european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
UNIVERSITY OF DEFENCE
INVESTMENTS IN EDUCATION DEVELOPMENT

STUDY SUPPORTS SUBJECT

GENERAL ENGINEER SUPPORT

Course Name: General Engineer Support

Supervisor: Assoc. prof. Ing. Gabriel Števko, CSc.

Lecture: Assoc. prof. Ing. Gabriel Števko, CSc.,
Col. Ing. Jan Kyjovský, Ph.D.

Educational goal: The course aims to provide students with theoretical and practical foundation in caring out the tasks of general engineer support. The study is focused on creating a basic habits and skills in the preparation and management of professional activities platoon.

Table of Contents:

1. Method for controlling and organizing tasks selected general engineer support

1.1 Characteristics and main tasks of general engineer support

The basic task of the Army of the Czech Republic (ACR) is the national defence and fulfilling allied commitments of the Czech Republic. These traditional duties are currently extended for the active participation ACR units in multinational operations in areas of instability or conflict and the implementation of rescue and humanitarian operations in different geographic conditions.

According to tasks and ways of use of military forces, these operations are divided into **combat** and **non-combat**. An integral part of military operations is support of activities of troops; its significant component is **engineer support**.

Engineer troops is a kind of support troops for provide engineer support of either defence operation of the Czech Republic or combat or non-combat operations of various intensities outside the Czech Republic, for provision of forces and means of ACR to strengthen the integrated rescue system in dealing with natural threats, disasters and industrial accidents, for strengthen of the Police of the Czech Republic and for provision (support) of engineer units in favour of operations NATO / EU. Organizational structure of Corps of Engineers allows creating task forces that will be able to provide modular deployment of forces and resources to perform the tasks in peace, in times of crisis and at war.

A) Characteristics of engineer support of operations troops

Engineer Support is a multi-departmental activity and one of very important types of troops support activity (task forces in operations). Consists of the set of measures to support of personnel, equipment and other materials; the activities of the command posts; creating conditions for the successful completion of tasks. It is carried out by all kinds of troops in all types of operations.

Main categories of Engineer support at **Strategic** and **Operational level** are considered:

- **Combat Support Engineering.** Combat Support Engineering encompasses those military engineer tasks associated with direct support to current or imminent operations. Combat support engineering is conducted with an emphasis on speed of operation to fulfil a short term tactical requirement.

- **Force Support Engineering.** Force Support Engineering encompasses the deliberate, longer-term preparation for, and indirect support to ongoing or future operations as well as those military engineering tasks associated with sustaining the joint force throughout all stages of an operation.

At the tactical level of command tasks of Engineer support are divided:

- **Tasks of Combat Support Engineering** (Mobility; Counter – Mobility and Survivability).
- **Tasks of General Support Engineering**.

Force Support Engineering directly affects the outcome of an operation. Depending on the level of an operation; it will be likely ratio of Combat Support Engineering on the overall engineer support the higher, how more it will be a lower level of operations and vice versa, with increasing levels of an operation the ratio of engineer support effort will increase.

Tasks and measures of Force Support Engineering are organized and implemented by own forces and resources of task forces. Ability to fulfil mentioned actions and resulting tasks of Engineer Support are determined by:

- amount and level of trained persons who can be predetermined for fulfilment to the tasks of Engineering Support;
- the amount of resources and capabilities of Engineer means (heavy equipment, engineer ammunition, engineer material) which are to fulfil of engineer support tasks available;
- time, which is possible to use for the task.

Troops and units of all military branches and services should be able in the relevant extent and in adequate way fulfil basically almost all engineering work. Specific engineering work, their scope and methods of performance may be different compared with units of Corps of Engineers, which results from their different predetermination, equipment and training level.

Units (Troops) of task forces are able to:

- build protective buildings of simple type (trenches for conducting fire and observation, shelters for personnel, trenches and covers for vehicles and material stocks) using heavy equipment, tractor mounted equipment and explosives;
- build positions and area of deployment of troops, provide barriers;
- and camouflage by using either prescribed or auxiliary means;
- outline and adjust routes for movement and manoeuvre of forces and resources in relation to routes which are repairing by units of Corps of Engineers;
- overcome explosive and non-explosive roadblocks and obstacles;
- overcome watercourses drive tanks underwater and amphibious combat technique;

- extract and treat water by prescribed means.

The proportion of units (formations) of Corps of Engineers on performance of Force Support Engineering tasks covers a wide range of activities, from providing engineer recommendations (suggestions) to implementation of the most complicated engineer measures in favour of task forces activities.

Corps of Engineers units provides Force Support Engineering operations in the implementation of various kinds of engineer measures.

Within engineer measures for **Mobility**, engineering support provides: reconstruction and maintenance of roads and trails and objects on them (detours, auxiliary paths); establishing and maintaining crossing areas; counter mines action; setting up gap lines in unexploded barriers and cave-ins; building, reconstruction and maintaining forward airfields; preparing area for airdrop of airborne forces.

Within engineer measures for **Counter-mobility**, engineering support provide: establishment of roadblocks and destruction of objects.

Within engineer measures for **Survivability**, engineering support provides: help in building protective buildings and their complexes in area, built on lines and occupied by units of military branches at command posts; modification of permanent buildings including installation of collective protection; help in cleaning of firing sectors; through the implementation of engineer deception measures.

Units of Engineer Corps support activities of other kinds of troops in the implementation of measures according to their abilities and based on **priorities** established **by the commander**. In addition to **Combat Support Engineering** to units of task force, the Engineer units (formations) can implement further measures under the **General Support Engineering**.

B) Characteristics of general engineer support

Generally, according to a site of operation and character of operations we can divide the main tasks of Engineer ACR into three groups:

- tasks performed on its own territory in the Czech Republic in peacetime;
- tasks performed in the Czech Republic threat in their own territory;
- tasks performed outside the Czech Republic.

Main tasks of general engineer support

a. Emergency supply of water.

b. Construction of air landing facilities.

c. Airfield damage repair (ADR).

d. Provision and maintenance of utilities and structures.

e. Maintenance and construction of main supply routes.

f. Explosive ordnance disposal (EOD).

g. Railways and ports.

h. Fuel storage and distribution.

i. Geospatial support.

j. CBRN decontamination.

k. Emergency supply of energy.

l. Diving which can also involve support to close combat operations.

m. Force Protection Engineering (FPE).

If we solve (analyse) the possibility of engineer support, respectively general engineer support, something or someone (an activity Commander, Staff, Task Force), we need to know what (by whom, what kind of activities, operations) will be discussed, as will be roughly what tasks, in what order, and the environment how a particular grouping is assumed during operation to perform.

Military Engineer is prepared to implement engineer support troops operations in full spectrum of operations, excluding operations in the Arctic environment. The range of possible deployment of grouping of Corps of Engineers ACR will necessarily be based on the military-political ambitions of the Czech Republic and commitments the Czech Republic concerning the earmarking of forces and resources in joint operations, NATO, EU and UN.

List of tasks for students:

1. Explain the position of general engineering support within the engineering support of troops operation.
2. Characterize the proportion of units Corps of Engineers ACR in fulfilling of individual tasks of general engineering support.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. Návrh předpisu Vševojsk-2-2. *Ženijní zabezpečení boje*. Praha 2004;
4. Pomůcka *„Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“.* Praha 2006.

1.2 Possibilities and capabilities engineer units ACR while fulfilling the tasks of general engineer support

Corps of Engineers in the existing organization and its current equipment and other resources engineer is able to perform some of the tasks of general engineering support, outlined in Chapter 4 of the standardization document ATP-52(B), or to participate in their performance and some are not unable to meet.

Therefore, it is necessary to proceed from its place and role of general engineering support. For what is corps of engineers capable, responsible? What they do. Who else is involved in the tasks and what a task is especially for engineer units.

Furthermore, it is necessary to respect the assistance in the implementation of individual tasks, opportunities applicable forces and means. It is also important to use the experience gained from deployments of engineer troops in these tasks in contemporary and generally multinational operations.

Tasks of general engineer support carried out by engineer units of ACR encompass:

- Emergency supply of water.
- Construction of air landing facilities.
- Airfield damage repair (ADR).
- Provision and maintenance of utilities and structures.
- Maintenance and construction of main supply routes.
- Explosive ordnance disposal (EOD).
- CBRN decontamination.
- Emergency supply of energy.
- Diving which can also involve support to close combat operations.
- Force Protection Engineering (FPE).

ACR has just small or no **experience** with performance of general engineer support tasks. This is due to the fact that these units were not deployed to perform these tasks; only exceptions are EOD units. ACR acquired some experience with assignments of similar character related with engineer support in the IFOR and SFOR missions (described in S-436, 2006).

List of tasks for students:

1. Characterize; what tasks can Engineer units of ACR carry out in the field of general support engineering.

2. Describe; what specific tasks can Engineer units of ACR carry out in the field of general support engineering with regard to the existing organizational structure.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. ZELENÝ, J., VODEHNAL, M. (S - 436) *Zkušenosti z plnění úkolů ženijního zabezpečení činnosti vojsk v mírových operacích IFOR a SFOR.* Brno: UO, 2006;
4. Návrh předpisu Vševojsk-2-2. *Ženijní zabezpečení boje*. Praha 2004;
5. Pomůcka *„Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“.* Praha 2006.

1.3 Basic concepts in the securing of electric power in the field

Mobile sources of electricity - generators and distribution sets and lighting devices are determined for supplies of electricity in supporting the activities of troops in field conditions and in garrisons. In field are supported mainly headquarters, communication centres, logistic installations, illumination, drive of electrical devices and etc.

A) Mobile sources of electricity - power

Single-phase and three-phase generators (EC) are either portable or transportable units for production of single-phase and three-phase alternating current in places where there is no commercial power and alternative energy sources such as in cases of blackout.

Main components of a generator

• Engine (petrol or diesel);

• Single-phase or three-phase synchronous alternator;

• Switchboard;

• Frame;

• Bonnet;

• Trailer and equipment.

B) Extension cables and cord lines

Extension cable and cord lines shall be made of suitable cords to the specific application in terms of mechanical strength, resistance to the environment and having the necessary qualities for their use = flexibility, smooth surface, non-marking surface durability. Its design must guarantee safe use of the connected device.

Accessories of moving inlets (plugs, sockets, connectors, adapters, switches) must conform to the specific application in terms of **safety and health**; operation and operators.

C) Plugs - systems

Sockets and plugs must be designed that in the disconnected state of the relevant socket joints there is no voltage on the available contacts, pins, that these parts are not normally touched by finger.

Plugs systems: Belgian, American, German, IEC

D) Wires of electric devices

According to the purpose wires are divided into two groups:

a) wires for conduction of electric power and communication lines;

b) winding wires of electrical machinery and apparatus.

They consist of electro - conductive core of Cu or Al and conventional insulation, which must meet the requirements of voltage, mechanical and thermal.

Wires for conduction of electric power

High voltage conductors are made in versions as:

a) wire (full circular cross section);

b) rope (wire coiled with several thin round wires, with ropes for overhead lines, reinforced with steel wire, located in the axis of the rope).

Colour marking is performed over the entire length of the conductor; in several layers of insulation is crucial and determining colour of exterior insulation.

The phase - the marking is either black or brown colour

Neutral conductor - the marking is light blue colour

Protective conductor - the marking is combination of green and yellow colour

List of tasks for students:

1. Characterize: mobile sources of electricity - power generators, used by engineer units within ACR.
2. Briefly describe: extension cables and cord lines, wires and electrical appliances socket systems of electrical means of Corps of Engineers.

Basic and recommended reading:

1. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem.* Vyškov: VVŠ PV, 2000;
2. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
3. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil.

1.4 Principles and applications power generators in Engineers ACR

A) Mobile sources of electricity – purpose

Generator 1 kVA

1 kVA generator is designed to produce a single phase AC power, voltage of 220 V and a frequency of 50 Hz when active power of 1 kVA.

Main components of 1 kVA generator are gasoline engine; alternator; switchboard (or voltage suppressor). The main parts are placed in a tubular frame which protects the components against mechanical damage.

Accessories of 1 kVA generator include spare parts and tools stored in a box or in canvas bag, flexible extension exhaust hoses and cover.

Generator 3 kVA

3 kVA generator is designed to produce a single phase AC power, voltage of 220 V and a frequency of 50 Hz when active power of 3 kVA.

Main components of 3 kVA generator are gasoline engine; alternator; switchboard (or voltage suppressor). The main parts are placed in a tubular frame which protects the components against mechanical damage.

Accessory of 3 kVA generator includes spare parts and tools stored in a box or in canvas bag, flexible extension exhaust hoses and protective cover and two fuel cans

Generator 2 kW

2 kW generator is designed to produce single-phase and three-phase AC, voltage of 400/231 V and a frequency of 50 Hz when active power of 2 kW, and simultaneously allows the supply voltage of 28.5 V DC

Generator is designed to providing of power for charging of radios, hand tools, small appliances, heating, lighting, motors, charging batteries and the like.

Generator can work without special protection in continuous operation in the field at temperatures from – 30° C to + 40° C, rainy weather and snowfall at elevations up to 1500 m.

Main components of 2 kW generator are gasoline engine; alternator; switchboard, protective frame and cover.

Generator 4 kW

4 kW generator is designed to produce single-phase and three-phase AC, voltage of 400/231 V and a frequency of 50 Hz when active power of 4 kW.

Generator is capable of operating in these voltage systems:

- the three-phase system with a voltage 400/231 V,
- the three-phase system with a voltage 231/134 V,
- the single-phase system with a voltage of 231 V.

Main components of 4 kW generator are gasoline engine; alternator; switchboard. The main parts are placed in a tubular frame which protects the components against mechanical damage.

Generator 6 kW

6 kW generator is designed to produce single-phase and three-phase AC, voltage of 3 x 400/231 V and a frequency of 50 Hz when active power of 6 kW.

Main components of 6 kW generator are gasoline engine; alternator; switchboard. The main parts are placed in a tubular frame which protects the components against mechanical damage.

Generator 8 kW

8 kW generator is transportable source of electricity designed for power of three phase and single-phase appliances with voltage of 3 x 240/400 V, 50 Hz and charging of batteries or low voltage appliances to 1000 W wattage.

Generator replaces older models such as 6 kW, 7.5 kVA single-phase and three phase EC 7.5 kVA.

8 kW generator is freestanding container, it is possible to lift by crane or forklift and transported on any chassis. It is not designed for parallel operation.

Generator in transport state consists of a base frame, diesel engine, alternator low voltage (LV), switchboards, bonnet, and accessories.

Generator 12 kW

12 kW generator is designed to produce single-phase and three-phase AC, voltage 400/231 V and a frequency of 50 Hz when active power of 12 kW. Generator is used for charging of radios alternatively for drive of three-phase appliances and motors.

Generator can work without special protection in continuous operation in the field at temperatures from – 40° C to + 40° C, rainy weather and snowfall at elevations up to 1500 m.

Main components of 12 kW generator are gasoline engine; alternator; switchboard; frame; bonnet; trailer and equipment.

Generator 16 kW

16 kW generator is transportable source of electricity designed for power of three-phase and single-phase appliances with voltage of 3 x 240/400 V, 50 Hz and charging of batteries or low voltage appliances to 1000 W wattage. Generator replaces older models such as 12 kW, 15 kVA.

There are two versions 16 kW generator in ACR - transportable and mobile. Transportable generator is freestanding container manipulated using a crane or forklift transportable at any chassis. Mobile version is on uniaxial chassis PM 35 U.

Generators 15 kVA a 30 kVA

15 kVA and 30 kVA generators are currently obsolete and they are replaced by newer comparable models. Just few units use these generators.

15 kVA and 30 kVA generators are designed to produce single-phase and three phase AC, voltage of 3 x 400/231 V and a frequency of 50 Hz when active power of 12 kW resp. 24 kW.

Main components of a generator are gasoline engine; alternator; switchboard; frame; bonnet; trailer and equipment.

Generators 30 kW a 60 kW

30 kW and 60 kW generators are designed to produce single-phase and three phases AC, voltage of 3 x 400/231 V and a frequency of 50 Hz when active power of 30 kW and 60 kW.

Main components of 30 kW and 60 kW generators are diesel engine; alternator; switchboard; frame; bonnet; trailer and equipment.

B) Mobile sources of electricity – operation

Generator is a complex electrical equipment and its operation must be qualified in accordance to Section 4 (§5) Decree no. 50/78 Sb. The professional competence in electrical engineering

Preparing for operation

Open the bonnet of a generator and perform the following tasks:

1. Ground the generator using the earth rod.

- Connect the earth rod to clamp at a Generator (marked) "HERE EARTH" or mark  .
- Linking to perform by a ground wire length 5 m and cross section 6 mm^2 respectively 10 mm^2.
- Earth rod must be pushed as far as possible throughout its length into the ground so that it is possible to connect the grounding conductor.

2. Inspect and check the engine and the area around the engine check the tightness of fuel and lubrication systems. Use the dipstick to check the oil level.

3. Check V- belt tension.

4. Check breakers and circuit breakers.

5. Check plugs.

6. Check the setting of protection method against electric shock

Start

- Starting of the engine to carry out the procedures set out in the technical regulations and manufacturers' manuals.

Check of devices

- Turn on voltage protector, the circuit breaker and voltage regulator.
- Set the engine revolution- settings can be done according to the data on the frequency meter (idle 52.5 Hz).
- Check the voltage (voltmeter should show 400 V).

List of tasks for students:

1. Specify the number of the above-described electro means within the Corps of Engineers ACR and what units use these devices.
2. Characterize the possibility of the use of generators with regard to their predetermination.

3. Describe the process of preparing for the operation of your selected generator.

Basic and recommended reading:

1. Žen-26-3. *Elektrocentrály 30 kW a 60 kW*. Praha: MO ČR, 1972;
2. Žen-26-6. *Elektrocentrála 4 kW a 6 kW*. Praha: MO ČR, 1977;
3. Žen-7-7. *Odborný výcvik strojníků ženijní techniky*. Praha: MO ČR, 2013;
4. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
5. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
6. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999;
7. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem*. Vyškov: VVŠ PV, 2000.

1.5 Principles and applications of distribution and lighting equipment

A) Distribution means used by Engineer Corps of ACR

Source and distribution set SU 230 (2 x 30 kW)

The source and distribution set 2 x 30 kW is intended for power of centres, communication centres. It is built into the container type ZSK / PE, which is mounted on the chassis middle terrain vehicle T-815 4x4. Vehicle is able to conduct its activities in areas with mild climate and is able to go on all kinds of roads and in different terrains.

Purpose equipment of source and distribution set 2 x 30 kW is divided into two main parts:

- **Source part**
- **Distribution part**

Source and distribution set 60 kW (container ISO 1C)

Source and distribution set 60 kW is designed as an independent source of power, which allows power supply both three-phase and single phase appliances in voltage system 3 x 230/400 V, 50 Hz. Its concept is predestined for use in foreign operations.

The main parts of the device consists of container ISO 1C, combustion engine, synchronous alternator, low voltage switchgear, batteries box, distribution kit and accessories.

Source and distribution set 20 kVA (Land Rover)

Source and distribution set 20 kVA on chassis Land Rover Defender 130 with power rating of 20 kVA (16 kW) is a mobile independent power source of general use which allows to power three-phase and single-phase appliances voltage system 3x230 / 400 V, 50 Hz.

The kit is designed for needs of troops in the field for the operational provision of electricity supply immediately upon arrival to the unit area of action.

B) Lighting means used by Engineer Corps of ACR

Individual lighting equipment

Flashlight TRIO

Flashlight TRIO is destined for commanders, members of staffs, drivers and operators as a light source during activities at night and in poor visibility. Also serves in transmitting commands, to signal, to stake out crossing sites, passages in roadblocks and crossings over obstacles.

Set of hand-held accumulator flashlights RAS-67

The kit is used for emergency lighting of shelters, tents and other temporary workplaces. Flashlights can be used in different weather conditions. Lamps are protected against rain but it is no water-resistant. It is forbidden to use it in the presence of flammable gases or fumes.

Lighting sets

Universal Lighting Set OS – U

Universal Lighting Set OS - U consists of cord lines in the rubber hose the CGSG version, fuse cabinet hub, hub cabinets with one three-phase plug and five times single-phase plugs, adapters cabinets with single-phase plugs, tools, spare parts, insulation, installation and consumables.

Power supply of Universal Lighting Set OS – U

Lighting set can be powered both single-phase and three-phase generators or from public utilities relevant voltage and frequency with a grounding. Accessory of the set allows you to connect to a power sources which are fitted by following plugs:

– three-phase socket 32 A;

– three-phase socket 16 A;

– single-phase socket 16 A;

– single-phase socket 10/16 A.

C) Calculation of voltage drop

During deployment of sets we must pay attention on voltage drop at appliances.

Maximal voltage drop must not exceed 5% of the output voltage source i.e. at **11 V** power supply in single-phase system with and **19 V** when powering in three phase network.

In practice the voltage drop does not usually count assuming that the lengths of the individual lines are not too large - do not exceed the radius of the set.

Voltage drop can be detected by these methods:

- calculation;
- reading the table;
- check the measurements at the input terminals of the appliance.

The voltage drop in single-phase system

The voltage drop for single-phase current we can calculate according to the equation:

$$\delta U = I.Rved \qquad (1)$$

δU … voltage drop in volts

I … current flowing in lines

Rved … resistance of wire

Resistance of wire can be calculated from the dimensions of the conductor and the current performance of the appliance:

$$Rved = \rho.\frac{2.l}{S} \quad , \qquad I = \frac{P}{U} \qquad (2)$$

After substituting (1) and (2) we get the equation for the voltage drop in the supply line:

$$\delta U = \frac{2.\rho.P.l}{S.U}$$

P …. Performance of appliance W

l ….. Cable length m

U …. Source voltage V

s ….. Cross section of wire mm^2

ρ ….. Resistance of wire Ωm

Voltage drop in the three-phase system

The voltage drop in the three-phase system we can count in the same way as for single-phase appliances

$$\delta U = 3.R.I.\cos\varphi$$

I substitute for the relationship of the formula for performance

$$I = \frac{P}{3.U.\cos\varphi}$$

Resulting pattern for the voltage drop:

$$\delta U = \frac{\rho.P.l}{U.S.\cos\varphi}$$

ρ … specific resistance Ω.m
l … Cable length m
P … Performance of three-phase appliance W
U … phase voltages V
S … Cross section of wire v mm^2

List of tasks for students:

1. Briefly characterise and describe distribution and lighting means of ACR engineers.
2. Calculate the voltage drop in the three-phase system.

Basic and recommended reading:

1. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem*. Vyškov: VVŠ PV, 2000;
2. Žen-26-5. *Polní rozvodné a osvětlovací prostředky*. Praha: MO ČR, 1967;
3. Žen-7-7. *Odborný výcvik strojníků ženijní techniky*. Praha: MO ČR, 2013;
4. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
5. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999.

1.6 Requirements for the operator of generating sets and their preparation

According to the regulation **Žen-7-7** just employee; who received licence (engineer's license a coupon machinist) from chief engineer of ACR; can operate engineer equipment.

Examination commissioners of Corps of Engineers can issue licences on behalf of the Chief Engineer of ACR.

Operator card without the coupon is **invalid**.

A) Requirements for the operator of generating sets

License may only be issued to applicant who has reached the age of 18 and who:

a) prove his medical fitness to operate machines required medical assessment or medical certificate, not older than 3 months;

b) holds a driver's license that is appropriate for heavy equipment prescribed by other legislation;

c) successfully completed a specialized training in relevant course for operator of heavy equipment and prove competence for the operation and control of the required equipment;

d) was not penalized by prohibition of activities or loosing driving license or heavy equipment licenses.

B) Training of generating sets operator

The aim of the training in courses for operators' heavy equipment is to achieve and ensure their proficiency in accordance with the laws and internal regulations. Systematic preparation of courses for operators of heavy equipment ensures the acquisition and improvement of their skills for safe, effective, efficient and economical use of heavy equipment.

List of tasks for students:

1. Characterise requirements for operating of power generators according Žen-7-7.
2. Describe the possible process of generator operator training and their final exam.

Basic and recommended reading:

1. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem.* Vyškov: VVŠ PV, 2000;
2. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
3. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999;
4. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011.

1.7 protections against electric shock and first aid in case electric shock

Development of accident rate shows us that electric shock tend to suffer mainly undisciplined workers who do not respect or knowingly violate safety regulations. Mostly young workers (most injuries were reported among workers aged 20 to 30 years) do not comply with safety regulations. Another group of injured workers makes up people between 50 and 60 years of age, who count on routine work or even medical reasons.

In general terms, the most common cause's electric shocks are:

- Ignorance of safety rules;
- Violation of safety regulations;
- Ignorance of danger during working with electricity;
- Underestimating of electric shock risk;
- Carelessness;
- Failures of electrical devices or unprofessional repairs of electrical installations.

A) Protection against electric shock

Electrical device - stationary or mobile device for production, distribution and power consumption.

Electrical items - items which are connected electrically or plugged into the working circuit.

Dangerous touch voltages - is such voltage that may person who touched conductive parts under power cause death or injury.

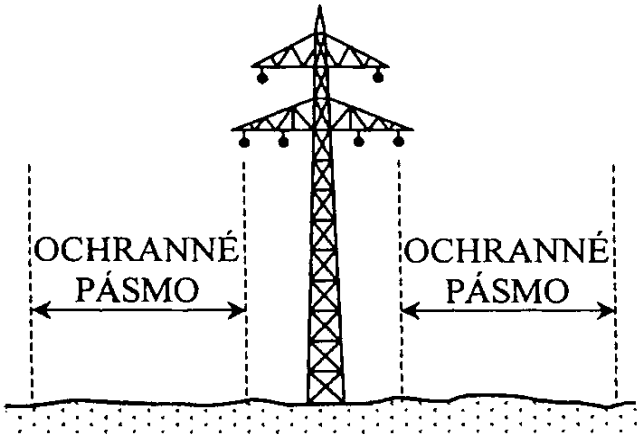
Grounding is often part of electrical equipment. It is important for safety from injury and often for their own operation.

B) Protective zones of electrical equipment

Protective zone means the area in the immediate vicinity of the production and distribution facility; designed to ensure reliable operation and to protect life, health and property of people. Protective zones are protected by overhead lines, underground lines and electrical substations.

Protective zone of overhead lines

Is defined by vertical planes along both sides of the lines at a horizontal distance measured perpendicular to the lines that makes the outer conductor lines on each side.



Voltage	Size of zone
up 1 kV do 35 kV	**7 m**
up 35 kV do 110 kV	**12 m**
up 110 kV do 220 kV	**15 m**
up 220 kV do 400 kV	**20 m**
up 400 kV	**30 m**

In the protective zone of overhead lines is prohibited, among other things:

- construct buildings,
- place constructions,
- store flammable or explosive substances.

C) First aid for electric shock

General procedure for the provision of first aid

Every action in the implementation of first aid must be meaningful, purposeful, calm and resolute. The speed of implementation cannot endanger an injured person.

Proposed procedure

Ensuring safety of both a injured and a rescuer

• switch off electric current;

• extinguish fire;

• towing away of injured person in explosion hazard;

• eliminate other negative threats (eg. Gas).

Examination of an injured person

• examine respiration, blood circulation, and state of consciousness;

• in the case of heart failure immediately begin the resuscitation;

• communicate with injured person; questioning on pain, ability to move with limbs etc.;

• assess the overall condition - facial expression, discoloration of the lips, nail beds perfusion;

• measure the pulse and watch its character.

Providing of First Aid

Prior to the beginning of First Aid, we must firstly determine the character of damage:

- vital functions are not damaged - less serious states.;
- vital functions are threatened - it is acute immediately life-threatening states;
- sudden breathing and blood circulation failure requires an immediate start resuscitation.

Report for Ambulance Service and Police

• What?

• Where?

• When?

• How many injured people?

• How serious are the injuries?

• Who reports and contact of reporter.

List of tasks for students:

1. Briefly describe the possibilities of protection against electric shock.
2. Generally characterize protective zones of electrical devices.
3. Describe activities in provision of First Aid for electric shock.

Basic and recommended reading:

1. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem.* Vyškov: VVŠ PV, 2000;
2. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
3. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999.

1.8 Organization and calculations emergency energy supply in the field

The need for electricity is increasing. If local power is not available due to missing of power lines or unreliable power; we use generators which have already achieved remarkable "perfection".

Generators:

- Highly reliable,
- Easy to operate and maintain,
- Refilling of fuel tanks during running,
- Small consumption.

Organization and calculations emergency energy supply at Command Post (CP)

A variant of CP of a mechanized battalion commander

We start from possible variations of composition and deployment command post of a mechanized battalion commander according to battalion standard operating procedures (SOP).

Composition of Command Post - Control Centre

Control Centre		**Number of persons**	**Comment**
HQ control	Battle Control Group	3	Commander, Chief of Operational groups, Chief of Intelligence Group
	Planning Battle Group	6	Chief of Staff, Chief of Logistics, Chief Operating Department, Operating Department Officer, Employee of Staff - Sergeant, Employee of Logistics - Sergeant
Branches group		3	Sergeant ČVO 17, Sergeant ČVO 570, Sergeant of Intelligence Group
Group of communications and information protection		4	Chief of communications, Informatics, Chief of information protection, Information protection - Sergeant
Liaisons group		4	2/2

Battalion FSO	4	FSO – *Fire Support Officer*
Battalion FAC	3	FAC – *Forward Air Controller*

The list of appliances of Middle Mobile Staff Site

Appliances	**number**	**Impute power [W]**		
		24 V	220 V	380 V
FVZ 180	1	312		
Heater X7-S-1	1	100		
Fluorescent luminaire	3	84		
Special lamps	2	80		
Luminaire articulated	2	80		
Luminaire articulated (board - shelter)	2	80		
Luminaire stand shelter	3		300	
Heater X7 – portable shelter	1		220	
Power supply NB 22 KB/2	1			1200
Choke - loss	1			100
Bulb lamps (rest area)	1	15		
Illuminating surface of map board	1		320	
Cooker	1		600	
Electric heater	1		500	
electric fan	1	55		
Suma	**22**	**806 W**	**1940 W**	**1300 W**

The list of appliances - Control Centre

Control Centre	**Middle Mobile Staff Site - vehicle**				**Middle Mobile Staff Site - Shelter**		ΣPn (W)
	PC		PnMMSS (W)	ΣPnMMSS (W)	PC		
	Number	Pn (W)			Number	Pn (W)	
Battle Control Group	1	350	3240	3590			3590
Planning Battle Group	3	1050	3240	4290			4290
Branches group	1	350	3240	3590			3590
Liaisons group					2	700	700
Group of communications and information protection	1	350	3240	3590			3590
FSO, FAC	Separate mobile workplace with their own source of energy.						
Suma	**6**	**2100**	**12960**	**15060**	**2**	**700**	**15760 W**

Calculation of appliances - Control Centre

From the above calculation we consider a source of electrical power with a minimum output of 16 kW, therefore proposes to use EC 16 kW, which is the source sets used ZRS 20 kVA LR and is equipped cooperative security command, HQ platoon, HQ Coy of battalion.

Calculation of appliances - Logistic Support Centre

From the above calculation we consider a source of electrical power with a minimum output of 8 kW, therefore proposes to use 2 pcs EC 4 kW, which are equipped cooperative security command, HQ platoon, HQ Coy of battalion.

List of tasks for students:

1. Based on the assignment calculate emergency power supply of command post of a mechanized battalion commander and suggest possible solution.
2. Calculate the voltage drop in the power grid at a command post of mechanized battalion commander where wires are copper 2.5 mm^2 (1-phase) and 4 mm^2 (3-phase), the length of single-phase conductors is 100 m and the length of three-phase conductors is 50 m.

Basic and recommended reading:

1. NEHODA, J. (S - 1084) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem*. Vyškov: VVŠ PV, 2000;
2. Žen-26-5. *Polní rozvodné a osvětlovací prostředky*. Praha: MO ČR, 1967;
3. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
4. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999.

1.9 Methods and process deployment and distribution of lighting networks for command posts

When connecting to the mains supply in general, the following principles:

For each generator may be connected only approved appliances which must be prescribed protection against touch voltage.

Generator is grounded in any way to protect by ground rod and grounding wire.

Ground rod is dropped into the ground if possible its entire length.

Cross section of grounding wire is min. 6 mm^2 cable shall be provided at both ends of the cable lugs. The grounding resistance must not exceed 200 Ω.

A) The process of deployment of distribution and lighting network – preparation

After receiving the order to set up a substitute power lines for electricity supply; the commander of the group following tasks:

- carries out an assessment of terrain (on Map) in which the object will be supplied by electric energy;
- draws a diagram of the layout of the object to be connected to an emergency source (generator) of electrical energy;

B) The process of deployment of distribution and lighting network – practical activity

Practical development in the field

- after arriving in the area of interest the unit performs reconnaissance of the presence of mines, the possibility of camouflage, hidden deployment, opportunities of anticipated location of generator and development of electric
- power networks;

Commander is responsible that:

- during operation will be used only approved tools and accessories, the whole device only for its intended purpose;
- operators use the prescribed protective and work aids;
- documentation of electrical equipment is complete.

List of tasks for students:

1. Briefly describe the preparation for the deployment of distribution and lighting networks.
2. Briefly describe the practical process unfolding distribution and lighting networks.

Basic and recommended reading:

1. NEHODA, J. (S - 1084) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem*. Vyškov: VVŠ PV, 2000;
2. Žen-26-5. *Polní rozvodné a osvětlovací prostředky*. Praha: MO ČR, 1967;
3. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
4. Vševojsk-16-8. *Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky*. Praha: MO ČR, 1999.

1.10 Draft emergency power supply chosen field of work

On the basis of specific tasks were elaborated proposals of emergency electric power supply within the Engineer Regiment. All students will introduce their propose conclusions.

A) Possible variant of emergency electric power supply – 151st EngBat Bechyně

- Organizational structure of the 151st Engineer Battalion
- Companies possess various types of generators

HQ Coy, EOD Coy, Engineer Construction Coy, Engineer Bridge Coy, Engineer Coy, Logistics Coy

- Conclusion

151st Engineer Battalion has available cca 492 kW.

