheel from the start to the end point
3) solar compass	c) the best known tool for measuring asymmetrical land areas as they eliminate the need for charts or manual calculations
4) total station	d) a type of surveying equipment used for measuring horizontal levels

5) auto level — e) has three legs with length varying capability

6) measuring wheels — f) a theodolite with an electronic distance measurement device

8. Fill in the table with the derivatives.

Noun	Verb	Adjective
1)	to transfer	
2) construction		
3)		optimal
4)	to measure	
5) determination		
6)		building
7)	to analyze	
8) surveyor		
9)		automatic
10)	to stabilize	

9. Fill in the correct prepositions and translate the phrases.

1) types … surveying equipment; 2) available … the market; 3) distance … two points; 4) to advance … time; 5) to be used … surveyors; 6) to consist …; 7) measurement … angles; 8) to be fixed … a tripod; 9) to work … the help of satellite systems; 10) to depend … the type of application.

10. Translate into English.

Широкое распространение геоинформационных систем и технологий обусловило расширение области применения GPS-оборудования в различных сферах деятельности, включая высокоточные геодезические измерения, навигацию, геоинформационные системы и др. Сегодня основными источни-

ками данных для геоинформационных систем и технологий являются: традиционное геодезическое оборудование, приборы спутникового позиционирования, лазерное сканирование и дистанционное зондирование Земли. Причем все больший вес приобретают методы и приборы глобального позиционирования, ориентированные на интеграцию спутниковой навигации и цифровых топографических карт, и оперативный мониторинг территорий и объектов недвижимости.

GRAMMAR FOCUS

11. Translate the following sentences paying attention to the functions of the verb "to have".

1. Many kinds of surveying equipment have been used in the past and present. 2. A transit is a type of theodolite but has less precision. 3. Tripods have three legs with length varying capability. 4. Recent development in technology has provided some of the finest surveying equipments present today. 5. The methods of surveying have also totally changed. 6. Some GPS equipment even has night vision which facilitates surveying during the night time. 7. It is advisable to have a thorough knowledge of both old and new equipment.

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. Surveying equipment used in ancient times.
2. Modern surveying equipment.

UNIT VI

THEODOLITE

READING TASK 1

START HERE

1. Form the nouns from the following verbs.

to circle →…	to measure →…
to transit →…	to prefer→…
to affix→…	to read→…
to adapt →…	to access→…

2. Fill in the correct prepositions, translate the phrases, then choose any five items and make up the sentences of your own.

1) An instrument_ measuring angles; 2) to be adapted _ specialized purposes; 3) a modern theodolite consists _ a telescope with two axes; 4) the telescope is pointed _ a desired object; 5) the telescope is mounted directly_ the vertical arc; 6) to be capable _ reading angles; 7) the first instrument _this sort; 8) with a vertical circle mounted _one side; 9) purchased _ the Royal Society; 10) specialized purposes _ fields like meteorology and rocket launch technology.

ACTIVE VOCABULARY

3. Give Russian equivalents of the following words and phrases. Try to memorize them.

Nouns and noun phrases

alidade	sight vane
graduated circle	trunnion axis
surveyor's transit	back-sighting
geodetic link	magnification

Verbs and verbal phrases

to affix	to move away
to mount	to flop over
to circle	to read angles
to wane	

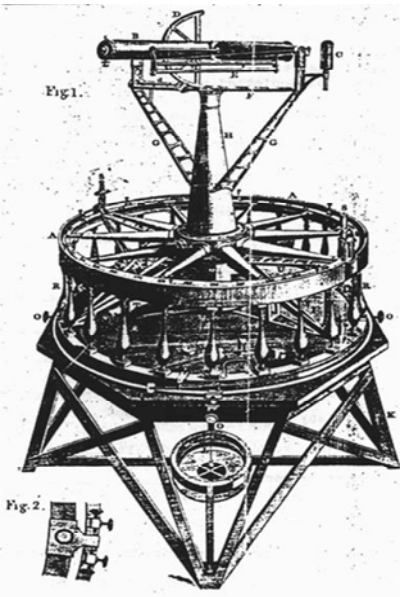
Adjectives

robust
pivoting
auxiliary
inaccessible

Text 1

4. Read the text below.

From the History of Theodolite



A theodolite is an instrument for measuring both horizontal and vertical angles, as used in triangulation networks. It is a **key** tool in surveying and engineering work, particularly on inaccessible ground, but theodolites have been adapted for other specialized purposes in fields like meteorology and rocket launch technology. A modern theodolite consists of a movable telescope **mounted** within two perpendicular axes–the horizontal or trunnion axis, and the vertical axis. When the telescope is pointed

at a desired object, the angle of each of these axes can be measured with great **precision**.

Leonard Digges introduced the word "theodolitus" in his Pantometria (London, 1571). This surveying instrument had a circular ring or plate divided into 360 degrees, and a pivoting alidade with sight vanes at either end. Theodolites of this sort, as well as others with a second pair of sight vanes affixed to the graduated circle, were soon in widespread use. In 1791, George Adams Jr. called this instrument a "common theodolet," **reserving** the term theodolite for the telescopic instruments with horizontal circles and vertical arcs that had been introduced in London in the 1720s.

While the telescopic theodolite was popular in England, Americans preferred the surveyor's compass and, later, the surveyor's transit, which were cheaper and more robust. In the 18th century form, the telescope is mounted directly on the vertical arc. In the transit theodolite, which originated in London in the 1840s, the telescope is transit mounted, with a vertical circle mounted at one side. Heinrich Wild's optical theodolite, introduced in Switzerland in the 1920s, had several new features, including an auxiliary telescope that lets the user read either circle without moving away from the station.

Some theodolites measure horizontal angles with geodetic accuracy. The first instrument of this sort was made by Jesse Ramsden in London in 1787, and purchased by the Royal Society for use on the geodetic link between Greenwich and Paris. The first instrument of this sort in America was made around 1815 by Troughton in London for the fledgling United States Coast Survey.

Transit refers to a specialized type of theodolite that was developed in the early 19th century. It featured a telescope that could "flop over" ("transit the scope") to allow easy back-sighting and doubling of angles for error reduction. Some transit instruments were capable of reading angles directly to thirty arcseconds. In the middle of the 20th century, "transit" came to refer to a simple form of theodolite with less precision, lacking features such as scale

magnification and mechanical meters. The importance of transits is waning since compact, accurate electronic theodolites have become widespread tools, but the transit still finds use as a lightweight tool on construction sites. Some transits do not measure vertical angles.

