TEACHING PLAN

BACHELOR OF EDUCATION IN BUILDING ENGINEERING (BE-BE) STUDY PROGRAM

DEPARTMENT OF CIVIL ENGINEERING, FACULTY OF ENGINEERING, UNIVERSITAS NEGERI PADANG

COURSE NAME	CODE	GRASS MK	SKS		SEM	VERSION
			Theory	Pract		
Heavy Equipment and Mechanical Earthmoving		Study Program Compulsory Courses	**2**			

Responsible Lecturer	**Nidal Zuwida, S.Pd., M.Pd.T**	**TTD Responsible Lecturer** **Nidal Zuwida, S.Pd., M.Pd.T** NIP. 199101172019032014

Information	**Dean of the Faculty of Engineering**	**Head of Civil Engineering Department**	**Chords. S1 Study Program Building Engineering Education**
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Learning Outcomes of Graduates	**Study Program Graduate Learning Outcomes (CPL)**
	By considering input from all stake holders and the minimum requirements set by ASIIN, the PLOs that must be possessed by graduates from the Bachelor of Education in Building Engineering Study Program are determined as follows: 1. Master *basic knowledge of science* (mathematics, natural sciences) and other scientific disciplines that form the basis of building engineering vocational education field for carrying out professional work *(Knowledge and Understanding).*

	1.1. Able to implement basic concepts of mathematics and physics to master subjects matter in the field of building engineering vocational education. 1.2. Mastering Statics, Mechanics, Statistics, Technology Materials, and Engineering Drawings as the basic knowledge in the field of building engineering vocational education. 2. Able to identify, formulate, solve, and evaluate various technical problems of buildings as the basic ability for teaching in the field of building engineering vocational education *(Engineering analysis, investigation and assessment)* . 2.1. Able to identify, formulate, solve, and evaluate technical problems in the field of geotechnical and transportation as the basic ability for teaching in the field of building engineering vocational education. 2.2. Able to identify, formulate, solve, and evaluate technical problems in the field of structure and construction management as the basic ability for teaching in the field of building engineering vocational education. 2.3. Able to identify, formulate, solve, and evaluate technical problems in the field of hydrology as the basic ability for teaching in the field of building engineering vocational education. 3. Possess the ability to design building by taking into account environmental, social, health and work safety issues as the basis for teaching in the field of building engineering vocational education (Engineering design). 3.1. Able to make design programming by taking into account environmental, social, health and work safety issues, in cooperation with various party related. 3.2. Able to analyze the design by taking into account environmental, social, health and work safety aspects. 3.3. Able to produce design by taking into account environmental, social, health and work safety aspects. 4. Possess social, managerial, team work, and effective communication competencies, entrepreneurial character, environmental insight and life-long learning habits. *(Transferable and soft skills)*. 4.1. Possess religious character implemented in personal and professional activities.

	4.2. Possess the spirit of nationalism, social sensitivity and environmental insight 4.3. Able to communicate effectively and work in a team. 4.4. Able to transfer science and technology to the community to improve the quality of life 4.5. Possess entrepreneurial character 5. Possess the ability to innovate and adapt to the development of science and technology, and implement it into the learning process of building engineering vocational education field by taking into account non-technical risks that may occur (ethical, ecological, commercial, and industrial impact) *(Engineering practice)*. 5.1. Able to innovate and use information technology (software) in the field of building engineering vocational education by taking into account the ethical, ecological, commercial and industrial impact. 5.2. Able to use information technology-based equipment (hardware) in field of building engineering vocational education. 6. Possess a good ability to design, implement and evaluate the learning process in the field of building engineering vocational education *(Educational design).* 6.1. Able to design curriculum and learning process of building engineering vocational education. 6.2. Able to implement, control, evaluate and improve the quality of learning process through research in the field of building engineering vocational education. 6.3. Able to develop an effective, efficient, and attractive learning media in the field of building engineering vocational education.
	Subject Learning Outcomes (CPMK)