B) Possible variant of emergency electric power supply – 153rd EngBat Olomouc

- Organizational structure of the 153rd Engineer Battalion
- Companies possess various types of generators

Engineer Reconnaissance Platoon, Engineer mechanized coy, EOD Coy, Engineer Construction Coy, Logistics Coy

- Conclusion

153rd Engineer Battalion in Olomouc has available in its organization generators with a total output of about 236 kW.

Elaborated presentations will serve as background material for students during service in their designated barracks. With planning, organization and calculation and any engineering activity, students will deal with in their daily activities on their units.

List of tasks for students:

1. Briefly characterize the possible deployment process distribution and lighting networks in the field. What are the principles unfolding lighting kits and safety measures.
2. Based on the assignment calculate emergency power supply of field workplace and suggest possible solution.

Basic and recommended reading:

1. NEHODA, J. (S - 3177) *Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem.* Vyškov: VVŠ PV, 2000;
2. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
3. Organizační struktury 15. ženijního pluku k 1.1.2014.

1.11 Construction of landing facilities for helicopters and their maintenance

A) Basic concepts

Safety area

Safety Area is provided around a FATO to:

- reduce risk of damage to a helicopter caused to move off the FATO by the effect of turbulence or cross-wind, misleading or mishandling; and
- protect helicopters flying over the area during landing, missed approach or take-off by providing and area which is cleared of all obstacles except small objects which because of their function must be located on the area.

Landing areas for helicopters

is a tactical landing facilities both in areas of combat operations troops and in rear areas with at least minimal technical equipment (heliport, helipad).

Mobile Helipad

is landing area, which is transportable by car or helicopter on the designated place. At the place it is built or established into operational status, either permanent, without the possibility of subsequent dismantling and other transportation or removable and transportable to another place.

Heliport

is a small airfield area, which is used wholly or in part for arrival, departure and ground movement of helicopters. The area is reinforced by appropriate means and is usually greater than the helipad.

Helipad

is prepared space reserved and used for take-off and landing of helicopters (includes seating space and place of hover / hovering of helicopter).

B) Planning of landing facilities

Important information for quality performance of engineer works during construction of landing facility:

- type of helicopter, which will use the facility;
- aerodrome standards (dimensions, bearing capacity, technical equipment);
- available civilian and military resources (construction equipment, manpower, material and military equipment);
- the time that is available to carry out engineer reconnaissance and engineer works;

C) Heliport data

For each facility of heliport shall be measured and marked:

a) type of heliport – level, elevated or helideck;

b) Touchdown and Lift-Off area (TLOF) - dimensions, slope, type of surface, bearing strength in tonnes;

c) Final Approach and Take Off area (FATO) – type of FATO, bearing, length, width, slope, type of surface;

D) Characteristics of heliport

Final Approach and Take-off area (FATO)

Each level heliport must have at least one FATO. FATO must be free of obstacles. For dimensions of FATO are valid following rules:

a) When it is intended for use of the first class helicopter performance, must correspond to the dimensions specified in the helicopter flight manual (HFM), except where this information is missing, in this case the width must not be less than the greatest overall dimension (D) of the largest helicopter the heliport is intended to serve.

b) Where it is intended for use of helicopters for the second or third class performance, must be of such dimensions and shape that in it can be inscribed in a circle of diameter at least:

- **1 D** of the largest helicopter,
- **0.83 D** of the largest helicopter.

Obstacle limitation surfaces

Places for helicopter facilities require:

- cleaning of area;
- ensuring adequate relegation and take-off angles.

Construction of landing facilities for the Air Force includes the planning and construction, cleaning and security areas corresponding relegation and take off angles for both helicopters and tactical aircraft (in limited scope).

List of tasks for students:

1. Briefly describe possibilities of scheduling of landing facilities for helicopters, who participates on the planning.
2. Characterize basic characteristics of the helipad.

3. Explain how units of ACR engineers can contribute during construction and maintenance of landing facilities?

Basic and recommended reading:

1. STANAG 2394, Doktrína bojového použití ženijního vojska ATP-52(B);
2. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
3. Letecký předpis. Heliporty. L14H;
4. FM 5-430-00-2 Požadavky na polní letiště a přistávací plochy.

1.12 Repairs of damaged landing facilities, airfields

Adequate airport facilities are essential for the successful implementation of tasks in operations. Construction of new airports and repairs (adjustments) of existing, whose parameters are not appropriate, in critical areas can reduce the time and cost required to complete the operation.

A) Planning of repairs of damaged airfields

Airfield Damage Repair (ADR) solves:

- rapid damage assessment;
- safe disposal of unexploded ordnance;
- repairing damaged airfields (craters, funnels, cracks);
- ongoing maintenance of airfields.

B) Categories of airfield damages

Category A is identified as cracks, damage size less than 150 cm in diameter and does not interfere with the base airfield. Probably caused by: small rockets, artillery firing, and ammunition with immediate lighter.

Category B are small funnels, in diameter less than 600 cm longer and extending into the subsoil of airfield. Probably caused by: large rockets, cluster munitions, small calibre piercing bullet.

Category C are large funnels, greater than 600 cm in diameter. Probably caused by: aerial bombs, ammunition with delay lighter, disruptive large calibre projectiles.

C) Execute of airfield repairs

- Corrections airfields are governed by pre-established safety criteria of Air Force Headquarters. Criterion for the corrections that must be taken into account:
- finishing must be +/- 2 cm from the original runway surface;

List of tasks for students:

1. Describe the method for planning repair of damaged airfields including data necessary for planning.
2. Briefly characterize categories of airfield damages.

Basic and recommended reading:

1. Stanag 2394, Doktrína bojového použití ženijního vojska ATP-52(B);
2. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
3. Letecký předpis. Heliporty. L14H;
4. FM 5-430-00-2 Požadavky na polní letiště a přistávací plochy.

2. Execution of the tasks units Corps of Engineers in favour of IRS CR

2.1 Organization, facilities and opportunities created by engineer units to accomplish tasks GES, cooperation with other forces

Character of **Force Engineering Support** tasks, filled by Corps of Engineers units, varies according to the command level, phase, type and intensity of activity of troops in an operation. Depending on those factors outweigh either performing tasks of **Combat Engineering Support** (direct support of combat forces) or tasks of **General Engineering Support**.

A) Headquarters and Staff of Engineer Regiment

Headquarters and Staff of Engineer Regiment provide planning, command and control, coordination and security of engineer forces and resources in accordance with the requirements of the superior. Its components are:

- Headquarters;
- Staff;
- Technical and information support centre of EOD;
- Support barracks group.

B) 151st Engineer Battalion

The organizational structure of an Engineer battalion consists of:

- Headquarters and Staff of Battalion;
- Command Company;
- Engineer Company;
- Pontoon Company;
- Engineer Mechanized Company;
- Explosive Ordnance Clearance Detachment;
- Engineer Construction Company;
- Rescue Company;
- EOD Company;
- Logistic Company;

C) 153rd Engineer Battalion

The organizational structure of an Engineer battalion consists of:

- Headquarters and Staff of Battalion;

- Command Company;
- Engineer Company;
- Engineer Mechanized Company;
- Engineer Construction Company;
- Rescue Company;
- EOD Company;
- Logistic Company;
- Aid station.

For successful management of engineer support and command of Engineer units is necessary to know its predestination, organization, equipment and capabilities for Force Engineering Support. On the basis of this knowledge is possible to perform necessary calculations during the planning of activities of troops and prepare realistic proposals for use of engineer forces and resources.

List of tasks for students:

1. Briefly characterize options of Corps of Engineers in tasks of General Engineering Support.
2. Describe capabilities and abilities of Headquarters of Engineer Regiment, including his predestination.
3. Describe capabilities and skills of Engineer Battalion, including his predestination.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. Návrh předpisu Vševojsk-2-2. *Ženijní zabezpečení boje*. Praha 2004;
4. Pomůcka *„Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“.* Praha 2006;
5. Organizační struktury ženijního vojska AČR. Praha 2014.

2.2 Principles for emergency water supply in field

Water is essential for the life of most organisms living on earth. Loss of 20 % water contained in the human body results in death. A person urgently needs 2-3 litters of water day (warmer latitudes it may be 10 to 20 litters).

Water is necessary for security forces in the field and can adversely affect combat readiness of troops and usability techniques. It is used for drinking, food preparation, medical purposes, decontamination, for technical purposes.

At present, becomes important water treatment, because the accumulation of substances degrading water (WMD, fertilizers, agrochemical sprays, oil and oil products) such large that surface water sources are contaminated considerably. Therefore, in this respect, an important task also ACR, ensure sufficient own departments water that is suitable for use under field conditions and their performance requirements for drinking water.

Tasks security forces water in the field dealing with all departments and units. Asks water security issues in the field commander of the unit (department). The tasks involved units (formations) Corps of Engineers, the Chemical Corps and logistics services.

Lifting and water treatment is an essential part of the tasks of the engineer security forces water field. Departments and Units Corps of Engineers involved in the excavation and water treatment.

A) Basic concepts

Emergency water supply (field units). The short-term supply of water to the armed forces by the armed forces in operations, covering the reconnaissance, development/extraction, treatment, acceptability, storage and distribution of water.

Potable water. Water that is safe for drinking Emergency Potable Water. Water which meets the minimum quality standards, laid down in STANAG 2136. It may be consumed without constituting a health hazard only in the quantities laid down in STANAG 2136.

Raw water. Water from natural water resources which is submitted to a water treatment with the aim to extract potable water.

Filtration. The removal of undesirable particles by filter.

Sedimentation. The removal of suspended matter by settlement.

Disinfection. The destruction, inactivation or reduction of the amount of microorganisms by chemical or physicochemical procedures.

Water point. An installation for development, treatment, storage and distribution of water.

Water supply. The supply of water from fixed facilities of the public supply of potable water or from other water sources, e.g. supply facilities for industrial use, which are assigned by the appropriate authorities for the intake of water when required.

B) General Principles of Emergency Water Supply in Field

Normally the provision of water for the armed forces is effected from public water supply facilities. In case of a breakdown of the public supply system or the supply facilities prepared for times of operations which are independent of the public supply system, armed forces must be in a position to meet their requirements for potable and domestic water for maintaining operational readiness through an emergency supply provided from their own resources.

Emergency Water Supply Measures

The following measures are required for an emergency water supply:

a. Assessment of existing public and private water supply facilities.

b. Reconnaissance and assessment of other hitherto undeveloped water sources for the extraction of raw water by using sub-surface and surface water.

c. Examination of the quality of raw water and decision on its acceptability either as potable water or for purification into potable water.

d. Purification of raw water to become potable water.

e. Establishment of the acceptability of the purified water.

f. Provision of such water through storage, transport and distribution.

Quality and Quantity

Potable Water. Potable water must meet the quality standards laid down for water from the public water supply.

Emergency Potable Water. In special emergency situations water may only be used for quenching the thirst as well as for nutrition purposes in a minimum quantity of 5 litters per individual per day over a period of 7 days. It must meet the minimum quality standards laid down in STANAG 2136. In some armies the emergency quantity may be increased to 7 litters/man/day or more.

Scales of Issue. The scales of issue can vary with climatic conditions. In arctic, tropical and torrid zones the requirement for drinking water may be greater than in temperate areas, particularly if heavy work is to be done. This requirement may be further increased if dehydrated rations are issued. Lower scales are only to be applied for limited periods. The table below relates to the consumption of potable water in temperate climates. Requirements for warm or cold weather may be up to 100 % higher.

Daily Rates of Potable Water Consumption

Serial	Use	Requirement (litres/individual/day) Under Normal Conditions
1.	Units in action (1) a. Drinking and cooking only (individual soldiers) a. b. General consumption	 25 (2) 70 (3)
2.	Medical Troops a. Battalion Aid Station b. Clearing Station (Brigade-Corps Level) a. c. Evacuation Hospital	 50 (4) 170 200 (4)
3.	Temporary or Semi–Permanent Camps:* a. Drinking, cooking and laundries b. As above, plus domestic water (5)	 100 150

* does not apply for DEU

Remarks:
1) Includes personnel in Armored Fighting Vehicles and personnel wearing CBRN protective clothing and equipment.
2) Normal planning figures for General Operations.
3) As (2) but bathing included.
4) In addition to Serial 1.b.
5) Unless a separate non-potable water distribution system is provided.

Domestic Water. Domestic water is required for a variety of other purposes such as firefighting, decontamination (of vehicles, equipment, ground surfaces, etc.), cooling of vehicles and machinery, as well as construction work. Frequently the quality of domestic water must meet the same requirements as potable water. This particularly applies if it is to be used as domestic water for food or for hygiene. For some technical purposes even higher requirements are made, e.g., with regard to salt content.

Effects of the Employment of CBRN Munitions

The employment of CBRN munitions may contaminate surface water supplies over a wide area.

Sub-surface water resources are unlikely to be contaminated initially. Earth or rock layers are, due to their particular filter capacity, more or less effective in diminishing contamination.

Impurities in Water

Impurities in water can be classified into natural and artificial impurities.

Nature of Impurities. A systematic classification of all impurities is not possible. However, classification can usually be made of the causes, the nature and the qualitative effects of impurities.

Natural Pollution Factors

- **Organic Matter.** This may take the form of suspended matter in water. The extent and nature of the impurities can be detected by taking some of the water in a glass container and by examining colour, cloudiness and smell.

- **Disease Bearing Organisms.** These include, for example, the pathological germs of diseases such as Bacillary Dysentery, Typhoid Fever and Cholera, or amoebic dysentery and others. Their detection requires that the water be examined by professionally trained personnel under laboratory conditions which is not normally practicable in the field. It is assumed that these microorganisms are always present in surface water, hence this water is to be purified and disinfected in any case.

- **Inorganic Matter**. Depending on nature and quantity, these will affect the chemical and physical characteristics and thus the quality of the water. Water must always be tested with respect to chemical impurities before it is released for drinking purposes.

Artificial Pollution Factors

Environmental Pollution. Waste water arising from industrial, agricultural or domestic use is likely to be contaminated. The extent and nature of the pollution can only be determined by special tests.

Nuclear Contamination. The employment of nuclear munitions will probably cause contamination by radioactive material. The amount of contamination depends on the yield of weapon, location of detonation in relation to the water supply, and whether it is an air, surface or sub-surface burst.

Biological Contamination. The majority of biological agents present in water can usually be removed by normal chlorination or boiling.

Chemical Contamination. Chemical agents may contaminate surface water sources to dangerous levels and will persist in water for periods ranging from a few hours to many days or even months especially in freezing or very cold temperatures.

Responsibilities for the Reconnaissance, Development / Extraction, Treatment,

Acceptability, Storage and Distribution of the Emergency Supply of Water in the Field.

Host Nation

The reconnaissance, development / extraction, treatment, acceptability, storage and distribution of water is, in principle, the responsibility of the Host nation. As it cannot be assumed that purification can also be ensured, the field units of all armed forces must be capable of providing their own supply of water if the host nation is no longer in a position to do so due to hostile acts.

Military Command and Control

Military command and control includes responsibility for:

a. Deciding on the scales of issue of potable and domestic water within the framework of the quantities provided by the host nation.

b. Notifying formations / units of:

- The location of water points and times of operation.
- Any special precautions or testing that may be necessary.

c. Monitoring the operation of water points.

d. Organizing the provision of water and its transport.

Implementation

The implementation of tasks with regard to the reconnaissance development / extraction, treatment, acceptability, storage and distribution of water is handled differently in the armed forces of the nations involved. An overview of responsibilities is shown in Appendix 1, Stanag 2885.

The lecture discusses the basic concepts of emergency water supplies, emergency water supply measures, and responsibility for emergency water supply.

The basic concepts of emergency water supply include:

- Emergency Water Supply (Field Units);
- Potable Water;
- Raw Water;
- Filtration;
- Sedimentation;
- Disinfection;
- Water Point;
- Water Supply.

Emergency Water Supply Measures

The following measures are required for an emergency water supply:

1. Assessment of existing public and private water supply facilities.
2. Reconnaissance and assessment of other hitherto undeveloped water sources for the extraction of raw water by using sub-surface and surface water.
3. Examination of the quality of raw water and decision on its acceptability either as potable water or for purification into potable water.
4. Purification of raw water to become potable water.
5. Establishment of the acceptability of the purified water.
6. Provision of such water through storage, transport and distribution.

List of tasks for students:

Within the self-study you read the following material and prepare for the exercise:

1. Technological water treatment processes used in ACR;

2. Technological water treatment processes accepted by NATO.

Basic and recommended reading:

1. STANAG 2885: 1996, Engr - Emergency supply of water in war.;
2. Vševojsk-16-2 Zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
3. ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001.

2.3 Technological procedures for (potable) water treatment process and requirements for pure water

Technological water treatment processes can be classified from different perspectives. Improving water quality is achieved by conventional water treatment plant (water removal of suspended and colloidal substances and other impurities), deactivation (ridding the water of radioactive substances), decontamination (removal of toxic substances and poisons), and disinfection (ridding the water of germs).

A) Technological water treatment processes used in the ACR

According to the nature of process technological processes are classified as described in Table.

Table - Classification of basic treatment processes

Methods of treating water	
Separation methods for water treatment 1. mechanical methods 2. chemical methods 3. physicochemical methods 4. biological processes	**Selecting the type** 1. by source 2. depending on the type determination
Separation methods by water source	
Surface water mechanical pretreatment clarification flotation filtration disinfection adsorption fluoridation ultrafiltration stabilization	**Subsurface water** deacidification Deferrization demanganization filtration disinfection Removal of calcium and magnesium deionization demineralization ion exchange desorption
Separation by the use of water	
drinking water utility water service water	

When you edit surface water, according to the degree of pollution of the commonly used single, double and three-tiered water treatment. From health and economic reasons, the selection of appropriate resources should be focused on groundwater and surface water from the headwaters of the rivers, accumulated in water tanks.

In water treatment in the conditions of the army will not be able to find appropriate sources of water. In water treatment will be used even less quality water sources, water sources contaminated radioactive, biological and toxic substances. In

terms of the army, therefore, must for water treatment to choose more sophisticated and expensive technological procedures of water treatment. Processes and equipment used in the field for the removal or reduction of impurities are different according to the nature and structural properties. However, the water treatment processes are in accordance with the most proven ways.

I. Water treatment by precipitation procedures

Substances present in water in a colloidal form, or in ionic or molecular form can be converted into precipitation forms by chemical interference-separable precipitation reactions. On this principle are based precipitation methods of water treatment procedures.

The addition of an appropriate chemical agent into the water by a few of soluble compounds. If the removed substances enter into the crystal lattice of the discharged solid phase, we are talking about the precipitation reaction with a primary effect. When precipitated substance enters secondarily sorption or coagulation of the particles secreted, we're talking about a precipitation reaction with the secondary effect.

The first group includes the reaction utilizing the low solubility of calcium carbonate and magnesium hydroxide.

The second group of precipitation reactions is the process of water clarification with iron salts and aluminium. The transition between the two groups is a basic process of clarification, where both types of reactions take place simultaneously.

Clarification

Clarification refers sum of the processes (coagulation, flocculation, sedimentation, flotation), which removes water particles colloid ally dispersed inorganic substances and organic origin. The main process is a coagulation of colloidal particles into larger aggregates, which can be removed from the water by sedimentation, flotation or filtration.

Coagulation

By adding a coagulating substances in raw water can be largely converted to colloidal impurities larger lighter falling or lighter filterable particles. Especially may be removed colloidal organic impurities, which are otherwise difficult to remove. Besides coagulation contributes to the removal of microorganisms and viruses.

The process consists in that the water added to the agent (coagulant) to hydrolysis produces particles which carry a charge of opposite sign and interaction with dirt particles are agglomerates. To further increase the particle interconnecting clotting/coagulation the energy is supplied mixing. The coagulant are used salt Al^{3+} ,

Fe^{3+}. Schematic equation coagulant hydrolysis are

$Fe^{3+} + 3H_2O \longrightarrow Fe(OH)_3 + 3H^+$

$Al^{3+} + 3H_2O \longrightarrow Al(OH)_3 + 3H^+$

In soft water are added alkalizing agents, NaOH, $Ca(OH)_2$, so that coagulation may take place.

Monitoring of clarification.. Physic-chemical processes occurring in particular during clarification of surface water include hydrolysis coagulants destabilization of colloids (especially the adsorption and partial hydrolysis products unhydrolyzed ions particulate colloids) per kinetic coagulation (aggregation of destabilized particles due to Brownian motion of the particles) and orthokinetic coagulation (aggregation due to the velocity gradient).

Sedimentation

Sedimentation effects (standing water at rest for several hours in the tank or container) materials sink to the bottom. Sedimentation can be accelerated by adding coagulating agents. Yet it is a longer process, which can be used in cases of considerable water pollution.

Sedimentation separation is by gravity. After separation of suspended solids from water precipitation reactions resulting in the treatment process, is used a method based on gravity forces. The suspended particles in the water force of gravity acts.

Upstream active resistor area. The interaction of forces on a particle is to move particles. Separation is by settling or in a fluidized bed.

II. Filtration

In most of the filter device, the raw water is sucked through the pump via fine mesh membrane covered with filter dust. If the water contains a lot of suspended substances, it is appropriate to carry the sedimentation before the filtration, otherwise the filters clogged too quickly.

Filtration is a process by which particles are removed from the water insoluble substances of a certain size. Usually, there are two basic types of filtration, filtration layer of granular material (bulk filtration) and filtration to filter counter (deposit, cake).

Bulk filtration of water removing particulate solids, of a size smaller than the grain size of the filter media. This is usually in the range from 0.5 to 3.0 mm. The filtering is typically used silica sand for water use, less often anthracite, activated carbon etc.

For filtration of the counter is suspended solid particles collected on the layer material prior to the commencement of alluvial filtration in a thin layer on the fabric of synthetic fibbers, fine mesh and the like. Silty material is usually diatomaceous earth, perlite, and others.

List of tasks for students:

Within the self-study of recommended literature the following materials:
1. Survey and evaluation of sources of drinking water,
2. Checking the quality of raw water and treated water,
3. Modification of raw water into potable water,
4. Security accumulation / storage, transport and distribution of treated water.

Basic and recommended reading:

1. STANAG 2885: 1996, Engr - Emergency supply of water in war.;
2. Vševojsk-16-2 Zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
3. ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001.

2.4 Organization unrolling water point, excavation and water treatment

The following measures are required for an emergency water supply:

1) Assessment of existing public and private water supply facilities.

2) Reconnaissance and assessment of other hitherto undeveloped water sources for the extraction of raw water by using sub-surface and surface water.

3) Examination of the quality of raw water and decision on its acceptability either as potable water or for purification into potable water.

4) Purification of raw water to become potable water.

5) Establishment of the acceptability of the purified water.

6) Provision of such water through storage, transport and distribution.

A) Reconnaissance and assessment of existing water supply facilities

In the reconnaissance of water resources, it is of importance to determine the quantity and quality of the water available, as well as the effort required for development, extraction and treatment at the water points. In principle, all surface water resources in a contaminated area are suspicious.

Information on the following points is required for all water resources:

1) The type of water resource with map reference and sketch.

2) The amount of water available.

3) The quality as determined by chemical, physical and microbiological examination.

4) Origin of the water with special consideration as to possible pollution.

5) Existing facilities for extraction, storage and distribution.

6) In the case of springs, streams and rivers, information as to the feasibility of impounding water by construction of dams or infiltration trenches is required.

7) Road access to the designated water point and dispersal areas for vehicles.

To the extent possible, this information shall be assembled in peacetime by the regionally responsible commands of the host nation and kept ready for the time it is needed.

B) Examination of the quality of raw water and potable water

The establishment of the acceptability may only be effected by a medical officer (physician veterinary office (N0)) after chemical, microbiological and radiological examination of the water eligible as potable water.

Purified water is to be re-examined prior to making it available.

C) Purification of raw water to become potable water

Developing water treatment / extraction water:

Equipment for the Development and Extraction of Water Sources. Drilling equipment as well as pumps and filters are required for the development and extraction of sub-surface water. As a rule, the extraction of surface water requires less effort.

Wells. Wells drilled by field units are to be closed in accordance with Appendix 1 and marked in accordance with Appendix 2.

Treatment

Purification is required when the quality of the available raw water does not meet the minimum requirements laid down in STANAG 2136.

For natural and artificial impurities in water see Appendix 1 to Annex A.

Depending on the equipment available polluted raw water can be purified and converted into potable water in the field by different procedures (boiling, chlorination, sedimentation, coagulation, filtration, distillation and treatment with activated charcoal).

D) Provision of such water through storage, transport and distribution

Storage

Units in the field carry only a limited supply of water. In some armies, units may hold a reserve of 5 days' supply.

Non-potable water must not be stored or transported in potable water containers.

In contaminated areas, only water from closed containers is usable provided the outside of the container is decontaminated before use. Some plastic containers do not offer any effective protection against liquid chemical agents.

The filler necks of all potable water containers will be marked with white paint. In addition, each nation may add some national identification. Containers not used for potable water remain unmarked.

Distribution

Water for emergency supply is collected from water points normally established in the rear areas - possibly in the vicinity of logistic facilities. The number of water points depends on the deployment of troops to be supplied and the available water sources.

As a rule, units should not have to cover more than 30 km to collect water.

The water is purified at the water point as required and – if possible – stored in covered tanks.

E) Water point

Site requirements and location

Location

The location should meet the following requirements or be capable of development to meet them:

1) Easy and short access to and from a main route.
2) Waiting areas for vehicles near the entrance to the water point.
3) Good access to the filling points so that a vehicle being filled does not block the traffic.
4) Well-drained hard standings at the filling points.
5) Ground with good natural drainage, if possible at a slope with sufficient inclination to enable deliveries to be made by gravity from tanks to vehicles and from sedimentation tanks to sterilising tanks. It should be possible to erect the tanks on level ground.
6) Wherever possible, water should be pumped directly from purification equipment into vehicles

A diagrammatic layout of a water point is shown at Appendix 1.

Dispensing Of Water

Water points will be so arranged that vehicles, water cans or water bottles can be filled separately but at the same time.

Vehicle Filling Points. Filler hoses should be not less than 50 mm in diameter and should be spaced 9-18 meters apart, if possible. They should normally be erected at a height of 4 meters above the road surface.

Filling Points for Water Bottles and Water cans. Flexible hoses enable water containers to be filled while on the transport vehicles. For occasional filling of individual water cans or water bottles, a rigid pipe with a number of taps to be operated manually should be provided. Loading platforms at a suitable height for loading cans on the vehicles are useful.

Protective Measures

The following protective measures are required for water points:

Fencing. If the water point remains in use for a longer period of time, it should be guarded and fenced.

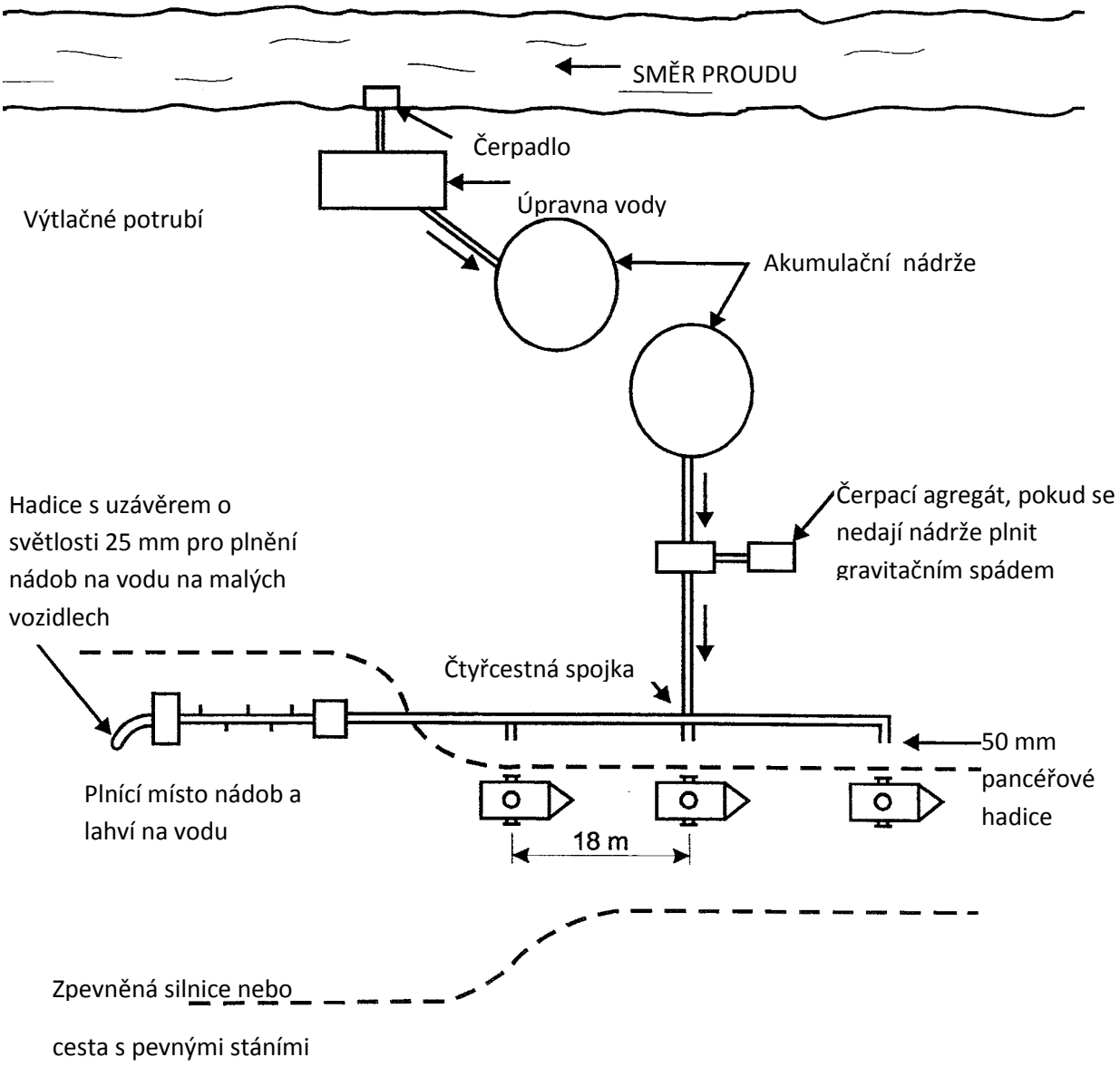
Sanitation. Latrines will not be provided in the immediate vicinity of the water point. If required they will be constructed at a distance of approximately 100 meters from the water point.

Pollution by Fuels. Measures will be taken to prevent the water point from being polluted by fuels used in transport vehicles, pump units, generators, etc..

Signs

Warning signs (in accordance with Annex A of STANAG 2035, paragraph 2) will be placed on the main route about 200 meters from the entrance to the water point.

Diagrammatic Layout of Water Point at a Body of Surface water



The following measures are required for an emergency water supply:

1) Assessment of existing public and private water supply facilities.
2) Reconnaissance and assessment of other hitherto undeveloped water sources for the extraction of raw water by using sub-surface and surface water.
3) Examination of the quality of raw water and decision on its acceptability either as potable water or for purification into potable water.
4) Purification of raw water to become potable water.
5) Establishment of the acceptability of the purified water.

6) Provision of such water through storage, transport and distribution.

List of tasks for students:

Within the self to prepare for the next exercise, study the following material:

1) Resources for accumulation and storage of water in the unit,

2) The need for water for the unit according to STANAG 2885th

Basic and recommended reading:

1. STANAG 2885: 1996, Engr - Emergency supply of water in war.;
2. Vševojsk-16-2 Zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
3. ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001.

2.5 Calculation of possible demands for potable water supply and relevant treatment

Units in the field were taking only a limited supply of water. In some armies units storing supplies water for 5 days.

For accumulation and storage of water in the Army used the funds collected. The number of resources is allocated to each unit, depending on the size of the units.

A) Means for accumulation and storage of water in the unit

The ACR are introduced following resources for treatment, storage, storage and dispensing drinking water under field conditions:

- water unit UV-2000
- ISO 1C container transport drinking water reservoir,
- T-815 Citra,
- trailer Vesna,
- trailer C180v,
- thermos 20 l,
- thermos 25 l,
- thermos 40 l

B) Water demand for unit

Water demand for the unit is given requirements according to STANAG 2885 and regulation Vševojsk-16-2.

Scales of Issue. The scales of issue can vary with climatic conditions. In arctic, tropical and torrid zones the requirement for drinking water may be greater than in temperate areas, particularly if heavy work is to be done. This requirement may be further increased if dehydrated rations are issued. Lower scales are only to be applied for limited periods. The table below relates to the consumption of potable water in temperate climates. Requirements for warm or cold weather may be up to 100 % higher.

DAILY RATES OF POTABLE WATER CONSUMPTION

Serial	Use	Requirement (litters/individual/day)
		Under Normal Condition
1.	Units in action (1)	
	a. Drinking and cooking only (individual soldiers)	25 (2)
	b. General consummation	70 (3)
2.	Medical Troops	
	a. Battalion Aid Station	50 (4)
	b. Clearing Station (Brigade-Corps Level)	170
	c. Evacuation Hospital	200 (4)
3.	Temporary or Semi-Permanent Camps *	
	a. Drinking, cooking and laundries	100
	b. As above, plus domestic water (5)	150

* does not apply for DEU

Remarks:
1) Includes personnel in Armoured Fighting Vehicles and personnel wearing CBRN protective clothing and equipment.
2) Normal planning figures for General Operations.
3) As (2) but bathing included.
4) In addition to Serial 1.b.
5) Unless a separate non-potable water distribution system is provided.

C) Calculation of water needs and methods of provision

Finally, determine the way of drinking water in the field. For example, compute the water needs for the unit. Results must fill in the table.

UNIT	Headq.	Head. Plat.	Aid Stat.	Com.	Com.	Com.	Com.	Log. Comp.	
Water Unit									
UV 2000									
Resources Storage									
T-815 CITRA									
trailer VESNA									
trailer C180V									
thermos 20 l									
thermos 25 l									
thermos 40 l									
Summary									
Individual Soldier									
Bottle 1 l									
Total reserves per day									
Summary									
Standard									
Difference									

List of tasks for students:

Develop namely assignments relating to the solution of the following parts:

1. Reconnaissance water sources
2. Development/extraction of water

3. Treatment of water through the water unit

4. Acceptability control of water and running water treatment plant

5. Water unit tasks to prepare for presentation at the next seminar.

Basic and recommended reading:

1. STANAG 2885 1996, Engr - Emergency supply of water in war.;
2. Vševojsk-16-2: Zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
3. ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001;
4. Armádní kontejner ISO 1C - přepravní nádrž pitné vody. [online] http://variel.cz/produkty/armadni-kontejner-iso-1c-prepravni-nadrz-pitne-vody/.