COMPREHENSION CHECK

5. Choose the contextual meanings of the words written in bold in Text 1.

1. Key

a) существенный
b) главнейший
c) опорный
d) центральный

2. Mounted

a) возвышенный
b) вооруженный
c) сложенный
d) закрепленный

3. Precision

a) точность
b) четкость
c) тонкость
d) тщательность

4. Reserving

a) бронируя
b) сохраняя
c) приберегая
d) откладывая

5. Magnification

a) аккумулирование
b) усиление
c) восхваление
d) увеличение

6. Complete the following sentences according to the text.

1. A theodolite is … .
2. A modern theodolite consists of … .
3. When the telescope is pointed at a desired object … .
4. ... introduced the word "theodolitus" in his Pantometria.
5. ... was popular in England.
6. Americans preferred ….

7. Heinrich Wild's optical theodolite included… .
8. Transit refers to… .
9. The importance of transits is waning because… .

7. Correct the following statements if necessary.

1. A theodolite is an instrument for measuring horizontal angles, as used in triangulation networks.
2. It is a **key** tool in surveying, particularly on easily accessible lands.
3. A modern theodolite consists of a movable telescope affixed within two perpendicular axes.
4. When the telescope is pointed at a desired object, the angle of each of these axes can be measured properly.
5. Theodolites with a second pair of sight vanes affixed to the graduated circle were not robust.
6. Transit theodolite allowed easy back-sighting.

8. Answer the following questions and give examples.

1. What is a theodolite?
2. What purposes have theodolites been adapted for?
3. What does a modern theodolite consist of?
4. How did the first theodolites look like?
5. What kinds of theodolites can you name?
6. What is a transit theodolite? What operations does it allow to fulfill?

RETELL TEXT 1 ACCORDING TO THE PLAN BELOW

1. Definition of a theodolite.
2. Main functions of theodolites.
3. The first theodolites and their functions.
4. Varieties of theodolites.

READING TASK 2

ACTIVE VOCABULARY

9. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

polygonal network	line survey
alignment	plummet
bubble level	tripod head
leveling	tribrach
vernier	screw
knob	fine pointing
clamp	
discrepancy	
sketching	
mapping	

Adjectives

knurled	tangent
rotatable	azimuthal
loose	

10. Match the words from the two columns to make phrases:

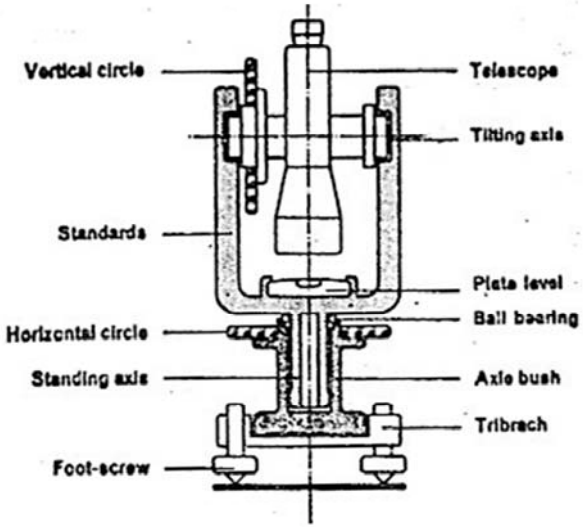
line	head
tangent	screw
knurled	network
azimuthal	survey
fine	pointing
tripod	wheel
polygonal	angles

11. Match the words with their definitions.

1) discrepancy	a) a first rough or incomplete draught or plan of any design.
2) sketch	b) a piece of lead attached to a line.
3) terrain	c) a kind of nail with a spiral thread and a head with a nick to receive the end of the screw-driver.
4) plummet	d) the operation of using a leveling instrument for finding a horizontal line, for ascertaining the differences of level between different points of the earth's surface included in a survey, etc.
5) adjust	e) the quality or state of disagreeing or being at variance
6) leveling	f) a piece of ground having specific characteristics or military potential.
7) screw	g) extended area; length; extent.
8) alignment	h) to make exact; to fit; to make correspondent or conformable; to bring into proper relations.
9) scope	i) principles from which other truths can be derived.
10) fundamentals	j) the act of adjusting to a line; the ground-plan of a railway or other road, in distinction from the grades or profile.

Text 2

12. Read the text below.



Using a Theodolite

In this section, we consider the use of the theodolite (an instrument with which points can be positioned very accurately), and some fundamentals of traverse surveying – **a means** to set out a local network of central points. Once a secure polygonal network of control points is established, local detail can be accurately placed either by sketching or by surveying the details using the theodolite.

Two types of traverse are:

a) open,

b) closed.

An open traverse is used in line surveys, such as highways, or where low accuracy inventories are being made in relatively unknown terrain.

Clearly, there is considerable **scope** for error here. The effect of small angular discrepancies is magnified, such that the position of E may be subject to considerable error. In such work, very accurate methods of measuring both angles and distances are required. A theodolite with a horizontal circle capable of reading directly to 1 second of arc is preferred.

A closed traverse is the preferable procedure, **since** error corrections can be made and it is best suited for mapping a

compact area. First walk out the area to determine the best locations for traverse hubs (instrument positions).

Essential Features of a Theodolite

A theodolite consists of the following main parts: a fixed base with tribrach, a movable upper part, and a telescope. The base with the tribrach is screwed **securely** to the tripod head and is levelled up by means of its three foot screws. In simple theodolites of older construction the horizontal circle which defines the azimuthal angles (or bearings) is fixed rigidly to this base. In modern instruments the circle can be rotated independently by means of a milled knob or some other device.

On the upper part, which is rotatable about the standing (vertical) axis, two vertical pillars (called standards) are mounted that support the tilting (horizontal) axis upon which the telescope rotates and the vertical circle which defines the vertical angles.

For rough leveling-up the base has a circular bubble level mounted to the instrument. For more accurate leveling-up, the more sensitive alidade tubular level (the plate level) is used. The instrument is centred over a station point by means of a plumbob or a **built-in** optical plummet.

The telescope may be aimed in any desired direction in space, by means of rotations about its standing and tilting axes. Fine pointing to a particular target is achieved accurately by means of clamping and slow motion (drive) screws.

Measuring Horizontal Angles

Setting the horizontal coordinate system

The theodolite has two clamps (upper and lower) to control horizontal surveying. Turn the knurled wheel to 0°0'0" (details on vernier later). Clamp the upper movement. Set the angle exactly with the tangent screw. The angular reading will not change, if the upper tangent screw is now left alone.

The lower movement is still loose. Point the theodolite at some **predefined** target, which will be used to define the horizontal angular coordinate system. Then clamp the lower motion. Adjust

the alignment of theodolite and the target with the lower tangent screw. Theodolite and azimuth 0°0'0" are now set on A.

Measuring the horizontal angle

Loosen the upper clamp. Rough point on the next survey point of interest, B. Clamp. Adjust the alignment of with B using the upper tangent screw. This procedure turns the theodolite over the horizontal circle, so one "turns off" and can read the angle between A and B. The effect of erroneously turning the lower tangent screw at this **stage** is to introduce an error into the angles.