<table>
<tr><td>Subject Learning Outcomes</td><td>
<table>
<tr><th>CPMK</th><th>CPL</th></tr>
<tr><td>1. Able to analyze the selection of alternative heavy equipment used at the project work site</td><td>1.1,2.1,2.2,3.2,5.2</td></tr>
<tr><td>2. Able to plan work methods using heavy equipment efficiently</td><td>1.1,2.1,2.2,3.2,5.2</td></tr>
<tr><td>3. Able to accelerate project work by using heavy equipment to implement management techniques as a construction project management tool, so that the project achieves its goals and objectives.</td><td>2.1,2.2,3.3, 5.2</td></tr>
</table>
</td></tr>
<tr><td>Short course descriptions</td><td colspan="2">This course provides knowledge about descriptions of the types of PTM tools and their determination of types and quantities, an explanation of the approximate determination of the type and quantity of heavy equipment, as well as an explanation of production and costs. Methods of unloading, loading and transporting excavated and stockpiled earth materials, followed by transportation equipment equipment and operations</td></tr>
<tr><td rowspan="4">References</td><td colspan="2">Main (RU):</td></tr>
<tr><td colspan="2">1. Mechanical Soil Transfers, Rochmanhadi, Dep.PU, 1998
2. Mechanical Soil Transfers and Heavy Equipment, Darmansya, UNSRI, 1998
3. Calculation of Work Implementation Costs Using Heavy Equipment, Rochmandi, Dep. PU, 1984
4. Mechanical Soil Transfers, Partanto, ITB, 1996
5. Calculation of Heavy Equipment Production, Dep Pu, 1984
6. Heavy Equipment, PEDC, Bandung, 1984</td></tr>
<tr><td colspan="2">Support (RP)</td></tr>
<tr><td colspan="2">1. Caterpilar Product Lina, PT. Trakindo, Jakarta, 1993
2. Caterpilar Performance Handbook 33, PT. Trankindo, Jakarta, 20</td></tr>
<tr><td rowspan="2">Learning Media</td><td></td><td>Hardware:</td></tr>
<tr><td>Office Word and Excel</td><td>Computers, LCD projectors and whiteboards and peripherals</td></tr>
<tr><td>Team Teaching</td><td colspan="2">Nidal Zuwida, S.Pd, M.Pd.T</td></tr>
<tr><td>Assessment</td><td colspan="2">UTS, UAS, Independent & group assignments</td></tr>
<tr><td>Requirements Subject</td><td colspan="2">Nothing</td></tr>
</table>

LEARNING MATERIALS

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
(1)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand the concepts and functions of PTM and heavy equipment, PTM field of work, material classification and soil properties	1. Concept and function of PTM and heavy equipment, 2. PTM field of work, 3. Classification of materials and soil properties	Material explanation Question and answer Review related subject matter Discussion	Make a summary and description of the material presented in the resume book	Able to understand concepts and functions of PTM and heavy equipment, PTM field of work, classification of materials and soil properties	
(2)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand development objectives, work site analysis, work planning and unit production costs	1. Development goals 2. Workplace analysis, perplan work and production unit costs	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Able to Understand development objectives, analysis of workplaces, work planning and unit production costs	
(3)	**CPMK-1 (PLO-2.1,2.2,3.2)** Understand the concept of machine use, machine ownership considerations, and machine selection systems	1. Heavy equipment usage concept 2. Ownership considerations heavy equipment 3. Machine selection system	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Able munderstand the concept of heavy equipment use, machine ownership considerations, and machine selection systems	
(4)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the	Grouping of heavy equipment according to the prime mover and its	Material explanation Question and answer	• Make a summary and description of the material	Able munderstand the classification of heavy	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	grouping of machines according to prime movers and their functions	function		presented in the resume book	equipment according to the prime mover and their functions	
(5)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing, breakers, rakes, cranes.	1. Types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing, crusher, dredger, crane	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Able munderstand the types and functions of excavators, loaders, cutters, diggers, compactors, spreaders, asphalt processing, concrete processing, breakers, rakes, cranes	
(6)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the definition power of heavy equipment and can analyze fallow powert such as: existing energy, energy needed and energy used	1. Heavy equipment definition and types of heavy equipment power such as: existing power, energy required,and power that is utilized 2. Analysis heavy equipment power such as: existing power, energy required,and power that is utilized	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Able munderstand and analyze definition power heavy equipment and various kinds of heavy equipment power such as: existing power, energy needed and energy used	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
(7)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Knowing and understanding the factors that affect production	Factors affecting production	Material explanation Question and answer	• Make a summary and description of the material presented in the resume book	Get Mknow and understand the factors that affect production	
(8)	**Mid-Semester Exam**					
(9)	**CPMK 2 (PLO-1.1,2.1,2.2,3.2,5.2)** Understand the calculation of unit costs: cost of ownership, operational costs and unit costs of equipment	1. Cost unit calculation: 2. Cost of ownership, 3. Operational costs and - Equipment unit costs	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Get Munderstand the calculation of unit costs: cost of ownership, operational costs and unit costs of equipment	
(10)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Understand the definition of heavy equipment production, basic calculation principles, and heavy equipment production calculations such as: bulldozers and excavators	1. Production work of heavy equipment 2. The basic principle of calculation of production 3. Heavy equipment production calculations such as: bulldozers and excavators	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Get Munderstand the definition of heavy equipment production, basic calculation principles, and heavy equipment production calculations such	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
					as: bulldozers and excavators	
(11)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have an understanding in calculating work production: Loaders, dump trucks and graders	Calculating work production: 1. Loader, 2. Dump truck 3. Graders	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and calculate work production: Loaders, dump trucks and graders	
(12)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have understanding in calculating work production: scraper, ripper, and compactor	Calculating the production of work: 1. Scraper, 2. Ripper, and 3. - Compactor	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and calculating the production work: scraper, ripper, and compactor	
(13)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Have an understanding in calculating work production: compressors, water pumps, concrete mixers and asphal processing	Calculating work production: 1. Compressor, 2. Water pump, 3. Concrete mixer and 4. Asphal processing	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Can understand and calculate work production: compressors, water pumps, concrete mixers and asphal processing	
(14)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)**	Analyzing equipment operation consists of: 1. Efficiency factor	Material explanation Question and answer	• Make a summary and description of the material	Can understand and analyzing the operation of the	