2.6 Extraction and water treatment

Emergency water supply in the field is short-term procurement for the armed forces by armed forces in the war, includes reconnaissance, development/extraction, treatment, acceptability, storage and distribution of water.

A) Reconnaissance of water resources

Engineer reconnaissance water sources:

a) the type of water resource with map reference and sketch;

b) the amount of water available;

c) the quality as determined by chemical, physical and microbiological examination;

d) origin of the water with special consideration as to possible pollution;

e) existing facilities for extraction, storage and distribution;

f) in the case of springs, streams and rivers, information as to the feasibility of impounding water by construction of dams or infiltration trenches is required;

g) road access to the designated water point and dispersal areas for vehicles.

B) Extraction and development of water

Extraction and development of water:

a) bank infiltration;

b) wells drilled;

c) well soccer;

d) calculation of the system for extracting water.

C) Treatment of water through a water treatment unit

Water treatment with water treatment UV-2000:

a) putting treatment into standby;

b) development of treatment;

c) preparation of base layers;

d) filtration;

e) preparation of doses

f) termination of operation

D) Acceptability of water quality and monitoring of the water treatment unit

Quality control of water and monitoring of the water treatment unit UV-2000:

a) quality control of raw water;

b) control the quality of treated water;

c) control functions of water treatment unit;

d) check the tightness of the hydraulic circuit.

E) Water point

Water point:

a) site requirements;

b) location;

c) dispensing of water;

d) protective measures;

e) fencing;

f) sanitation;

g) pollution by flues.

List of tasks for students:

Elaborate namely individual tasks related to the solution of the following parts:

- reconnaissance of water resources,
- develop a water treatment plant,
- excavation and development of water

- water treatment using a water treatment plant,
- monitoring of water quality,
- accumulation and distribution of water.

Tasks after incorporation of comments surrender to the teacher in printed form.

Basic and recommended reading:

- Zákon č. 254/2001 Sb. „Vodní zákon“;
- ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001;
- Vševojsk-16-2 zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
- Stanag 2885: 2004 Nouzové zásobování vodou v době války;
- Stanag 2394:2005 Ženijní doktrína pozemních sil. ATP 52 (B);
- Stanag 2136: 2002 Normy minimální kvality pitné vody v krizových situacích;
- Žen-2-3 Ženijní průzkum. Praha: MO, 1992;
- Žen-2-9 Ženijní práce druhů vojsk. Praha: MO, 1981;
- Žen-31-5 Úpravna vody 2000 l.h-1. Praha: MO, 1974;
- ČSN 75 3102: 1992 - Ochrana vodních zdrojů. Značení ochranných pásem zdrojů hromadného zásobování pitnou vodou;
- ČSN 75 5115: 1993 - Vodárenství. Studny individuálního zásobování vodou;
- STRNADOVÁ, N., JANDA, V. Technologie vody. Praha: VŠCHT, 2004;
- AMBROŽOVÁ, J. Aplikovaná a technická hydrobiologie. Praha: VŠCHT, 2003;
- PITTER, P. Hydrochemie. Praha: VŠCHT, 1999;
- Armádní kontejner ISO 1C - přepravní nádrž pitné vody. [online] http://variel.cz/produkty/armadni-kontejner-iso-1c-prepravni-nadrz-pitne-vody/ .

2.7 Characteristic and distribution of diving work in ACR

To fulfil this task, general engineer support are of engineer units ACR applicable only **engineer reconnaissance team engineer reconnaissance platoons of**

Engineer Battalion, which have in their diving equipment sets and airlock.

A) Characteristics of diving work

Diving works are work under water, which is the wide range and can be divided into several groups: construction work - work of mechanical character - rescue work and investigation and control.

Diver leads, organizes and is responsible for staff performing various diving work, work at elevated pressure, elevated pressure in the work environment - hyperbaric work, or who work directly performs and provides.

B) Distribution of diving work in ACR

Diving works according to the **conditions** under which it performs and the **nature of the activities** are divided into:

a) exploration diving work

Working underwater focused on obtaining data on water barriers, state underwater objects and data necessary to perform the technical engineer and some special diving work.

b) technical diving work

Working under water used in the search, and edit fords for deep wading and driving tanks underwater, for the establishment of ship, ferry and bridge crossing site for restoring a destroyed building new water structures and special objects under water, for setting up and removing roadblocks underwater or establishment through those roadblocks.

c) special diving work

Working under water in search and destroy ammunition, explosives use to remove roadblocks in places designated for the establishment crossing site and various exploration and diversionary activities behind enemy lines.

d) extrication and rescue diving work

Work carried out by divers under water with the location of the sunken techniques to help, eventually. when rescue crews who remained in the sunken technique, during inspection and preparation techniques to pick pocketed or pull ashore.

e) diving work under specific and difficult conditions

Diving works when realized using special skills (climbing rope technique) in degraded meteorologist. Conditions in confined spaces, aircraft, when using explosives...

According to the demands of diving work is divided into:

- Light - search gout, gout relief detection, inspection of buildings, objects and search their markings;
- Medium - lifting up to 1 ton, minor assembly and dismantling, removing obstacles, laying of cables;

• Severe - hand cutting and chopping, disintegration of rocks;

• Special - search and destroy ammunition under water, use of explosives underwater.

Under the terms of the diving work is divided into:

• Normal - quiet and clean water depth of 10 m, the time of day;

• Difficulty - flowing water depth over 10 m, work under the ice, the water temperature is lower than + 5° C, night-time, work with explosives.

C) Qualification divers ACR

Qualification divers are given the extent of its theoretical and practical training, specialization and experience in underwater work.

According qualifications divided divers:

• divers

• divers for depths up to 20 m,

• divers for depths up to 30 m,

• diver trainer

• diver instructor.

Professional requirements for qualification divers by:

• the training can be selected only by persons who have undergone a medical examination and meet its criteria;

• must master basic ways of moving water:

- Swimming freestyle min. 100 m,

- Swimming crawl min. 50 m,

- Facial immersion in water and holding the breath for 30 s,

- Jump into the water from a height of 1 m.

The diver must be able to:

a) swim;

b) descend into the water and work under it in all kinds of diving equipment introduced in ACR;

c) the basic engineering work underwater at depths up to 13 m (7 m in difficult conditions);

d) remove common faults on diving equipment;

e) operate and maintain high-pressure air compressors for filling SCBA bottles and carry air tanks;

f) provide quick and effective help other divers;

g) provide first aid for drowning.

D) Use of divers within GES

In fulfilling the tasks of general engineering support divers are exploited diving for reconnaissance work. This is essentially a survey of water hazards and rescue diving and rescue work.

Survey water hazards include:

- survey shores and coastal sections of floor water hazards to determine min and other barriers;
- research into the bottom section to determine engineer roadblocks and other obstacles;
- surveys on water hazard for the establishment of ship and ford crossing site;
- detection of water structures and their state;
- detection preparations to destroy enemy buildings and bridges water.

Data on water hazard, which is necessary to find out:

1. The width of the first water hazards - (Engineer rangefinder);
2. A maximum depth of water - (echography, echo sounder, depth);
3. Stream velocity - (speedometer current);
4. Bottom bearing capacity - (penetrometer);
5. Visibility in the water - (estimated).

Diving works carried out by a specialist engineer corps includes a range of activities and tasks, and have a unique place in the engineer support of combat operations troops.

Preparation of divers is focused on performance measures for the implementation of exploration, technical, special, rescue diving and rescue work.

Trained specialists participate in security training and other specialties (e.g. in rescue and recovery operations, in training mechanized units, etc.).

List of tasks for students:

1. Briefly characterize diving work in the Army.
2. Describe the second division of diving work in the Army.
3. Discuss the possibility of training divers and their qualifications.
4. Explain the possibilities of divers in the performance of tasks GES.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora*. Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) *Ženijní doktrína pozemních sil*;
3. Žen-24-6 *Vojenské potápění* Praha: MO, 2009;
4. MACH V., SOCHR J. *Přepravy* (S 1182 Vyškov 1988, PČT 502);
5. Žen-2-4 *Výcvik na vodě* Praha: MO, 2010;
6. Tank-6-2;
7. Pomůcka - *Záchranné a vyprošťovací práce*.

2.8 Geospatial support, information about the Earth's surface

Geomatics according to ISO 19122 as defined scientific technical and interdisciplinary field dealing with the collection, distribution, storage, analysis, processing and presentation of geographic data and geographic information.

Geomatics

(a set of scientific measurements of the earth's surface) is a term used to describe the science and engineering activities, which are included in the process:

- assembly;
- preservation;
- analysis;
- processing;
- presentation;
- dissemination;
- management of information about the earth's surface.

Supporting information on the Earth's surface include: responsibility for updating, repairing and maintaining a database of information about the earth's surface, including paper maps; providing limited production capacities; distribution of geographic data, including mapping and electronic copying of data; other products containing information about the earth's surface usable for terrain analysis; assurance teams to analyse terrain units (formations) task force and taking measurements in the field.

Supporting information on the Earth's surface is essential for modern military operations.

Each weapon system, the Task Force, aircraft and ship need some kind of information about the earth's surface to develop navigation, manoeuvre and fight. Supporting information on the Earth's surface includes responsibility for updating,

correction and maintaining a database of information about the earth's surface, including paper maps provide limited production capacity, distribution of geographic data, including mapping and electronic copying of data, and other products containing information the Earth's surface that supports terrain analysis, assurance teams terrain analysis for units / formations, and implementation of field measurements.

The tasks of geospatial support

Tasks by ATP-52 (B):

- MAINTAINING A DATABASE
- PRODUCTION
- DISTRIBUTION OF GEOGRAPHIC INFORMATION
- TERRAIN ANALYSIS
- FIELD RESEARCH (FIELD SURVEYING)
- CREATING GEOGRAPHICAL VISUAL MATERIAL

Geospatial groups (data processing component of the Earth's surface) provide users with practical security map data both in printed form and in the form of software. It is necessary to ensure that information about the earth's surface were readily available, updated and distributed throughout the area of operations (operations).

Because staff, processing data on the earth's surface, can also maintain databases in relation to landmines, unexploded ordnance and engineer support intelligence, there is a requirement for close cooperation between components processing data on the Earth's surface with members of EOD specialization and engineer support intelligence.

List of tasks for students:

1. Characterize the first general geospatial support.

2. Clarify who is in the Army or the staff department deals with the collection of data the Earth's surface and what this information is used.

3. Brief description of tasks within the geomantic aid granted.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. Návrh předpisu Vševojsk-2-2. *Ženijní zabezpečení boje*. Praha 2004;

4. Zákony a Nařízení vlády ČR;
5. Dokumenty NATO;
6. Mezinárodní dohody.

2.9 Organization disposal of explosive ordnance, EOD activity

EOD incidents (events and activities associated with the explosive ordnance disposal) impair the freedom of movement of combat forces, disrupt communications, impair the morale or incapacitate industrial centres, seaports, waterways, air bases or urban agglomerations.

Although operations at the disposal of explosive material disseminated throughout the rear areas and forward combat areas, it is important to realize that the existence of EOD incidents in civilian areas will often have serious effects on the military situation.

A) EOD incident

EOD incident is initiated, if any of the following events:

- If you find unexploded ordnance occurred subsequent explosion,
- u occurring unexploded ordnance is suspected the possibility of an explosion or there is other evidence,
- suspicious device was found in the case of an event (incident) with an improvised explosive device was received warning of the presence of the device,
- threat assessment confirmed the need for defensive or offensive search operations.

Category EOD incidents:

Category A. It assigns the EOD incidents that pose a serious and immediate threat. Incidents of this category are given priority over all other incidents and surgeries to remove them are initiated immediately regardless of risk persons.

Category B. Allocates the EOD incidents that pose an indirect threat. Before starting the operation to remove them can be maintained safe waiting period in order to reduce the risk to people, designed to remove the explosive material.

Category C. Allocates the EOD incidents that pose little threat. These incidents are normally dealt with until after the incidents of category A and B as soon as the situation permits and minimal danger to people.

Category D. Allocates the EOD incidents that pose no threat at the time of the incident.

B) General principles

For disposal of unexploded ordnance are certain principles that should ensure the survival of all members of the EOD team:

- minimal risk
- minimum number of people
- minimum number of specialists in the target area,
- minimum time in space,
- destruction of the place / the situation,
- worst option,
- unity of command,
- request information
- interventions,
- qualification / training,
- proper planning and preparation,
- one team - one nationality,
- dismantling.

C) Activities before disposing of explosive material

Until the arrival of specialists to explore and disposal of explosive material, the incident commander should:

- until the police arrived to redirect traffic to avoid clogging traffic,
- after checking UXO choose a suitable and safe place to rendezvous / concentration, and transmit information about its location to all the participating organizations on the task and responsible organizations,
- perform appropriate action to control any hostile environment,
- to ensure that they are available to the most important military and witnesses will be collected separately. Identify the most important civilian witnesses and assist civilian officials in dealing with witnesses,
- if you are locked buildings, ensure the availability of key holders,
- exercise caution when dealing with the press and television.

D) Activities during the survey / disposal of explosive material

Upon arrival specialists meeting place will be a specialist for investigation and disposal of explosive material:

- fully informed EOD incident commander,

- where appropriate, confesses witnesses,
- assess the situation and decide on the action plan,
- in the case of a confirmed improvised explosive device will be a specialist for disposal of explosive material included in the control station without making a survey of the explosive material.

E) Management EOD operations

Among the most common tasks in removing explosive material include:

- Exploration of explosive material (EOR)
- cleaning of explosive material (EOC)
- removal of improvised explosive devices (IEDD)
- removal of explosive material, which includes chemical, biological, radiological and nuclear agents (CBRN EO).

The multinational groupings must be clearly defined command structure and management. This structure but may be different in each operation.

EODINCREP (EOD incident report)

The message that is undergoing EOD specialists group.

This report should contain sufficient information to allow create priority tasking for EOR (survey explosive material).

EORTASKREP (EOR tasking report / EOR report)

Used to tasking specialists EOR (survey explosive material) body giving the task EOD and EOR group to supplement the particulars provided for the survey.

Details should be sufficient to establish the priorities and challenges for the EOD group.

EODTASKREP (EOD tasking report / EOD report)

Serves authority to command authority tasking EOD group of relevant information EOD group and enable the group to report any changes to the information and conclusions adopted measures.

G) Obligations of the management of explosive ordnance disposal

The duties undertaken by the management of the explosive ordnance disposal:

- ensure the functioning of the control centre for the disposal of explosive and the specific tasks in liquidation, based on the priorities,
- allocate personnel and equipment for the disposal of explosive ordnance
- provide operational and technical management and coordinate security

- To evaluate the activity units for disposal of explosive material and recommended distribution of persons and equipment so as to achieve a balance in terms of workload,
- maintain a connection with the "control centre" and through them with police forces and civilian organizations,
- Be in the emergency unit for disposal of explosive material when moving nuclear, biological or chemical munitions through their area of responsibility.

"Until the world really not organize satisfactorily and consequently does not occur general disarmament, will always be crime to liberate people from such species and ways of training that can give them a reasonable chance of survival“

Dwight David Eisenhower

Invasion of Europe

List of tasks for students:

1. Brief description of activity during EOD incident.
2. Characterize the second category EOD incidents.
3. Explain third operation before disposing of explosive ordnance and disposal.
4. Discuss the management of EOD operations, including expert reports supervisor.
5. Describe the responsibilities in managing the disposal of explosive material.
6. Give the duty troops at the disposal of explosive ordnance.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. ATP-72(A). *Interservice Explosive Ordnance Disposal Operations on Multinational Deployments*. Brusel: NSA, 2011;
3. STANAG 2143 EOD. *Explosive Ordnance Reconnaissance/Explosive Ordnance Disposal (EOR/EOD)*. 5. edice. Brusel: NSA, 2005;
4. AEODP-6(A). *Explosive Ordnance Disposal Reports and Messages*. Brusel: NSA, 2008.

2.10 The survey, design, construction and repair of military roads and bridges

One of the basic tasks Corps of Engineers in the tasks Engineer to support the fight is to ensure the movement of friendly forces (mobility). Under this name hides and complex and intricate task of performing the following tasks:

- Survey and reconnaissance marching as;
- The establishment of crossing over obstacles;
- Removal (overcoming) identified barriers;
- Restoration of damaged sections of roads and paths and objects on them
- Search and Ranging detours;
- Strengthening few viable terrain establishments of auxiliary roads.

The objective of securing movement to create the necessary conditions for the timely and hidden passion combat reports and the manoeuvre troops.

The most popular and most used type of transport is obviously the right road.

To move and manoeuvre troops on the territory of the Czech Republic will primarily use the existing road network. The density of the network is 71.4 km / 100 km^2 but the motorway density is only 6.5 km / 1.000 km^2, while in developed European countries ranges from 14-55 km / 1.000 km^2. In a satisfactory state is only about 60 % of the length of roads and highways.

In the Czech Republic is 55.752 km of roads, of which 5.833 km main roads, 14.635 km II. classes and 34.129 km of roads III. class. Highways are planned 1.228 km (operation is still around 49 % - 734 km). Express way 422 km.

The road network, complemented by a network of tertiary roads, it is sufficient to protect the movement and manoeuvre our troops and their all-round security (the Czech Republic).

A) The distribution of military roads

From the viewpoint of military uses road network divided into:

- roads for automobiles;
- military roads.

Intended automobile roads are selected motorways and main roads matching the following military-technical requirements:

- Road width of 6 m;
- Curve radius 20 m;
- Capacity of bridges 60 to 80 tons;

- Clearance height 4.5 m;

- Capacity 4000 - 6000 vehicles per 24 hours.

Military roads are classified according to:

- Destination (for movements and manoeuvre troops, infeed and out feed on);
- Use (for automobiles, for tracked vehicles, to mixed);
- Military-organizational instance, which is established, operated and uses (to the battalion, brigade ...);
- During the highways and roads due to a line contact with the enemy (on the longitudinal, transverse to).

The term military road or military road is called every kind of roads that serve military needs. (transfers, supply, ...).

B) Research on the military roads and bridges

Engineer reconnaissance trips used to determine the condition of the roads for their use as a military road. Based on the scope and details of the survey data is divided into:

a) general,

b) detailed.

Engineer reconnaissance can therefore, by purpose, to divide the survey:

- to identify the basic technical parameters for security after the transfer of communication (survey of route);
- to identify the data on flotation;
- to determine the basic technical parameters determining the degree of usability of a particular road or track;
- to determine the evidence to develop a project military roads or paths.

ENGINEERS SURVEY OF ROADS AND PATHS MAINLY MEASURED:

- State roads (routes);
- Condition of the road crown damage and impassable sections, the kind and extent of damage or destruction;
- Practicability, slope and length of the pitch, slope;
- Nature of the terrain adjacent to the road;
- The type and density of vegetation;
- Flotation along the roads;

- The location and character of the engineer roadblocks and cave-ins, including and possible way to eliminate or circumvent, the possibilities of overcoming contaminated areas;
- The location and characteristics of railway embankments, overpasses and underpasses leading both via road and along them;
- Characteristics of water hazards in places where intersect communication;
- Characteristics of road constructions, their capacity and throughput;
- Excavates space for construction and repair of roads.

Key information obtained pioneer exploration of ways:

• path width;

• sledding depending on the weather - so-called the category of roads and paths;

• capacity - MLC (MILITARY LOAD CLASSIFICATION);

• transhipment port;

• fords;

• restrictions:

- Height (tunnels, underpasses, power lines, buildings protrusions);
- Width (bridges, tunnels, broken pavement, walkthroughs minefields, debris);
- Pitch of 7 % and higher;
- Bend with a radius of 25 m or smaller.

MILITARY LOAD CLASSIFICATION (STANAG 2021)

- Standard system that assigns paths, bridges or ferries class number representing the load that can endure.
- The vehicles are also given a number which indicates the minimum class path, bridge or raft, which can be used.
- This system is also known as "classification of bridges and vehicles".

STANAG 2021 classification of military calculations bridges, ferries, barges and vehicles (MLC) is determined as follows:

If the total weight of the load the vehicle or combination expressed in tones (metric), temporary MLC will be calculated as follows:

Tracked vehicle total weight of the composition x 1.20

Wheeled vehicle total weight of the composition x 1.25

It should be noted that MLC only number!

Final MLC route is always determined by the lowest value of MLC on the route. This is usually the bridges that limit the entire route. If there is a bridge on the route, will determine the final MLC worst stretch of road.

C) The survey of basic technical parameters of roads and paths

Basic technical parameters determining the degree of usability of a particular road or path for military purposes are:

- width of the road and the crown of the road (path);
- curve radius and its extension;
- longitudinal or transverse slope and length of vision;
- the quality of the road surface;
- the nature and condition of the road objects.

D) Estimation of terrain possibility

Detection and evaluation of flotation is performed engineer reconnaissance patrol when it is necessary to move the vote after the detour terrain.

Resistance terrain depends on physical-mechanical properties of the rock and the amount of water it contains.

Measurement shall be either the engineer with a crowbar or a telescopic penetrometer (PT-45).

EVALUATION

For the few viable terrain that is impassable even for different vehicles can mark a field in which the engineer crowbar digs one stroke to a depth of more than 10 cm and using the PT-45 is found lower than 3 MPa.

If it is necessary to lead operations such as terrain, it is necessary to take measures to increase the resistance of the terrain and road conditions.

When choosing the route of military roads and paths respecting the principle of minimum distances between different paths (in terms of protection against attacks WMD), avoid large settlements, communication nodes and places that can be easily a quick bar.

The most important requirements imposed on the military roads and paths in the current conditions are:

- The sufficient number and appropriate course;
- The quality of the surface;
- The possibility of establishing a fast, easy recovery and maintenance, degree of resistance to the current means of destruction.

E) Design military roads and paths

a) Finding a survey of the course in the field

Before processing, implementing project documentation communication needs to be clarified:

• tactical and technical requirements, which the roads meet;

• intensity of traffic that affects the width configuration of communication;

• mode of transport and vehicle weight, which will affect the construction of the road;

• time to make the building from which implies the need for forces and resources.

b) Trace

• activities that determine the course of the route is called the trace section of this activity restricted to the marking of trails in nature, is called marking the route.

• trace on the 1: 25,000 fold rule for the preliminary design of the gross determine the direction of the route. With lines combine for points that must be planned communication through. According to this line can lead cut terrain and is obtained by tilting the image height differences. Assess the difficult stretches of terrain, etc.

c) Find the route in contour plan

• find control lines;

• proposal directional tangent line polygon;

• designing directional arcs;

• appoint axis;

• delivery of a longitudinal section;

• designing vertical alignment.

d) Selection variants military roads

• must agree to set direction and must be minimized;

• the extent of earthworks must be minimized;

• must have the least amount of sophisticated roadside objects;

• scope of work shall not impair the completion of construction within the deadline;

• must avoid long maximum pitch and arcs of small radii;

• must have adequate subsoil rock roadway;

• must meet the requirements for camouflage.

e) A survey routes in the field

- check the terrain variations routes and assess whether local conditions are consistent with the best selection of proposed routes;
- specify the connection point of the route in the starting and ending point;
- specify the method of removing the high terrain;
- determine the location and type of road objects;
- specify the type of drainage;
- obtain information on appropriate building materials from local sources;
- carry out geological exploration.

Observed data from a survey engineer paths are building blocks for further planning troop movements and can greatly influence the decisions of the commander.

It is therefore necessary to transmit all the information disclosed, although it seemed of little importance.

Explorer does not evaluate information. Explorer gets information, collects and forwards in time.

List of tasks for students:

1. Describe the general division of roads and paths.
2. Explain the implementation of the second survey of military engineer of roads and bridges.
3. Briefly describe the method for determining the basic technical parameters of the trip.
4. Briefly describe way of measuring throughput terrain.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora*. Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) *Ženijní doktrína pozemních sil*;
3. MACH, Václav. „*Vojenské mosty, cesty a přepravy“.* [S 3174] Vyškov: VVŠ PV, 1995, 81 s.;
4. MAREČEK, Karel. „*Vojenské silnice“.* [U 1397] Brno: VA, 2004, 460 s.;
5. Žen-2-16 „*Vojenské silnice a cesty“.* Praha: MO ČR, 1987, 227 s.

2.11 Maintenance of the main route for supplies in serviceable condition

Preparation and maintenance of roads and trails is one of the most important tasks of ensuring the operability of roads. This is achieved by periodically routine maintenance and drainage.

Preparation and maintenance of roads for the movement and manoeuvre troops are among the basic tasks of engineering support the implementation in all types of combat.

This task is fulfilled forces engineer units as well as all kinds of arms and services.

A) The maintenance and repair of roads and trails

Maintenance of roads and trails means performing an operation designed to preserve the roads and their parts in a satisfactory condition.

The main tasks of routine maintenance include:

- Settlement ruts and inequalities,
- Cleaning of roads and roadsides,
- Maintenance of the slope,
- Ditch cleaning of mud and grass,
- Cleaning of culverts.

In winter, it is mainly about snow removal, spreading ice and protection of road from snowdrifts.

Maintenance and restoration of roads and paths are divided into:

• routine maintenance (summer and winter);

• fault repairs the road and the road surface.

B) Overcoming few viable terrain

As a little bearable terrain we might call such a terrain, which is composed of less stable soils.

An important factor influencing the stability of the earth is in most cases moisture. Bottlenecks vehicles depend on soil strength, and generally, that with increasing amounts of water possibility decreases.

Overcoming few viable terrains is one of the main tasks primarily at times when they are so used - auxiliaries' paths.

As explained in the introduction to the seminar, the adjustment and maintenance of roads and paths one of the most important tasks of ensuring the operability of roads.

Preparation and maintenance of roads for the movement and manoeuvre troops are among the basic tasks of engineering support the implementation in all types of combat.

This task is filled not only forces engineer units, but also all kinds of arms and services.

List of tasks for students:

1. Describe the activity in the maintenance and repair of roads and paths, and engineer units that ACR would these tasks contributed most.
2. Characterize possibility of overcoming little bearable terrain, including its evaluation.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora*. Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) *Ženijní doktrína pozemních sil*;
3. MACH, Václav. „*Vojenské mosty, cesty a přepravy".* [S 3174] Vyškov: VVŠ PV, 1995, 81 s.;
4. MAREČEK, Karel. „*Vojenské silnice".* [U 1397] Brno: VA, 2004, 460 s.;
5. Žen-2-16 „*Vojenské silnice a cesty".* Praha: MO ČR, 1987, 227 s.

2.12 Design and construction of temporary and permanent facilities for accommodation

Designing and actual construction of temporary and permanent facilities for accommodation among the tasks of general engineering support to units filled Corps of Engineers, and especially logistics unit. Military Engineer is involved in this activity equipment, material and trained personnel. Project documentation is processed logistics department, who then gives the commander for approval. Engineers designing the task involved only.

Temporary and permanent facilities for accommodation in operations belong to the issue of protecting the troops.

Protection of forces is defined as a set of measures and means to minimize detection of possible enemy targets vulnerable people, equipment, armaments and

equipment and operations before any threat in every situation and maintaining agility and combat capability of troops.

The aim of protecting troops, the maximum reduction in the efficiency of enemy action on his own troops, eliminates the consequences of attack, preserving or restoring the combat capability of troops and protection against the adverse effects of its own weapons and combat techniques.

Protection of forces includes:

- protection against weapons of mass destruction (including protection against industrial hazardous substances);
- protection against conventional weapons and high-precision weapons;
- protection against electronic effects and deceiving the enemy;
- protection against the adverse effects of their own weapons and combat equipment;
- fire protection;
- police protection;
- health.

Protection of forces is also one of the key elements to ensure the safety of all forces and elements deployed in the context of non-combat operations. Measures to protect troops are realized in the form of general or specific measures. Both general and specific measures to implement the use of military force own forces and means or the measures may be implemented in the form of support.

A) Accommodation - general

The actual establishment of military bases, where the issue is dealt with accommodation, shall be based on the approved project. The goal is to build more resistant space effect units and simultaneously create conditions for normal life units in the area over a longer time span. Emphasis must be placed on the defence space, protection of persons and equipment and the possibility of evacuation units of space.

It is convenient to divide the work according to the draft Regulations to field work:

- **first order:** they are works that are designed to ensure the effectiveness of firings and resistance command - circumferential perimeter emplacements, booby signalling, build connections, build makeshift command post, the entrance to the base, access road;
- **second order:** it works to increase the protection of manpower, equipment, techniques and mat, building a solid command posts, emergency shelters, kitchen, dining room, billeting of troops, sanitary facilities, temporary accommodation;
- **another order:** it's work to further improve the protection and comfort of the troops.

Tents

For short-term accommodations are the best types of tents with so-called. Inflatable structures and the possibility of joining the into larger units.

ISO containers

For the longer term effects of foreign missions in the site brings accommodation in containers significantly improved comfort accommodation. But it is at a higher cost of transporting and handling itself and seating, with material handling technology.

Wooden buildings

It is a lightweight prefabricated building, which are used to build bases on foreign missions for units with long-term effects.

B) Protection of bases

Question circumferential perimeter is one of the most important. If we look at the hierarchy of building the foundation and construction of such structures is always done in the first place.

Unless built enough functioning circuit protection, cannot begin any construction of infrastructure base. Perimeter must be continuously improved in order to minimize the possibility of disrupting traffic base.

Circumferential perimeter - circumferential perimeter is meant the area that is necessary to protect and guard the available forces and means.

C) Protection of construction and their distribution

Protective structures - are engineering constructions, which allow direct protection in combat manpower, equipment and material resources from the effects of the destruction of the enemy, hidden manoeuvre under enemy fire, and the effective management of their own fire and solid command of troops.

Complexes OF BUILDINGS - means a set of buildings built to protect troops and other targets against the effects of the enemy and firing shots weapons of mass destruction and providing activities according to the intended use of forces and means in the fight.

Units Corps of Engineers play in the implementation of measures of protection engineer troops decisive role. Due to its destiny and equipment engineer resources contribute significantly through engineering support for the implementation of measures of protection engineer troops. They are especially able to build protective structures and edit existing objects, set up roadblocks, to perform tasks in the field of research and deception of the enemy. In terms of usability are primarily engineering and construction units equipped with the means to modify the terrain (roads, areas and perimeters bases).

List of tasks for students:

1. Discuss the first general accommodation of troops at bases.
2. Characterize protection options bases in foreign operations.
3. Could you describe briefly protective structures and their distribution within the ACR.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. Návrh předpisu Vševojsk-2-2. *Ženijní zabezpečení boje*. Praha 2004;
4. Pomůcka *„Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“.* Praha 2006.

2.13 Ensuring movement in decontamination area

Members of the Corps of Engineers must implement the general principles of protection against chemical, biological, radiological and nuclear substances that are common to all components of the joint forces. Members of the Army Corps of Engineers individual countries may be assigned specific tasks in the field of protection against chemical, biological, radiological and nuclear agents. These tasks are different in every army.

Sappers (in terms of belonging to the country) may be based on the organization, skills and equipment involved in performing the **following tasks**:

- helping to preserve combat capability;
- possibility way through space after the attack by chemical, biological, radiological and nuclear agents;
- contributing to the activities in the area of decontamination;
- participation in the said consequences in the release of industrial hazardous substances (ROTA) and threats to industrial toxic substances (TIH);
- dealing with the effects of combat operations using chemical, biological, radiological and nuclear resources to drive Corps of Engineers.

A) Decontamination space

Characteristic

1) The decontamination area is established for the decontamination of intervening troops and resources after returning from the danger zone. It is located on the windward side in the outer zone and located immediately adjacent to the danger zone.

2) Reduce contamination caused by hazardous substance to a safe level consists of:

- The organization of the decontamination area,
- Decontamination procedures,
- Correct postponement means
- Isolate contaminated resources in airtight containers.

3) The decontamination area is performed following activities:

- Decontamination of intervening troops and resources,
- Discarding of protective equipment after decontamination,
- Discarding contaminated equipment and their isolation in airtight containers.

4) The decontamination work is divided into space for:

- Discarding contaminated material resources,
- Application of the decontamination agent and rinsing,
- Measuring the effectiveness of decontamination,
- Removing personal protective equipment and place for re-equipping.

B) Engineers in CBRN environments

Decontamination of chemical, biological, radioactive and nuclear agents (CBRN - Chemical, Biological, Radiological and Nuclear).

All types of troops (including engineers) must comply with the general principles of protection against CBRN threats. Combat engineers NATO armies receive different specific tasks against CBRN threats as it is common in their countries.

Combat engineers are often involved in strenuous physical labour, the use of CBRN substances units than other types of troops. Long-term use of means of protection against CBRN agents may decrease the performance of soldiers and equipment engineer units (in planning is necessary to take this count).

General CRBN (decontamination) is a special task CRBN units. Fulfilling this task, general engineer support, ACR is the responsibility of the Chemical Corps. Units Corps of Engineers may be due to its equipment earth-moving machinery involved in the removal of contaminated soil.

List of tasks for students:

1. Short term nature of space decontamination.
2. Explain and describe the possible fulfilment of tasks engineer units in CBRN environments.
3. Could you describe what units ŽV could participate in the decontamination of personnel and technology within the ACR.

Basic and recommended reading:

1. ZELENÝ, J. (S - 10490) *Všeobecná ženijní podpora.* Brno: UO, 2011;
2. STANAG 2394-ATP-52(B) Ženijní doktrína pozemních sil;
3. Pomůcka *„Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“.* Praha 2006.

3. The means of transport, bridge devices and diving equipment

In recent years there have been significant changes in the global, strategic and security environment. However, traditional engineer tasks forces remain and are based on the engineer measures:

- mobility;
- counter-mobility;
- survivability;
- force support engineering*

**Notice: force support engineering – new term, (old term - General engineer support)*

Force support engineering (General Engineer support) involves the provision of engineer advice, technical expertise, resources and work other than the intimate combat support engineering provided directly to combat operations.

ACR military engineer uses for carrying out the variety of means. The next lecture will discuss the floating means of transport, bridge equipment, diving equipment.

