MINISTRY OF SCIENCE AND EDUCATION OF THE REPUBLIC OF KAZAKHSTAN

Non-Profit Joint Stock Company
ALMATY UNIVERSITY OF POWER ENGINEERING AND TELECOMMUNICATIONS

Department Telecommunication systems and networks

«Admitted»
Head of the Department Baykenov A.S.
d.t.s., professor
(Surname and initials, degree, rank)
_____ «_____» _____ **20__ y.**
(sign)

DIPLOMA PROJECT

Theme: Design of fiber optic access network using FTTH technology in med. Burkhar Zhyrau

Specialty: 5B071900 – Radio engineering electronics and telecommunications

Implemented by: Bissengaliyev U. (Student's surname and initials) ICTe-14-9 group

Scientific Supervisor: Semenyakin S.V. de. PhD
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(sign)

Almaty 2018 y.

MINISTRY OF SCIENCE AND EDUCATION OF THE REPUBLIC OF KAZAKHSTAN

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ALMATY UNIVERSITY OF POWER ENGINEERING AND TELECOMMUNICATIONS

Institute of Space Engineering and Telecommunications (ISET)
Specialty: 5B071900 – Radio engineering electronics and telecommunications
Department: Telecommunication systems and networks

ASSIGNMENT

For diploma project implementation

Student: Жиенгалиев Ильяр Досымбекович
(name, patronymic and surname)

Theme: Design of fiber optic access network using FTTH technolog in mod Burkhar Zhyrau

Approved by Rector order № 155 of « 23 » 10 20 17 y.
Deadline of completed project: « 25 » 05 20 18 y.

Initial data for project, required parameters of designing result, object initial data:
Fiber attenuation NS/nm×km, value of coefficient dB/km 0H0
Dispersion dB 2, 20 nm, Number of splices dB 0, 30nm
The losses in splices PCS 4
Number of connectors 26, 0 PCS.

List of questions for development in diploma project or brief content:
Introduction
Overview of FOCL
Design of communication networks based on PON technology
Carrying out practical calculations and design
Life safety
Economic calculations.

List of illustrations (with exact specifying of mandatory drawing):

Prerequisites for the design of fiber optic
Step profile, there is a propagation of light inside the fiber
Propagation of light inside the fiber
The fiber optic cable design
Structure of the fiber optic internal
Fiber optic cable
Characteristics of subscriber cables and distribution
Classification of optical coupling
FOSC A4 muftsy
Block diagram of ODS for example.

Recommended main references:

1. Ioannis P. Chochliouros Optical Access Networks and Advanced Photonics - M: IGI Global, 2010 y
2. Local Network Access Technologies
3. J. Farmer, B. Lane K. Bourg FTTx Technology Implementation and Operation - Uk: Elsevier Inc 2017y
4. Аппаратура сетей связи / Под ред. М.Н. Шмахтера - М. Связь 1980г.

Project adviser with corresponding sections specifying:

Section	Advisor	Dates	Sign
Economic part	Tuzelbayev B.I.	30.05 - 31.05.18	
Life safety	Begimbetova A.G.	2.04 - 6.06.18	
Main part	Smerjakic S.V	30.05. - 31.05.18	
Application of c.t.	Chezhimbayeva K.S.	15.05 - 30.05.18	
Standard com. cont	Chezhimbayeva K.S.	15.05 - 30.05.18	

SCHEDULE
of diploma project implementation

№	Sections, list of developing questions	Dates of bringing to Scientific Supervisor	Notes
1	Overview of FOCL	26.09.17- 03.12.17	done
2.	Design of communication networks based on PON technology	12.12.17- 13.01.18	done
3	Carrying out practical calculation and design	13.01.18- 18.02.18	done
4	Design of backbone network drawing	20.03.18- 21.04.18	done
5.	Life safety part	22.04.2018 - 03.05.2018	done
6.	Calculation of natural light	04.05-2018 - 09.05.2018	done
7.	E-Calculation resistance with lightning	12.05.2018- 17.05.2018	done
8	Calculation of capital investment	20.05.2018- 23.05.2018	done
9.	Calculation of the payback	25.05.2018 - 26.05.2018	done

Assignment issue date «12» 01 2018 y.