COMPREHENSION CHECK

13. Decide whether the following statements are true or false according to the text.

1) A theodolite is an instrument with which points can be positioned with great precision.

2) Once a secure polygonal network of control points is fixed, local detail can be accurately positioned by means of sketching.

3) There are 3 types of traverse.

4) An open traverse is the preferable procedure, since error corrections can be made.

5) A closed traverse is best suited for mapping a compact area.

6) The upper part of a theodolite is rotatable.

7) For low accuracy leveling-up the base has a circular bubble level adjusted to the instrument.

8) Plate level and bubble level mean the same.

9) The telescope may be aimed in any direction by means of rotation.

10) Fine pointing to a particular target is achieved only by means of clamping.

14. Answer the following questions.

1) What is traverse surveying?

2) How many types of traverse are there? What are they?

3) When is open traverse used?

4) What are the disadvantages of an open traverse?
5) Why is closed traverse a preferable procedure?
6) What are the main parts of a theodolite?
7) What is the essential difference between modern instruments and older constructions?
8) What is mounted on the upper part of a theodolite?
9) What is the function of a plate level and a bubble level?
10) What are clamps used for?

15. Choose the contextual meanings of the words written in bold.

1. Means

a) путь
b) средства
c) способ
d) материальное положение

2. Scope

a) предмет
b) область
c) пределы
d) масштаб

3. Since

a) с тех пор
b) с
c) на протяжении
d) поскольку

4. Securely

a) спокойно
b) плотно
c) защищенным образом
d) надежно

5. Built-in

a) защемленный
b) встроенный
c) утопленный
d) имплантированный

6. Predefined

a) заранее заданный
b) готовый
c) стандартный
d) встроенный

7. Stage

a) шаг
b) период
c) сцена
d) этап

16. Match the synonyms.

1) terrain	*a) plumbob*
2) scope	*b) roughly*
3) to establish	*c) precise*
4) to position	*d) way*
5) accurate	*e) thwart*
6) plummet	*f) web*
7) error	*g) objective*
8) rigidly	*h) area*
9) discrepancy	*i) tool*
10) traverse	*j) safe*
11) a means	*k) mistake*
12) point	*l) difference*
13) network	*m) to mount*
14) target	*n) to place*
15) secure	*o) scale*
16) instrument	*p) dot*
17) fundamentals	*q) basics*

17. Match the antonyms.

1) open	*a) undesirable*
2) loose	*b) spacious*
3) movable	*c) flexible*
4) preferable	*d) minor*
5) rigid	*e) tight*
6) great precision	*f) smooth*
7) compact	*g) similarity*
8) considerable	*h) low accuracy*
9) discrepancy	*i) close*
10) rough	*j) static*

18. Arrange the words according to their parts of speech:

Mapping, traverse, establish, mount, adjust, fundamentals, angle, rigidly, polygonal, considerable, loose, network, surveyor, screw, point, scope, sketching, scale, accurately, knurled, precise, error, inaccessible, discrepancy, means, clamping, leveling, alignment, access, rotatable, plumbob, measurement, tripod, terrain, azimuthal, pillar.

Verb	Noun	Adj.

19. Fill in the prepositions then choose any three items and make sentences.

1) a means to set _ a local network _ central points; 2) theodolite and azimuth 0°0'0" are now set _ A.; 3)_this stage; 4) to be leveled up _ means_ screws; 5) to introduce an error _ the angles; 6) the instrument is centred _ a station point; 7) point the theodolite _ some predefined target; 8) mounted _ the instrument); 9) best suited _ mapping a compact area; 10) the tilting axis _ which the telescope rotates.

RETELL THE TEXT ACCORDING TO THE PLAN BELOW

1. Definition of traverse surveying.
2. Types of traverse.
3. Essential features of theodolites.
4. Measuring horizontal angles.

READING TASK 3

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

expertise
encoder
stake
proficiency

Adjectives

integral
simultaneous

Verbs and verbal phrases

to execute
to incorporate
to ensure
to facilitate

2. Fill in the table with the derivatives.

Noun	Verb	Adjective
1)		executive
2)	incorporate	
3) operation		
4)	measure	
5)	align	
6)		proficient
7)		rotatable

Noun	Verb	Adjective
8) integrity		
9)	assist	
10)		predefined

3. Cross the odd word out.

1. a) proficiency; b) experience; c) skillfulness d) ignorance.
2. a) differency; b) discreetness c) discrepancy d) deviation.
3. a) integral; b) built-in; c) innate; d) appropriate.
4. a) movable; b) mobile; c) portable; d) digital.
5. a) ensure; b) determine ; c) provide; d) guarantee.
6. a) ease; b) loosen up; c) complicate; d) facilitate.

Text 3

4. Read the text below.

Comparison of Theodolite and Total Station

Both the total station and theodolite are devices for the measurement of vertical and horizontal angles during engineering projects and surveying. Each has specific characteristics due to which they are used. Normally, the factors of time, expertise available, and cost will determine the use of either of these instruments. However, the major differences in these survey instruments are explained below:

Theodolite

A theodolite includes a suitable telescope that is fixed between the horizontal and vertical axes. The axes angle can be calculated accurately only if the operator has enough information regarding trigonometry. Furthermore, a theodolite normally needs the assistance of one person in addition to the operator, to facilitate the measurement and alignment of angles. To ensure accuracy,

both operators should be able to level the tripod and the measuring post. Furthermore, they should be able to align the measuring line and the stake to obtain an accurate data. Mathematical and graphical proficiency is also required to produce the appropriate data. A theodolite is normally used for small size plots. In the modern theodolites, the reading of the vertical and horizontal circles is executed electronically by a rotary encoder. Additionally, sensors are added to allow auto-targeting and automatic measurements by using integral software. Some modern theodolites have electro-optical distance measuring tools, usually infrared, permitting simultaneous measurements of the vectors.

Total Station

A total station is considered to be a superior surveying tool compared to the theodolite due to its digital integration and all-inclusive features. A total station incorporates the functions of theodolite to determine angles and distances by an electronic distance meter. Total stations employ a combination of lasers and prisms to record digital readings of the measurements in a computer. This data can be used for further analysis. Robotic total stations have been developed that can be operated remotely. However, the total stations are expensive and need not only survey expertise, but also detailed training on software. Total stations are suitable for survey requirements over large distances, particularly over difficult terrain. The results of a total station on such environments are more accurate.

COMPREHENSION CHECK

5. Read the text another time and point out:

a) what theodolites and total stations have in common;

b) specific features of a theodolite and a total station;

c) main distinctions of a theodolite from a total station.