3.1 Fundamentals of design and the use of the water crossing transportation means

A) Basic terms and identification of means of transport resources, bridge resources and diving equipment in ACR

Military vessels are all kinds, floating craft, floating equipment and combat vehicles that are introduced and used in the Armed Forces of the Czech Republic and are intended to overcome watercourses, to move or to work on a watercourse or to perform specific tasks of the armed forces to watercourses. [9] The naval vessels are divided into categories:

a) military ships;

b) floating military machine;

c) floating military equipment;

d) amphibious military combat vehicles.

B) Floating Transport resources

The engineers ACR use the following means of transport:

- inflatable boats with outboard motors (AVON, ZODIAC);
- engineer fiberglass boats with outboard motors (RUSB);

- motor boats /pusher barges/ (MO-634 MO-2000);
- pontoon bridge kit (PMS);
- engineer amphibious transport means (PTS-10).

At present, the vessels used in the engineer corps are designed to transport cargo and people. What purpose do these are military vessels, designed for inland waterways. According to the trading pattern applies buoyant cruise and cruise mode transition.

C) Theory vessels

Theory vessels:

- basic concepts of the vessels and sailing;
- display the shape of the vessel;
- buoyancy vessels;
- initial stability of vessels;
- stability at high tilt angles;
- tilting moments acting on the vessel;
- unsinkability;
- navigational resistance;
- resistance gliders;
- drive vessels;
- manoeuvrability of vessels.

The vessel's hull:

- basic concepts related to the hull;
- hull.

Drive unit:

- basic dependence;
- choice of propulsion devices;
- engines;
- clutch;
- boat gear;
- shafting;
- piping system.

D) Boat equipment

Boat equipment:

- steering system;
- active helm;
- thruster systems;
- anchoring devices;
- coupling and mooring equipment;
- towing and pushing device;
- loading equipment;
- mast equipment;
- electrical equipment;
- gear vessels.

E) Bridge resources

Bridges had in the past a significant role in influencing economic and cultural development of mankind. They witnessed the technical maturity of his epoch. Its role is currently not lost in the development of other modes of transport.

Also play an irreplaceable role in the armies of the world when security forces moved on the road. Their quick and appropriate use to accelerate the pace moving troops on the road. This is due to the fact that it is necessary to circumvent and difficult to overcome natural and artificial barriers.

Basic concepts:

- dividing bridges;
- the basic elements of metal bridges.

The requirements for the construction of bridges:

- basic requirements;
- materials;
- limit states;
- ultimate limit states;
- joints;
- design by testing;
- tiredness.

The construction of military bridges:

- folding bridges (one-piece, two-piece, multi-part);
- retractable bridges (one-piece, two-piece, multi-part);
- research directions.

F) Diving equipment

Diving equipment

- fundamentals of diving;
- diving sets;
- dive compressors;
- decompression chambers;
- dive simulators.

List of tasks for students:

To secure the main objective of the operation need military force able to move quickly and without restriction in the area of operations. Higher mobility can balance the numerical insufficiency and is influenced by terrain, weather and enemy intended activity.

The means of transport, bridge devices and diving equipment play one important role in the movement's own security forces.

Basic and recommended reading:

1. Gabriel Števko. *Technika ženijního vojska – plovoucí přepravní prostředky*. Brno: Univerzita obrany, 2009. 86s. ISBN: 978-80-7231-636-6.
2. Žen-2-4 Výcvik na vodě. Praha: MO, 2009.
3. Žen-24-2 Motorový člun MO-634 s podvozkem SP-5. Praha: MO, 1981.
4. Žen-24-3 Ženijní laminátový člun s přívěsnými motory (RUSB). Praha: MO, 1982.
5. Žen-24-13 Pásový obojživelný transportér PTS. Praha: MO, 1977.

3.2 Fundamentals of design and the use of bridge transportation means

A) Basic requirements for vessel construction

Theory vessels:

- basic concepts of the vessels and sailing;
- Display the shape of the vessel;
    - the theoretical drawing of the vessel
    - the basic dimensions of the hull
    - the ratios of the main dimensions of the vessel
- buoyancy vessels;

Note: The definition of buoyancy. Buoyancy call basic feature of the ship to remain in equilibrium immersion in the water, thus swim.

Terms of buoyancy are four and are expressed by the following relationships:

1. $G = F = \rho . V. g$ *(N), (1)*

2. yG = yC = O (mm), (2)

3. xG = xC (mm), (3)

4. zG < zC + r or (zG > zC) (mm). (4)

- initial stability of vessels;

Note: The stability of a vessel is the vessel's return to equilibrium, cease to operate outside forces. Deflection around the longitudinal axis is called the tilt angle. The deflection in the longitudinal plane, is around a transverse axis is called slope.

Characteristic longitudinal inclination of the vessel is either the angle of inclination or the difference different dives TP fore and aft TZ:

$$_{PZ}\Delta = L \cdot tg\psi = T - T \qquad \text{(mm).} \qquad (5)$$

When simplifying assumptions it is possible to speak of stability at low angles (10^o *to* 15^o *to) and stability at high tilt angles. When stability at low angles (initial, static stability), then is the linear dependence between the overturning moment and the angle of deflection.*

- stability at high tilt angles;
- tilting moments acting on the vessel;

Note: Moments acting on the vessel:

- *the effects of wind,*
- *the impact strength of the rope tug*
- *the effect of centrifugal force when cornering.*

- unsinkability;

Note: unsinkability is called the property to maintain eligibility ships sailing under flooding one or more spaces. Unsinkability is measured by dividing the hull watertight transverse and longitudinal ridges that extend to the deck.

Flooded space has resulted in:

a) increase the pressure and mean draft,

b) change different, is longitudinal slope at the bow or stern,

c) in the case of longitudinal ridges or unbalanced areas also cross slope,

d) reduction of metacentric height the stability due to formation of other free water levels in flooded areas.

- Navigational resistance*;*

Note: For practical calculations and model testing is based on Froude number of the equivalence of the frictional resistance of the hull to the frictional resistance of a flat plate. Of the total resistance R real boats or model subtracts the frictional resistance RF calculated based on the generalized results of systematic tests flat plates. Thus, the total resistance is expressed by two components:

$$R = R + R = R + R + R + R \qquad (N). \qquad (6)$$

While the second component RR is called residual resistance and include viral resistance RV, RW and wave resistance of the resistor R τ - RF caused due to the curvature of the hull. Distribution of resistance to frictional resistance RF and residual resistance RR is based on a breakdown by causes of individual components of resistance. This principle for reasons of simplicity of modelling has gained wide use in model tests, first and second, in practical calculations, and so most practical computational methods based on Froude law of the similarity.

- resistance gliders;
- drive vessels;

Note: For security uniform motion of the ship at a certain speed (or the naves) has created driving force to overcome the resistance of the water against the motion. In the simplest case of external forces their size is equal to the resistance of the ship.

[2] It is a case of pulling the ship, respectively. naves hawser, the case of aerodynamic forces on the sails or the rotors by the wind, etc.. If the sum of the tensile forces in the direction T at a certain speed of movement is in equilibrium with the resistance R of the vessel at this speed, then power is towed

$$P = T \cdot v \qquad (W). \qquad (7)$$

Most often, however, the ship moves so that its propulsion device gives the water a certain momentum opposite movement of the ship and the response that arises while on the ship, presents its own motive power. This type of device is called the general method of propulsion and thruster propulsion.

By the way, how thruster generates the necessary impetus to divide the propulsion machinery blade, wing and current.

- manoeuvrability of vessels.

Note: Manoeuvrability is the ability of the vessels to sail the desired trajectory and change course as required. We mean the controllability of the vessel, ie. Ability of the vessel to maintain and change the direction of navigation and manoeuvrability of the vessel, ie. The ability to change direction, speed, direction and position of the boat cruises suitable devices (propulsion device, rudder, propulsion equipment, anchoring, mooring equipment, etc.).

Technical means steering

The securing of required manoeuvrability of the vessel must be equipped with the necessary steering system. The basic steering means includes steering fins, rotating nozzles, deflectors fountains, Voith-Schneider thruster, steering propulsion systems.]

The group of auxiliary steering systems, which are designed to improve steering characteristics of the main rudder, thruster systems include, front thruster fins, rudders and active.

B) The main part of the vessels

The vessel's hull

The body is made up of the vessel hull and superstructure of the vessel.

To understand the basic parts of the hull will discuss the basic concepts, the basic parameters of the hull, main dimensions determining a ship's hull.

The basic parts of the vessel's hull. The vessel's hull is composed of Framing, plating, bulkheads. The hull ensures create the desired discharge, must have sufficient strength, enables the distribution of people, cargo, equipment.

The construction of the hull is given by the navigation area for which the vessel is intended. Hull design is also given purpose vessels, cruise manner.

The superstructure of the vessel is part of the hull above the main deck.

Drive unit

Propulsion states ship moving under its own power plant. Drive unit consists of propulsion machinery and propulsion equipment.

Drive train consists of a combination of capital equipment and gear mechanism.

Propulsive device system consisting of a propeller shaft and the respective management, which are listed in the movement of propulsion aggregates.

The main part of the drive sets is the main engine that provides the power for propulsion or work equipment technical craft.

Propulsion element (also thruster) is part of the propulsion device which acts on the water and thus a response (also simultaneously formed hydrodynamic buoyancy), which drives the ship.

Propeller Propulsion is a type of ship propulsion, which uses the movement of the ship pressure generated on the leaves of the propeller.

Thruster systems is a means of active control of the ship with propulsion element positioned in the lateral tunnel hull or veneer outside the fuselage causing a move that is perpendicular to the axial plane of the ship.

Outboard motor is separate easily detachable and portable power unit. It consists of a motor, drive shaft and propeller. Used for smaller vessels.

In describing the power plant is necessary to answer the basic depending on the choice of:

- propulsion equipment,
- Engines,
- Clutch
- Boat Gear,
- Shafting
- piping system.

Boat equipment

Ship (board) equipment (deck engines, deck machinery) is a file, usually mechanical equipment on board, which is used to perform a certain task operation. We recognize the device anchor, steering, mooring and handling, boat, mast, loading, towing and thrust, coupling, for control of oesophageal covers ...

Marine Equipment is a summary of additional structural and other parts of the vessel strictly necessary for navigation [3,5,13]. Recognizes the loose rigging and rigging firm. Free rigging (also free equipment, boat inventory) are handset equipment and vessels used for different purposes. According to distinguish free rigging:

- anchor
- trawl,
- on-board
- navigation,
- rescue,
- compression,
- emergency and fire,

- signal,
- measuring and others.

Under the fixed-gear components include boat permanently attached to the deck. Examples are shipping doors, stairs, ladders, tarpaulin decks, foundations, consoles and racks, steel floors, signs and labels, shafts, hold hatches, chimneys, abrasions and solid bumpers.

Boat mechanisms are needed to ensure the safety and operating vessels for sailing and parking. If necessary, allow you to connect to other vessels required reports.

Boat mechanisms also provide cargo handling.

C) Basic requirements for the design of metal bridges

The requirements for the construction of bridges:

- basic requirements,
- materials,
- limit states,
- ultimate limit states,
- joints,
- design by testing,
- tiredness.

D) The main parts of the bridges

The construction of military bridges:

• folding bridges (one-piece, two-piece, multi-part)

• retractable bridges (one-piece, two-piece, multi-part)

• research directions.

E) Main TTD and determination of transport means

To secure mobility own units in combat operations are used bridge tanks, amphibious assault weapons and boats.

To ensure the mobility of units and formations advancing for fighting units are used amphibious bridges (barges, ferries), floating bridges, bridges and other logistical means to overcome obstacles and roadblocks.

The following section will discuss:

- destination;

- main tactical and technical data;
- main parts and their functions;
- transport by floating transport means.

F) Main TTD and determination of bridging equipment

The ACR are introduced standardized means for establishing bridges. The following types of bridge funding:

- armoured bridge layer (MT-55A);
- spare bridge carrier (PM-55);
- bridge layer (AM-50 AM-70).

Offensive bridges are used to secure mobility own units in overcoming anti-tank obstacles. Offensive bridges can be divided by:

- building technology for folding and sliding;
- the number of bridge parts per piece, two-piece and multi-piece;
- chassis to the tank, wheel, automobiles, trailers and semi-trailers;
- the material of which are made on bridges of steel alloys, aluminium alloys, composite materials.

In the last century have been introduced into the army bridge cars (AM-50), which replaced the bridge kit MS. At present, was designed to modernization (AM-70).

From a structural point of view consist standardized bridges currently established in the Army of the following parts:

- chassis;
- laying equipment;
- bridge;
- accessories.

The following section will discuss:

- destination;
- main tactical and technical data;
- main parts and their functions;
- building technology bridges.

G) Main TTD and determination of diving equipment

In this section we discuss:

- fundamentals of diving;
- diving sets;
- dive compressors;
- decompression chambers;
- dive simulators

List of tasks for students:

Process seminar work, focusing on:

1. Folding Float Bridge - set PMS, determination, TTD main, main parts and their functions, method of use (running, truck transportation, inducing transport, and vessel transport).

2. Boat RUSB - determining TTD main, main parts and their functions, method of use (running, to flow, to drift, cruise, turnover, loading). The design of the outboard motor.

3. Boat MO-634 - determining TTD main, main parts and their functions, method of use (running, sailing, manoeuvre the vessel, the gambit connections ships, loading).

4. Boat MO-2000 - determining TTD main, main parts and their functions, method of use (running, sailing, manoeuvre the vessel, the gambit connections ships, loading).

5. Transporter PTS-10 - determining the main TTD, the main parts and their functions, method of use (transport cycle, the entrance into the water, boating, exit out of the water, unloading - loading).

6. Bridge Layer AM-50 - determining TTD main, main parts, building technology.

7. Bridge Layer AM-70 - determining TTD main, main parts, building technology.

8. Armoured Bridge Layer MT-55A - determining TTD main, main parts, building technology.

9. Spare Bridge Carrier PM-55 - determining TTD main, main parts, building technology.

10. Diving Kit SP-20 - determining the main TTD, the main part and use.

11. Diving Kit SP-20D - determining the main TTD, the main part and use.

12. Deco chamber Haux - determining the main TTD, the main part and use.

13. Diving Simulator - determine the main TTD, the main part and use.

Basic and recommended reading:

1. Gabriel Števko. *Kovové mosty (přednášky)*
2. Žen-34-11 Mostní tank MT-55A. Praha: MO, 1975.
3. Žen-24-14 Mostní automobil AM-50. Praha: MO, 1877.
4. Žen-24-15 Přepravník mostu PM-55. Praha: MO, 1974.

3.3 Fundamentals of design and the use of diving equipment.

To secure the main objective of the operation require military forces to move quickly and without restriction in the area of operations. Higher mobility can balance the numerical insufficiency and is influenced by terrain, weather and enemy intended activity.

The means of transport, bridge devices and diving equipment is used in the tasks of security motion. Commanders need to know to determine the basics of design and technology work used techniques and resources to be able to use the established technique in performing tasks engineer support in the circumstances within their technical capabilities.

A) Main TTD and determination of transport means

- Folding Float Bridge (Set PMS) - determination, specification (main TTD), main parts and their functions, method of use (running, truck transportation, inducing transport, vessel transport).

- Boat RUSB – determination, specification (main TTD), main parts and their functions, method of use (running, to flow, to drift, cruise, turnover, loading). The design of the outboard motor.

- The boat MO-634 - determination, specification (main TTD), main parts and their functions, method of use (running, sailing, manoeuvre the vessel, the gambit connections boat, loading).

- The boat MO-2000 determination, specification (main TTD), main parts and their functions, method of use (running, sailing, manoeuvre the vessel, the gambit connections boat, loading).

- Tracked Amphibious Vehicle (Transporter PTS-10) - determination, specification (main TTD), main parts and their functions, method of use (transport cycle, the entrance into the water, boating, exit out of the water, unloading - loading).

B) Main TTD and determination of bridging equipment

- Bridge Layer (Bridge automobile) AM-50 - determination, specification (main TTD), main parts and their functions, building technology.

• Bridge Layer (Bridge automobile) AM-70 - determination, specification (main TTD), main parts and their functions, building technology.

• Bridge Layer Tank MT-55A - determination, specification (main TTD), main parts and their functions, building technology.

• Spare Bridge Carrier (Transporter Bridge PM-55) - determination, specification (main TTD), main parts and their functions, building technology.

C) Main TTD and determination of diving equipment

• Diving Kit SP-20 - determination, specification (main TTD), main parts and their functions and use.

• Diving Kit SP-20D - determination, specification (main TTD), main parts and their functions and use.

• Deco chambers Haux - determination, specification (main TTD), main parts and their functions and use.

• Dive simulator - determination, specification (main TTD), main parts and their functions and use.

Transport means, bridge devices and diving equipment play a major role in securing the movement of friendly forces.

Students will create conditions for self-performing and interpreting the information relevant for solving practical problems identified security movement.

List of tasks for students:

1. Characterize determination and specifications (main TTD) transport means.
2. Characterize determination and specifications (main TTD) Bridging Equipment.
3. Characterize determination and specifications (main TTD) diving equipment.

Basic and recommended reading:

1. Gabriel Števko. *Potápěčská technika (přednášky)*
2. Žen-24-6 Potápěčské práce a potápěčská technika. Praha: MO, 1989.
3. Žen-24-6 Vojenské potápění. Praha: MO, 2009.
4. J. Jahns, A. Růžička, V. Vrbovský. *Přístrojové potápění.* Svaz potápěčů České republiky, 2012

4. Mining and demining equipment

4.1 Fundamentals of design and use of mining and demining equipment

Military forces must be able to fast unrestricted movement in space activities to fulfil the primary objective of the operation. Mobility is necessary to achieve concerted effort for the rapid deployment of troops and to break away from the enemy.

Higher mobility can balance the numerical inferiority and is affected by terrain, weather and enemy action.

In the context of the changed operational environment will be guided by enemy action to restrict the activities with the intention to stop or slow the NATO forces so that they are detained in a target area. Or will this enemy activity aimed at limiting freedom of manoeuvre

To achieve these objectives can be used equipment that include both the means conveying air and the use of landmines (min Asked sparsely) and IED.

One of the main tasks of ensure movement is demining, which is aimed at detection, reconnaissance, marking, bypassing, breaching and clearance of mined areas.

Counter mobility operations affect an enemy`s ability to manoeuvre freely and selectively deny him the use of terrain. Counter mobility operations may also reduce the effect of an attacker`s superiority in numbers, and channel him into areas of our choosing where he can be defeated. Counter mobility planning must also take account of own force maneuver requirements.

Despite the restrictive measures imposed by States, international and national laws are constant demand for storing large supplies of resources to limit enemy activity.

Operational analysis has clearly demonstrated the benefits of munitions based capability in particular but there are other ways of achieving this effect including air, direct and indirect fire weapon systems.

One of the main tasks of action to restrict the movement of the enemy is emplacing obstacles. Emplacing obstacles includes a wide range of options such as the use of mines, explosives and earthworks to achieve the desired effect on the movement of the enemy.

A) Basic concepts and determine mining and demining equipment in ACR

During combat operations with the use of landmines - the explosive material for placement below the ground surface or near another area. To initiate the land mines there, zooming or direct contact persons, vehicles, aircraft or boat, including landing craft.

demining / dépollution à des fins civiles / odminování

The removal of all unexploded mines, explosive ordnance, improvised explosive devices and booby traps from a defined area to make the area safe for civilians.

Note: demining is not normally conducted by military units. *Related terms: countermine operation; improvised explosive device; unexploded explosive ordnance.*

tactical mining / mouillage tactique de mines / minování na taktickém stupni

In naval mine warfare, mining designed to influence a specific operation or to counter a known or presumed tactical aim of the enemy. Implicit in tactical mining is a limited period of effectiveness of the minefield.

strategic mining / minage stratégique / strategické zaminování

A long term mining campaign designed to deny the enemy the use of specific sea routes or sea areas.

mine clearance / déminage2 / odstranění minového pole

The process of removing all mines from a route or area.

mined area / zone minée / minové pole; zaminovaný prostor

An area which is dangerous because of the presence or suspected presence of mines.

mine disposal / déminage1 / odminování

The process of rendering safe, neutralizing, recovering, removing or destroying mines.

minefield1 / champ de mines1 / minové pole1

In land mine warfare, a defined area in which mines have been emplaced.

Related terms: antisubmarine barrier; antisubmarine patrol; barrier; barrier gap; mixed minefield; nuisance minefield; phoney minefield; protective minefield1; tactical minefield.

minefield breaching / overture d'un champ de mines / zřizování průchodů v minovém poli

In land mine warfare, the process of clearing a lane through a minefield under tactical conditions. *Related terms: gap marker; intermediate marker; lane marker; marker1,2; minefield lane; row marker; strip marker.*

minefield lane / passage à travers un champ de mines / průchod v minovém poli

In land mine warfare, a marked passage leading through a minefield, free of obstacles and not directly exposed to the effects of mines. *Related terms: gap marker; lane marker; row marker; strip marker.*

minefield marking / marquee des champs de mines / vytýčenì minového pole

A standardized system of marking to indicate the location and extent of a minefield.

minehunting / chasse aux mines / vyhledávánì min

The employment of ships, airborne equipment and/or divers to locate and dispose of individual mines.

mine spotting / repérage à vue des mines / vyhledávánì, průzkum min

In naval mine warfare, the process of visually observing a mine or minefield.

mine warfare / guerre des mines / bojová činnost s použitím min

land mine warfare MW

The strategic and tactical use of mines and their counter-measures.

mine weapons / arms de guerre des mines / minový materiál a prostředky

The collective term for all weapons which may be used in mine warfare.

B) Mining equipment

Tank minefields are established:

a) by mechanical equipment

a. mine trimmers,

b. scatter able high-capacity minelaying systems

c. lorries chutes,

d. mine throwers.

b) manually

a. through mine rope

b. entended order manner.

Tank minefields are established:

- using automated equipment out of contact with the enemy,
- using mine strand in contact with the enemy,
- intended order manoeuvre in areas that enemy does not control the fire (mainly as a protective minefields; these minefields set up all kinds of troops).

Universal mine-laying UMU allow mine laying surface. In a minefield of three lines should be placed mines in a row at a distance of four meters, about four rows can lay mines at a distance of 4-8 meters from each other. Laying speed is 4-8 kph-1.

Universal minelaying UMU:

- determination,
- specification (main TTD),
- main parts and their functions
- methods of laying mines.

Mine-laying vehicle MU-90 allow surface laying anti-tank mines using slip with automatic unlocking min. Minefields are usually set up on four lines, mines are laid in rows in the possible distances 4, 6, and 8 meters apart. The speed of presentation is 5-15 kph-1.

Mine-laying vehicle MU-90:

- determination,
- specification (main TTD),
- main parts and their functions
- methods of laying mines.

If the shortage of mine laying machine, used for surface mine laying trucks with slides.

Mine launcher MV-3 allow the establishment of anti-tank minefields by remotely mining are using container bullets KS / PT Mi-D from uncovered and covered firing positions at distances of 500-3000 m after jumping 500 m. The establishment of an anti-tank minefield of medium length of 100 has medium depth of 120 m at a distance of 2,500 m is needed 12 shots container KS / PT Mi-D (4 volleys), at a distance of 2500-3000 meters of container 18 shots (6 rounds).

Operation of a mine-launcher MV-3 consists of commander and gunner. Mine launcher is transported on a truck.

Mine launcher MV-3:

- determination,
- specification (main TTD),
- main parts and their functions
- methods of laying mines.

C) Demining equipment

Demining equipment is the sum of facilities, equipment, devices and kits of material intended for exploration explosive roadblocks, creating passages in minefields and to complete demining field.

Demining equipment is divided into:

- Explosive,
- mechanical,
- manual demining.

Explosive mine equipment used to activate or destruction min pressure wave caused by an explosion or detonation transmission and thus create a passage in a minefield.

Explosive mine clearance are:

- explosive demining,
- line charge.

Explosive demining VO is used to expand rail passes in the minefields for the tanks established mechanical demining.

Explosive demining VO:

- determination,
- specification (main TTD),
- main parts and their functions
- methods of demining.

Mechanical mine clearance are special devices. They can be mounted on a tank or other resources that are used to set up the passages in the minefields. Mechanical deminers can create a passage of any length depending on their resistance to explosions min. Their disadvantage is that they are applicable only in a certain field.

The demining is bringing min explosion pressure demining equipment to mine or plowing min and moving them out of the passage or impact demining equipment to trigger a crash.

Mechanical mine clearance can be divided into:

- disc,
- harvesting
- drums,
- expatriatrion.

Disc mechanical demining form disc wheels pushed tank. Hung on the front of the tank and are intended to create rolling or continuous passages in minefields. Mines are activated by the pressure of each disc.

Mechanical demining toppers forms arrow blade or two independently working blade placed in front of the tank. Mine clearance to remove mines even with plowed rock outside passageway formed. They can be used in light to medium rocks.

Mechanical demining KMT-6 is designed to establish rail passes in the minefields.

Mines before the tank straps dig the ground and cleans the outside of the belt skew a shin. In setting up the passages in the minefields laid in the snow and frozen ground in the working system strengthens winter demining equipment.

Mechanical mine clearance forms a passage track width 620 mm, with an internal space no mine clearance 2070 mm. Mines with a stir inflator is fed to an explosion in the entire width of the tank.

Mechanical demining KMT-6:

- determination,
- specification (main TTD),
- main parts and their functions
- methods of demining.

The effectiveness of mechanical demining is reduced by using non-contact against the bottom antitank mines that can destroy a means of fighting with demining.

Against non-contact Mina tanks with mechanical demining equip electromagnetic demining or other attachments.

Mechanical demining BOŽENA 1 BOŽENA 5 is designed for surface mine clearance. Mines are activated before demining or disrupted by striking mechanism. Mine set BOŽENA is suitable for large-scale demining mined areas. In addition to demining machine can be used to dispose of shrubs and low vegetation, after replacing the working tool then also for the transport and handling of hazardous materials or as a remotely controlled earth-moving machine. Its working speed depends on the terrain.

Mine set BOŽENA 1 Universal Remote Control armored loader fitted with demining equipment. The ACR is used as a special engineer demining means.

Specifications **BOŽENA 1**

Parameter	**Size**
length	5282 mm
width	2716 mm

high	2100 mm
weight	11 720 kg
cleared path width	2000 mm
clearance depth	do 250 mm
clearance area coverage	1800 m^2/h
range	do 5 km

Mine clearing system/complete BOŽENA 5 is remotely controlled self-propelled armored demining machine that is equipped with a rotary flail demining equipment.

In light terrain is working an average speed of 4900 m², in the medium terrain 2400 m² and the difficult terrain of 1 050 m² per hour.

Specifications **BOŽENA 5**

Parameter	**Size**
length	7320 mm
width	3350 mm
height	2225 mm
weight with attachment	11 720 kg
clearing width	2655 mm
brodivost	do 800 mm
speed	4-9 km/h
range	až 2000 m

The system BOŽENA 5 consists of a base support and snímatelé working unit, which is Cepák mine or mill. In addition, the ability of machines are widespread proven accessories and accessories for handling unexploded munitions, but also for other engineer, works.

To secure the main objective of the operation need military force able to move quickly and without restriction in the area of operations. Higher mobility can balance the numerical insufficiency and is influenced by terrain, weather and enemy intended activity.

Mining and mine clearance equipment plays a major role in securing the movement of friendly forces.

List of tasks for students:

Process seminar work, focusing on:

- Universal Minh swapper UMU - determining TTD main, main parts and their functions and use.
- Mine thrower MV-3 - to determine the main TTD, the main parts and their functions and use.
- Minh swapper MU-90 - determining the main TTD, the main parts and their functions and use.
- Minh swapper MU-01 - determining the main TTD, the main parts and their functions and use.
- Mechanical demining KMT-6 - determining TTD main, main parts and their functions and use.
- Explosive demining VO - determining TTD main, main parts and their functions and use.

Basic and recommended reading:

1. PALASIEWICZ, Tibor. *Zatarasování 1. díl*. Brno: Univerzita obrany, 2013. 102s. ISBN 978-80-7231-951-0;
2. Žen-2-7 Výbušné zátarasy. Praha: MO, 1996;
3. Žen-2-8 Minový vrhač MV-3. Obsluha a bojové použití. Praha: MO, 1997;
4. Žen-2-9 Ženijní práce všech druhů vojsk. Praha: MO, 1981;
5. Žen-29-3 Minový vrhač MV-3. Popis a provoz. Praha: MO, 1998;
6. Žen-29-6 Výbušný odminovač VO. MO, 1976;
7. Žen-29-9 Univerzální minový ukladač UMU. Praha: MO, 1968;
8. Žen-29-11 Mechanický odminovač KMT-6. Praha: MO, 1981.

5. Machines for lifting and wood processing means for lifting and water treatment, EC and distribution means

5.1 Fundamentals of design and the use of the machinery for timber industry. Basic design and the use of means for drilling, extraction and water treatment

A) Machinery for lifting and woodworking

Wood has always been important for human society raw material with many uses. Served for the construction of dwellings, housing production equipment, tools and apparatus and was an important source of thermal energy.

Large expansion timber found in military conditions in the past and at present primarily for their useful physical and mechanical properties such as e.g. a relatively low density, bending strength and compressive strength, good process ability and a relatively long shelf life.

For the army is also important easy availability of wood as a raw material, mainly for the construction of bridges low water, strengthening of existing bridges, construction of various buildings fortification, reinforcing roads and other engineering work.

The wood is used in the performance of a wide range of tasks within the movement's own security forces, restrictions on the activities of the enemy, preserve combat capability and within the general engineer support.

In this section we discuss the properties of wood, ways of cutting wood, sawmills, timber plants.

Properties of wood

Wood is a material of organic origin produced perennial woody plants during the growth of strains in length and thickness. After morphological page consists of the cells, respectively. from their walls.

Since the cell timber consisting mostly elongated, oriented in parallel with the axis of the trunk or branches and arranged concentrically around it, has wood in different directions or the same structure or the same properties. It is therefore anisotropic material and as such need to be assessed and evaluated. In order to allow the wood raw material is optimally used, it must have a minimum knowledge of its physical, mechanical, chemical and other properties.

The basic physical property of wood includes:

- Moisture content,
- Density of the wood,
- Porosity of wood,

- Thermal properties,

- Electrical characteristics,

- Acoustic properties.

Mechanical properties of wood express its resistance to external forces. Against them has internal cohesive forces between the molecules of wood (material), called voltage.

Wood as a biological material is a complex anatomical and chemical complex.

Consists of cells and intercellular parts of different chemical composition. In addition to water and air wood predominantly contains macromolecular substances carbohydrate (sugar) and lignin nature each other more or less chemically bonded. Minerals in the wood is less than 1%, determined from the ash content.

Wood is an inhomogeneous material - the composition of the layers of the cell wall, the annual rings (spring and summer wood), individual parts of the trunk and particular species differ from each other. These ingredients are macromolecular character.

Felled trees Branch and gave crude tribes in the full length. Subscribers raw timber, however, usually have very specific requirements for tree species, size and quality, or asking quite a particular range of raw timber.

Basic categories of characteristics of round wood are species, size and quality [2]. In most cases, the quality is assessed by the incidence and extent of the defects of timber [3].

The basic defect of timber, by which we judge the suitability of wood for inclusion in one of round wood is divided in sequential order as to the significance of the following groups:

• knots,

• cracks,

• defects in shape tribe

• defects caused by fungi

• defects in the wood structure,

• insect damage

• damage cryptogrammic plants,

• some specific defects.

Minerals in the wood is less than 1%, determined from the ash content.

Splitting wood

Work piece material poses during stock removal tool tooth resistance, which is called the cutting resistance. The force which must be applied to the tool to overcome the cutting resistance is called the cutting force.

Specific cutting resistance calculated from the relation

$$K = \frac{P}{b \cdot s} \quad (MPa)$$

where: P is the cutting force (N)

b - width (mm)

s - Followers chip thickness (mm).

Cutting force for any chip cross section is calculated from the known values of K according to the relation

$$P = K \cdot b \cdot s \quad (N).$$

Cutting force P multiplied by the cutting tool path L gives the size of the cutting work A

$$A = P \cdot L \quad (J).$$

Cutting power needed for cutting N per second is calculated as follows:

$$N = K \cdot O = K \cdot b \cdot h \cdot u, \quad (W).$$

where: b = O. h. u (cm 3. s-1); and

b - width of the chip,

h - cutting height (or depth conclusion)

u - speed (m. s -1).

Saws

These are machines which cut the kerf, the cutting edge of the tool should be a little wider than the thickness of the blade, the teeth must be pushing or distribution.

Cutting process is actually a composite cutting, wherein the removal of sawdust is done by external cutting forces overcoming the strength of wood in compressive and shear.

The tools are called blades, saw blades or saw chains. When the work is done by reciprocating motion (frame saws), linear orbiting (belt and chain saws) or rotary (circular saws and cylinders).

Pila aliased logs on slots, slots process timber into lumber, joists and rafters, produce sections of natural wood and agglomerated materials and machining them to create flat surfaces, grooves or pins.

The saw comprises a cutting mechanism, a feed mechanism, a rack and base drives, auxiliary mechanisms and control. Saws are classified by the type of the saw tools:

- Saw-rectilinear reciprocating saw blade, usually cut only in one stroke. These include band saws, scroll saws and sober (fretsaw)
- saw with rotating saw blade, usually cut one branch of the blade.

This includes belt and chain saws,

- rotary (circular) saw with rotating saw blades or rollers.

Lumber Mill

The term timber plants - wood complex includes:

- space for logging,
- store logs,
- storage of logs,
- sawmill - a lumber mill,
- mechanized yard.

B) Means for extracting and water treatment

Means for extracting and processing of water are used to perform the tasks of general engineering support for emergency supplies of water troops in the field. In this section we discuss the requirements for water, technological water treatment processes, means for lifting water, water treatment, water stations.

Water Requirements Water security in the future an important task. Water is in many parts of the world greatly polluted residential and industrial wastes so that they cannot be used for the needs of the population without modification. For the army not natural water sources also comply. Water Requirements for the army are more stringent than the standards set requirements for drinking water [14].

In the case of the use of weapons of mass destruction will be water contaminated with radioactive, poisonous and biological agents and task forces water security will be more complicated. In this case, the need for treated water will rise considerably.