Sunday	Competence to be achieved	Study Materials	Learning Methods and Strategies	Assignments / assignments	Assessment Criteria / Indicators	Reference
	Have an understanding of analyzing equipment operations consisting of: Efficiency factors and equipment combination modeling	2. Equipment combination modeling	Work on assignments	presented in the resume book • Task work on questions	equipment consisting of: Efficiency factors and equipment combination modeling	
(15)	**CPMK 3 (PLO-2.1,2.2,3.3, 5.2)** Students can calculate planned costs: Based on equipment costs and based on equipment production, maintenance and maintenance of heavy equipment.	Calculating the cost plan: 1. Based on cost tool 2. Based on the production of tools 3. Maintenance and maintenance of heavy equipment.	Material explanation Question and answer Work on assignments	• Make a summary and description of the material presented in the resume book • Task work on questions	Dapat calculate cost plan: Based on equipment cost and based on equipment production, maintenance and maintenance of heavy equipment.	
(16)	**Final Semester Evaluation (Evaluation which is intended to determine the final achievement of student learning outcomes)**					

Note :

1. Face-to-face lectures last for 14 meetings
2. Scoring system consists of individual Tasks, UTS and UAS
3. Group discussion: Looking at projects, especially those that use heavy equipment. Students are asked to make a paper about the operation of the heavy equipment

Correlation between CPMK and CPL and Assessment Methods2.1,2.2,3.3, 5.2

	Assessment	Weigh t (%)	CPL-1			CPL-2				CPL-3				CPL-4			CPL-5			CPL-6		
			1	2	3	1	2	3	4	1	2	3	4	1	2	3	1	2	3	1	2	3
CPMK-1	Assignment, Paper, Mid Semester	40	x			x	x	x										x				
CPMK-2	Assignment, Mid Semester, Final Exam	30	x			x	x	x										x				
CPMK-3	Tasks, Final Exam	30		x			x	x										x				
TOTAL		100																				

Assessment Components

Midterm exam : 30%
Final exams : 30%
Assignment 1 : 15%
Assignment 2 : 25%
Presence : (minimum 80%)
Total : 100%

Rating Level Description

	Excellent	Good	Satisfy	Fail
Description	Be able to describe with right and complete	Be able to describe with right but less complete	Be able to describe but unclear and less complete	Not capable describe

Formulations	Able to formulate correctly and completely	Able to formulate correctly but incomplete	Able to formulate but less clear and incomplete	Not able to formulate
Calculate	Able to calculate correctly and completely	Able to calculate correctly but not complete	Able to count but less clear and incomplete	Not able to count
Analysis	Able to analyze correctly and completely	Able to analyze correctly but incomplete	Able to analyze but less clear and incomplete	Not able to analyze