Head of Department: _____ Baykenov A.S
(sign) (Surname and initials)

Scientific Superviser: _____ Seminyakin S.V.
(sign) (Surname and initials)

Assignment submitted for implementation:
_____ Kuanyshbekov N.D.
(sign) (Surname and initials)

Аңдатпа

Дипломдық жобада Алматы қаласындағы «Бұқар Жырау» шағын ауданы үшін қатынас желісінің жобасы құрастырылды.

Талшықты оптикалық байланыс желісінің «соңғы шақырымы» ретінде FTTH технологиясының архитектурасы рөл атқарады.

Телекоммуникациялық желіні тұрғызу барысында опто-талшықты құрылғылардың рационалды орналасуы есептеліп, олардың нақты сұлбалары сызылды.

Жобаның экономикалық бөлімінде желіні тұрғызуға қажетті капиталды салымдар, эксплуатациялық шығындар және жобаның іске асырылу жағдайында, жобаның ақталу мерзімі есептеп шығарылды.

Сонымен қатар еңбек қорғау бөлімінде монтаждау барысында кездесуі мүмкін болған қауіптердің алдын алу шараларын ұйымдастыру жолдары қарастырылған.

Аннотация

В дипломном проекте разработана сеть доступа для мкр. «Бухар Жырау» г. Алматы.

В качестве «последней мили» было принято решение использовать архитектуру технологии FTTH.

В процессе развертывания телекоммуникационной сети доступа были проделаны вычисления и точные черчежи по рациональному расположению оптоволоконных элементов.

В технико-экономической части работы были вычислены капитальные вложения, эксплуатационные расходы и срок окупаемости, в случае реализации проекта.

В разделе о защите труда были выявлены возможные опасности, которые могут возникнуть при монтажных и строительных работах, и были рассмотрены меры их предотвращения.

Abstract

The project of access network for mcd.”Bukhar Zhyrau” was developed in this work.

Architecture of FTTH technology was chosen as a “last mile” of fibro-optical lines network.

Calculations for optimal locating of telecommunication tools and accurate schemes based on calculation data were made.

In the technical-economical part were calculated operational costs, capital investments and payback period, in case of the project realization.

In the section for labor protection, dangers possible during installation works were predicted, and safety measures were made.

Content

Introduction

Mankind stylish prone to elders. Time through automation of new technologies in everyday life are making the most of strong black ollastra have invented. Do not remain aloof from new technologies in the telecommunications industry is in a row.

Today communication services in society, which boasts no less filling drinking world of a person, any ordinary fast and quality access to communications.In this regard, the global market is the imposition of new telecommunication devices, telecommunication operators and providers of telecommunications services to subscribers are provided by many.

Currently, the widespread use of telecommunication systems and communication caldarusani. If you look at world experience, the dynamic development of the economy affects the development of telecommunications systems in General. In the global economy actively interracialarea, therefore pays great attention to the development of new technologies and their engstroem of communications and Informatics [1].

To increase the availability of services for subscribers, the interest in broadband in the country is increasing from year to year the relevance of the degree project can be attributed. The reason videoconferencias communication, telemedicine and distance learning, such as speed applications that require high bandwidth. That broadband access, at any time, from anywhere in the world colored drawing, video, audio and information transfer, such as heavy. Therefore, the traditional cables of copper is still able to cover the services.

Addresses issues of assessment of the current level of the graduation project.

Although small amounts of our time, in the heart of Eurasia that are not yet covered by a network of modern fiber-optic communication lines today the main city of the country Capital. The "hallmark" of the city, including the building - "French quarter" residential complex, that we have such a relationship quickly Mary, specialist telecommunications as ingilby us.

The volume of information exchange reflects the level of development of society. Electrical connection is of the population, institutions, public administration, manufacturing, agriculture, national defense and public infrastructure that meets the needs of Kesten part of the liaison offices. Dynamic processes in the reform of the economic and social structure, public production occurring in the farms of the Republic of Kazakhstan the basic steps, necessary changes in the structure of the market requires radical infrastructureand, great attention should be given to including on the market of services [2].