Water is needed for logistic support for the disposal of nuclear, chemical and biological contamination.

To support the troops drinking water, industrial water and water for industrial purposes using local groundwater and surface sources. When there is enough water from local sources, or if there are sources of water, set up the simplest wells or water

imported from hydroelectric stations built logistics unit or units of the Corps of Engineers.

By use of water divided into:

- drinking water,
- potable water
- water for technical purposes.

Drinking water is wholesome water, not even during prolonged use causes health disorders and diseases caused by microorganisms or toxic substances and responsibility requirements of the standard.

When choosing a water source for public water supply should be to focus on those water resources, which in its natural state of physical, chemical, microbiological or biological composition and properties as close as possible the requirements for drinking water. When deciding between several possible water resources must also be based on the optimum investment and operational costs in relation to the complexity of the treatment technology and demands on the transport of water.

The requirements set most suited to:

a) groundwater quality with satisfactory or approaching drinking water,

b) surface water from the headwaters of rivers from areas unencumbered by human activity, accumulated in the water reservoirs.

Technological water treatment processes. Technological water treatment processes can be classified from different perspectives. Improving water quality, for example, a normal water treatment plant (removal of water suspended and colloidal substances and other impurities), deactivation (ridding the water of radioactive substances), decontamination (removal of toxic substances and poisons), disinfection (ridding the water of germs).

Suggested water treatment processes in field conditions according to the STANAG 2885 is divided into:

- physic-chemical processes,
- removing soluble substances,
- disinfection,
- chemical processes finish.

Means for extracting water

Water treatment units

Currently used in the Army of the Czech Republic following a water treatment plant:

- CC-20 Water Treatment 20 l.multidot.h-1,

• UV-2000 water treatment plant in 2000 l.multidot.h-1,

• Aquaozon.

Water stations

Habitat requirements

Location

1. The location should meet (or should be practicable) to the following requirements:

a. Easy and quick access to the resource and back onto the main road.

b. The rally cars waiting near the entrance to the water station.

c. Good access to the dispensing points, so that the vehicle does not block traffic filled.

d. Well-drained hard standing at dispensing site place.

e. The substrate with good natural drainage, if possible, on a slope with sufficient gravity to be able to supply water by gravity from the tank to the vehicle and from septic tanks to the disinfection tank. It would allow building the tank on a flat terrain.

f. Whenever possible, water should be pumped directly from the water treatment plant in vehicles.

2. Graphic drawing water station in Appendix 1.

Water dispenser

3. Water stations will be deployed so that the vehicles, water containers and water bottles can be filled separately at the same time.

Filling fourth place for vehicles.

4. Filling hoses should have a minimum diameter of 50 mm and should be 9-18 m away, if possible. They should normally be at a height of 4 meters above the road surface.

5. The filler space for flasks and water tanks. Flexible hoses must fulfil to allow the water tank located on the transport vehicle. For occasional filling individual containers for water and water bottles should be available to the fixed pipeline with several manually operated closures. They should be used appropriately high loading platform for loading containers onto trucks.

Safety (protective) measures

6. Water stations are necessary following precautions:

a. Fencing (enclosure). If water station uses a longer period should be guarded and fenced.

b. Sanitary measures. Latrines should not be set up close to the water station. If necessary, should be built at a distance of about 100 m from the water station.

c. contaminated fuel. Implement measures to prevent pollution of the water station fuel used in transportation vehicles, pumping units, generators, etc.

Marking

7. Warning signs (according to Annex A STANAG 2035, under Section 2) will be placed on the main road about 200 meters from the entrance to the water station.

List of tasks for students:

Zpracujte seminární práci se zaměřením na:

1. Souprava MPZD - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití.
2. Motorové řetězové pily - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití při kácení, odvětvování, zkracování.
3. Motorové kalové čerpadlo MKČ - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití.
4. Úpravna vody ÚV-20 $l.h^{-1}$ - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití.
5. Úpravna vody ÚV-2000 $l.h^{-1}$ - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití.
6. Úpravna vody AQUAOZON - určení, hlavní TTD, hlavní části a jejich funkce, způsob použití.

Basic and recommended reading:

1. Mobilní pracoviště pro zpracování dřeva – MPZD. Popis a stručný návod k obsluze. Vyškov: VOP-026 Šternberk, divize VTÚPV Vyškov, 2007;
2. Žen-21-21 Řetězové motorové pily a jejich používání. Praha: MO, 1991;
3. PACIGA, Alexander. *Projektovanie a prevádzka čerpacej techniky.* Bratislava: Vydavateľstvo ALFA, 1990. ISBN 80-05-00650-0. 438 s.;
4. Žen-31-2 Čerpadla Praha: MO, 1969;
5. Žen-31-3 Úpravna vody ÚV-20 l.h-1. Praha: MO, 1985;
6. Žen-31-5 Úpravna vody ÚV-2000 l.h-1. Praha: MO, 1974;
7. Kontejnerizovaná úpravna vody Aquaozon 32. Kadaň: F&R s.r.o., 2007.

5.2 Power generators, power distribution and field lighting equipment for units of the Czech Army

General Engineer Support includes providing engineer consultancy, professional expertise, resources and activities other than direct combat engineer support provided within combat operations. From a wide range of tasks also include the tasks of emergency water supply, energy security in the field, security protection engineer troops.

Students act independently, search, sort and interpret information relevant to the identified practical problems general engineering support in the field of building objects, security, water and energy in the field.

A) Determining and specification (major TTD) machinery for excavation and processing of wood

- Set MPZD - determination, specification (main TTD), main parts and their functions and use.
- Motor chain saws - determination, specification (main TTD), main parts and their functions, method of use when felling, limbing, shortening.

B) Determining and specification (major TTD) equipment for excavation and water treatment

- Motor sump pump MKC - determination, specification (main TTD), main parts and their functions and use.
- Water unit UV-20 lh-1 - determination, specification (main TTD), main parts and their functions and use.
- Water unit UV-2000 lh-1 - determination, specification (main TTD), main parts and their functions and use.
- Water unit Aquaozon - determination, specification (main TTD), main parts and their functions and use.

C) Determining and specification (major TTD) equipment for distribution of power generators and resources

- Power Generator EC 30 kW and 60 kW - determination, specification (main TTD), main parts and their functions and use.
- Power Generator EC 4 kW and 6 kW - determination, specification (main TTD), main parts and their functions and use.
- Power Generator EC 12 kW - determination, specification (main TTD), main parts and their functions and use.

• Power Generator EC 2 kW - determination, specification (main TTD), main parts and their functions and use.

• Power Generator EC 8 kW and 16 kW - determination, specification (main TTD), main parts and their functions and use.

• Lighting kit US-U - determination, specification (main TTD), main parts and their functions and use.

Machines for lifting and wood processing equipment for excavation and treatment of water, power and distribution equipment used in performing tasks of general engineer support. Commanders should know the destination, the basics of design and technology work mentioned techniques and resources to be able to use the established technique in performing tasks of general engineering support in the circumstances within their technical capabilities.

Students will create conditions for independent manner, and interpreting information relevant to solving practical problems identified security forces.

List of tasks for students:

- Characterize determination, specification (main TTD), main parts and their functions and use machinery for excavation and processing of wood.
- Characterize determination, specification (main TTD), main parts and their functions and use, machinery for excavation and water treatment.
- Characterize determination, specification (main TTD), main parts and their functions and use, distribution of power and resources.

Basic and recommended reading:

1. Žen-26-3 Elektrocentrála 30 kW a 60 kW. Praha: MO, 1972;
2. Žen-26-6 Elektrocentrála 4 kW a 6 kW. Praha: MO, 1977;
3. Žen-26-7 Elektrocentrála 12 kW. Praha: MO, 1988;
4. Žen-26-5 Polní rozvodové a osvětlovací prostředky. Praha: MO, 1967.

6. Machines for earthwork and rock

Machines for earthwork and rock are the most widely represented at the technology engineer units.

They are used for construction work and in meeting the challenges engineer support, particularly for:

- securing movement of friendly forces,
- restrictions on the activities of the enemy,
- preservation of the combat capability of its own troops,
- general engineer support,
- other tasks (natural disasters, industrial accidents).

6.1 Earth-moving machines and excavators – basic theory about the determination and employment

A) Basic concepts and destination machines for earth and rock work in the ACR

In this section we will only several basic concepts.

Tractor engine crawler or wheeled, with its own engine for travel, which is used in order to apply a pushing or pulling force carried through the work equipment or towing hitch.

Loader machine with its own engine for travel, crawler or wheeled chassis with integral front to support the supporting structure shovels and lever systems, which loads or excavates through the travel of the machine, and that material lifts, transports and poured out.

Excavator is powered machine to travel as rotary uppers, which is able to rotate in the range of at least 360 degrees, which grub, extract, raises, pivots and discharges material effect bucket mounted to the boom or the lower part of the taxiway during any cycle of this machine.

Motor Grader is a machine with its own engine to chassis, equipped with an adjustable blade, positioned between front and rear axles, which cuts, moves and spreads materials according to the requirements of generally sloping grading.

B) Dozers

Dozers are earthmoving work characterized by a cyclical manner.

Work equipment consists of blade suspended by buckling shoulders and linear hydraulic motors on tracked or wheeled tractor - carrier. Power effects needed to disintegration, transport and spreading infer dozer travel.

Important characteristics of dozers are nominal motor power P [kW], weight machines m [Mg], and maximum traction force Ft [kN], or the ratio of these parameters.

Use and distribution of dozers

Dozers are today one of the most widely used construction earthmoving machinery. In addition to carrying out earthworks often helping work. In earthmoving dozer digging, moves, stores or spreads. Coordinating these operations can be performed:

- excavations for different purposes - building foundations, drainage ditches, pits various
- and depressions, trenching,
- lifting and spreading excavated soil or weighed, its storage in the embankment, gross settlement and spreading,
- piling-up of soil based producer to other machines, for example. Excavators,
- backfilling trenches, pits, ditches,
- spreading or piling-up of various building materials and others.

Dozers are also used for various odd jobs, such as:

- removal of vegetation and stumps, tree felling,
- snow removal
- shove scrapers when engaged in hard soils,
- move rippers, rollers and various auxiliary machinery,
- disposal of soil over the ramp,
- rescue.

The basic functional units dozer:

- carrier - wheeled or tracked (Figure 2-2 crawler chassis with top Turas)
- bulldozer equipment - blade pusher arms, hydraulic motors to change the tilt blade, hydraulic blade lift.

Distribution dozers:

a) according to the type of chassis base machine is divided into wheeled and tracked dozers,

b) if possible blade adjustments know:

- bulldozers - blade is permanently set perpendicular to the longitudinal axis of the machine. Can dig and pour only forward.

• angle dozer - blade can be turned in the horizontal plane to about 60 ° relative to the longitudinal axis of the machine. It can work either as a bulldozer or earth may roll into the party.

• tildozer (Fig. 2-4a) - the blade can be rotated in the vertical plane of up to 30o.

• universal dozers (Fig. 2-4b) - Blade has all of the above options, or it can be changed for different working body.

• special dozer, which are mostly used dozers chevron. Among the special also includes dozers Dozer loaders equipped with a claw blade (Fig. 2-5).

The ACR is used dozer Caterpillar D5N, D6K or old dozer D-686th.

C) Graders

Grader is a self-propelled wheeled machine (wheeled), equipped with an adjustable blade between the front and rear axles. Grader mines, moves and spreads material, usually according to the requirements for comparing a sloping terrain. Those movements, positions and settings grader blades give a wide range of applications.

In addition to the main blade (between axes) are motor graders also have:

• front bulldozer blade,

• ripper,

• shortened or extended blade, which can, if necessary, mount instead of the base blade

• possibly other special additional sensing devices.

Distribution graders

According to the travel options (power sources) distinguish graders drawn (outboard or trailed) and motor graders. Motor graders are working with self-propelled machines (own engine for taxiing and control) and therefore with a single operator. Usually have one front and two rear axles, same speed forward and reverse and modern structures also be able to turn the 1800 Operator Station.

Work graders affected by the following conditions:

• the location of the blade,

• setting the cutting blade angle,

• angle of rotation of the blade,

• tilting front wheels,

• manoeuvrability graders,

- automatic levelling.

Grader blade is positioned approximately in the middle of the wheelbase (distance between the front and rear axles). If grader moves on inequality blade is lifted only about half the height of this inequality. Graders it allows relatively precise range of finishing earthworks, especially settlement areas, grading, spreading material into the layers of a given thickness, etc.

The ACR is used grader Caterpillar CAT 120M.

D) Wheel loaders and backhoe loaders

The loader is a self-propelled machine belt or wheel (wheeled or crawler), which applies when using a push or pull force through mounted work equipment.

Their original identifying belongs to a group of machines loaders for loading of bulk and lump materials. This group includes loaders:

- cyclical effects work; especially shovel, scraper;
- a loader with a continuous manner of work; bucket loader, paddle, worm, with conical head, plate and more.

Shovel loaders have evolved in the last period of such changes, they changed their character. Contemporary shovel loaders notably higher performance (over 100 kW) rank among the earth-moving machinery, as the soil can not only treat, but also to benefit and transport. Digging force is with them pulling force exerted forces carriers and implement control.

Distribution and use of loaders

Shovel loaders are different from each design solution undercarriage of their own carriers, working device, placing the engine and frame structure.

According chassis divided loaders:

- crawler
- wheeled chassis.

According to the work equipment can be divided into loaders:

- front loader,
- rotate - with a rotating boom.

Track loaders are usually designed as a front.

Wheel front loaders can be subdivided according to the carrier frame loaders:

- a rigid frame,
- articulated frame.

Depending on the location of the engine divided loaders:

- front-engine,
- rear engine.

According to the control system with traction driving the front wheels, rear-wheel, all wheel articulated frame, with independent rotating wheel slippage wheel slippage passports, with independent movement of the belt.

According traction drive system:

- front wheel drive,
- rear-wheel drive,
- all-wheel drive.

The ACR is used:

- medium loader KN-251,
- small loader UNC-750/752, JCB Robot 170,
- backhoe loaders JCB 4CX.

E) Automotive excavators

Shovel excavator is a self-propelled machine belt or wheel (crawler or wheeled) with a rotating body, capable of turning in the range of at least 360, which grub, benefits, raises, pivots and discharge of materials using a bucket mounted on a boom without moving the bottom of the machine or running gear during any part of the machine cycle.

Excavators can be divided by a number of different aspects, according to the work equipment, type of travel, drive type, transmission of forces working on the device by storing the upper chassis, etc.

According to the work equipment shovel excavators are divided into:

- excavators with bucket height - when the mechanisms are adapted for digging mainly over the rolling plane,
- excavators, backhoe buckets - when the mechanisms are adapted for digging beneath the rolling plane,
- universal digging - the basic parts can be used in addition to the height of bucket also various devices such additional work. Buckets, grab, crane, tamping, sloping.

Depending on the type of travel may be digging:

- wheel - with chassis with castor wheels for example tires,
- belt - crawlers with two or more belts,

- car - truck,
- tractor - crawler or wheeled tractor
- rail - chassis for riding on rails.

According to the type of drive excavator:

- motor - driven by a combustion engine,
- the associated drive - a drive combinations (eg. Diesel-electric).

According to the imposition of the upper chassis excavator:

- rotary - upper excavator is mounted rotatable on the chassis in part or completely,
- nonrotatably - upper is rotatable mounted on the chassis.

According to the transfer of forces at work equipment:

- mechanical excavator - power to the tool is transmitted by gears, chain or rope transfers,
- hydraulic excavator - sucking on an instrument is transmitted by hydraulic elements.

Mechanical excavators lower categories have already ceased production in all sectors are gradually replaced by hydraulic excavators, which are compared to mechanical, many advantages.

In recent years there have been based on hydraulic shovel excavators universal finishing machines. Their development is so great that it was singled out in a separate group of earthmoving machinery.

The ACR are introduced hydraulic excavators UDS-114, UDS-214th

F) Mobile drill

Drilling rig means a machine designed for drilling holes on construction sites by:

- percussive drilling,
- rotary drilling or
- rotary percussion drilling.

Drilling rig drilling remains in place and can move under its own power from one work to another.

Self-propelled drilling rig rigs are mounted on lorries, wheeled chassis, tractors, crawlers, skid bases (pulled by winch).

When drill rigs are mounted on trucks, tractors and trailers, or a wheel, it can be transported on public roads at high speeds.

The ACR is introduced mobile drill PZV.

G) Rams

Rams are piling machines and pilot.

Piling rig at work means a device for installation or extraction pilot (eg impact hammers, extractors, vibrators or static pile pushing and pulling), which is an assembly of machines and components used for installation and extraction of piles, which also includes:

- piling rig consisting of carrier machine (crawler, wheel or rail floating body), control or the control and guidance equipment,

- accessories, such as the pile caps, helmets, plates, tamping mechanism, clamping mechanism, handling equipment pilots, pilot lines, acoustic covers and absorbing shock and vibration, power packs (generator) and lift or mobile platform for the operator .

Planks and poles are hammered heavy pneumatic hammer or diesel rammer Delmag H2, which is provided with a U-shaped extension is also recommended for hammering wooden mallet weight of 12 kg. The hammering pilot can use a hand iron ram weighing up to 80 kg.

For light ramming into a depth of 6 m are used trap (mechanical) rams. They are cast housing 300 kg in manual lifting (today exceptional, and 500 to 1500 kg friction in mechanical lifting winch. Heavier lambs are connected to the rope using hanger that when lifting ram attaches to the rope, while on the contrary it fall off. (Fig. 79 a). The drop height is several meters of reinforced concrete piles with a maximum of 1.5 m. For medium-hard ramming into a depth of 15 m diesel rams are used which operate on the principle of diesel engines. Heavy piston compresses air in the cylinder, which is heated by compression heat; thereby ignites the injected and atomized mixture of diesel oil (gas oil) with the air pressure acting on the pilot. The drive just naphtha, and operation is therefore simple. Aries is triggered manually by pulling the plunger to the upper dead center, and the mixture is ignited falling piston. Fumes an expansion piston in the cylinder expels the top ram and works until it stops fuel injected into the cylinder. If you hit diesel ram on soft soil, enough resistance to draw compressing the mixture and ramming it stops.

The ACR is introduced kit Pile SB-4H.

H) Machines for rock work

Rock work or tears concern the foundations for buildings and also the production of aggregates quarries for building production (natural stone, gravel, gravel, rocky material for construction of earth dams, stone plinth for artistic purposes). When it is disintegrated rock with vigorous strength and cohesion within the 4 to 7 excavation class (see CSN 73 3050).

Rock disintegration explosion also called blasting. This method is used the most in the world. When the rock work, there is often combination the above technologies. In

this work, however, I will deal only with mechanical disinter, since the focus is on work mechanization means for rock works introduced in ACR. The optimal choice of technology has a decisive influence on the economics of rock work and hence, should be the preparation of the work already adequately addressed. For example, the weathered upper layers notch extract either excavator with increased digging force, or ripper.

Mechanical breaking rock today is performed mostly by machine. Manually only in cases where it is not possible to use explosives, eg. In urban centers where you can use hand chisels (d better wise), pickaxes and hammers light hand scooping weight 7-9 kg. When disconnecting the use of heavy machinery excavator over 40 t the increased digging force, rippers, disconnecting the hammer, drilling and punching.

Rock cutting ripper

They are machines fitted ripper knife, with which the rock opens to a certain depth and then other means of mechanization, thus dozers, excavators, loaders, scrapers, or excavator scrapers processed. Modern rippers are carried, located on the rear of the tractor (dozer).

Ripper blades are controlled hydraulically. There are two basic types of blades: straight with a curved apex and the arcuate blade. Direct knives are preferred for ripping solid materials.

Rock cutting through heavy hammers

These hammers are mounted as an attachment to the boom of heavy excavators or other sufficiently powerful carrier. During his deployment, through rhythmic beats demolition sticks conquest hard rock or brick or concrete wall, thereby performing the necessary demolition work. Rock disintegration using hammers to effectively apply especially in densely populated cities where it is not possible to apply the blasting technique further in cutting road construction, refining high rocky walls (the ability to work well in an inclined position) and secondary loosening of oversize pieces of rock.

Drilling

Drilling of rock as construction, at which creates holes in the rock of different profiles and different lengths. Digging can be routed in different directions from the vertical through pitched exceptionally up to the horizontal. Drill holes in the vast majority are used to blast rock disintegration, but also for the strange ways of disintegration, ie. Thermally

and expandable cement are used. In exceptional cases serves more profiles such as manholes, openings and the like. For drilling mechanized methods we use today.

Mechanized drilling are:

- shock,
- rotary,

- rolling,
- combined (rotary-shock).

Rock disintegration using tunnelling milling machines.

They are equipped with modern machinery complexes embossing head with cutting elements of hard metal which rotating around an axis machines are cut in the rock fixed circular profile. The extracted material is transported by belt system into the waiting trucks.

Special methods of rock cutting

To this group belong disintegration disintegration thermal and chemical.

Thermal disintegration is based on the principle of a rock breaking thermal stress thermite cartridges. After the ignition is achieved in boreholes in rock high temperature, which causes the increase in volume of the rock and then its cracking pressures incurred.

Chemical disintegration provides expansive cement. Cement mortar to fill the holes drilled in a chemical process that occurs later to expand cement and the development of high pressures.

All these above methods can excite the rock mass and disconnect it on the stone.

They are used in mining in small localities, the extraction of stone blocks for artistic purposes, but mostly on secondary disintegration of large boulders.

The ACR is used:

1. Mechanical disintegration hand:
   - using a kit pneumatic instruments SPP-2000
   - using sets of hydraulic machines,
   - using a drill hammers combustion engine Atlas Copco.

2. rock disintegration using hammers, accessories for excavators UDS-114, UDS-214 and small loaders JCB 4CX.

3. drilling with core drills CEDIMA.

4. particular method of drilling (cutting) the thermal suite CALDO.

List of tasks for students:

1. Basic equations of motion of the machine.

2. The stability of the machine.

3. External forces acting on the machine.

4. Calculation of machine performance.

5. Technology of machine work.

6. Reliability sets.

Basic and recommended reading:

1. Števko, G. Technologie práce zemních strojů. Vyškov: VVŠ PV ve Vyškově, 2003.112 s.;
2. Břoušek, M., Vávra, I. a Zapletal, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s.;
3. BRETŠNAJDR, J. *Stroje pro zemní práce*. Brno: VA, 1984. 425 s.;
4. JEŘÁBEK, K. a kol. Stroje pro zemní práce. Silniční stroje. Ostrava: VŠB – TU Ostrava, 1995.

6.2 Basic computing specific performances of earthmoving machinery and technology of work.

Machines for earthwork and rock works in difficult conditions. Their design must transmit large static and dynamic forces must operate in diverse terrain, with large gradients in unpredictable conditions.

Users should know the basics of assessing appropriate conditions of use of the machines, on the one hand to avoid accidents and injuries due to insufficient knowledge of masters and on the other hand that the technique used to accomplish tasks within their technical capabilities.

The exercise will discuss the principles for determining and calculating:

- basic equations of motion of the machine,
- determination of stability,
- determining the external forces acting on a machine at work.

A) Basic equations of motion of the machine

Operating modes of construction and earthmoving machinery

Construction can work in two basic modes [3]:

1. work,

2. transmission - load, no load.

Working mode is characterized by large resistors when moving the machine or when moving its working bodies and small machine speed. There are three kinds of mode:

- the machine is stationary and its working tools to move,
- moving machine and its tools are against him in relative peace,
- machine and its working tools to move.

The size of the working resistor is highly dependent on the type of material processed.

Transport mode occurs at a lower resistance when moving at higher speeds in order to achieve maximum efficiency in transport. It occurs when moving all construction machines and materials.

Total resistance [3] when the machine is composed of several sub-resistors:

- rolling resistance,
- climbing resistance,
- inertial resistance
- air resistance,
- resistance in curves,
- resistance at work working tools etc.

The basic equations of motion of the machine

Construction and earthmoving machines are often used for carrying out the engineer support. When used to damage of the machine due to improper operation and use of the conditions for which it is not intended for earthmoving machines.

The commander should know the approximate calculation to determine the possibility of using the machine.

The goal is to learn how to build approximate calculations for determination of free traction. Using the calculation be able to assess whether said earth moving machine can be used while working in the class soils and under specific conditions.

B) The stability of the machine

Verification of stability of machines is part of astatic calculation earthmoving machinery. In most cases the methodology to calculate the stability and relatively simple given the relevant standards.

Static stability is one of the essential functional properties of machines, since it affects not only safety, but also the efficiency of machines.

From the structural point of view, this parameter characterizes the ability of a machine to maintain a balanced position under the action of external forces for their constant size over time.

Dynamic stability will not deal with.

C) The external and internal forces acting on the machine

Power relations between the working device and machine bottom (carrier).

During the development of the machine, while optimizing the design parameters when evaluating phenomena and processes resulting from its activities and in evaluating its operating characteristics, it is necessary to investigate the force ratios, especially the ratios between work equipment and machine bottom (carrier).

Ability to work for earthmoving machines depends primarily on whether their parameters correspond to the nature of the technological process, the conditions in which the machine is working, whether it is respected mutual influence of work equipment and machine bottom. Wrong, inaccurate and random selection of parameters commonly leads to serious loss of productivity and efficiency of work machines.

Force ratios machines must be monitored from two aspects: the fortress and operational.

When investigating force ratios machine it is necessary to further distinguish two basic modes: transport and working.

Transport mode applies when driving around the jobsite and machine transportation over long distances self-propelled.

Operating mode is determined by technology, design ensuring a major labour movement - cutting force tool or machine relationship as a whole to the process uncoupling. There are basically three options in this regard:

1. Working movement is developed tractive force carriers, moving the entire machine (dozers, plows, loaders etc.).

2. Working movement is developed special mechanisms work equipment, machine stands on the bottom (excavators, drills).

3. Working movement is the sum of machine motion and movement of the work equipment (Rift excavators, bucket-wheel excavators).

When investigating the power relationships between the working device and carrier for machines 1st group is necessary to distinguish two basic constitution states that their structures and functions:

- Fixed connection with work equipment carrier hydraulic system is blocked,
- articulation working device with a carrier, the hydraulic device allows rotation of the working device.

Fixed connection with work equipment carrier

This condition occurs when the steady digging when the machine moves evenly over the plane, working tool is recessed and removes a splinter, corresponding to the given conditions. It occurs in all plows machines.

Analytical solutions planar array

Drum Machine - planar array

The methodology of calculation of external forces in belt plows machines is quite similar, based on the same principles. The force diagram is shown in Figure.

Graphical solution of external forces

For fast and straightforward calculations external forces acting on earthmoving machines are very suitable graphic solutions, particularly for planar systems.

The application here is for example resultant partial method or the method of direct decomposition.

Partial method can detect the size of the resultant of the three forces on those wearers, if given the power to fourth.

In the method of direct decomposition of forces uses the rule that the power can be supplied upon the wearer and move freely at any point on its wearer decomposed into two directions.

Direct decomposition method is used for solving the forces acting on the belt dozer.

List of tasks for students:

1. Reliability Report.
2. Calculation of machine performance.
3. Technology of machine work.

Basic and recommended reading:

1. Břoušek, M., Vávra, I. a Zapletal, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s.;
2. BRETŠNAJDR, J. *Stroje pro zemní práce*. Brno: VA, 1984. 425 s.;
3. Vaněk. *Moderní strojní technika a technologie zemních prací.*;
4. TM 3-34.62 *Zemní práce*. A.US.;
5. *CAT 120M Army* [Online] [cit. 2013-7-18] Dostupné na World Wide Web: http://www.cat.com/cda/files/1856761/7/DFP%20120M%20MG%20web.pdf
6. *CaterpillarPerformanceHandbook42_A* [Online] [cit. 2013-7-18] Dostupné na World Wide Web: http://www.warrencat.com/performance-handbook.pdf
7. Števko, G. *Technologie práce zemních strojů*. Vyškov: VVŠ PV ve Vyškově, 2003.112 s.

6.3 Design of machines for earthmoving and rock work

Machines for earthwork and rock are widely used in the tasks Engineer combat support (security movement of friendly forces, enemy activity limitations, preserving combat capability of its own troops) and general engineer support.

Students using the expertise and based on generally defined task of solving practical problems in the use of machines for earth and rock work focused on determining the performance of machines and technology work earthmoving machinery.

A) Calculation of machine performance

Term performance of construction and earthmoving machinery [3] indicates the quantity of product produced per unit of time machine. Unit is [m3.h-1; m2 .h -1; m per hour 1]

There are four kinds of performance construction and earthmoving machinery:

- theoretical,
- technical,
- operating,
- real.

Performance loaders and dozers

Theoretical performance - is the volume of the rock softened calculated from theoretical work cycle and the nominal volume of excavator tools. It is therefore given by the construction and machine parameters and is not affected working conditions, machinist and labour organizations.

The technical performance - includes the effect of working conditions is not affected by the operator and labour organizations. It is therefore possible maximum machine performance given the amount of natural ground for 1 hour of continuous work in specific conditions. Therefore, the value of technical performance suitable for assessing the degree of organization of work time and machine utilization.

Operating performance - is the actual volume of the extracted natural ground. Operating performance Qp machines gives the operator the best basis for decision the use of a calculation of its performance. It is a value that includes the effect of work organization of training service, repair and maintenance. In addition to pure time machine works, there is also time loss, however, related to washing machines, which includes:

- moving the machine at work,
- derived maneuvering means,
- necessary maintenance equipment,

- unplanned repairs necessary equipment,
- breaks machinist,
- other breaks and other downtime (combat operations).

B) Technology of machine work

Technological process deals with the technical aspect of the manufacturing process for the production process and the binding is determined by the appropriate technological standards. Correct technological process aims to ensure efficiency of the production process, ie. The lowest consumption of raw materials, energy and time. technology selection.

When selecting technology takes into account the fact that:

- simple and stable,
- raw material, material and less energy consuming,
- automatable,
- based on automatic processes.

The basic duties of a building contractor:

- keep records of their employees to start work after leaving office,
- provide all persons entering the workplace personal protective equipment appropriate threat.

On the unit's commander executing earthworks relate obligations as a building contractor.

Preparation for construction

The building contractor must supply documentation within to **create conditions to ensure safety.**

Part of the supplier documentation is technological or workflow that must be for construction work are available on site.

Technological process must provide:

a) continuity and overlapping of individual work operations,

b) workflow to fit the job,

c) the use of machinery and equipment and special work equipment, tools, etc.,

d) the kinds and types of auxiliary structures,

e) modes of transport material, including communications and storage areas,

f) technical and organizational measures to ensure the safety of workers, workplaces and surroundings,

g) measures to ensure the site over time when not working on it,

h) precautions when working in extreme conditions.

Workflow must stipulate the requirements of the works in compliance with the principles of safety.

The supply documentation must also be made for the case of exposure to natural elements, measures during construction work during operation and overlapping work.

The responsible person shall determine the necessary measures to ensure safety in this case. These include landfills, deployment and use of machinery, equipment, work processes.

Submission of site

Relationships, commitments and obligations in the field of occupational safety must be record of the submission site (workplace).

The building contractor is obliged to inform the other suppliers with occupational safety requirements contained in the construction project.

The operator must be familiar with the principles of the contractor safe behaviour in the workplace as possible and source of danger construction work for the operation.

Similarly, it is obliged contractor for construction works designed to familiarize staff of the risks of construction activities.

Interruption of works

Interruption of works

An employee who observes a hazard that could endanger the life or health of persons or cause operational accident or failure of technical equipment, or the signs of danger, is obliged, if not eliminate danger itself, stop work immediately and report it to the responsible employee and possibly alert all persons who could be vulnerable to this danger.

Similarly worker progresses:

- if the person is at work under the influence of alcohol or other intoxicating substances,

- if there is a risk that could endanger the life or health of persons or cause operational accident

- workers in jeopardy, buildings or surroundings due to various circumstances that can build and staff somehow threatening.

When work is interrupted, it is necessary to take the necessary measures to protect the health and property and must be drawn up and filed about it.

Construction work in extreme conditions

For construction work in extreme conditions are considered work under traffic, work under difficult conditions and work in hazardous environments and in the danger zone.

For the execution of works under extraordinary conditions must be in the construction project establishes the principles of technical, organizational and possibly other measures

to ensure safety. The intended measures must contractor for construction works acquaint workers, of which those measures relate.

Construction work in hazardous environments and hazardous area

The investor is obliged to provide workers building contractor other personal protective equipment and facilities at the building contractor unusual.

Ensuring safety in protection zones must be done advance on the basis of a written agreement with the owners, operators or network administrators.

Any damage to the network immediately reported to network operators and building contractor must execute measures to prevent the entry of unauthorized persons.

During construction work must be taken against touching near energized equipment or when approaching the high voltage parts.

A worker must not work alone in the workplace where in sight or earshot of another employee who in case of accident or provide calls for help, or should there be other effective form of control or connection.

List of tasks for students:

1. Dozer Caterpillar D5N - determination, specification (main TTD), main parts and their functions, method of use.

2. Dozer Caterpillar D6K - determination, specification (main TTD), main parts and their functions, method of use.

3. Grader Caterpillar CAT 120M - determination, specification (main TTD), main parts and their functions, method of use.

4. Wheel Loader KN-251 - t determination, specification (main TTD), main parts and their functions, method of use.

5. Loader UNC-750/752 - determination, specification (main TTD), main parts and their functions, method of use..

6. Loader JCB Robot 170 - determination, specification (main TTD), main parts and their functions, method of use.

7. Backhoe loader JCB 4CX - determination, specification (main TTD), main parts and their functions, method of use.

8. A hydraulic shovel excavator UDS-114 (UDS-214) determination, specification (main TTD), main parts and their functions, method of use.

9. Undercarriage driller PZV - determination, specification (main TTD), main parts and their functions, method of use.

10. Kit for ramming SB-4H determination, specification (main TTD), main parts and their functions, method of use.

11. Kit pneumatic instruments SPP-2000 - determination, specification (main TTD), main parts and their functions, method of use.

12. Set of hydraulic machines (SPP-2000H) - determination, specification (main TTD), main parts and their functions, method of use.

13. Drilling and hammers combustion engine Atlas Copco - determination, specification (main TTD), main parts and their functions, method of use.