6. Combine the words from the column on the left with the suitable nouns from the column on the right. Translate them into Russian.

1) vertical	*a) instruments*
2) specific	*b) readings*
3) major	*c) characteristics*
4) survey	*d) data*
5) graphical	*e) proficiency*
6) simultaneous	*f) circle*
7) digital	*g) measurements*
8) appropriate	*h) angle*
9) horizontal	*i) post*
10) measuring	*j) differences*

7. Translate into English in the written form.

Теодолиты предназначены для измерения углов в горизонтальной и вертикальной плоскостях. Они могут быть оптические и электронные. Тахеометры выполняют и эти операции, но также многие другие: определяют расстояние, а главное, делают расчеты. Электронные тахеометры стоят значительно дороже теодолитов. Их по достоинству можно назвать самым совершенным геодезическим оборудованием, потому что не только замеры, но и их анализ, можно проводить на месте работы. Цена такого вида техники значительно выше, чем у теодолита. Тахеометры, как и теодолиты, в основном используются профессионалами: инженерами, геодезистами. Теодолиты – обязательное оборудование, которое должно быть на любой строительной площадке, в то время как тахеометры могут позволить купить только крупные строительные компании.

8. Get ready to speak about main distinctions between theodolites and total stations.

READING TASK 1

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

satellite	constellation
space shuttle	route
geocaching	receiver

Verbs and verbal phrases

to pinpoint	to stray
to launch	to delay

2. Translate the following international words in Russian with no dictionary.

Signal, position, planet, operate, system, transport, active, navigation, military, fix, demonstrate, atomic, transit, territory, orbit, climate.

3. Match the English and Russian equivalents.

1) originally designed	*a) группировка спутников*
2) for military purposes	*b) в военных целях*
3) constellation of satellites	*c)первоначально спроектированный*
4) adapted for surveying	*d)приспособленный для изыскательских работ*
5) in available receivers	*e) с погрешностью в несколько метров*
6) with an uncertainty of a few metres	*f) в имеющихся приемниках*

Text 1

4. Read the text below.

From the History of GPS

Originally designed for military and intelligence applications at the height of the Cold War in the 1960s, with inspiration coming from the launch of the Soviet spacecraft Sputnik in 1957, the global positioning system (GPS) – is a network of satellites that orbit the earth at fixed points above the planet and beam down signals to anyone on earth with a GPS receiver. These signals carry a time code and geographical data point that allows the user to pinpoint their exact position, speed and time anywhere on the planet.

Transit was the first satellite system launched by the USA and tested by the US Navy in 1960. Just five satellites orbiting the earth allowed ships to fix their position on the seas once every hour. In 1967 Transit was succeeded by the Timation satellite, which demonstrated that highly accurate atomic clocks could be operated in space. GPS developed quickly for military purposes thereafter with a total of 11 "Block" satellites being launched between 1978 and 1985.

However, it wasn't until the USSR shot down a Korean passenger jet – flight 007 – in 1983 that the Reagan Administration in the US had the incentive to open up GPS for civilian applications so that aircraft, shipping, and transport the world over could fix their positions and avoid straying into restricted foreign territory.

Upgrading the GPS was delayed by NASA space shuttle SS Challenger disaster in 1986 and it was not until 1989 that the first Block II satellites were launched. By the summer of 1993, the US launched their 24th Navstar satellite into orbit, which completed the modern GPS constellation of satellites – a network of 24 – familiar now as the Global Positioning System, or GPS. 21 of the

constellation of satellites were active at any one time; the other 3 satellites were spares; in 1995 it was declared fully operational. Today's GPS network has around 30 active satellites in the GPS constellation.

Today, GPS is used for dozens of navigation applications, route finding for drivers, map-making, earthquake research, climate studies, and an outdoor treasure-hunting game known as geocaching.

COMPREHENSION CHECK

5. Put the questions to the given answers in written form.

1) What … ?	For military and intelligence applications at the height of the Cold War in the 1960s
2) What … ?	A network of satellites that orbit the earth at fixed points above the planet and beam down signals to anyone on earth with a GPS receiver
3) What … ?	Transit was the first satellite system launched by the USA
4) When … ?	In 1967
5) Why … ?	Due to NASA space shuttle SS Challenger disaster in 1986
6) What … ?	A network of 24 – familiar now as the Global Positioning System, or GPS
7) How many … ?	Today's GPS network has around 30 active satellites in the GPS constellation

8) What … ?	GPS is used for dozens of navigation applications, route finding for drivers, map-making, earthquake research, climate studies, and an outdoor treasure-hunting game known as geocaching

6. Make an oral summary of the Text 1 in not more than 10 sentences.

READING TASK 2

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

technique
intermediate
point
survey control
uncertainty
frequency
baseline

Adjectives

sophisticated
simulteneous

Verbs and verbal phrases

to work out
to broadcast

2. Match the words from the two columns to make phrases.

sophisticated	receivers
intermediate	control
search and rescue	software
survey	points
special	calculation
simultaneous	position
available	equipment
to work out	observation

3. Match the words with their definitions.

1) technique	a) the number of times that something happens during a period of time; the rate at which a sound wave, light wave, or radio wave vibrates (=moves up and down)
2) satellite	b) to send out messages or programmes to be received by radios or televisions
3) frequency	c) a quantity, value, or fact used as a standard for measuring other quantities, values, or facts
4) instantly	d) a way of doing something by using special knowledge or skill
5) sophisticated	e) programs used by computers for doing particular jobs
6) simultaneous	f) the skill of choosing a path so that a ship, plane, or car can go in a particular direction, especially by using maps or instruments

7) baseline	g) an object that is sent into space to travel round the Earth in order to receive and send information
8) navigation	h) happening or done at the same time
9) to broadcast	i) complicated and advanced
10) software	j) happening or done quickly or suddenly

Text 2

4. Read the text below.

Surveying with GPS

Initially developed for military use, GPS is now part of everyday life; used in mobile phones, in car navigation and search and rescue equipment to mention just a few. But there is a wide variety of equipment and **techniques** that can be used for surveying.

GPS was rapidly adapted for surveying, as it can give a position (Latitude, Longitude and Height) directly, without the need to measure angles and distances between **intermediate** points. Survey control could now be established almost anywhere and it was only necessary to have a clear view of the sky so the signal from the GPS satellites could be received clearly.

GPS is similar in some ways to the Trilateration and EDM previously discussed, except that the known positions are now the GPS satellites (and their orbits) 20,000 km in space. The equipment and calculations are extremely complex, but for the user the process is generally very simple.

In the commonly available receivers, the GPS receiver almost instantly **works out** its position (Latitude, Longitude and Height) with an uncertainty of a few metres, from the data broadcast by the

satellites. This data includes a description of the satellites changing position (its orbit) and the time the data was transmitted.