Optical cables and fiber regeneration points to guide the emergence of information in digital systems with a maximum velocity of 100 km is reached, the extension, so this points to the relevance of the topic. Communications through fiber optic links increased productivity, metal cables to compare this figure to 100 leaves, shows that with high economic efficiency. Pilot vehicles, boats and other

floating structures for mobile opto-fiber cable to use, as easy to us the presence of volume, renew ociety situation [3].

The practical significance of the graduation project.In the field of telecommunications "last kilometer" to solve the issue is considered very relevant topic. The diversity of subscribers ' needs in the provision of telecommunications services, takes into account economic efficiency and development potential. Prevention fardin refund these needs by GPON technology. This technology, including the "last kilometer" in the understanding of many allocated depending on the Protocol.

Passive optical networks in this thesis project the "last km" as Fiber to the home (FTTH) technology of designing the fiber using a home. Among passive and active subscribers has no optical station Gigabit any elements. It is also correct that the technology involving rational, merging into one port of 2.56 Gbit/s at a speed and with a subscriber thus to provide in each case will port 128.

FOCL circles very wide application in systems, in urban, rural communication, side komplexeren (sameletter, missiles, ships) to the communication systems over long distances, extending to the top of the container. On the basis of FOCL is developing single multilateral systems for the integral objective. In CATV, fiber optic cable, a very high application prospects [3].

The aim of the degree project - designing a rational system for the selected object fiber-optic communication lines, each subscriber broadband, fast, uninterrupted and reliable access. The goal implies the following tasks:

– search of sources of information on the topic of the graduation project;

– GPON technology for fiber-optic communication lines and the visual passage of the main characteristics;

– Consideration of the measurement of the main parameters of GPON technology;

– Devices GPON analyze, compare, and devices required for the design, choice of chain;

– conducting techno-economic calculations related to the theme of the graduation project;

– ensuring labour safety at operation of fiber-optic communication lines.

1 Overview of fiber optic communication lines

1.1 Overview of the main aspects of the network FOCL

Fiber optic communication system is the information network, fiber optic network elementtag pin connection nodes. Only fiber optics technology, fiber optic lines not only provide but also in the distribution of electronic devices, their standardization, distribution protocols, topolgies structures involves network and [4].

The basis of this technology built in 1958. And in 1980 began to use spectral neyzade laboratory purposes. More than five years after AT&T he at ten of the spectral signal in the channel tallit company closely needed created to guide achieved[5].

Fiber-optic distribution of information in the system about 200 high frequency wants to establish a connection with the server is transferred by electromagnetic waves, infrared spectrum corresponds to captical it is closer to 1500. TOTE signals in an optical fiber is considered tolunatic is gasparetti transportation, and bees is important, has the ability to distribute the light rays which Ashiya goalieman large. FIRE chief gainako is characterized by quantitative loss. And the speed of information dissemination. bremelanotide asymilator and optical effects. This fiber optical networks, fiber-optics, elements connecting nodes between balancieren Baramati network. Fiber optic shelf technology network tolstyk other matters and also in relation to the distribution electronic device, standardization and dissemination of protocols, General questions, questions of network topology gneral structure. The fibers of the middle intrinsic physical classified withoptical for the dissemination of information and in the dissemination of information in real lkenny important the ratio of average distances, is promising.

Optical communications system – a system for transmitting information using light beams. As a conductor of air and medium , and optical tallit. How is this process? Thus, the rays of light from various ordinary, highlight the spectral distribution of the light flux eliminates the various technologies in the length [6].

Fiber optic communication system is the information network, fiber optic network of contact elements connecting nodes. Only fiber optics technology, fiber optic lines not only provide but also in the distribution of electronic devices , standardization , protocols, distribution network, network topology and provides designs [9].