14. Core drills CEDIMA - determination, specification (main TTD), main parts and their functions, method of use.

15. Thermal set CALDO - determination, specification (main TTD), main parts and their functions, method of use.

Basic and recommended reading:

1. Števko, G. Technologie práce zemních strojů. Vyškov: VVŠ PV ve Vyškově, 2003.112 s.;
2. Břoušek, M., Vávra, I. a Zapletal, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s.;
3. CaterpillarPerformanceHandbook42_A [Online] Dostupné na World Wide Web: http://www.warrencat.com/performance-handbook.pdf
4. Vševojsk-2-9: Bezpečnostní opatření při výcviku. Praha: MO, 2011.

6.4 Maintenance and reparation of earthmoving machinery

Machines for earthwork and rock are widely used in carrying out tasks related to supporting the fight Engineer (Security movement of friendly forces, enemy activity limitations, preserving combat capability of its own troops) and general engineer support.

Commanders should know the destination, the basics of design and technology work mentioned techniques and resources to be able to use the established

technique in performing tasks engineer support in the circumstances within their technical capabilities.

Students using the expertise based on the defined task are prepared to solve practical problems identified using machines for earth and rock work.

A) Dozers

- Dozer Caterpillar D5N - determination, specification (main TTD), main parts and their functions, method of use.
- Dozer Caterpillar D6K - determination, specification (main TTD), main parts and their functions, method of use.

B) Graders

- Grader Caterpillar CAT 120M - determination, specification (main TTD), main parts and their functions, metod of use.

C) Wheel loaders and backhoe loaders

- Wheel Loader KN-251 - t determination, specification (main TTD), main parts and their functions, method of use.
- Loader UNC-750/752 - determination, specification (main TTD), main parts and their functions, method of use..
- Loader JCB Robot 170 - determination, specification (main TTD), main parts and their functions, method of use.
- Backhoe loader JCB 4CX - determination, specification (main TTD), main parts and their functions, method of use.

D) Automotive excavators

- Hydraulic shovel excavator UDS-114 (UDS-214) determination, specification (main TTD), main parts and their functions, method of use.

E) Mobile driller

- Undercarriage driller PZV - determination, specification (main TTD), main parts and their functions, method of use.

F) Lambs and rams

- Kit for ramming SB-4H determination, specification (main TTD), main parts and their functions, method of use.

G) Machines for rock work

- Kit pneumatic instruments SPP-2000 - determination, specification (main TTD), main parts and their functions, method of use.

• Set of hydraulic machines (SPP-2000H) - determination, specification (main TTD), main parts and their functions, method of use.

• Drilling and hammers combustion engine Atlas Copco - determination, specification (main TTD), main parts and their functions, method of use.

• Core drills CEDIMA - determination, specification (main TTD), main parts and their functions, method of use.

• Thermal set CALDO - determination, specification (main TTD), main parts and their functions, method of use.

List of tasks for students:

1. Brief Discuss the design dozers.
2. Brief Discuss the structure and graders.
3. Brief Discuss the design of wheel loaders.
4. Brief Discuss the design of automotive excavators.
5. Brief Discuss the design of mobile augers.
6. Brief Discuss the construction of rams.
7. Brief Discuss the construction of machines for rock work.

Basic and recommended reading:

1. Břoušek, M., Vávra, I. a Zapletal, I. Inženýrské stavby - technologie 1. Bratislava: Alfa konti, 1995. 269 s.;
2. BRETŠNAJDR, J. Stroje pro zemní práce. Brno: VA, 1984. 425 s.;
3. Žen-2-9 Ženijní práce druhů vojsk. Praha: MO, 1981;
4. Žen-21-7 Přívěsný kompresor DK-661. Praha: MO, 1978;
5. Žen-21-12 Souprava pneumatických přístrojů SPP-75. Praha: MO, 1978;
6. Žen-22-2 Hydraulické lopatové rýpadlo UDS-110a. Praha: MO, 1980;
7. Žen-21-16 Kolový nosič KN-251. Praha: MNO, 1978;
8. CaterpillarPerformanceHandbook42_A [Online] Dostupné na World Wide Web: http://www.warrencat.com/performance-handbook.pdf
9. Števko,G. Technologie práce zemních strojů. Vyškov: VVŠ PV ve Vyškově, 2003.112 s.;
10. JCB 4CX Příručka pro obsluhu. JCB, 2005;

11. ROBOT 160, 170, 170HF Návod na obsluh JCB;
12. Smykem řízený nakladač Locust 750 (UNC 750) http://www.kohut.cz/locust-750-smykovy-nakladac-118-info

7. Technique Rescue Company

7.1 Determination, subdivision and conditions for the use of the Rescue Company equipment

Rescue Company are in accordance with relevant laws military rescue units designed to perform humanitarian tasks and prepare for the tasks of civil protection for war.

Under the provisions of the Integrated Rescue System (IRS) is designated powers and resources between the other components of the IRS.

Terms and Policies deployment of forces and means of the Army and thus separate rescue rot to perform tasks within the IRS establish internal regulations and guidelines ACR.

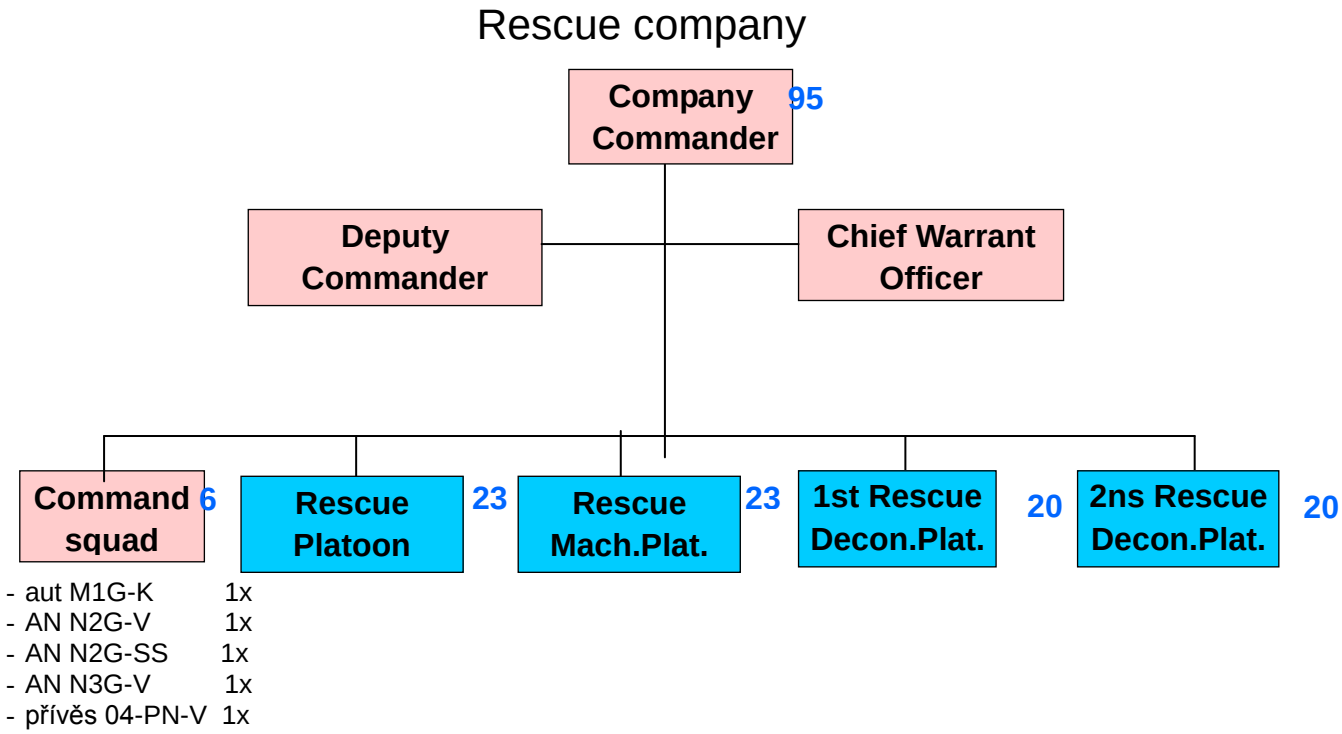
When performing tasks in favor of the IRS are able to separate Rescue Company:

- search, rescue and extricate people from buried under the rubble of buildings and shelters,
- carry out rescue work on the water,
- extinguish small and medium fires,
- ensure the transport of persons, livestock and material during the evacuation,
- distributing potable water,
- provide emergency survival of the population, including the establishment of a material base for humanitarian aid (hamb)
- emergency supply of electricity from alternative sources,
- perform radiological, chemical and biological research,
- staked out a dangerous area
- decontamination of personnel, equipment, materials, field and remediation of the contaminated area,
- dispose of leakage of petroleum products and provide assistance in liquidation of oil spills
- perform diving work,
- extricate jammed or crashed technique
- carry out the collection and disposal of dead animals
- freeing riverbeds like.

A) Determination of the rescue teams, organizations Rescue Company

Rescue company is able to:

- perform engineering and humanitarian tasks of civil protection, rescue, rescue and other emergency work during disasters or other serious situations threatening the lives, health, property of significant value or the environment;
- perform tasks when an accident at Dukovany and Temelín;
- carry out humanitarian missions to other countries and international organizations.



The aim was to introduce students to the basics of construction firefighting equipment, chemical equipment and emergency rescue techniques used in engineer companies of ACR.

This technique is used in the performance of their designated tasks and knowledge destination, design and technology work is essential for understanding and proper implementation of activities, which are among the basic skills of the commanders of engineering units.

List of tasks for students:

1. Identification of opportunities and rescue teams, organizations Rescue Company.
2. Rescue Platoon, its capabilities and technology rescue squads.

3. Rescue Machine Platoon, its capabilities and engineering machinery rescue squad.
4. Rescue Decontamination Platoon, its possibilities and rescue equipment decontamination platoon.

Basic and recommended reading:

1. DVOŘÁK, J., ŠTEVKO, G. *Technika a materiál záchranných jednotek* (S 480); VVŠ PV Vyškov, 2001; 126 s.; ISBN 80-7231-087-9.

7.2 The design and the use of the Rescue Company Equipment

Knowledge of design techniques unit itself is a prerequisite for its use.

For units Corps of Engineers is a technique that is designed to perform tasks engineer support, but in accordance with stuffed tasks within the IRS's engineering units used during the aftermath:

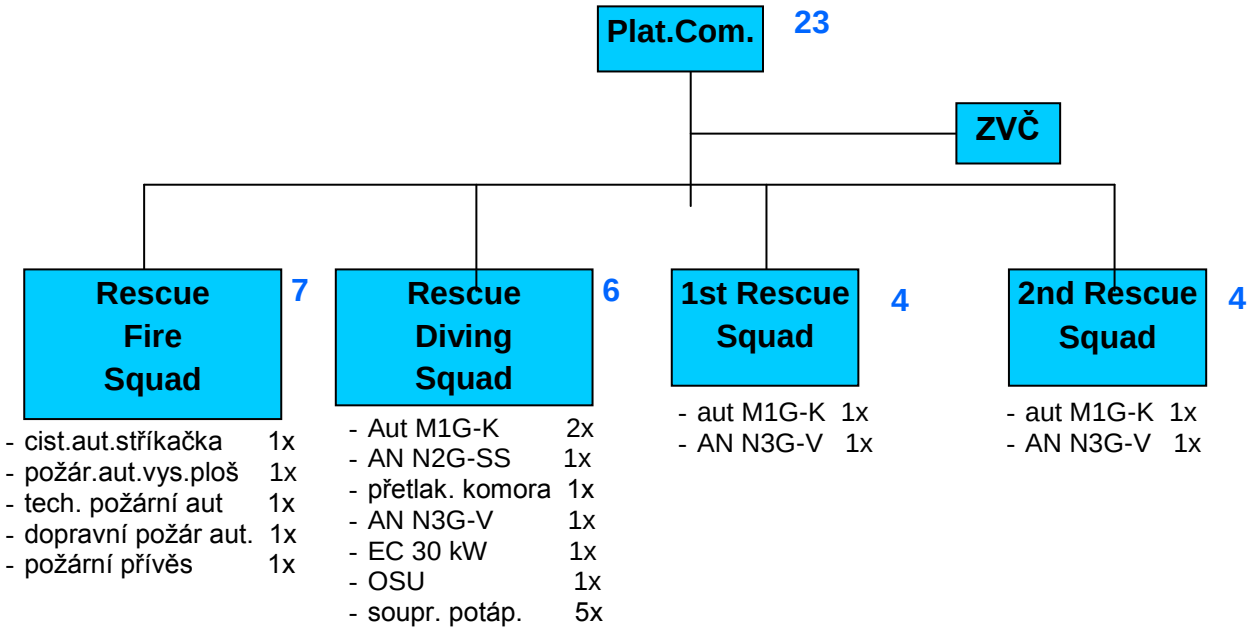
- natural disasters,
- industrial and environmental accidents,
- radiation and chemical accidents,
- large and dangerous fires,
- complex accidents,
- collapse of buildings.

A) Construction and use techniques of rescue platoon

Determining TTD main, main parts and their functions, technology use:

- equipment of fire squad,
- equipment of diving squad,
- equipment of rescue squad.

Rescue Platoon

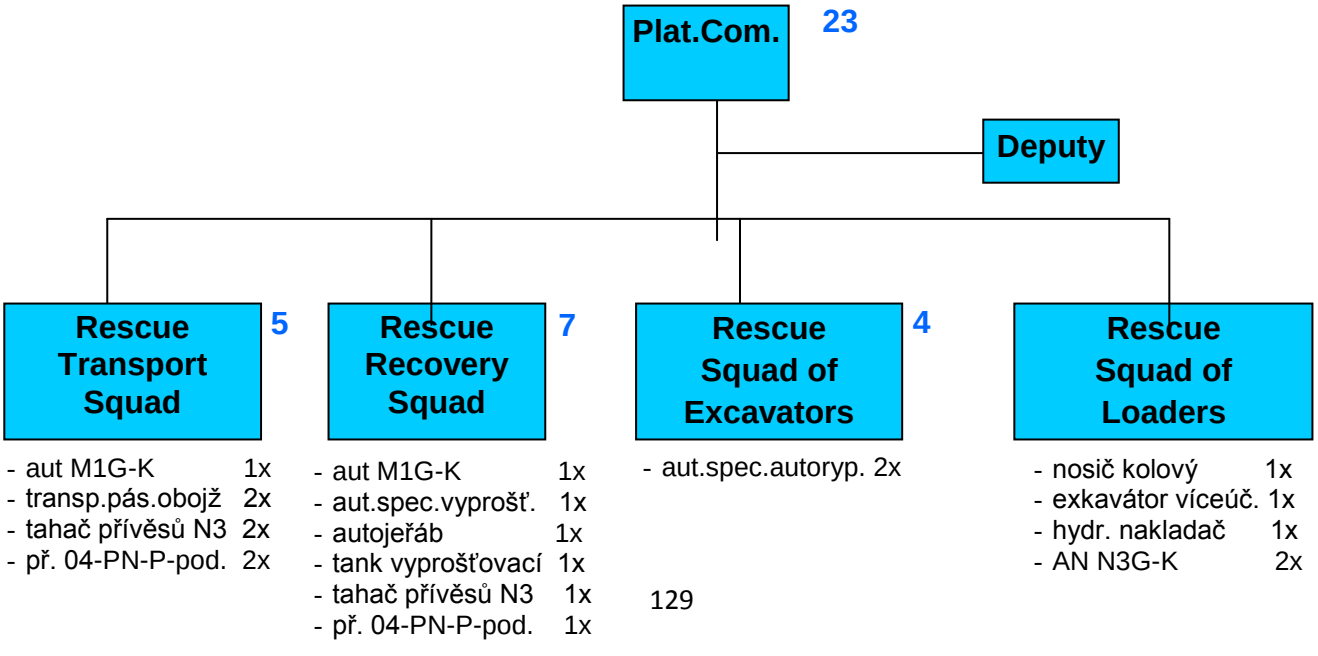


B) Construction and use techniques of rescue machine platoon

Determining TTD main, main parts and their functions, technology use:

- equipment of transport squad,
- equipment of salvage squad,
- equipment of excavators squad,
- equipment of loaders squad.

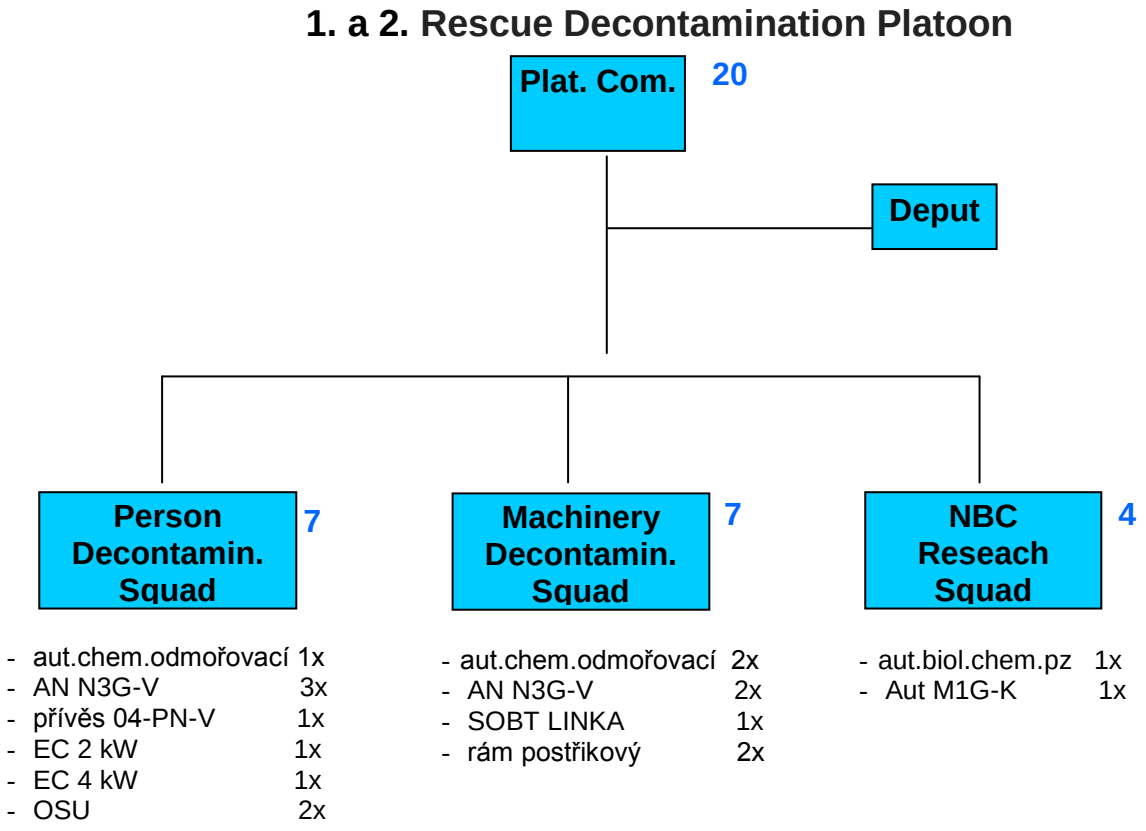
Rescue Machinery Platoon



C) Construction and use techniques of decontamination platoon

Determining TTD main, main parts and their functions, technology use:

- equipment and material of decontamination personnel squad,
- equipment and material of decontamination techniques squad,
- equipment of radiological, chemical and biological survey squad.



Chemical equipment, fire equipment, rescue equipment and vehicles used in the tasks engineer support, but in accordance with stuffed tasks within the IRS's engineering units used during the aftermath:

- natural disasters,
- industrial and environmental accidents,
- radiation and chemical accidents,
- large and dangerous fires,
- complex accidents,
- collapse of buildings.

Commanders should know the destination, the basics of design and technology work mentioned techniques and resources to be able to use the established

technique in performing tasks of general engineering support in the circumstances within their technical capabilities.

Students will create conditions for independent manner, and interpreting information relevant to solving practical problems identified in the above tasks.

List of tasks for students:

1. Characterize the possibility of using technique rescue platoon and describe the structure of this technique.
2. Characterize the possibility of using technique rescue platoon and describe the structure of this technique.
3. Characterize the possibility of using technique decontamination platoon and describe the structure of this technique.

Basic and recommended reading:

1. DVOŘÁK, J., ŠTEVKO, G. *Technika a materiál záchranných jednotek* (S 480); VVŠ PV Vyškov, 2001; 126 s.; ISBN 80-7231-087-9.

8. Policies and procedures engineer mechanization of work, work organization and performance

The task of art is to facilitate human work that partly or completely replaces the production function of man, and raise multiple productivity and efficiency of operations.

The main task of mechanization of construction work includes improving productivity, quality and safety through the replacement of strenuous manual labour activities of machines and mechanisms.

The commander should be able to independently and responsibly make decisions in familiar contexts. According to a limited assignment and allocations should coordinate team activities.

He needs to know the selected principles of mechanization and automation, to be able to propose necessary means to fulfill the tasks of engineer support.

8.1 Tenets/principles and procedures for mechanization of Military Engineering (MILENG)

A) Mechanization and automation engineer works

Mechanization earthworks

Mechanization - replacing manual labor work carried out by the machine.

The machine is a mechanical device, converting one type of energy to another, or performing different working operations. Machines are divided according to the machine driving and working.

Working machines make change shape, size, position and characteristics of the processed material. They consist of a drive, gear and working mechanism.

Machines are assembled into:

- machine lines (fixed machines - manufacturing of building materials);
- mechanical assemblies (moving machinery on site).

Scale deployment of machines into the production process, the degree of mechanization

$$S_m = \frac{h_c - h_m}{h_c} \cdot 100 \quad [\%]$$

Where: h_c is the number of working hours for manual work

h_m - the number of working hours, partially mechanized work.

When full mechanization of construction works is a building material passed all stages of the production process from machine to machine without the intervention of manual labour.

The next evolution is the automation that frees man from the intellectual and managerial work. It can be partial or complete. Complete automation of lower grade automates all stages of the production process, while complex automation has a higher degree of self-regulatory skills - feedback between the product and the process.

Automation of construction and earthmoving machinery

Automation - the process of implementation (application) technology using the theory of automata and devices that are essentially machines. Currently, most often computer systems to process control technology and information systems to support the work of management support and solving problems in design.

Robotic - automation production using robots instead of manual labour. [Big encyclopedia - Encyclopedia of Diderot].

Depending on the type divided automation [4]:

- partial,
- full,
- complex.

Partial automation automates the only one function or operation of the working machine and can be used most commonly for all-purpose construction machinery.

Full automation automates all functions and business operations of the machine.

Comprehensive automation, compared to full automation ensures both optimize the production process and product quality, continuous production process quality control.

In the construction industry uses these elements of automation:

- automatic control;
- program management;
- remote control.

The remote control can sometimes be retrofitted on commercially available machines. For example, universal loader UNC-750 is supplemented by additional percussion demining equipment and remote control. The loader is used for surface mine clearance.

Automatic control of the drives of construction machinery

It is the inner self drive depending on the workload. Constantly changes workload when construction equipment working. To fully utilize the power drives are very useful systems that regulate the working speed based on the size of the load of the machine. These requirements can fulfil the hydrodynamic torque converter.

Hydrodynamic control is suitable for machines which have a greater number of movements. Depending on the complexity distinguish control:

• single circuit,

• multi-circuit.

Automatic control of drives use brand manufacturers of earthmoving machinery Caterpillar, Komatsu and others for many years. Automatic drive control based on the evaluation of climatic conditions, machine load and other factors set the optimum operating parameters of the drive.

Note: The degree of mechanization and automation.

By gaining knowledge of:

- mechanization and automation engineer works;
- Performance Calculation engineer equipment;
- determining the performance reporting tools;
- based on the reliability of the assembly structure recommending techniques for carrying out the engineer support.

List of tasks for students:

1. In the context of self-study and preparation for the exercise of recommended literature study determining the performance of a single machine, performance kits.
2. Consider the recommended literature performance evaluation reports.

Basic and recommended reading:

1. Števko, G. *Technologie práce zemních strojů*. Vyškov: VVŠ PV ve Vyškově, 2003.112s.;
2. Břoušek, M., Vávra, I. a Zapletal, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s.;
3. *Caterpillar Performance Handbook* 42 A [Online] Dostupné na World Wide Web: http://www.warrencat.com/performance-handbook.pdf

8.2 MILENG - Organization of engineer works and work performance

Performance tools denote the amount of product produced per unit time. For machines for earthwork and rock distinguish the performance of theoretical,

technical, operational and real. A method of determining performance is necessary to evaluate assemblies machines.

The parameters for peer review and comparison of mechanical assemblies include performance, productivity, cost and power consumption.

Based on these parameters can perform optimization and selection of mechanical assemblies for specific performance of complex tasks engineer support.

A) Determination of performance reports and performance indicators

Determination of performance reports, which transports soil at a distance of 400,800, 1200 m:

- **assembly KN-251 + 2xT-815**
- **assembly KN-251 + 4xT-815**
- **assembly UDS-114 + 2xT-815**
- **assembly UDS-114 + 4xT-815**

Notes:

• KN-251 performs one cycle for 60 s; ie. 3 loading shovels for 180 s;

• T-815 S3 bucket has a volume of 9 m, a useful load capacity is 15 000 kg;

• UDS-114 performs one cycle per 22 s, bucket capacity is 0,63/0,75 m3, and 12 buckets loaded for 264 s.

B) Indicators of optimization

Optimization indicator is calculated from

$$U_{o(i)} = (V_g \,.U_{g(i)} + V_n \,.\, U_{n(i)} + V_{wn} \,.\, U_{wn(i)} + W_e \,.\, U_{we(i)} + V_c \,.\, U_{c(i)}).10^{-2}$$

The sum of the weights of each parameter must equal 100 because the weights of all parameters optimization applies

$$V_g + V_n + V_{wn} + W_e + V_c = 100$$

Worst assembly will have a maximum value Uo (i), the other is sorted according to size. When possible combination of alternatives deployment of machine configurations and multiple variations of conditions during their deployment would be best suited to, that achieves the minimum value of the indicator optimization.

Determining indicators report that transports soil at a distance of 400 m:

Variant	**The parametric values**				**The share values of indicators and their sum**				**Products of weights and shares**				**The resulting indicator**
	$1/Q_C$	N_m	W_n		U_g	U_n	U_{wn}		$V_g \cdot U_g$	$V_n \cdot U_n$	$V_{wn} \cdot U_{wn}$		U_o
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1													
2													
3													
4													

Commander engineer units should be able to determine, on the basis of performance reports and performance indicators, cost and cost indicators, consumption and consumption indicator and indicators optimization decide according to general assignment and allocated resources for optimal assembly machines to perform more complex tasks of engineer support.

List of tasks for students:

Elaborate namely assignments relating to the solution of the following parts:

• determination of performance reports and performance indicators

• determination of cost and cost indicators,

• determining consumption and consumption indicator,

• pointer optimization.

Tasks submitted in paper form by the set deadline teacher.

Basic and recommended reading:

1. Břoušek, M., Vávra, I. a Zapletal, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s. ISBN 80-88739-14-4;
2. ŠTEVKO, G. *Technologie práce zemních strojů*. Brno: VVŠ PV Vyškov, 2003.

9. The technology works, safety and hygiene at work with engineer equipment, external factors acting on the fulfilment of tasks

Machines for earthwork and rock are widely used in carrying out tasks related to supporting the fight Engineer (Security movement of friendly forces, enemy activity limitations, preserving combat capability of its own troops) and general engineer support.

Commanders should know the destination, the basics of design and technology work mentioned techniques and resources to be able to use the established technique in performing tasks engineer support in the circumstances within their technical capabilities.

9.1 MILENG - working technology with using of engineer equipment

A) Technology Work

Technology is a manufacturing process resulting from a combination of factors. [1]

Technology is a technical discipline that deals with the application of natural science -especially physical and chemical knowledge in the implementation, improvement, utilization of production processes, ie. in the acquisition and processing of the starting materials (raw materials) for intermediate or final products. It is closely linked with the development of knowledge, science and technology and engineering various fields [1].

Technology is concerned with a process of conversion work in their finished products. For a given manufacturing process technology determines the way of using existing manufacturing techniques. This means that not only gives a summary of used machinery, tools, appliances and equipment, including definition of their work, but also sets the sequence of their use, or so technological progress.

Technological process deals with the technical aspect of the manufacturing process for the production process and the binding is determined by the appropriate technological standards. Correct technological process aims to ensure efficiency of the production process, ie. lowest consumption of raw materials, energy and time.

The choice of technology. When choosing technologies in terms of best strategy:

- simple and stable technology;
- raw material, material and less energy consuming technologies;
- automatable technology;
- technology based on automatic processes (biotechnology).

The level chosen technology is higher, the more strategic requirements meets. The strategic requirements are:

- flexibility of the production system, ie. adaptability device at a relatively rapid change,
- active monitoring and diagnostics technology throughout the production system,
- system management processes in real time,
- training of human factors.

The choice of technology is among the important issues to be addressed in the preparation of technical economic studies. In many cases, the use of technology and production facilities depend largely on the specification of the base material or feedstock, which may affect the availability of your chosen size production units and other places are a primary factor in the chosen technology, which has already determined unambiguously production or raw material.

Mechanized construction processes as a system

System approach [see 2, pp. 53-76]. External links:

- to the surrounding natural system,
- to the surrounding social system,
- to technical works,
- to the infrastructure.

Internal links:

- interaction between humans and machines deals with ergonomics,
- the relationship between man and the work object manifests the action of human labour working on the subject, in the opposite direction of the resistance to the treatment. Failure to comply with the rules of occupational health and safety threat manifests Occupational Safety and Health (slipping walls excavated excavation dusting of lime);
- machine and work relationship object manifests the action of tools working on the subject. Processed raw material has resistance to the action of the working tools and occupational health and safety of non-compliance may result in damage and danger to the operator.

The structure of the production process

The structure of the process depends [2] on many factors, such as organization manufacturing enterprise, technology, level of specialization and on the product itself.

The main consideration in the structuring process is to achieve its maximum efficiency.

When designing the building process is appropriate to reduce to:

- technology structure;
- spatial structure;
- temporal structure.

B) Safety and hygiene work with engineer equipment

Knowledge of safety regulations, guidelines, standards and technical requirements when working with construction and earth-moving machinery and mechanization is a fundamental prerequisite for ensuring safety in construction and are among the main responsibilities of each construction technique.

Regulations have this sequence according to a legally binding [3]:

- law;
- decree;
- technical standard;
- safety and technical requirements of the machine manufacturer.

Currently, construction output in terms of health and safety at work and environmental protection legislation treated Occupational Safety Inspectorate (IBP), providing a substantial portion of these obligations Inspectorate and the Environment (Environmental Engineering). The given issues are related regulatory documents [3].

List of selected safety rules and regulations relating to the operation of construction machines is given in Annex 1.

The Army of the Czech Republic (ACR) are mandatory basic rules [3].

C) Factors affecting operations engineer

Factors influencing the nature and level of required engineering support are assessed and related to a succession of phases of the process of deployment of forces and their retention. Any operation will include phase:

- building force;
- activity before developing forces;
- operational tasks;
- the post-conflict situations;
- withdrawal of forces and their reorganization.

Factors affecting the engineering activities are:

- mission;
- threat;

- level of forces;
- HNS and infrastructure;
- standards for creating / building;
- terrain;
- climate;
- time.

List of tasks for students:

To read the recommended literature [2, 3] section relating to:

- task analysis;
- analysis of the technological structure of the production process;
- analysis of the spatial structure of the production process;
- analysis of the temporal structure of the production process;
- performance analysis.

Basic and recommended reading:

1. HLÁSNÝ, J. a kol. Technika a technologie. Praha, VŠE 1996. 257 s. (ISBN 80-7079-103-9
2. Břoušek, M., Vávra, I. a Zapletal, I. Inženýrské stavby - technologie 1. Bratislava: Alfa konti, 1995. 269 s. ISBN 80-88739-14-4
3. ŠTEVKO, G. Technologie práce zemních strojů. Vyškov: VVŠ PV Vyškov, 2003.
4. ŠTEVKO, G. Řízení rizik v rámci opatření všeobecné ženijní podpory. Brno: UO, 2012. 84s. ISBN 978-80-7231-915-2

9.2 MILENG - Health and Safety precaution

Design of mechanical assemblies is a creative activity based not only on experience but also on the expertise of the possibility of using individual kit components for various kinds of engineer work depending on certain operating conditions.

The term mechanical assembly means a system of main and auxiliary machinery, which are designed to implement a comprehensive working process, which are connected by ties transposing selected works in due time, in due time and to the required quality while respecting resources.

When designing a mechanical assemblies used technological, spatial and temporal structure.

A) Analysis of task

Task analysis. Using methods of analysis tasks leads to more efficient and effective involvement of operators in the system and operating in three main areas: security, performance, usability.

Analysis of the task may involve a number of representative methods (9) dealing with management processes and corresponding systems, which can be divided into the following categories:

- methods of data collection tasks (sampling technique, technique critical events, technology observation, questionnaire technique, technique structured interview technique verbal record);
- methods for the description of tasks (technology network charts and charting, decomposition techniques, hierarchical task analysis, network technology, time working patterns, temporal analysis);
- simulation methods (computer modelling and simulation, modelling / models);
- investigative methods (behaviour) tasks (analysis of occupational safety, tree diagrams, fault analysis and consequences, fault trees, risk analysis, charts causes technique omissions in the proceedings);
- evaluation methods (checklists, rating interfaces).

Task analysis techniques can be used as techniques for improving system performance, operation, maintenance, or can be used for specific issues characterizing the performance of the system:

- assignment of functions;
- requirements for maintenance (ability to perform tasks efficiently);
- recruitment and staffing requirements;
- design tasks and interfaces (in the workplace);
- requirements for skills and knowledge (training);
- ensuring performance.

Project management in the engineer corp. Project management in the planning phase proposes anticipated product or service. Planning stage can be divided into preliminary planning and detailed scheduling.

The outcome of the preliminary planning is:

- the project charter;
- preliminary project definition.

When planning the project we use the results of preliminary planning. The results of preliminary planning are transformed into a tactical plan for project implementation.

The outcome of detailed planning documents are authentic:

• definition of the subject project;

• project plan.