GPS Baseline

The GPS receivers used for surveying are generally more complex and expensive than those used in everyday life. They use the two frequencies broadcast by the GPS satellites and they use the physical characteristic of the GPS signal (the phase) and sophisticated calculation methods to greatly improve the accuracy of the positions obtained. These receivers usually have a separate high-quality antenna.

A GPS baseline uses two survey-quality GPS receivers one at each end of the line to be measured. They collect data from the same GPS satellites at the same time. The duration of these simultaneous observations varies with the length of the line and the accuracy needed, but is typically an hour or more. When the data from both points is later combined, the difference in position (Latitude, Longitude and Height) between the two points is calculated with special software. Many of the **uncertainties** of GPS positioning are minimized in these calculations because the differences between the observations at each end of the baseline are used.

The accuracy obtained from this method depends on the duration of the observations, but is typically about 1 part per million (1 millimetre per kilometre) so a difference in position can be measured over 30 kilometres with an uncertainty of about 30 mm, or about 100 mm over a 100 kilometres. **Because** the GPS satellites are in a very high orbit (20,000 km) the ends of the GPS baseline can be hundreds, or even thousands of kilometres apart and still observe the same satellites.

Although a single baseline from a known position is enough to give the position at the other end of the baseline, additional GPS baselines to other points are often measured to give a check on the results and a an estimate of the uncertainty of the calculated position.

COMPREHENSION CHECK

5. Choose the contextual meanings of the words written in bold in Text 2.

1. Technique

a) техника
c) технология
b) метод
d) уменье

2. Intermediate

a) посредник
c) промежуточный
b) средний
d) вспомогательный

3. Work out

a) вычислять
c) отрабатывать
b) налаживать
d) разрешить

4. Uncertainty

a) ошибка
c) ненадежность
b) неуверенность
d) погрешность

5. Because

a) потому что
c) поскольку
b) ибо
d) значит

6. Complete the following sentences according to the text.

1) …, GPS is now part of everyday life.
2) GPS was rapidly adapted for … .
3) … could now be established almost anywhere.
4) GPS is similar in some ways to... .
5) The equipment and calculations are extremely complex, but for the user... .
6) The GPS receiver almost instantly … .
7) … are generally more complex and expensive than those used in everyday life.
8) A GPS baseline uses … .

9) Many of the uncertainties of GPS positioning are minimized in these calculations because … .

10) Additional GPS baselines to other points are often measured… .

7. Correct the following statements if necessary.

1. Initially developed for everyday life, GPS is now widely used by the military.
2. The uses of GPS are just a few: in mobile phones, in car navigation and search and rescue equipment.
3. GPS was gradually adapted for surveying, as it can give a position (Latitude, Longitude and Height) directly.
4. GPS is similar in some ways to the Trilateration and EDM.
5. The equipment and calculations are extremely complex, but for the user the process is generally very simple.
6. The GPS receivers used for surveying are generally more sophisticated and high priced than those used in everyday life.
7. They use the three frequencies broadcast by the GPS satellites.
8. A GPS baseline uses two survey-quality GPS receivers one at each end of the line to be measured.

8. Answer the following questions and give examples.

1. What is a GPS?
2. What purposes has GPS been adapted for?
3. What are GPS receivers like? How do they work?
4. How does a GPS baseline operate?
5. How can many of the uncertainties of GPS positioning be minimized?
6. Why are additional GPS baselines to other points are often measured?

RETELL TEXT 2 ACCORDING TO THE PLAN BELOW

1. Definition of a GPS.
2. Main functions of a GPS.
3. GPS in surveying.
3. The functioning of GPS receivers and GPS baseline.

READING TASK 3

ACTIVE VOCABULARY

1. Read and translate the words given below. Mind the stresses.

Nouns and noun phrases

trip
site
survey crew
setup
roving

Adjectives

conventional
digital
hands-on
consuming

Verbs and verbal phrases

to incline
to champion

2. Match the synonyms from the two columns.

1) hands-on	a) wide
2) site	b) plot
3) to champion	c) complicated
4) diverse	d) collect
5) broad	e) research
6) crew	f) to promote
7) to allow	g) correctly
8) to work out	h) varied
9) data	i) particular
10) study	j) practical
11) conventional	k) team
12) to work	l) permit
13) certain	m) to operate
14) properly	n) traditional
15) complex	o) info
16) to gather	p) to calculate

3. Match the antonyms from the two columns.

1) complex	a) to forbid
2) single	b) to decline
3) to champion	c) uniform
4) to incline	d) multiple
5) conventional	e) small
6) to allow	f) slow
7) diverse	g) to increase
8) considerable	h) simple
9) to reduce	i) extraordinary
10) fast	j) to hamper

4. Fill in the table with appropriate derivatives if possible.

Noun	Verb	Adjective
	to champion	
convention		
		reduced
	to incline	
		consuming
delay		

Text 3

5. Read the text below.

Problem: Surveying Land Areas for Highway Infrastructures is Time-and Labor-Intensive

There are considerable costs associated with conventional surveying technology. Methods are time-consuming and often require multiple trips to the same site to gather data and to ensure the collected data is accurate. In addition, workers must be trained to operate conventional surveying equipment properly. Weather also can delay data collection and highway surveys; crews are not always able to work under certain weather conditions, such as snow, rain, or extreme temperatures.

Solution: GPS Increases Survey Accuracy, Improves Productivity, and Reduces Costs

Over the past 5 years, studies across the United States have shown that GPS technology increases the productivity of conventional survey crews, reduces data collection time, improves survey accuracy, and allows crews to work under a broad range of weather conditions. Moreover, less expertise is required to operate a GPS surveying unit than is needed to operate conventional surveying technologies.

What is GPS?

GPS is a space-based, radio-navigation system that provides worldwide, all-weather, three-dimensional position, velocity, navigation, and time data to both civilian and military users. Potential uses for GPS within the highway community are diverse and range from providing traveler information to mapping (GPS technology can be integrated easily with Geographic Information Systems).

How does it work?

GPS can provide a very accurate digital map of the highway infrastructure. The technology operates on the principle of triangulation–if the difference from an observer to three known points can be measured, the position of the observer can be calculated. The system includes at least 24 satellites in orbit 19,320 kilometers (12,000 miles) above the earth and inclined at 55°. These satellites continuously broadcast their position, aiming signal, and other information. By combining the measurements from four different satellites, users with receivers can determine their 3-dimensional position, currently within 4–20 meters (13–66 feet).

Putting it in Perspective

It takes many days to survey small sections of road using traditional techniques.

Complete road inventories may take years.