Scoring system

Score	Quality Value	Quality Score	Designation of Quality	Score	Quality Value	Quality Score	Designation of Quality
85 - 100	A	4.0	With compliments	55 - 59	C	2.0	Enough
80 - 84	A-	3.6	Very very good	50 - 54	C-	1.6	Not enough
75 - 79	B +	3.3	Very well	40 - 49	D	1.0	Less
70 - 74	B	3.0	Good	≤ 39	E	0.0	Failed
65 - 69	B-	2.6	Pretty good	-	T	-	Delayed
60 - 64	C +	2.3	More than enough				

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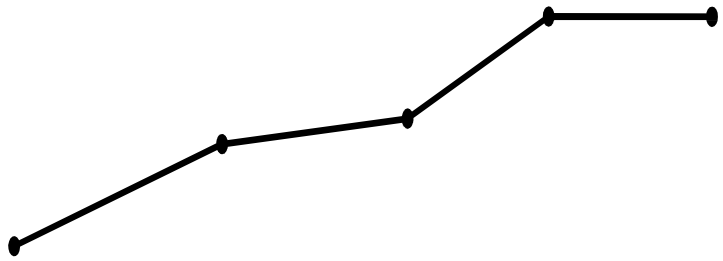
MIDDLE SEMESTER EXAM PROBLEM

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open the book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 60 minutes
Maximum value weight : 30

No.	Question	Weight
1	Describe the function of the tool: a. Excavator b. Bulldozer c. Ripper d. Wheel Loader e. Dump Truck	2.5
2	In making preparations for earth moving work, a number of soil conditions must be taken into account which may affect the volume of soil found in earth moving work. Explain the state of the land in question?	2.5
3	Determine the bulk density of the soil in the original state (BM) and in the solid state (CM), if it is known that the bulk density of the soil at the loose state (LM) is 9xy kg / m3, the% expansion and% shrinkage are 6y% and 4x%, respectively. Also determine the LF of the soil conditions?	5
4	Calculate the speed of a Dump Truck that has a working power of 400 HP, where the Dump Truk has a traction of 15000 kg in 1st gear,	10

	10000 kg in 2nd gear, 6000 kg in 3rd gear, 5000 kg in 4th gear and 3500 kg in 5th gear, if efficiency tool is 0.8x!	
5	A 550 HP off highway Truck is operated to transport gravel material from a project location A to location D for landfilling, as illustrated below:  Tool model : 651 E / 550 HP Capacity : 85 m3 Tool Empty Weight : 50 tons Traction Factor : 0.40 Weight distribution: - Loaded : 63% - Empty : 55% Material Content Weight : 1500 kg / m3 Work Efficiency : 85% Constant number : 375 Average speed: Gear 1 6.98 km / hr Gear 2 8.30 km / hr Gear 3 10.26 km / hr Gear 4 14.53 km / hour Gear 5 20.52 km / hour Gear 6 32.59 km / hr Gear 7 45.89 km / hour Gear 8 72.66 km / hr A - B □ RR = 40kg / ton, GR = 7.0%, Distance = 200 m B - C □ RR = 70 kg / ton, GR = 5.5%, Distance = 400 m	10

	C - D □ RR = 30 kg / ton, GR = 6.0%, Distance = 300 m D - E RR = 50 kg / ton, GR = 0.0% Distance = 600 m Count: 1. The power required for each section from A - E and from E– A! 2. Power available at every gear level! 3. Calculate the usable power of AE! 4. Compare the energy needed with the energy available! 5. Maximum speed for each section!	

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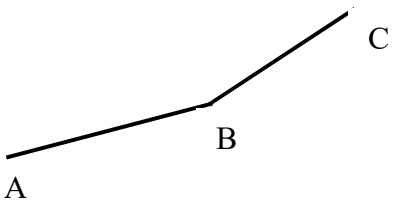
SEMESTER FINAL EXAM PROBLEMS

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open the book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 60 minutes
Maximum value weight : 30

No.	Question	Weight
1	Describe the classification of machines according to prime mover and according to their function	2.5
2	A road surface that will be passed by the dump truck consists of two sections, as shown below:  Section AB RR = 4x kg / ton GR = 2% Section BC RR = 5x kg / ton GR = 2.5% Calculate the power required for the two sections if the total weight of the tool is 90 tons?	5
3	Komatsu bulldozer on road works carried out the eviction with the following data: Blade width = 2.20 m Blade height = 1.20 m Blade factor = 0.80 Distance Eviction = 30 m Speed = a) forward = 3 km / h (50 m / min) Backward = 6 km / hr Change of gear time = 0.20 minutes	7.5