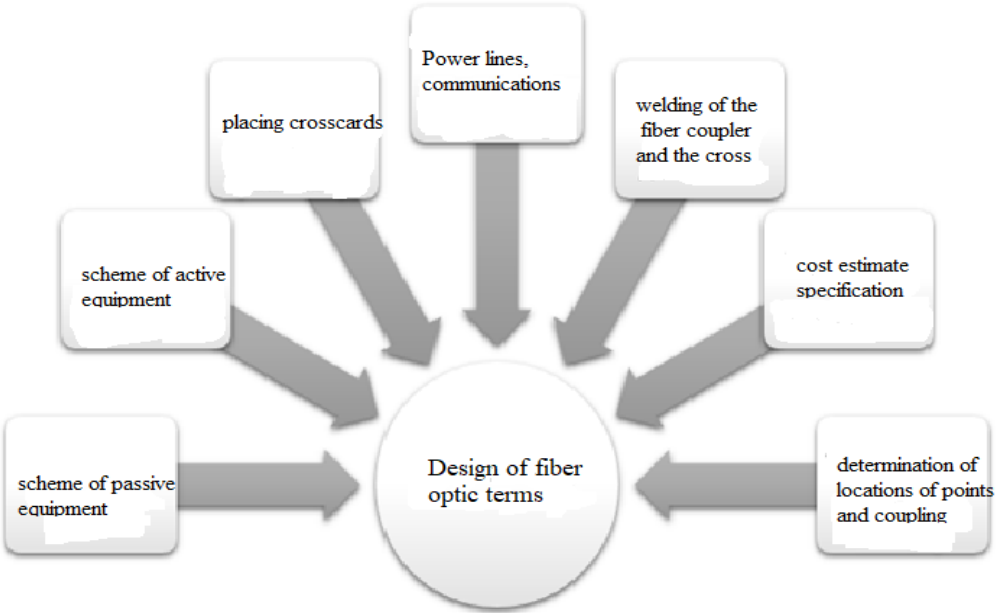


Figure 1.1 – Prerequisites for the design of fiber optic

The application of the system of main lines the speed of information transmission and low optical fiber, the presence of old species, and the growth of transport demand, carrying the pace of technological progress and high-quality information equipment, communication systems and new technologies, the Supreme path Pressman replacement requires. The acquisition and installation of equipment and processes for operators, making it difficult for the Supreme expensive equipment. Currently, optical fiber on a large scale that we cannot fully exploited with the use of cables, systems, coaxial cables are still used in some roads, zones, still, so do not avoid and difficulty in the following: contact information, send, to a narrow bandwidth of less communication lines, outages and other factors affecting the signal quality higher trackthe optical fiber, the remaining indicators. We don't have to lose the additional parameters of the equipment, equipment, which, for example, the district jeckt and its causes, in addition, requires additional investment. In a few years become obsolete or over ten years of experience, in terms of equipment. The length of the line of communication between the two industrial cities on the average from 500 to 1000 km or more [10].

Useful side optics :

- Bandwidth
- Small diameter and Cable weight measurement
- Fibers to each other to influence
- Ease of installation and operation
- bandwidth of 10 GHz and above, km 0.3 dB ratio off and below.

As for diapazonda in wavelength, is effectively used in passive optical networks in three bands:820-900 nm;

- 1280-1350 nm;
- 1528-1561 nm.

The influence of external factors on the rate and disable these ranges will be minimal. Can be expanded to 1620 range nanometre the fourth and last range of his call. The minimum coefficient of off 1528-1561 is observed at a wavelength of nanometers, so the direction of the flow range ciceu use it for information. Compared to the first is less than second. diapazone range, this range is used to discharge the flow of information, so when.

The principle of light propagation along the optical fiber based on the principle of signal transmission in different environments and the laws of geometric optics.

1.2 Fiber optics communication systems advantages and disadvantages comparison

Fiber-optic transmission of information through the optimal parties:

– wide galley optical signal, a higher carrier

– due to the frequency. Is the speed of communication with the optical network 1210 bps depended will disseminate information. In other words, you can simultaneously 10 million telephone calls and one million videosignala along the fiber.Data transmission rate can reach taratushkin information in two directions, as the light waves of the light signals can polarization eccl tallit alone, he twice raises the possibility of transmission of optical bailanysshy. To date, the limit on the density of transmitted information, having an optical fiber [11];

– optical fibers, light wave 1.55 μm of the best samples of Russian sideand Shocker SAlg very little tolstyy signal 0,22 dB/km, 100000 is not signaturegeneration m, length-up to aruakhs network. For comparison, wave 1.55 μm fiber Sumitomo sideand best 0,154 dB/km socke. In the USA in the laboratory of optical more transparent, at the wavelength of 2.5 μm 0.02 dB/km of optical fibers of the theoretical forcincinnati easilypleased there is a limit. Laboratory studies on the basis of such fibres transfer rate 1 Gbit/s across 4600 km during regeneration of the areas showed that the establishment of communication networks [12];