Successful Applications: Research Indicates Improved Survey Accuracy and Reduced Costs

The Utah Department of Transportation found that one person operating GPS equipment is generally twice as fast as a conventional survey crew, and a GPS system with two units is potentially four times faster than crews using conventional surveying technologies. Other advantages of GPS technology include the ability to use the technology across long distances with minimal setups. After a GPS system is placed, roving can be performed within a radius of 10 kilometers (6 miles) of the stationary base unit. Using conventional

technologies, the base unit would have to be moved every 183 meters (600 feet). In one study, GPS equipment recorded 5,511 topographic points in 30 person-hours, while a similar project using conventional technologies covered only 1,500 topographic points in 120 person-hours.

Utah, Michigan, and North Carolina are the lead States of the American Association of State Highway and Transportation Officials'Technology Implementation Group (TIG) initiative to champion GPS for surveying applications. Plans include hands-on demonstration workshops and training programs for agencies that plan to apply GPS to surveying efforts. The GPS TIG group also is considering developing national standards and protocols for GPS programs.

Benefits

Compared to conventional surveying technology, GPS:

Is faster.

Requires less labor.

Requires less training.

Is more accurate.

COMPREHENSION CHECK

6. Answer the following questions and give examples.

1. Are conventional survey technologies time-consuming? Why?
2. Why can weather delay highway surveys?
3. What have the studies of GPS technologies shown?
4. How can you define GPS?
5. Who are the potential users for GPS within the highway community?
6. How does GPS function?
7. What advantages of GPS technologies can you mention?

7. Translate into English in the written form.

Для геодезических GPS измерений необходимо одновременное наблюдение одних и тех же четырех (или более) спутников, по крайней мере, двумя GPS приемниками: базовым приемником и приемником-ровером. Базовый приемник в течение всего процесса измерений располагается на пункте геодезической основы с известными координатами. Ровер перемещается по определяемым точкам или участвует в процессе *выноса точек в натуру*. Результатом объединения данных, полученных этими приемниками, является пространственный вектор между базой и ровером. Этот вектор называется базовой линией. Для определения положения ровера относительно базы используются различные методы измерений. Эти методы отличаются длительностью выполнения измерений: для измерений в реальном времени используется радиомодем, который передает данные базы роверу. Результаты получаются непосредственно в поле.

8. Make up a plan and retell Text 3 in not more than 10 sentences.

UNIT VIII

IS SURVEYING A DYING PROFESSION?

START HERE

1. Arrange the words according to their parts of speech.

Expand, extinction, gradual, perception, comparable, encourage, enrollment, additional, existing, maturation, worsen, solution, retire, argument, convincing, associate, reconsider, mortgage, benefit, consider.

Verb	Noun	Adj.

2. Match the words with their definitions.

1) boundary — a) a deficiency or lack in the amount needed, expected, or due; deficit

2) encourage — b) a course of study in one subject at a school or college

3) shortage — c) something that indicates limits; a limiting line

4) database — d) the act of enrolling or state of being enrolled

5) curricula — e) a systematized collection of data that can be accessed immediately and manipulated by a data-processing system for a specific purpose

6) enrollment — f) to stimulate (something or someone to do something) by approval or help; support

3. Translate the following words and phrases into English using the vocabulary of the text.

Двигаться к исчезновению, постепенный спад, современное и мощное оборудование, решение проблемы, неблагоприятно воздействовать, общественное восприятие, гибель профессии

применение имеющихся знаний, дополнительное обучение, дистанционный сбор данных, делать акцент, в ущерб другим областям, основанная на делении участков земли.

ACTIVE VOCABULARY

4. Give Russian equivalents of the following words and phrases. Try to memorize them.

Nouns and noun phrases

maturation	demise
mortgage	metadata
enrollment	

Verbs and verbal phrases

to contend	to
to ascertain	

Adjectives

sophisticated	rewarding
capable	cited
convincing	downward

Adjectives

adversely

READING TASK

5. Read the text.

Is surveying a dying profession?

Dr. Francis W Derby

Surveyors need to adopt the new technologies and to expand their operations beyond traditional activities

The future of the surveying profession is an issue that has been lingering for many years. Recently, the concern has been growing wider and louder among surveyors. Some surveyors contend that the surveying profession, in its current form, is heading towards extinction. Their reasons include a gradual decline in the number of qualified and licensed professionals, impact of emerging technologies, sophisticated and more capable equipment, and a decline in the number of new graduates into the profession. Others have even considered it a less rewarding profession. But are these reasons valid and if so, is there a solution to the problem? To address these questions, one needs to look at current challenges to the profession as well as the possible impact of any factors that could adversely impact the future of the profession.

To begin, let us look at the public perception of the surveyor. It is clear that compared with architects, engineers, computer scientists and other professionals, surveyors have a low social status, at least in the US, despite the fact that the starting salaries are comparable among all the categories. Also, among those people who are employed by the government, the surveyor's salary increases at a faster pace than some members of the same categories. One would expect that salaries alone should encourage people to choose careers in surveying. Unfortunately, in the US, the average person does not see surveying as a profession. Most people in the US think of surveying in terms of boundary or construction activities, which makes surveying a trade rather than a profession. This misconception makes it is difficult to encourage

high school students to pursue careers in surveying. This public perception of the surveyor is different in places like Canada or Europe where surveying is viewed as a profession.

In the US today, the average age of a surveyor is over 55 years. This means that within the next fifteen years many surveyors are going to retire. With declining numbers of students graduating from surveying programs, there is a strong possibility that the current shortage of surveying professionals is going to worsen.

Often cited, but least convincing, is the emergence of enabling technologies and associated equipment such as Global Positioning Systems (GPS), Robotic Total Stations, Geographic Information Systems (GIS), powerful computers and database management systems. An argument has been made that application of GPS technology in the construction industry is impacting the extent to which surveyors are needed on construction projects. In a similar manner, it is the belief that upon the maturation of parcel-based GIS technology, when banks and mortgage institutions no longer need a surveyed plan of the land to ascertain its extent ownership, and value, boundary surveying will also be curtailed. However, the notion that these new technologies are catalysts to the demise to the surveying profession is completely false. It is important to know that job losses will only come to those who fail to adapt to these new technologies. This requires continuous education and training of current professionals and adaptation of existing curricula in surveying institutions.

Every new technology requires some additional training. For example, whereas application of GPS technology in surveying requires some knowledge least squares solution principles, the surveyor who provides data for GIS analyses needs to understand GIS principles and the importance of metadata. The same goes for digital photogrammetry, remote sensing and other technologies. Surveying institutions that offer associate degrees have difficulty introducing these important topics into their curriculum. Furthermore, the requirements for professional licensure in the US place emphasis

on boundary surveying, to the detriment of other areas. Most importantly, the requirements for licensure discourage students from pursuing advanced degrees in surveying. This is causing low enrollments in graduate education programs in surveying, lack of faculty with advanced degrees in surveying, and therefore, lack of research in surveying.