B) Analysis of the structure of the technological process

Optimization activities and operations

Flowchart. Flowchart is used to analyse the details of the operation. The second step is a table of time sequences of each process flow diagram. Overworked flowchart flow determines the time required to perform each activity is more elaborate and detailed.

Preparation. Flowchart is standard for diagrams. Process of cutting of parts trusses using two saws, based on the flow chart and will serve as an example.

Record the data on processes, people or material can be determined from the work process and place or time when the process begins or ends. Enumerating each activity detailed process in the left column. This list is based on the flow diagram and actions should go in that order. The column symbols are drawn by interconnection procedure corresponding symbols for each step. Just enter the distance in meters, if the part will move. In the "amount" is the number of items that will be processed during each activity. In the column "time" to indicate how long it will take each step, time coefficients shall be included in the "Remarks" column.

Analysis optimization. Other columns are for the analysis of the evaluation process.

Study each step in detail. Looking for answers to the questions:

1. Is it possible to exclude or combine certain activities?

2. Can the distance and shorten deadlines?

3. It should be reordered?

4. Can be simplified individual operations?

5. Who does the work?

6. Who could do it better?

7. Change will lead to carry out activities of a person unprepared, or they can use more powerful machines?

8. Where the work is done?

9. Could be made to work efficiently implemented?

10. When work is to be done?

11. It would be better if it did work some other time?

12. How work is to be done?

This allows the machine to propose an alternative method or use machines instead of annual work.

Analysis shows all the unnecessary manipulation, excessive material movements, duplicity, excessive amount of steps, number and type of loss of time, work efficiency etc.

This is only a portion of the possible questions that should be put at each step for the activity in order to reduce to the minimum steps to create a simple "design" plan.

Solution. As commander creates the best method of making each piece skeleton can be analysed in detail all activities. Location landfill material, equipment, tasks and storage area of concentration must be spread and multiplication determined distance to be simultaneously designed flowchart.

C) Analysis of the spatial structure of the manufacturing process

The analysis of the spatial structure of the manufacturing process can consume:

- three-dimensional models,
- a two-dimensional models.

Preferred are diagrams that can be used for example to represent material flow between production areas. We starting from the planar size of the individual workstations (derived from the size and quantity of processed material, the technological procedure, handling technological waste), the intensity of the material flow and the total area that is available.

On either flow diagrams follow a single type of material, or the flow of several materials at once. If we want to represent the flow of material production process, we start from technological process. The diagram illustrates the types of activities carried out, watching the time of the transfer, mass transfer distance and intensity tic material between the points where the work is performed. Activities rank in technologically correct order and as illustrated by diagrams.

Surface diagram based on the illustrated work areas necessary for the production in series so as to maintain the prescribed technological process. In determining linkages between production areas we use also of material flow diagrams. The final draft of workplace arrangement includes in addition to workspaces and communication and ancillary areas.

If we follow the flow of material between sites for large volume, it is appropriate intensity flow between various sites write to the table. Adding up the material streams that flowed and subtract those flows out, the result should be zero.

D) Analysis of Performance

Calculation. The flow charts flow speed cutting (based on a 50-minute hour) varies for each part. To achieve a balanced production of several components making up the finished product (roof truss) to analyze production workflow and introduce each section, the average time cutting each piece will have defined a balanced production.

The values in column B are determined from the project. The values in column C are determined from the flow chart (or measure the stopwatch).

Performance Analysis. The table shows such an analysis for balanced output of individual components needed to produce 4000 trusses. Cutting speed is determined by a process flowchart for each machine number in column speed cutting – cutting performance (column C) remains constant. Similarly, ratios cutting time (column E) remain constant for each element, regardless of how many trusses to be constructed.

Balance (uniformity) production. For each time interval can be determined from the table balanced production.

List of tasks for students:

Develop namely assignments relating to the solution of the following parts:

- task analysis;
- analysis of the technological structure of the production process;
- analysis of the spatial structure of the production process;
- analysis of the temporal structure of the production process;
- performance analysis.

Tasks prepare for presentation at the next seminar.

Basic and recommended reading:

1. BŘOUŠEK, M., VÁVRA, I. a ZAPLETAL, I. *Inženýrské stavby - technologie 1.* Bratislava: Alfa konti, 1995. 269 s. ISBN 80-88739-14-4
2. ŠTEVKO, G. Technologie práce zemních strojů. Brno: VVŠ PV Vyškov, 2003.
3. Stanag 2394: Doktrína bojového použití ženijního vojska pozemních sil (ATP-52B). Brusel: Vojenská agentura pro standardizaci, 2008. 151s.

9.3 External factors affecting the performance of MILENG tasks

Design of mechanical assemblies is a creative activity based not only on experience but also on the expertise of the possibility of using individual kit

components for various kinds of engineer work depending on certain operating conditions.

The term mechanical assembly means a system of main and auxiliary machinery, which are designed to implement a comprehensive working process, which are connected by ties transposing selected works in due time, in due time and to the required quality while respecting resources.

When designing a mechanical assemblies used technological, spatial and temporal structure.

A) Technological structure manufacturing process

When analysing the technological process follows the progress of the operations carried out by workers and mechanisms for processing materials and semi-finished products, recorded the type of activity of each element of the production process, the duration of activity and volume of the final product.

Student on the challenges demonstrate the application of time-technological analysis machine- and hand-working group.

B) Time structure of the production process

When performing timing analysis we pay attention to the duration of the production processes and optimize their time. In doing so, we use the conclusions of the spatial and technological analysis.

Student on the challenges demonstrate the application time analysis of the working group.

C) Space Structure of the production process

To analyse the spatial structure of the manufacturing process can use a variety of models. Are very suitable schemes of material flow between the different production areas.

Student on the challenges demonstrate the application of spatial analysis working group.

D) Analysis of Performance

In the flow charts flow duration is different activity for the production of each component. To achieve a balanced production of several parts forming the finished product is analysed workflow production of each part.

Based on the analysis of performance is determined balanced production of parts for the manufacture of finished products.

Student on the challenges demonstrate performance analysis working group and sets an example for the balanced production.

Commander engineer units should be able to based on task analysis, analysis of the technological structure of the manufacturing process, analyse spatial structure analysis of temporal structure performance analysis and decide according to general assignment and allocation of resources the optimal configuration of machines for filling complex tasks engineer support.

List of tasks for students:

Elaborate namely assignments relating to the solution of the following parts:

- task analysis;
- analysis of the technological structure of the production process;
- analysis of the spatial structure of the production process;
- analysis of the temporal structure of the production process;
- performance analysis.

Tasks after incorporation of comments surrender teacher in printed form.

Basic and recommended reading:

1. HLÁSNÝ, J. a kol. Technika a technologie. Praha, VŠE 1996. 257 s. (ISBN 80-7079-103-9
2. Břoušek, M., Vávra, I. a Zapletal, I. Inženýrské stavby - technologie 1. Bratislava: Alfa konti, 1995. 269 s. ISBN 80-88739-14-4
3. ŠTEVKO, G. Technologie práce zemních strojů. Vyškov: VVŠ PV Vyškov, 2003.
4. ŠTEVKO, G. Řízení rizik v rámci opatření všeobecné ženijní podpory. Brno: UO, 2012. 84s. ISBN 978-80-7231-915-2

10. Efficiency and optimizing the use of forces and means

The theme is focused on a selected portion of the tasks of engineering support and implementation of project management methodology in planning the anticipated actions performed by engineer ACR.

Project management is a set of methods and procedures, whose task is to achieve the desired targets with limited human and material resources, and a lack of time and limited editions.

10.1 The efficiency and optimizing process of the use of MILENG forces and machinery/equipment

A) Basic concepts

The project is specific discrete operations with a defined beginning and end that require special management to ensure its timely completion and retention of its budget. The project can be eg. the design, development and introduction of new products, opening new factories or any investment.

Project Management – is special type of managerial activity, which is mainly engaged in the planning, performance and consolidation project of any type within the limits laid down by the company and its surroundings. Project management proved to be a very important technique for controlling costs and schedules in the project, which in some cases averted their financial failure that would otherwise occur. This particular showed the value of a quantitative planning and control.

Project management:

- management of project;
- project management.

project management - understood as a philosophy of approach to project management with a clear objective that must be achieved within the required time, cost and quality.

Project management - has a wider significance as a management project involves organizing and coordinating. It is that specific methodologies for planning and managing its implementation.

Definition of the project - the definition of objectives, organization, required resources, inputs, etc.

Project management – is the way management and coordination of human and material resources throughout the life of the project, when using modern management techniques to achieve predetermined objectives within a given range, cost, time, quality and satisfaction of project participants.

The project - a set of activities defined in time, organized to meet identified needs.

Project management -is managing time, resources, quality, etc.

Project management (access) – is method of management and coordination of human and material resources throughout the life of the project, using modern management techniques to achieve predetermined objectives within a given range, cost, time, quality and satisfaction of project participants.

The project is a set of activities defined in time, organized to meet identified needs.

B) Access to project management

The project is temporarily developed the efforts made to create a unique product or service. Temporarily in the sense that it is clearly set the start and end of the project. Unique in the sense that a given product or service substantially different from all existing ones.

Project management is the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations from the project. Filling or exceeding those needs and expectations always requires cope opposing requirements between:

- work scope, time, cost and quality;
- interest groups with different needs and expectations;
- established an undetermined requirements (needs).

Currently in Europe and the CR approaches PMI and IPMA field.

The following section will repeat chapters PM BOK, according to which approach project management PMI:

1. **Outline of Project Management** - describes the basic structure for understanding project management.

2. **Background of Project Management** - describe the environment in which projects are implemented. Managing project team must understand that these broader context of managing daily activities within the project are critical to success, but not sufficient.

3. **Processes Project Management** - represents a general view of the common links between the different processes of project management. Understanding these relationships is important for understanding the material present in the following chapters.

4. **Management Integration Project** - describes the processes required to ensure proper coordination of the various elements of the project. It consists of a compilation of the project plan, the implementation of the project plan and overall coordination of changes.

5. **Management Project scope** - describes the processes required to ensure that the project included all the required work and only these works and so could be

completed successfully. It consists of initiation (boost), scoping, verification scope and operational management of scope changes.

6. **Management Project time** - describes the processes required to ensure timely completion of the project. It consists of defining activities, sequencing activities, estimating the duration of activities, build schedule and inspection schedule.

7. **Management of project costs** - describes the processes required to complete the project within the approved budget. It consists of resource planning, cost estimating, cost budgeting and operational management costs.

8. **Control the quality of the project** - describes the processes required to ensure that the project meet the needs, for which it is implemented. It consists of quality planning, quality assurance and quality control.

9. **Management of human resources within the project** - describes the processes required for the most effective use of people involved in the project. It consists of planning organizational structure, recruitment and development teams.

10. **Management of communication within the project** - describes the processes required to ensure timely and proper preparation, collection, dissemination, storage of project information and straightforward handling of this information. It consists of communications planning, information distribution, performance reporting and administrative closure.

11. **Management of project risks** - describes the processes involved in recognition and analysing risks and responding to those risks. It consists of risk identification, risk assessment, creation of Risk Response and operational management Risk Response.

12. **Management of procurement under the project** - describes the processes required to obtain goods and services outside the implementing organization. It consists of procurement planning, scheduling demands, RFP, sourcing, management of contractual relations and termination of contractual relationships

C) Preliminary planning

The first step in planning is to get all the basic information related to the project. Most information can be determined from the recommendations and orders for individual tasks issued by the commander of the unit (platoon, battalion), which carries out the construction. At the level of platoon and the team's task (activity) performed on the basis of an order.

After gathering the information, the commander should carry out a detailed survey of construction sites, or to merge with the commander at the tactical level to ensure that the final planned facility meets its needs.

Planning requires setting goals (mission), methods, procedures planning. The core of management is to adopt a decision based on a survey and analysis.

Preliminary planning (project initiation) is a set of activities aimed at defining project objectives and create basic conditions for the project. We often hear about the project phase, during which the project sponsor formulate ideas about what should be realized by the project, choosing the optimal variant acquisition project selects the appropriate supplier (Contractor) project.

The outcome of the preliminary planning is:

- Project charter;
- preliminary project definition.

The foundation charter formally approved and initiated a project or phase of the project, documenting requirements of the customer. It establishes relationships between the sponsor (the customer) and supplier (executor) of the project. It is determined by the project manager, who is involved in project planning, processing project charter. The project manager has the authority to request and use the resources for the project.

Form and structure of the constituent instrument may be different, it should include:

1. Name of project;

2. Initial conditions of the project;

3. Aim and purpose of the project;

4. An organizational relationships and the initial allocation of authority in relation to the project:

   a. the senior commander (commander of the brigade, battalion, project sponsor);

   b. the allocation of authority to the Project Manager (battalion commander);

   c. the allocation of the scope of liability line managers with respect to the project (rot commanders, platoon leaders);

5. Relations between project managers and functional managers (relations battalion commander, company commanders, platoon commanders, commanders working groups);

6. The basic framework for defining financial or other sources of coverage;

7. The basic time frame, such as the dates for the project should be completed and its outputs will be available to its users;

8. List of basic restrictions and assumptions;

9. Other strategic, operational and tactical criteria to consider when creating project assignment taken into consideration, if any;

10. Final provisions and explicit statements commander (superior commander, management) for the approval of this document.

Preliminary definition of the project in the preliminary form pre-defined project.

Each project has a specific goal to be achieved by its implementation. Preliminary definition of the project includes:

- description of the problem, the requirement Commander (customer or market opportunity);
- programmatic objective of the project (global, strategic, operational, tactical goal);
- specific objectives of the project;
- quantified criteria;
- assumptions, risks and limitations, other criteria.

D) Detailed project planning

When planning the project use the results of preliminary planning. The results of preliminary planning are transformed into a tactical plan for project implementation.

The project plan is subjected to detailed analysis.

The commander must study the plans and specifications, design a project and then divided into individual parts operations. The activity is starting element of the work, has a defined beginning and end.

The output is applicable:

- definition of the subject project;
- project plan.

Definition of the project's subject

The definition of the subject project typically includes:

1. detailed breakdown of project objectives, answering the question "Why?", The course will serve a project typically includes:

a. the rationale and specific operational (strategic) plan;

b. plan;

c. the list of the targets or outputs;

d. evaluation criteria and benchmarks for the task.

2. Detailed description of the subject expresses the requirement for the "what" is to be created under the project, what they do:

a. description of the project, its properties and parameters;

b. the definition of project outputs;

c. detailed information to ensure clarity and instantiation assignment;

3. The main limits and restrictions that assumes the sponsor (the customer) as:

a. description of the environment in which the object of the project is to be incorporated;

b. legislative and environmental constraints;

c. the basic requirements for the quality of the course of the project.

When drawing up the definition of the course of the project may proceed to draft detailed work breakdown (WBS - Work Breakdown Structure), which corresponds to the schedule of milestones and product breaks down into a logical hierarchy of tasks.

His help is then converted into project objectives definition of the object to the project:

1. work breakdown into sections, which are the basis for:

a. create an organizational structure of the project;

b. ensure quality outcomes, risk analysis;

c. the required professional development,

2. timetable for the project, which is:

a. basis for determining the order and sequence of individual tasks;

b. basis for determining the time of the tasks and the volume of labour input (output);

c. basis for coordinating all tasks;

d. comparative basis;

3. plan pumping costs, which represents:

a. total cost attributable to the individual tasks;

b. basis for the expected performance of the project budget.

The project plan

The project plan is another important document. Presents a summary of what must be done during the project, to meet the goal of the project and created object of the project as described in the definition of the project. The project plan answers the question "How?" will proceed to create the desired subject.

The project plan includes partial plans:

- **project management plan** (milestones and time schedule of the project, change management);
- **management plan objective** of the project (WBS, change management);
- **cost management plan** (budget project management, change management);

• **plan for staffing the project** (organizational structure, description of the roles, responsibilities, calendar involvement of people);

• **plan communication management** project (communication channels, means of communication, communication rules);

• **subcontracts management plan** (method of acquisition, technical and business requirements, coordination and monitoring of subcontracts);

• **risk management plan** (procedures, risk reduction);

• **quality management plan** (quality indicators, checklists for quality measurement, general plans for quality improvement).

List of tasks for students:

Students in the self-study the sources for part:

1. approach to project management;
2. preliminary planning;
3. detailed project planning.

Elaborate the concept of pre-project, which responds to the following points prior planning:

1. The project charter;
2. The preliminary project definition.

Basic and recommended reading:

1. ŠTEVKO, G. Projektování ženijních prací. Brno: Universita obrany, 2011. 89 s.
2. Hyndrák, K. *Microsoft Office Project, Hotová řešení.* Brno : Computer Press, a.s., 2007. str. 308. ISBN 9788025116814.
3. *A Guide to the Project Management Body of Knowledge (PMBOK Guide)-Fourth Edition.* [Online] [Citace: 22. prosinec 2010.] http://www.pmi.org/Resources/Pages/Members/Library-of-PMI-Global-Standards-Projects.aspx#pmbok .
4. *Project Management (FM 5-412).* [Online] [Citace: 4. říjen 2011.] http://www.bits.de/NRANEU/others/amd-us--archive/fm5-412(94).pdf.

10.2 Calculation of the Performance of MILENG machinery and equipment

A) Pre-project planning

The first step in planning is to get all the basic information related to the project. Most information can be determined from the recommendations and orders for individual tasks issued by the commander of the unit (platoon, battalion), which carries out the construction. At the level of platoon and squad's task (activity) performed on the basis of an order.

Preliminary planning (project initiation) is a set of activities aimed at defining project objectives and create basic conditions for the project.

We often hear about the pre-project phase, during which the project sponsor formulate ideas about what should be realized by the project, choosing the optimal variant acquisition project selects the appropriate supplier (Contractor) project.

The outcome of the preliminary planning is:

- project charter;
- preliminary project definition.

Form and structure of the **project charter** may be different, it should include:

1. name of project;
2. initial conditions of the project;
3. aim and purpose of the project;
4. an organizational relationships and the initial allocation of authority in relation to the project:
   a. the senior commander (commander of the brigade, battalion, project sponsor);
   b. the allocation of authority to the project manager (battalion commander);
   c. the allocation of the scope of liability line managers with respect to the project (rot commanders, platoon leaders);
5. relations between project managers and functional managers (relations battalion commander, company commanders, platoon commanders, commanders working groups);
6. the basic framework for defining financial or other sources of coverage;
7. the basic time frame, such as the dates for the project should be completed and its outputs will be available to its users;
8. list of basic restrictions and assumptions;
9. other strategic, operational and tactical criteria to consider when creating project assignment taken into consideration, if any;

10. final provisions and explicit statements commander (superior commander, management) for the approval of this document.

Preliminary definition of the project in the preliminary form defined project. Each project has a specific goal to be achieved by its implementation. Preliminary definition of the project includes:

• description of the problem, the requirement Commander (customer or market opportunity);

• programmatic objective of the project (global, strategic, operational, tactical goal);

• specific objectives of the project;

• quantified criteria;

• assumptions risks and limitations, other criteria.

B) Project management using MS Project

- project Management;
- Introduction to Microsoft Project;
- The hierarchical structure of tasks;
- Links between tasks, activities;
- Duration of activity;
- Costs;
- Allocation of resources;
- Project updates.

Pre-project planning is often referred to as pre-project phase, during which formulates the project sponsor, what is to be realized by the project.

The outcome of the preliminary planning is:

• project charter;

• preliminary project definition.

Processing tasks set out in content and study of recommended literature, students will be able to find and use the information needed to solve a given task.

List of tasks for students:

Within the process of self-study materials for students detailed project plan below that range.

Detailed project planning

When planning the project uses the results of preliminary planning. The results of preliminary planning are transformed into a plan for project implementation. The project plan is subjected to detailed analysis.

The output is applicable:

- definition of the subject project;
- project plan.

The definition of the subject project typically includes:

- detailed breakdown of project objectives;
- detailed description of the subject;
- main limits and restrictions that assumes the sponsor (the customer);
- detailed work breakdown (WBS - Work Breakdown Structure);
- timing of project;
- plan pumping costs.

The project plan includes partial plans:

- project management plan;
- management plan for the subject project;
- Plan cost management;
- plan for staffing;
- communications management plan;
- management plan subcontracting;
- management plan;
- quality management plan.

Basic and recommended reading:

1. ŠTEVKO, G. Projektování ženijních prací. Brno: Universita obrany, 2011. 89 s.
2. Hyndrák, K. *Microsoft Office Project, Hotová řešení.* Brno : Computer Press, a.s., 2007. str. 308. ISBN 9788025116814.

10.3 Planning process of MILENG machinery/equipment application

When planning the project uses the results of pre-planning that will be transformed into a plan for implementing the project.

The commander must study the plans and specifications, design a project and then divided into individual sections and activities.

The output is applicable:

- Definition of the subject project;
- Project plan.

A) Detailed project planning

Students in the seminar will be detailed plans for its proposed project.

When planning the project uses the results of pre-planning. The results of preliminary planning is transformed into a plan for project implementation. The project plan is subjected to detailed analysis.

The output is applicable:

- definition of the subject project;
- project plan.

The definition of the subject project typically includes:

- detailed breakdown of project objectives;
- detailed description of the subject;
- main limits and restrictions that assumes the sponsor (the customer);
- detailed work breakdown (WBS - Work Breakdown Structure);
- timing of project;
- Plan pumping costs.

The project plan includes partial plans:

- project management plan;
- management plan for the subject project;
- Plan cost management;
- plan for personnel;
- communications management plan;
- management plan subcontracting;
- management plan;
- quality management plan.

Processing tasks set out in content and study of recommended literature, students will be able to find and use the information needed to solve a given task.

List of tasks for students:

Within the process of self-study materials for students detailed project plan in that range.

Basic and recommended reading:

1. ŠTEVKO, G. Projektování ženijních prací. Brno: Universita obrany, 2011. 89 s.
2. Hyndrák, K. *Microsoft Office Project, Hotová řešení.* Brno : Computer Press, a.s., 2007. str. 308. ISBN 9788025116814.
3. *A Guide to the Project Management Body of Knowledge (PMBOK Guide)-Fourth Edition.* [Online] [Citace: 22. prosinec 2010.] http://www.pmi.org/Resources/Pages/Members/Library-of-PMI-Global-Standards-Projects.aspx#pmbok.
4. *Project Management (FM 5-412).* [Online] [Citace: 4. říjen 2011.] http://www.bits.de/NRANEU/others/amd-us--archive/fm5-412(94).pdf.

11. The requirements for the engineering Corps of Engineers

11.1 Requirements for the MILENG machinery/equipment

The aim is to design machinery for the work system so that it coincides with the capabilities, limitations and needs of people. This requires an analysis of the jobs that the operator must perform, and the effects of any limitations of the proposal and its impact on the environment (eg noise, vibrations) probably acting on the health, safety and welfare of workers.

A) Ergonomic design principles with regard to

Machinery must be designed so as to take into account the variability in the behaviour of the operator. This includes:

1. physical dimensions (see 4.3.2)

2. position (see 4.3.3)

3. body movements (see Section 4.3.4)

4. Physical strength (see 4.3.5)

5. mental abilities (see 4.4).

Person's ability to use the machine is highly dependent on its reasonable and assigned a corresponding relationship to this device. Information about the body size allows designers to apply ergonomically major construction machinery (such as providing the necessary coverage or sufficient space for the operator).

Physical dimensions

Machinery must be designed with due regard to the physical dimensions of the projected operating and taking into account:

- Physical dimensions (both static and dynamic with suitable clothing and / or personal protective equipment) adults and people with special needs,
- range of body sizes and related movements,
- safe distance
- dimensions of access (in use, installation, adjustment, maintenance, cleaning, repairing, dismantling and transportation).

The proposed machinery must be adapted to at least 5th to 95th percentile estimated working population. If there are important health and safety aspects, must be the risk assessment used a wider range of at least first and / or the 99th percentile. For machinery intended for working men and women apply significant percentiles combined working population.

In determining the free space (e.g. leg) must be used or larger 95th percentile values.

To reach (for example from the operator) must use the 5th percentile or lower. For machinery with adjustable dimensions must be attainable range covering the 5th to 95th percentile.

Positions

Working positions must be as comfortable as possible and those working to promote ease of movement and do not have any harmful effects on individual workers.

When designing machinery must take into account the following principles:

a) must eliminate unsuitable location, such as twisted, bent or tilted during prolonged work leading to physical fatigue. It must support the ability to change position;

b) machinery intended to allow occasional changes in the working position sitting service and standing; as the main operating position to a standing position and prior to prefer sitting position;

c) the need for the supine position, kneeling and squatting should be limited if possible (or maintaining);

d) there must be a suitable body position and rest for the body; fulcrum must be designed and located so as to avoid unbalanced positions;

e) requirements for strength must correspond achievable posture. To achieve the desired effect must provide technical aids and prevent physical overload; To fulfil this requirement when using handheld devices, it is important that the risk changes or inappropriate grasping during use were excluded correct placement of the handles;

f) design workspace machinery has to take into account the following factors;

- angles of vision,
- viewing distance,
- easy visual resolution,
- duration and repetition task,
- any special restrictions on user groups, such as wearing multifocal glasses and
- constraints caused by the use of personal protective equipment (PPE).

Body motion

Machinery must be designed with respect to the work process, so that the body or body part to move in accordance with their natural paths and rhythms. First of all it is necessary to consider whether the employee does not perform long-term frequent movements involving extraordinary job rotation in the joints.

The proposal machinery must apply the following principles:

a) Machinery must allow sufficient freedom of movement (avoid static positions);

b) machinery must be designed to avoid repetitive movements, which may lead to damage, illness or injury;

c) If there is the occasional need to work beyond normal hand at working the system you must enable bend or slant party; Risks to workers shall be reduced by the fact that it can be supported and support the weight of his body;

d) movements with high precision and accuracy for its implementation must require little power (see also 4.4);

e) if necessary aids (such as a hoist rails, stops, agents etc. to reduce excessive muscular load) must have adequate working space dimensions allowing these aids;

f) must be ruled out turning motions or extraordinary joint position or arm involving the use of force.

Physical Strength

The activities of the operator of machinery, which requires the use of large forces can cause musculoskeletal system load. This increases the risk of fatigue, discomfort and disruption musculoskeletal system.

The proposal machinery must apply the following principles:

a) it is also necessary to use physical force and can not keep it at a safe level, must be provided with mechanical aids;

b) must be excluded prolonged static muscle tension (for example caused by raised arms or holding hands); weight of the device gripped longer hands can be a significant cause of muscle fatigue, its effects to be reduced for example supporting system for the method of suspension;

c) use of physical force must be minimized wherever possible, for example, measures such as balancing weight;

d) controls, knobs, handles and pedals machinery must be designed, selected, and arranged to meet the requirements of EN-894-3;

e) depending on the required strength, size, shape and position controls must avoid uneven loading of the trunk and limbs;

f) weight distribution hands gripped portable devices must ensure the right balance with regard to the control and support locations.

Description of the mental faculties of man

Machinery and its associated elements (media, signals, drivers, manuals etc.) must be designed to fit only the physical but also the mental capacity anticipated groups of workers. The term mental in this sense refers to cognitive, informational and emotional processes of the human being, as specified in the standards (EN ISO 10075-1). Mental fitness is associated with the ability of the operator to control the machine and perform the required operations.

NOTE low compatibility between the worker's mental abilities and the requirements for their use has resulted in an uncertain performance and leads to damaging effects on the health and well-being of the worker. This poor compatibility is also a barrier to learning and training.

Requirements for the interaction between the operator and machinery

Requirements and guidelines to ensure a controlled and safe operation of machinery are given in the standards (EN ISO 7731, EN 842, EN-894-1, EN-894-2 and EN 981).

Directive to help designers avoid the damaging effects on both servant (excessive or insufficient load, fatigue, monotony, reduced alertness, glut, see EN ISO 10075-1) are described in detail in the standards (prEN ISO 9241-110 and EN ISO 10075 -2).

Principles of design work tasks with regard to the operation are described in the standards (EN 614-2: 2000).

Must apply the following ergonomic principles:

a) Machinery must support the operator in carrying out repetitive tasks. The operator has to be supported in a way that works too are not burdened her mental abilities, but not to avoid under-utilization of these capabilities (principle of proportionality task);

b) the basic features and functions of the machinery must be easy to understand for the operator (principle understandable description);

c) the operator must machinery and equipment control (controllability principle);

d) machinery must preferably be compatible with the operating assumptions based on previous experience and training (the principle of conformity with user expectations);

e) machinery must be resistant to disturbances and the operator must provide the means for their removal (failure does not lead to a dangerous situation; policy options to correct the error);

f) machinery must enable the operator to the appropriate degree of autonomy concerning decisions, priorities and procedures (principle of proportionality of the individual);

g) machinery must enable the operator to develop relevant skills and reach new (principle of proportionality doctrine);

h) machinery must be flexible enough to be adapted to the different abilities of the anticipated workers (see EN 614-2) and, if necessary, and special needs (see 4.2).

Communication and control devices

When designing the interaction between the operator and the machinery special attention must be paid to the following aspects:

a) any information required to do the job must be readily accessible to the operator; this information must be presented in such a way that they can easily understand

worker and acted upon, for example, provide a quick overall view of the entire workflow and give information about the details;

b) the media and signalling devices must be designed to a certain extent compatible with the characteristics of human perception and exercised task;

c) when used interactive system, the icons, symbols and commands respect and function coincide;

d) when designing machinery must be taken into account visual errors; therefore not be color coding single species, but it is used and also the shape, position or text;

e) when designing machinery must be taken into account auditory abilities; in noisy environments to be used as signals other than sound.

Of controllers and their functions shall be designed, selected and arranged so as to ensure their recognition and control. Whenever possible, it must be the direction of motion controls to activate functions and indicators consistent with the expected effect, or in line with normal practice.

B) Description of the influence of the physical working environment on humans

In accordance with the principles contained in (EN ISO 1200-1 and EN ISO 1200-2) proposal machinery must reckon with the effects of certain pollutant emissions from these facilities to operate or work environment.

Noise and vibration

Exposure to noise and vibrations generated during the operation of machinery must be minimized. This will help eliminate health and safety hazards and discomfort of the operator (detailed guidance on noise exposure are given in EN ISO 11688-1 and EN ISO 11688-2).

NOTE are recognized vibration arms and hands (see ISO 5349-1 and EN ISO 5349-2), and the entire body (see ISO 2631-1).

Thermal emission

Thermal emissions generated by operation of the work equipment must be minimized to avoid health and safety risks and to ensure thermal comfort.

In particular, it must take into account:

a) necessary physical workload;

b) thermal characteristics necessary clothing and personal protective equipment (PPE);

c) the expected heat load worker;

d) the temperature of all surfaces accessible contact.

Lighting

Lighting must meet user requirements necessary to perform the work task. The manufacturer shall in the instructions describe how minimal lighting in the workspace machinery needed for safe operation. Adequate lighting control and monitoring equipment of the machine must be delivered together with the machinery. Adjustable lighting must be easy to operate.

In particular, it must take into account:

a) prevent flutter;

b) prevent glare or dazzle;

c) avoid confusing shadows;

d) prevent stroboscopic phenomena;

e) contrasts the work must conform to the task;

f) to preserve colour.

Note that the criteria for lighting are shown in (EN 1837).

List of tasks for students:

Recommended literature study the procedure applying ergonomic principles in the process of designing machinery:

1. setting design requirements,
2. of the basic features of the proposal,
3. processing of detailed design,
4. implementation of the proposal.

Basic and recommended reading:

1. ŠTEVKO, G. Projektování ženijních prací. Brno: Universita obrany, 2011. 89 s.

2. Hyndrák, K. *Microsoft Office Project, Hotová řešení.* Brno : Computer Press, a.s., 2007. str. 308. ISBN 9788025116814.

11.2 Process of the organization and planning of MILENG machinery/equipment reparation

The aim is to propose the application of ergonomic principles in the design of machinery in the work system. This requires an analysis of the jobs that the operator

must perform, and the effects of any limitations of the proposal and its impact on the environment probably acting on the health, safety and welfare of workers.

A) The application of ergonomic principles in the process of designing machinery

The design process can be carried out in four main stages (see table).

Table 1 - Description of the process of drafting the work task

Číslo	Etapa tvorby návrhu	Popis
1	Stanovení cílů návrhu	Shromáždění informací o srovnatelném existujícím strojním zařízení Zpracování základních cílů návrhu a specifikace návrhu Stanovení základních výkonových požadavků a hodnoticích kritérií
2	Analýza funkcí	Určení funkce a subfunkce a specifikování jejich hierarchie a funkčních vztahů Specifikace funkcí společně s kritérii výkonu Vyhodnocení specifických funkcí vzhledem ke specifikaci návrhu
3	Přidělení funkcí	Přidělení funkcí a subfunkcí obsluze nebo stroji, nebo oběma, je-li to vhodné Vyhodnocení přiměřenosti funkcí jako lidské aktivity nebo činnosti strojního zařízení Naznačení alternativních řešení návrhu a analýza jejich výhod a nevýhod
4	Specifikace pracovního úkolu	Shromáždění informací o existujících srovnatelných úkolech Podrobná specifikace úkolů pro obsluhu Vyhodnocení pracovní náročnosti každého úkolu pro obsluhu
5	Přidělení pracovních úkolů obsluze	Určení požadovaného počtu pracovníků obsluhy Přidělení úkolu obsluze Vyhodnocení celkové pracovní zátěže obsluhy a splnění charakteristik dobře navržených pracovních úkolů

In the proposed process should include experience of the staff to ensure the participation of health, safety and ergonomics experts.

This Annex provides a description of the drill, and illustrates the design procedure described in 4.2.1 to 4.2.5. Not a complete description of the whole process, but a certain set of illustrations as examples of important decision-making process points. (This example focuses on ergonomic aspects). It is important that the simultaneous fulfilment of the requirements of existing European standards for machinery safety (eg risk assessment (EN 1050) and a safe distance (EN 294 and EN 811).

Figure B.1 is a flowchart representing the process design, its interaction and repeated steps. Figure also contains links to images B.2 to B.7.