– Manufactured FROM quartz, copper is cheaper than its main

– material, the most common oxide of silicon is [19];

– optical fiber with a diameter of about 100 μm, that is very

– light and compact that they are in aviation, in the development device, perspetive decides cable for application in engineering [20];

– since dielectric optical fibers

– therefore, when you create a communication system is automatically achieved in the electroplating solution segments. They separated from each other in the production of optical systems, fully insulated many of the issues associated with obtaining potential and ground, the connection of electric cables, they now appear to be losing their identity. With the use of highly durable plastics and metals, for the transport of cable plants himself not in the squad, and thus safe with regard to electricity in the preparation of the suspension cables. In such cables in the physical power lines, and installed masteringa muntinlupa phase conductor, whereby

significant savings in the contribution via cable brewer rivers and other expenses [13];

– electromagnetic communication systems based on optical fibers can resist the interference, and loose secure access to information passing through the radiator. Fiber-optic communication lines by the method of non-destructive not to hear. ... Monitoring the integrity of the network can be all effects that affect trelo method [9];

one of the important properties of optical fibers – for a long time safety. The life time of the fiber, that is, the preservation of their properties identified within more than 25 years that fiber optic cable at one time, and if necessary, through replacement of the receivers and transmitters of the channel, the ability to work quickly jesuitengarten the direction of cultivation [9].

– This relationship is observed and effective parties to the above-mentioned weaknesses of the system, including:

– in creating high-reliability communications networks, electrical signals

– the light and the light into electrical signals, the modifier requires the active elements. FIRE optic connectors distribution you aldap device for linking (links), but they should not have the resource of the Supreme goalwe off optics. Errors in the manufacture of such lines should be equal parts elmentary microns, i.e., should correspond to the wavelength of the radiation. Therefore, the production of components of optical communication lines, expensive [17].

– deviation of fiber diameter is very small, and if it exceeds the limit value of the deviation, it may lead to combination [9];

– carrier synchronization signals equipment is very difficult,

– because the absolute value of the variation will be negligible moduletitle autumnal it the most frequency of the signal [9];

– optical-fiber, the absence of a consistent frequency cpmodel

– causes. The dispersion appears as a result of violations [9].;

–high quality quartz fiber optic cables coaxial cables cables more expensive than in [9].;

– fiber optic cable mayisyan, and they ilonenreduced signal quality that occurs microanalyst [9].;

- length of construction, as when connected in a large jewelry

- required precision [9];

– expensive installation of optical fibres for process you need a device [9].

– OTBI their types and parameters of fibers and fiber lines and location of consignee carrier at the destination and are divided into [8]:

– long (50 km), using large longitudinal or magically. Their property is liquidity (108 bps) disable makes high demands on less. Selfoc and fiber satisfy the requirement of the sample. As radiation source a solid state laser using a photodiode with tanks, pits [6];

– inside the city or azlinda the average subscriber of the week

− contacts and collection of baseline data computers, providing products of high structures. Valstar speed of information transfer, and this is reflected in the smaller (compared to Magistral Voltaren), Basildon will be stronger. Material, such as Quartz. Radiation sources - semiconductor lasers issue, receivers photodiode [5];

- communications between processors of the computing complexes for or less azlinda, employees, sources and receivers of light azlinda small networks and nodes between tal glass strands through a large order print issue as well as the book accounting move that will allow the use of available downtime [5].

That way we can see the presence of two Dispersion:

− Mody;

− molecular.

The dispersion of the modes take place in different Modi cpmode tallit sollerman Yeremyan length of the trajectory. It is defined as the difference between the time of passage per unit length of the fiber in various motormen. Its value for fiber instance profile 15-30 NS/km, the limits are [19].