Although the decline in enrollments into surveying programs is causing some institutions to reconsider the cost benefits for offering surveying education, the prognosis is not all gloom and doom. The new technologies are bringing exciting opportunities for the surveyor to expend beyond the traditional surveying activities. Surveyors need to adopt the new technologies and to expand their operations beyond traditional activities. Students of today are technology oriented and therefore more excited by the emerging technologies in surveying.

The downward trend in enrollments will change if high school students are informed about the emerging opportunities in surveying beyond boundary surveying.

COMPREHENSION CHECK

6. Put the questions to the given answers in written form.

1) What … ?	Some surveyors contend that the surveying profession is heading towards extinction
2) What … ?	The reasons include a gradual decline in the number of qualified and licensed professionals, impact of emerging technologies, sophisticated and more capable equipment, etc
3) Does … ?	In the US, the average person does not see surveying as a profession
4) How old … ?	In the US today, the average age of a surveyor is over 55 years

5) Why … ?	With declining numbers of students graduating from surveying programs, there is a strong possibility that the current shortage of surveying professionals is going to worsen
6) What … ?	Application of GPS technology in the construction industry is impacting the extent to which surveyors are needed on construction projects
7) Who … ?	Job losses will only come to those who fail to adapt to these new technologies
8) What … ?	Every new technology requires some additional training
9) Do … ?	Surveyors need to adopt the new technologies and to expand their operations beyond traditional activities
10) When … ?	The downward trend in enrollments will change if high school students are informed about the emerging opportunities in surveying beyond boundary surveying

7. Make an oral summary of the Text in not more than 10 sentences.

8. Translate in written form.

За последние 50 лет достижения в области технологий повысили эффективность профессии геодезиста, особенно в области «полевых» работ и сбора данных. Применение технологий сделало доступной ранее невозможную точность измерений и позиционирования. Кроме того, технологический прогресс позволил непрофессиональным геодезистам проводить измерения с точностью, отличающей профессионала,

благодаря огромному количеству приложений, начиная созданием базы данных геоинформационной системы (ГИС) и заканчивая системой автоматического контроля. Тем не менее новые технологии в совокупности с уменьшающимся количеством профессиональных геодезистов по всему миру ставят условие, что роль инженера-геодезиста должна и будет меняться в сторону управления, интерпретации, анализа и описания геоинформационных данных. Геодезист должен быть проводником для потребителей геопространственных данных в различных смежных приложениях в области того, как происходит сбор и использование данных при сохранении высокого уровня интеграции данных. Вступая в будущее, нам необходимо помнить базовые геодезические знания, а также менять и адаптировать новые навыки и области применения. Кроме того, необходимо понять, что представители промышленности и производители могут объединить свои усилия для подготовки профессиональных специалистов в области геодезии завтрашнего дня.

SUPPLEMENTARY TEXTS FOR WRITTEN TRANSLATION

UNIT I

Surveying

Surveying or land surveying is the technique, profession, and science of determining the terrestrial or three-dimensional position of points and the distances and angles between them. A land surveying professional is called a land surveyor. These points are usually on the surface of the Earth, and they are often used to establish land maps and boundaries for ownership, locations like building corners or the surface location of subsurface features, or other purposes required by government or civil law, such as property sales.

Surveyors work with elements of mathematics (geometry and trigonometry), physics, engineering and the law. They use equipment like total stations, robotic total stations, GPS receivers, prisms, 3D scanners, radios, handheld tablets, digital levels, and surveying software.

Surveying has been an element in the development of the human environment since the beginning of recorded history. The planning and execution of most forms of construction require it. It is also used in transport, communications, mapping, and the definition of legal boundaries for land ownership.

The American Congress on Surveying and Mapping (ACSM), defines surveying as the science and art of making all essential measurements to determine the relative position of points or physical and cultural details above, on, or beneath the surface of the Earth, and to depict them in a usable form, or to establish the position of points or details.

UNIT II

Forest Surveying Methods - Distances and Angles

Using a Compass and Chain to Reconstruct a Forest Boundary

By Steve Nix

With the advent of public use of geographic positioning systems and the availability of aerial photographs (Google Earth) for free over the Internet, forest surveyors now have extraordinary tools available to do make accurate surveys of forests. Still, along with these new tools, foresters also depend on time tested techniques to reconstruct forest boundaries. Remember that professional surveyors have traditionally established nearly all original land lines but landowners and foresters have a need to retrace and reestablish lines which either disappear or become difficult to find as time passes.

A Fundamental Unit of Horizontal Measurement – The Chain

The fundamental unit of horizontal land measurement used by foresters and forest owners is the surveyors' or Gunter's chain with a length of 66 feet. This metal "tape" chain is often scribed into 100 equal parts which are called "links", but I digress.

The important thing about using the "chain" is that it is the preferred unit of measure on all public U.S. Government Land Survey maps (mostly west of the Mississippi River) – which include millions of mapped acres charted in sections, townships and ranges. Foresters prefer using the same system and units of measure that were originally used to survey most forest boundaries on public land.

A simple calculation from chained dimensions to acres is the reason the chain was used in the initial public land survey and the reason it is still so popular today. Areas expressed in square chains can be easily converted to acres by dividing by 10 – ten square

chains equals one acre! Even more attractive is that if a tract of land is a mile square or 80 chains on each side you have 640 acres or a "section" of land. That section can be quartered again and again to 160 acres and 40 acres.

One problem using the chain universally is that it was not used when land was measured and mapped in the original 13 American colonies. Metes and bounds (basically physical descriptions of trees, fences and waterways) were used by colonial surveyors and adopted by owners before the public lands system was adopted. These have now been replaced by bearings and distances off permanent corners and monuments.

Measuring Horizontal Distance

There are two preferred ways foresters measure horizontal distance – either by pacing or by chaining. Pacing is a rudimentary technique that roughly estimates a distance while chaining more accurately determines distance. They both have a place when determining horizontal distance on forested tracts.

Pacing is used when a quick search for survey monuments/waypoints/points of interest might be useful but when you don't have the help or time to carry and drop a chain. Pacing is more accurate on moderate terrain where a natural step can be taken but can be used in most situations with practice and the use of topographic maps or aerial photo maps.

Foresters of average height and stride have a natural pace (two steps) of 12 to 13. To determine your natural two step pace: pace the 66 foot distance enough times to determine your personal average two step pace.

Chaining is a more exact measurement using two people with a 66 foot steel tape and a compass. Pins are used to accurately determine the count of chain length "drops" and the rear chainman uses the compass to determine the correct bearing. In rough or sloping terrain, a chain has to be held high off the ground to "level" position to increase accuracy.