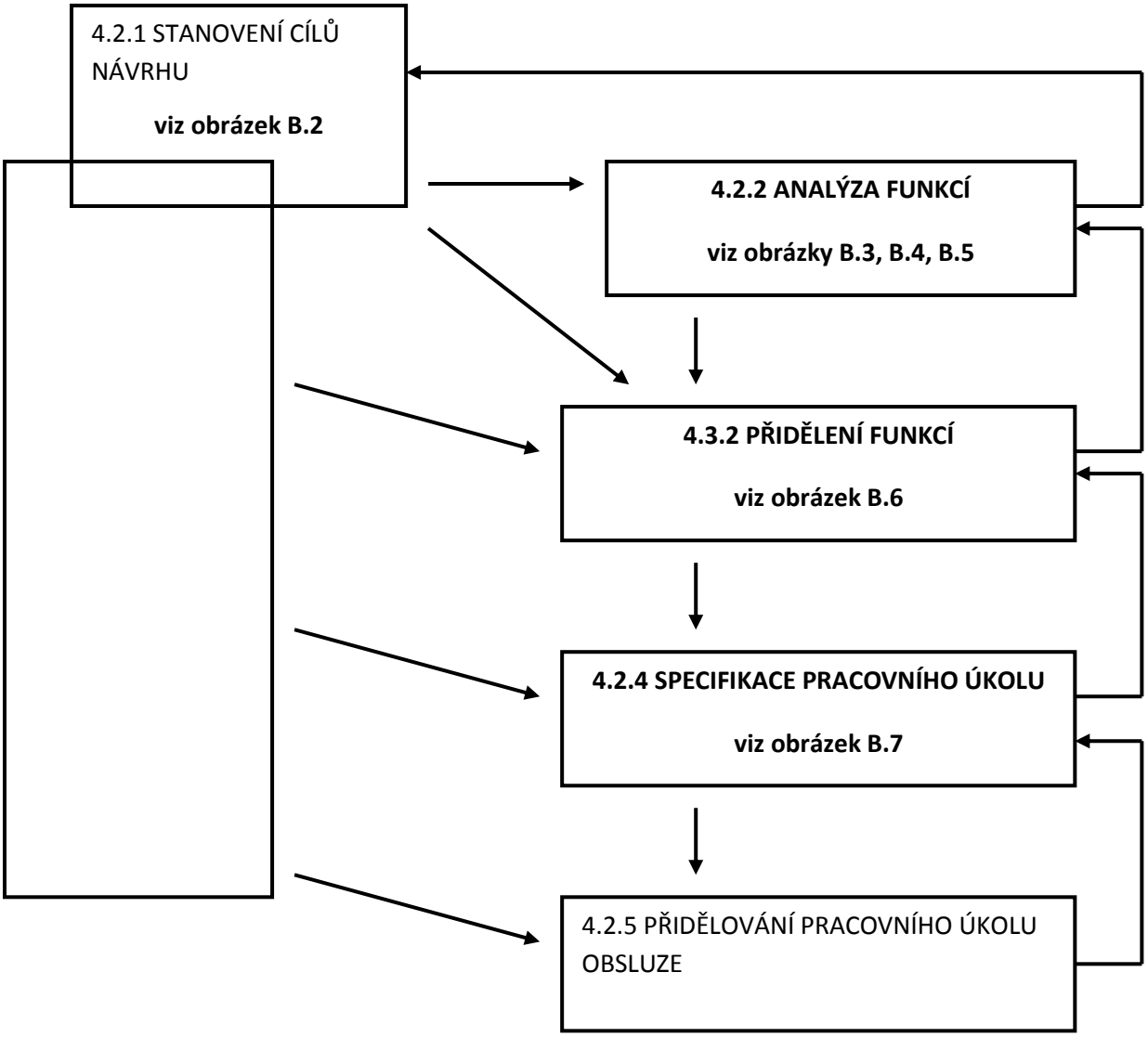


Figure B.1 - Flowchart design procedure

B.2 Setting objectives of the proposal

Figure B.2 shows an example of how this can be the objective of working together with specified performance requirements and evaluation criteria. From left to right are the objectives presented in three different levels, starting from the most general goals of a particular drill hole (columns 1-3}. Specifications at more detailed levels and appropriate evaluation criteria are given in columns 4 and 5.

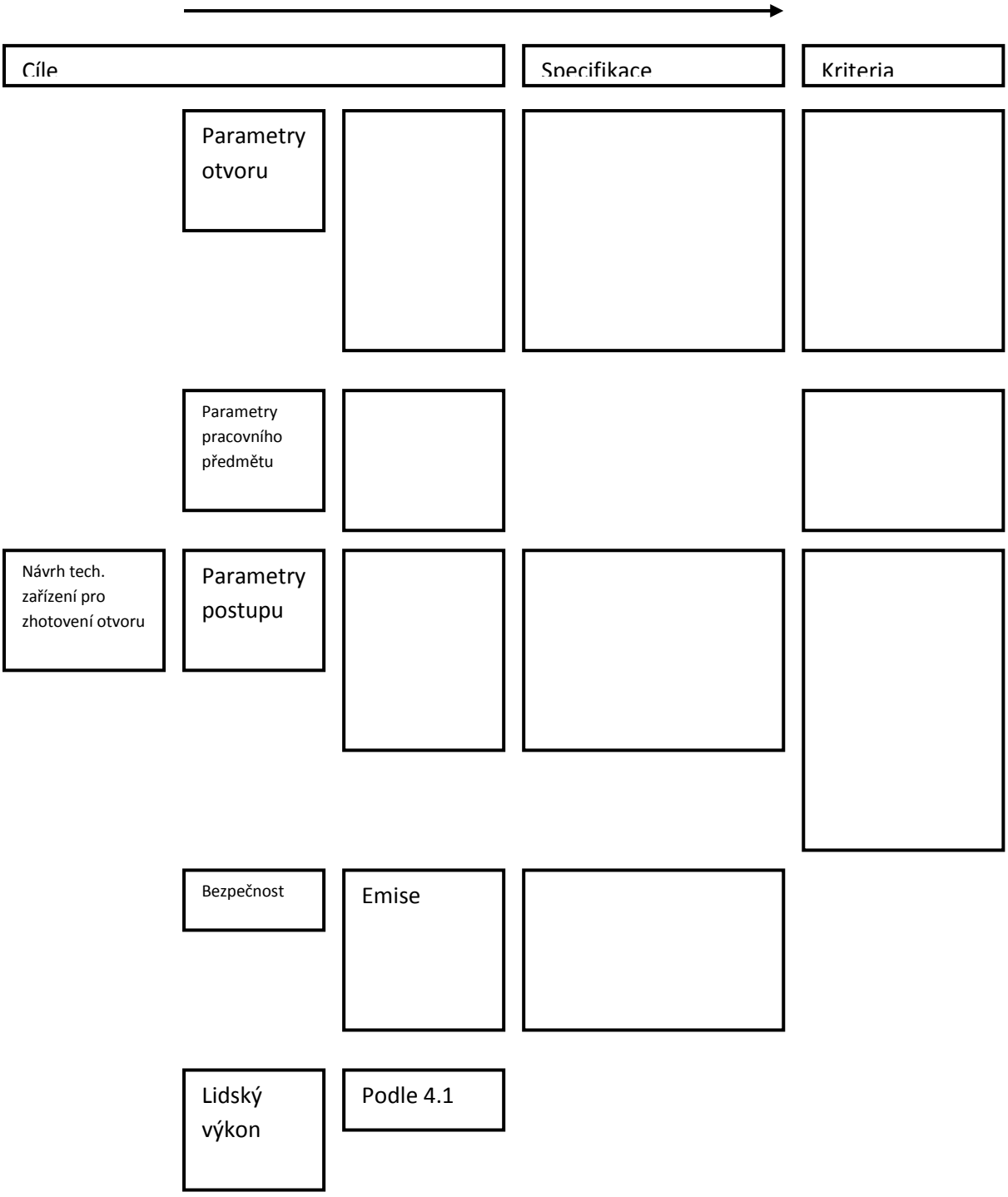


Figure B.2 - Example of the general objectives of the proposal

B.3 Analysis functions

Figure B.3 is a flowchart of process functions. It is assumed that the technique a method to perform a task is not yet determined. The flowchart shows from left to right main process steps: input, which includes the function of information processing in various items. This is followed by step process, which includes the function of

preparation, fabrication and inspection hole. The last column contains the ascent, which contains functions to remove product, equipment and by-products (waste) and maintenance.

Figure B.3 - Flowchart process at the most general level

The most important thing is to check if it is to perform a given task using proper techniques and methods. Figure B.4 shows a matrix, which used to compare different methods of making the existing holes. Methods can be analysed by objectives, specifications and criteria listed in Figure B.2. In this case it is assumed that the proper method of manufacture is drilling holes.

Alternativní/cíle Zařízení	…	Tvar	Velikost	Hloubka	Přesnost	Počet	Variabilita	Emise	Poloha	…

Legend:

+ suitable of sufficient

- inappropriate

Note: For exact specifications where possible.

Figure B.4 - Comparison of existing design solutions

Figure B.5 shows a flowchart of the functions of the drilling process in its chronological order (from left to right). In the upper part of the figure are the functions

specified first on a general level. The lower part shows a more detailed specification of functions and sub-functions, which are further divided into lower levels, where it is possible to transform them into work assignments service and develop technical solutions for the design of the drilling machine.

Figure B.5 - Hierarchical flowchart of specified functions

B.4 The allocation functions

Figure B.6 shows how you can assign functions Manual (0) or machine (M). function and sub function specified task drilling resulting analysis functions are indicated on the left. To the right are specified functions assigned to both the operator and the machine in three different ways. Assigning functions guide depends on its needs, capabilities, etc., As indicated in 4.2.3. The final decision can be done by only the results of the specification of the task as described in 4.2.4.

B.5 specification of the task

B. In Figure 7 are specified in detail work tasks resulting from the functions assigned to the operator. Three different ways in Figure B.6 were transformed into the corresponding working operator task (1-3). At this stage it is determined human sequence of activities in the workflow, and together with appropriate technical solutions it evaluated.

Work task 1 operator with its corresponding technical solutions and illustrates the current draft of the task, the normal drill. This solution contains a certain lack of safety, because there is no technically solid separation between positioning and drilling parts, which can lead to injury. Drilling depth is controlled by the operator (visual inspection depth of the display). This activity consists mainly of behaviour based on operator skills.

Solution B offers two optional specification of the task. Work assignment operator 2 is a common design manual task with a certain safety improvements on two hands.

Subtask control drilling depth is eliminated, while the added Subtask precise speed setting ("Setting rev / min continuous range", "Conversion Settings"). U subtask 1 and 2 controls the drilling operation ("normal resistance hands, sound, smell, etc.") Work assignment operator 3 offers machine drilling. The main part of operation is detailed settings of the machine, which consists of mechanically precise behaviour of the operator.

The final choice of design solutions depend on assessment of the components of the workload in the performance of the work task. Solution A (úkol1) probably involves a high health risk and is therefore not recommended. Solution B, with the task of operating 2 and 3, it can be because it takes into account the main aspects of a well-designed work assignment operator as they are described in 1.4

SPECIFIKACE FUNKCÍ			PŘIDĚLENÍ FUNKCÍ		
Funkce		**Subfunkce**	**Alternativy**		
Informace			O O O	O O O	O O O
Příprava	**Pracovní předmět** **Zařízení**		O O O O O O O O O O	O O O O O O O O O O	O O O O O O O O O O
Řízení operace	**Začátek** **Operace**		O O M O O O - O - O O	O O M O O O - O - O M	O O M M M M - O - O M
Informace	**Výrobek** **Vedlejší produkt** **Zařízení**		O O O O O	O O O O O	O O O O O
Bezpečnost			- - - -	- - O/M O/M	- - -

Figure B.6 - Assigning functions

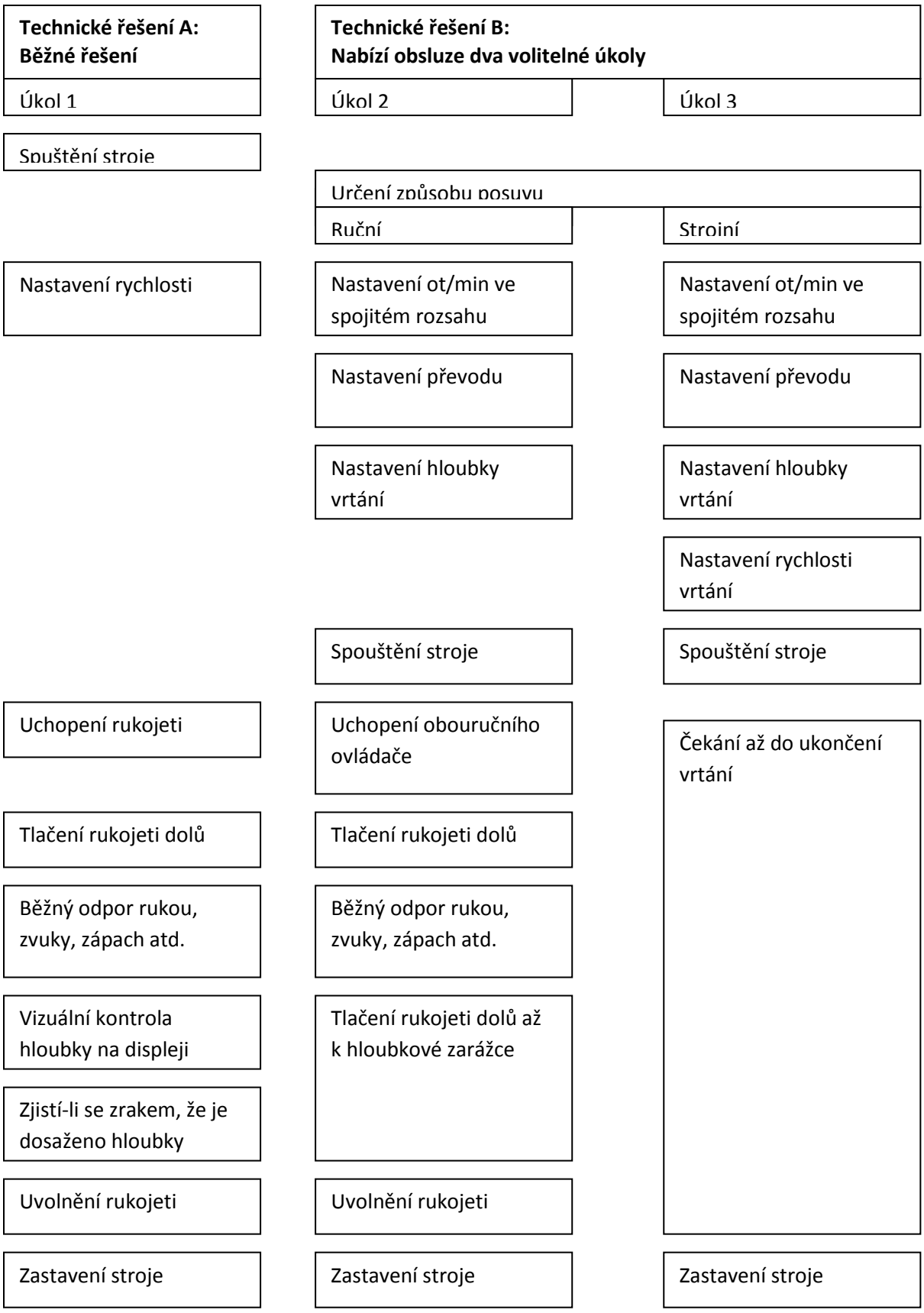


Figure B.7 - Specifications work assignment operator

Examples

1. **Provide an adequate degree of freedom and autonomy instructions. The** operator has a choice between two alternatives for doing so.

2. **Recognition experience, skills and abilities of the group or expected operating personnel.** Serving used conventional way of performing tasks (task 1) are able to use a large part of their skills in task 2. By providing two options to perform a task, the drilling process adaptable to many intended users.

3. The granting of options using the appropriate skills, abilities and activities

and in particular the possibility of providing an appropriate combination of the following behaviours:

• **Behaviour based on skills**: for example, in process control drilling in task 2 control ("normal resistance hands, sound, smell, etc.")

• **Behaviour-based rules**: for example, a regulation setting a drilling rig in task 2 and 3 ("set rev / min continuous range", "set the drill feed")

• **Behaviour based on knowledge**: Usage behaviour based on knowledge depends on the context of the task of drilling. Behaviour based on knowledge Ize used when setting up the machine according to different material parameters (such as setting rev / min), the maintenance and the development of new working practices which would be able to offer a more modern machines.

4. The provision of opportunities to use and develop current skills and abilities and acquire new ones. As stated in paragraph (a) and (e) the operator can choose between two ways of performing the task, and therefore has a certain degree of autonomy. In task 2 is the operator given feedback on the implementation of the task of checking the "normal resistance hands, sound, smell, etc.", Which gives the opportunity to gain experience by trial and error. In task 3 provides the control of the drilling process machine. The operator must develop tasks and adjustment of the machine is able to receive feedback process observation and review of results. The degree of autonomy increase by the proposal include behaviour based on knowledge, as envisaged in paragraph (d).

List of tasks for students:

1. Process requirements for the design of machinery:

• determining the design requirements,

• Processing of the basic features of the proposal,

• Preparation of detailed design,

• Implementation of the proposal.

The electronic version handed to the teacher.

2. Study the technical requirements for products intended for the national defence (see ČOS 051,625 - Technical conditions for products intended for the national defence).

Basic and recommended reading:

1. ŠTEVKO, G. Projektování ženijních prací. Brno: Universita obrany, 2011. 89 s.

2. Hyndrák, K. *Microsoft Office Project, Hotová řešení.* Brno : Computer Press, a.s., 2007. str. 308. ISBN 9788025116814.

11.3 Maintenance and reparations of MILENG machinery/equipment

Specifications are binding upon the approval of a technical document which defines the characteristics completeness, and other characteristics of the products, their conservation and influence throughout its lifecycle. Technical conditions also determine the conditions for production, inspection, testing, operation, maintenance, repair, inspection, packaging, storage, transportation, labelling and disposal of the product.

In this section only the technical conditions on the specification of requirements engineering technique for specific tasks and engineer works.

A) Technical conditions

The structure of the tactical and technical requirements for development:

• Name of technology

• Development Goal (modernization)

• Characteristics, determination and composition developed (modernized) techniques

• Requirements for typing and unifying relationship developed (modernized) techniques

• Scope TTP

• Requirements for confidentiality

• Policy development (modernization) Related documents - Examples of current laws, decrees, agreements, standards and regulations.

I. Requirements for Basic Combat (commercial) properties developed (upgraded) techniques:

• indicators requested combat effectiveness (u weapons - tanks, BVP, OT etc.).

• required service parameters (for other techniques, instruments and equipment)

• requirements for the composition sets and a breakdown into sub-units and assemblies

• requirements for the dimensions and weight of the unit (sets) and individual parts

• requirements for attendance

• requirements for transportability

• requirements for compatibility and interchangeability

• requirements for radio-electronic protection.

II. Requirements for the operation, maintenance and repair developed (modernized) techniques:

• requirements for resistance to external influences

• reliability requirements

• reliability requirements are expressed in two planes

• requirements for operating materials

• requirements for the operation, maintenance and repair.

III. Other requirements

• design and technological requirements

• requirements for the program and information security

• ergonomic requirements, conditions for the whereabouts and activities of persons technical and aesthetic

• safety requirements

• requirements for packaging and labelling

• requirements for storage and transport

• standardization requirements.

IV. Technical and economic requirements:

• requirements for operating and training documentation and utilities

• requirements for hygiene, health and safety at work

• requirements for the guarantee terms techniques of mass production

• requirements for ecology

• metrological requirements for security

• requirements for cataloguing security

• specification parameter validation methods and qualitative characteristics of the prototype

• requirements for special methods and instrumentation for testing,

Technical conditions consist of the following main parts:

• requirements for basic combat (commercial) properties developed (modernized) techniques,

• requirements for the operation, maintenance and repair developed (modernized) techniques,

• other requirements

• technical - economic requirements.

The technical conditions serve as a methodology for setting specific requirements for technical means performing specific engineering tasks and activities.

List of tasks for students:

Based on the methodology you process the technical requirements for machinery, which are designed to perform the allocated engineer tasks, activities. Technical requirements will consist of the following parts:

- requirements for basic combat (commercial) properties developed (upgraded) techniques,
- requirements for the operation, maintenance and repair developed (modernized) techniques,
- other requirements;
- technical - economic requirements.

The conclusions of their work and submit text in electronic form and will present them to the next seminar.

Basic and recommended reading:

1. ČOS 051625 - Technické podmínky pro produkty určené k zajištění obrany státu)

11.4 The organization, preservation and storage of MILENG machinery/equipment

Specifications are binding upon the approval of a technical document which defines the characteristics completeness, and other characteristics of the products, their conservation and influence throughout its lifecycle. Technical conditions also determine the conditions for production, inspection, testing, operation, maintenance,

repair, inspection, packaging, storage, transportation, labelling and disposal of the product.

In this section only the technical conditions on the specification of requirements engineering technique for specific tasks and engineer works.

Technical conditions

Students will perform separately and will present the technical requirements for machinery, which is designed to perform the allocated engineer tasks and activities.

Technical requirements consist of the following:

• requirements for basic combat (commercial) properties developed (upgraded) techniques,

• requirements for the operation, maintenance and repair developed (modernized) techniques,

• other requirements

• technical - economic requirements.

The conclusions of their work and submit text in electronic form and will present them to the next seminar.

Technical conditions consist of the following main parts:

• requirements for basic combat (commercial) properties developed (modernized) techniques,

• requirements for the operation, maintenance and repair developed (modernized) techniques,

• other requirements

• technical - economic requirements.

List of tasks for students:

Based on the comments received in the seminary you finish technical requirements for machinery, which is designed to perform the allocated engineer tasks, activities.

Repaired conclusions of our work you left in text form to teacher.

Basic and recommended reading:

1. COS 051 625 - Technical conditions for products intended for the national defence)

12. Field training

Practical training enables not only deepen the already acquired theoretical knowledge the possibility of using engineering techniques, but also enables quick orientation when looking at individual types of engineer equipment and material used in units and ACR units.

It also enables **quick and efficient** decision making when handling this technique and materials and their use in the field.

In practical training are discussed following subtasks:

- Determination, TTD and major items of equipment;
- Function of the main part of the technique;
- Special equipment technology;
- Technology works with the technique;
- Precautions when working with machinery.

A) Construction and engineering techniques

- Pontoon bridge set PMS;
- Powerboat MO 2000;
- Laminated boat RUSB;
- Tracked amphibious carrier PTS-10;
- Automobile bridge AM-50;
- Transporter bridge PM-55;
- Bridge tank MT-55A.

List of tasks for students:

Brief description of the construction and use of any transportation equipment.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR.

B) The construction and use of mine and demine equipment

- Universal Minh swapper UMU;
- Mechanical demining KMT-6;

- Explosive demining VO;
- Mine thrower MV-3;
- Mine swapper MU-01;
- Mine swapper MU-90.

List of tasks for students:

Brief description of the construction and use of any of mine and demine equipment.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR.

C) The construction and use of machines for wood processing

- Motor chainsaw, STIHL a HUSQVARNA;
- Mobile workplaces woodworking MPZD.

List of tasks for students:

Briefly describe the construction and use of any of the machines for woodworking.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR..

D) The construction and use of engineer equipment for ground work

- Excavators automobile UDS-114a, 214a;
- Wheel carrier KN-251;
- Bulldozer Caterpillar D5N, D6K;
- Mobile auger PZV.

List of tasks for students:

Brief description of the construction and use some of the techniques for ground work.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR.

E) The construction and use of diving equipment

- Diving Kit SP-20M, SP-20D;
- The unit rescue ZP-10M;
- Compressor high TRIDENT;
- Decompression chamber DK-2;
- Rescue inflatable vest ZNV-1, ZNV-3.

List of tasks for students:

Brief description of the construction and use of any diving equipment.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR.

F) The construction and use of electro technical equipment

- Generator EC-2 kW, EC-4 kW, EC-6 kW, EC-8 kW;
- Generator EC-12 kW, EC-16 kW, EC-30 kW, EC-60 kW;
- Universal lighting kit OS-U;
- Source and distribution set SU 230 (2x30 kW), ZRS-60 kW;
- Source and distribution set ZRS-20 kVA LR.

List of tasks for students:

Brief description of the construction and use of any of electro technical equipment.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR..

G) The construction and use of means for editing and extracting water

- Water Treatment Plant ÚV-2000;
- Water Treatment Plant AQUAOZON 32;
- Motor sludge pump MKČ.

List of tasks for students:

Briefly describe the construction and use of any of means for editing and extracting water.

Basic and recommended reading:

Žen-x-x Professional standards engineer ACR.

Military Engineer is prepared to implement engineer support operations troops using engineering techniques and materials that are currently available u engineer units ACR. Therefore, the practical preparation of future engineer commanders crucial not only in terms of prudent deployment and management of people, technology and material, but also in terms of defining priorities engineer in the quest for the most economical and most efficient use of engineer forces and resources.

Engineer support of troops is one of the kinds of support operations troops. Effective Business Support Engineer troops are important for the successful completion of the operation's objectives and quality performance of tasks all kit components created task forces.

Basic and recommended reading – the full list:

1. ZELENÝ, J. (S - 10490) Všeobecná ženijní podpora. Brno: UO, 2011;
2. STANAG 2394, ATP-52(B) Ženijní doktrína pozemních sil. Brusel: Vojenská agentura pro standardizaci, 2008. 151s.;
3. Návrh předpisu Vševojsk-2-2. Ženijní zabezpečení boje. Praha 2004;
4. Pomůcka „Organizace, vybavení, možnosti a zásady použití ženijního vojska a záchranných praporů“. Praha 2006.
5. ZELENÝ, J., VODEHNAL, M. (S - 436) Zkušenosti z plnění úkolů ženijního zabezpečení činnosti vojsk v mírových operacích IFOR a SFOR. Brno: UO, 2006;
6. NEHODA, J. (S - 3177) Elektrotechnické prostředky ženijního vojska a ochrana před úrazem elektrickým proudem. Vyškov: VVŠ PV, 2000;
7. Žen-26-3. Elektrocentrály 30 kW a 60 kW. Praha: MO ČR, 1972;
8. Žen-26-6. Elektrocentrála 4 kW a 6 kW. Praha: MO ČR, 1977;
9. Žen-7-7. Odborný výcvik strojníků ženijní techniky. Praha: MO ČR, 2013;
10. Vyhláška č. 50/1978 Sb. O odborné způsobilosti v elektrotechnice;
11. Vševojsk-16-8. Bezpečnostní předpis pro elektrická zařízení v pojízdných nebo převozných prostředcích pozemní vojenské techniky. Praha: MO ČR, 1999;
12. Žen-26-5. Polní rozvodné a osvětlovací prostředky. Praha: MO ČR, 1967;
13. Letecký předpis. Heliporty. L14H;
14. FM 5-430-00-2 Požadavky na polní letiště a přistávací plochy;
15. STANAG 2885 Emergency supply of water in war. 1996;
16. Vševojsk-16-2 Zabezpečení Armády České republiky pitnou vodou. Praha: MO, 2013;
17. ŠTEVKO, G. Ženijní stroje – Prostředky pro těžení a úpravu vody. Vyškov: VVŠ PV, 2001;
18. Zákon č. 254/2001 Sb. „Vodní zákon“;
19. STANAG 2136 Normy minimální kvality pitné vody v krizových situacích. 2002;
20. Žen-2-3 Ženijní průzkum. Praha: MO, 1992;
21. Žen-2-9 Ženijní práce druhů vojsk. Praha: MO, 1981;
22. Žen-31-5 Úpravna vody 2000 l.h-1. Praha: MO, 1974;
23. ČSN 75 3102: 1992 - Ochrana vodních zdrojů. Značení ochranných pásem zdrojů hromadného zásobování pitnou vodou;

24. ČSN 75 5115 Vodárenství. Studny individuálního zásobování vodou. 1993;
25. STRNADOVÁ, N., JANDA, V. Technologie vody. Praha: VŠCHT, 2004;
26. AMBROŽOVÁ, J. Aplikovaná a technická hydrobiologie. Praha: VŠCHT, 2003;
27. PITTER, P. Hydrochemie. Praha: VŠCHT, 1999;
28. Armádní kontejner ISO 1C - přepravní nádrž pitné vody. [online] http://variel.cz/produkty/armadni-kontejner-iso-1c-prepravni-nadrz-pitne-vody/;
29. Žen-24-6 Vojenské potápění Praha: MO, 2009;
30. Mach, V., Sochr, J. Přepravy (S - 1182 Vyškov 1988, PČT 502);
31. Žen-2-4 Výcvik na vodě. Praha: MO, 2010;
32. Pomůcka - Záchranné a vyprošťovací práce;
33. ATP-72(A). Interservice Explosive Ordnance Disposal Operations on Multinational Deployments. Brusel: NSA, 2011;
34. STANAG 2143 EOD. Explosive Ordnance Reconnaissance/Explosive Ordnance Disposal (EOR/EOD). 5. edice. Brusel: NSA, 2005;
35. AEODP-6(A). Explosive Ordnance Disposal Reports and Messages. Brusel: NSA, 2008.
36. MACH, Václav. Vojenské mosty, cesty a přepravy. [S - 3174] Vyškov: VVŠ PV, 1995, 81 s.;
37. MAREČEK, Karel. Vojenské silnice. [U 1397] Brno: VA, 2004, 460 s.;
38. Žen-2-16 Vojenské silnice a cesty. Praha: MO ČR, 1987, 227 s.;
39. ŠTEVKO, Gabriel. Technika ženijního vojska – plovoucí přepravní prostředky. Brno: Univerzita obrany, 2009. 86s. ISBN: 978-80-7231-636-6.;
40. Žen-24-2 Motorový člun MO-634 s podvozkem SP-5. Praha: MO, 1981;
41. Žen-24-3 Ženijní laminátový člun s přívěsnými motory (RUSB). Praha: MO, 1982;
42. Žen-34-11 Mostní tank MT-55A. Praha: MO, 1975;
43. Žen-24-13 Pásový obojživelný transportér PTS. Praha: MO, 1977;
44. Žen-24-14 Mostní automobil AM-50. Praha: MO, 1877;
45. Žen-24-15 Přepravník mostu PM-55. Praha: MO, 1974;
46. ČOS 999917 Mechanizované mosty. Všeobecné technické požadavky. Praha: MO, 2005;
47. PALASIEWICZ, Tibor. *Zatarasování 1. díl*. Brno: Univerzita obrany, 2013. 102s. ISBN 978-80-7231-951-0.;

48. Žen-2-7 Výbušné zátarasy. Praha: MO, 1996;
49. Žen-2-8 Minový vrhač MV-3. Obsluha a bojové použití. Praha: MO, 1997;
50. Žen-2-9 Ženijní práce všech druhů vojsk. Praha: MO, 1981;
51. Žen-29-3 Minový vrhač MV-3. Popis a provoz. Praha: MO, 1998;
52. Žen-29-6 Výbušný odminovač VO. MO, 1976;
53. Žen-29-9 Univerzální minový ukladač UMU. Praha: MO, 1968;
54. Žen-29-11 Mechanický odminovač KMT-6. Praha: MO, 1981;
55. Mobilní pracoviště pro zpracování dřeva – MPZD. Popis a stručný návod k obsluze. Vyškov: VOP-026 Šternberk, divize VTÚPV Vyškov, 2007;
56. Žen-21-21 Řetězové motorové pily a jejich používání. Praha: MO, 1991;
57. PACIGA, Alexander. *Projektovanie a prevádzka čerpacej techniky.* Bratislava: Vydavateľstvo ALFA, 1990. ISBN 80-05-00650-0. 438 s.;
58. Žen-31-2 Čerpadla Praha: MO, 1969;
59. Žen-31-3 Úpravna vody ÚV-20 l.h-1. Praha: MO, 1985;
60. Žen-31-5 Úpravna vody ÚV-2000 l.h-1. Praha: MO, 1974;
61. Kontejnerizovaná úpravna vody Aquaozon 32. Kadaň: F&R s.r.o., 2007;
62. Števko, G. Technologie práce zemních strojů. Vyškov: VVŠ PV, 2003.112s.;
63. Břoušek, M., Vávra, I. a Zapletal, I. Inženýrské stavby - technologie 1. Bratislava: Alfa konti, 1995. 269 s.;
64. BRETŠNAJDR, J. Stroje pro zemní práce. Brno: VA, 1984. 425 s.;
65. JEŘÁBEK, K. a kol. Stroje pro zemní práce. Silniční stroje. Ostrava: VŠB – TU Ostrava, 1995;
66. Vševojsk-2-9: Bezpečnostní opatření při výcviku. Praha: MO, 2011;
67. Žen-21-7 Přívěsný kompresor DK-661. Praha: MO, 1978;
68. Žen-21-12 Souprava pneumatických přístrojů SPP-75. Praha: MO, 1978;
69. Žen-22-2 Hydraulické lopatové rýpadlo UDS-110a. Praha: MO, 1980;
70. Žen-21-16 Kolový nosič KN-251. Praha: MNO, 1978;
71. Žen-2-9 Ženijní práce druhů vojsk. Praha: MO, 1981;
72. DVOŘÁK, J., ŠTEVKO, G. Technika a materiál záchranných jednotek (S - 480); Vyškov: VVŠ PV, 2001; 126 s.; ISBN 80-7231-087-9;
73. HLÁSNÝ, J. a kol. Technika a technologie. Praha, VŠE 1996. 257 s. (ISBN 80-7079-103-9;

74. ŠTEVKO, G. Řízení rizik v rámci opatření všeobecné ženijní podpory. Brno: UO, 2012. 84s. ISBN 978-80-7231-915-2;
75. Hyndrák, K. Microsoft Office Project, Hotová řešení. Brno: Computer Press, a.s., 2007. str. 308. ISBN 9788025116814;
76. ČSNEN 614-1+A1 (833501): 2009 Bezpečnost strojních zařízení - Ergonomické zásady navrhování - Část 1: Terminologie a všeobecné zásady.;
77. ČSNEN 614-2+A1 (833501): 2009 Bezpečnost strojních zařízení - Ergonomické zásady navrhování - Část 2: Interakce mezi konstrukcí strojního zařízení a pracovními úkoly.;
78. ČOS 051625 - Technické podmínky pro produkty určené k zajištění obrany státu);
79. Organizační struktury ženijního vojska AČR. Praha 2014.