<table>
<tr><td></td><td>Work efficiency = 0.75 good
What was the productivity per hour of the bulldozer?</td><td></td></tr>
<tr><td>4</td><td>In road construction, the Hitachi Ex-100 brand loader is used for loading crushed stone material, with the following data:
Bucket volume (q1) = 1.5 m3
Bucket factor (K1) = 0.6
Efficiency (E) = 70%
Conversion factor 1.65
Time cycle: Transport distance (D) = 30 meters
Forward speed = 125 m / min
Reverse speed = 150 m / min
Fixed time (Z) = 0.5 minutes
What is the loader productivity per hour?</td><td>7.5</td></tr>
<tr><td>5</td><td>Empty scraper weight = 12 tons, load weight = 6 m3 x 1,300 t / m3 = 7.8 tons. RR: rubber tire = 60 kg / ton, crawler / track = 30 kg / ton. The scraper is towed by a crawler tractor weighing 15 tons, and hauling distance = 600 meters. How long does it take for the scraper to operate?
<table>
<tr><th>Gear (Gear)</th><th>Speed (km / h)</th><th>DPB (kg)</th></tr>
<tr><td>1</td><td>2.36</td><td>9000</td></tr>
<tr><td>2</td><td>3.8</td><td>5340</td></tr>
<tr><td>3</td><td>4.51</td><td>4050</td></tr>
<tr><td>4</td><td>6.45</td><td>2540</td></tr>
<tr><td>5</td><td>10.0</td><td>1530</td></tr>
</table>
</td><td>7.5</td></tr>
</table>

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Assignment

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Group discussion
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 30 minutes
Maximum value weight : 40

Group	Question	Max value
CPMK-1	Field studies Looking at projects, especially those that use heavy equipment. Students are asked to make a paper about the operation of the heavy equipment Paper 1. Hazard Identification 2. Risk Assessment 3. Risk Reduction or Control Performance	 10% 30%

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Assignment

Courses : Heavy Equipment and Mechanical Earthmoving
Code / SKS :
Nature of the Exam : Open book
Lecturer : Nidal Zuwida, S.Pd., M.Pd.T
Time : 30 minutes
Maximum value weight : 10%

Group		Question	Max value
CPMK-1	1	a. What the heavy equipment said b. Explain the purpose of using heavy equipment from a technical, economic and humanist point of view	
	2	a. What is the heavy equipment ownership system that you know b. Explain the advantages and disadvantages one by one	
	3	Describe the classification of machines based on their main movers and their functions	
CPMK-2	1	A Wheel Tractor Scraper with an empty weight of 40 tons, a load capacity of 30 m3 and carries sandy soil with a volume of 2000 kg / m3. This tool operates on a project with haul road conditions having Rolling Resistance (RR = 4%), as well as the slope of the GR = 3% road, the road is in a muddy condition with a penetration of 3 cm. How much power is needed by the tool to move	
	2	A heavy equipment that has an empty weight = 35 tons and is able to carry a load of 25 tons on the road with a rolling resistance of 40 kg / ton and with an incline of 5% and 7%, what is the total resistance of the above conditions.	
	3	2. A 769c / 450 Hp Dump-Truck with a total weight (GVW) of 60 tonnes, operating on haul roads that have a traction factor of 0.40 (clay road full of ruts). Based on the specifications, the weight distribution of the driving wheels is 66.7%. How much traction can be used?	

CPMK-3	1	Describe the work cycle of the Excavator and Wheel Loader machine and of the cycle This work determines the group of work cycles that are included in fixed time and non-fixed time!	
	2	Explain why the efficiency factor needs to be considered in the calculation production work heavy equipment!	
	3	Calculate the labor efficiency factor requiring a break 40 minutes for 4 hours of work!	
	4	Calculate the Bulldozer work production which has the following data: Tool model: D 7G / 7A Blade Height: 0.970 m Blade Width: 4.27 m Displacement speed: 6.6 km / hour Return speed: 12.2 km / h Fixed time: 0.1 minutes Cast / return distance: 85 m Correction factor: Operators: 0.75 Weather (rainy): 0.80 Work efficiency: 0.67	
		Calculate Dump Truck Work Production, if the data are known as Dump Trucks as follows : Tool model: 785 B Body capacity: 57 m3 Waste time: 2 minutes Transport speed: 20 km / hour Return speed: 25 km / h Transport / return distance: 5 km Fixed time: 4.5 minutes Wheel Loader production work: 380 m3 / hour Content factor: 0.9 Work efficiency factor: 50 minutes / hour	