UNIT III

How to Use Surveying Equipment to Determine Land Boundaries

Surveying is the technique, profession, and science of determining the dimensions and contour of the Earth's surface. Using specialized surveying equipment, professional surveyors determine land boundaries for a variety of important reasons. One of the most common reasons for a consumer to acquire the assistance of a surveyor is the acquisition (приобретение) of a new piece of land, as it has to be legally determined where one person's property ends and another begins for government issued deeds (юридические документы). Additionally, surveyors work with cartographers to create accurate maps.

Surveying has existed in one form or another for at least 5,000 years; virtually all of recorded human history and likely even beyond. The pyramids in Egypt and Stonehenge in England are believed to have been created with the assistance of an ancient surveyor. It is an essential element of civilized society. Working with a combination of skills derived from physics, engineering, law, and the mathematics, surveyors are well trained to accurately measure flat and three-dimensional points, as well as the distance and angles between them.

Surveying Tools

Surveying requires data from three primary components. This includes the measurement of distance, angles, and elevation. There are several different types of survey tools but each tool is capable of providing the necessary data from one or more of the measurement types.

The art of surveying remained relatively unchanged until the late 1990s. Since the advent of more technologically advanced survey equipment, such as global positioning systems and electronic measurement devices, the tools available to the surveyor have

become greater and more enhanced. As a result, some of the older techniques, such as the use of chains and tape are falling out of favor.

UNIT IV

Surveying Techniques

Historically, distances were measured using a variety of means, such as with chains having links of a known length, for instance a Gunter's chain, or measuring tapes made of steel or *invar*. To measure horizontal distances, these chains or tapes were pulled *taut* according to temperature, to reduce *sagging*.

Historically, horizontal angles were measured using a compass, which would provide a *magnetic bearing*, from which *deflections* could be measured. This type of instrument was later improved, with more carefully *scribed discs* providing better angular resolution, as well as through mounting telescopes with *reticles* for more-precise sighting *atop* the disc.

The simplest method for measuring height is with an *altimeter* – basically a barometer – using air pressure as an indication of height. But surveying requires greater precision. A variety of means, such as precise levels (also known as differential leveling), have been developed to do this. With precise leveling, a series of measurements between two points are taken using an instrument and a measuring rod.

Triangulation is another method of horizontal location made almost *obsolete* by GPS. With the triangulation method, distances, elevations and directions between objects at great distance from one another can be determined. Since the early days of surveying, this was the primary method of determining accurate positions of objects for topographic maps of large areas. A surveyor first needs to know the horizontal distance between two of the objects. Then the height, distances and angular position of other objects can be derived, as long as they are visible from one of the original objects. High-accuracy transits or theodolites were used for this

work, and angles between objects were measured repeatedly for increased accuracy.

UNIT V

Instruments using radiowaves and microwaves

Since the 1930's there has been more and more research in the field of using radiowaves for positioning and navigation. Some of the systems developed had an accuracy also sufficient for geodetic purposes. That was true for the Shoran and Hiran systems. The latter is an improvement of the first one with respect to accuracy. To maintain a sufficiently high relative accuracy, the application of these systems was limited to distances of 100 km or more. In geodesy, they were mainly used for special purposes, such as establishing geodetic connections between islands and between islands and continents.

An instrument more appropriate for the general surveyor's need, the Tellurometer, became commercially available in 1957. The Tellurometer, which uses microwaves and which is based on the principle of phase comparison, was developed by W a d l e y, F e j e r and H e w it t of South Africa. The working range of the first Tellurometer had an upper limit of 80 km and rendered an accuracy of 10 cm. Compared to the available geodimeters at that time, the Tellurometer was of lighter weight, easier to handle, simpler to operate, and it functioned independently of daytime and weather conditions. Improved models of the Tellurometer with some wider working ranges were produced the following years. EDM supplemented and to a certain degree replaced angle measurement which earlier was the main method for higher order control nets. For shorter distances of up to about 10 km, electro-optical distance meters are most commonly used. This is due to the fact that for short and medium ranges they render a higher accuracy than the microwave instruments and because they only need a simple, passive signal reflector, a mirror or a reflecting prism. The

microwave method, however, needs two active instruments, one at either end of the line to be measured.

The developments of modern equipment for aircraft and ship navigation were, during the 1970's, leading to significant improvement of survey technology. The new systems are mainly based on the application o f satellite and inertial technology. The surveyors have got new tools for point positioning and establishing of control nets.

UNIT VI

How Does a Theodolite Work?

A theodolite works by combining optical plummets (or plumb bobs), a spirit (bubble level), and graduated circles to find vertical and horizontal angles in surveying. An optical plummet ensures the theodolite is placed as close to exactly vertical above the survey point. The internal spirit level makes sure the device is level to to the horizon. The graduated circles, one vertical and one horizontal, allow the user to actually survey for angles.

How to Use a Theodolite

1. Mark the point at which the theodolite will be set up with a surveyor's nail or a stake. This point is the basis for measuring angles and distances.

2. Set up the tripod. Make sure the height of the tripod allows the instrument (the theodolite) to be eye-level. The centered hole of the mounting plate should be over the nail or stake.

3. Drive the tripod legs into the ground using the brackets on the sides of each leg.

4. Mount the theodolite by placing it atop the tripod, and screw it in place with the mounting knob.

5. Measure the height between the ground and the instrument. This will be used a reference to other stations.

6. Level the theodolite by adjusting the tripod legs and using the bulls-eye level. You can make slight tunings with the leveling knobs to get it just right.

7. Adjust the small sight (the vertical plummet) found on the bottom of the theodolite. The vertical plummet allows you to do ensure the instrument remains over the nail or stake. Adjust the plummet using the knobs on the bottom.

8. Aim the crosshairs in the main scope at the point to be measured. Use the locking knobs on the side of the theodolite to keep it aimed on the point. Record the horizontal and vertical angles using the viewing scope found on the theodolite's side.

UNIT VII

How do I get started with using drones for surveying?

The use of unmanned aerial systems (UAS) is rapidly expanding as geospatial and construction companies learn how much easier and more cost-effective completing surveying and mapping projects can be with drones.

Unmanned aerial vehicles (UAVs), or drones, can vastly reduce the time spent on projects by collecting accurate surveying data in a much shorter timeframe. Because of this, their benefits are considerable. Drones eliminate the need for humans to physically access hard-to-reach and dangerous terrain. To put it simply, UAS technology makes companies more efficient, profitable, and safe.

It's becoming an accepted fact in the surveying and construction industries that drones offer a better way to complete mapping projects. But the technology is so new that most professionals are unsure where to begin.

The first step is getting legal permission

Choose the system created for surveying

Choose the training program designed to help companies get started easily

Deciding on which system to incorporate into your business can be tricky. One of the best tips is this: choose a complete solution made specifically for your intended application.

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