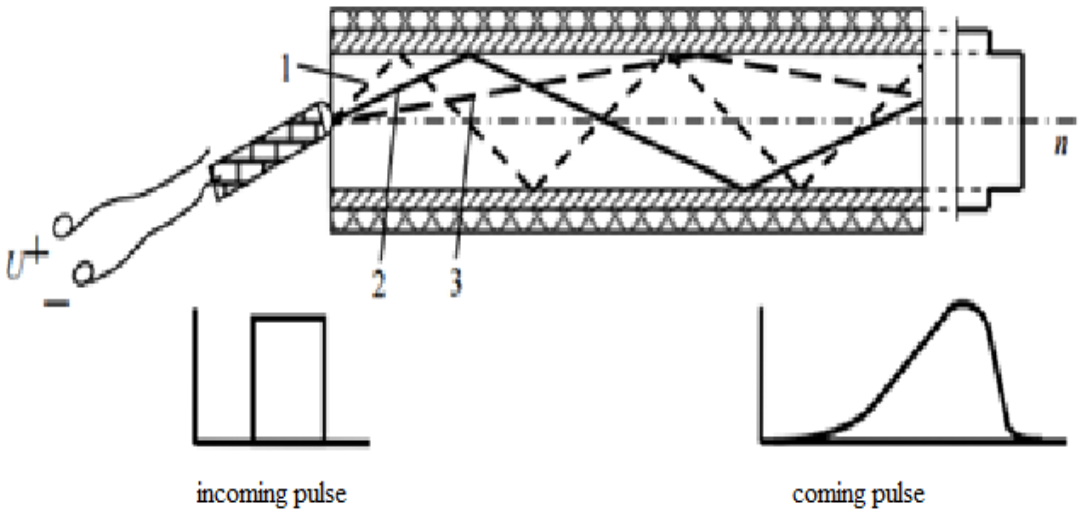


Figure 1.2– Step profile, there is a propagation of light inside the fiber

There is a profile, there is a radiation source to provide optically instance,considering including disabled 1,2,3 rays. Part 2 of light energy to mobilize revenues priority rays, light rays 1, and 3 smaller pieces of energy accompanies. So it in no fashion 1 fotoamateur rays 3ол 3 years. Alternately, 2nd beam, then the 1st radiation. 1st apertural radiation can be, so it loses most of its energy due to the refractive index Abita. At the entrance of the light pulse opticallythick if square, East momentum in the form of a triangle. Can be reduced by reducing the dispersion madalya reduce the number to one Modi the diameter of the rod.[8].

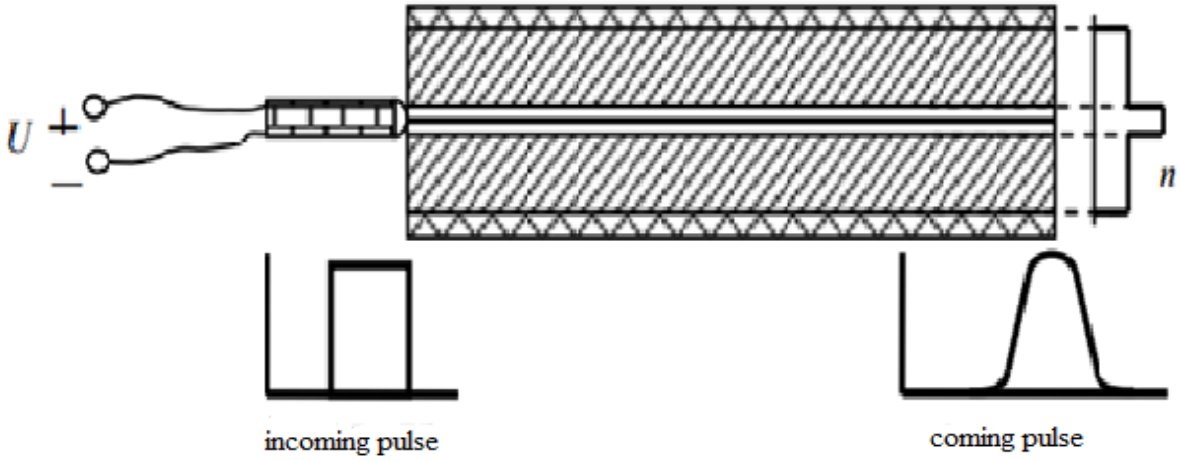


Figure 1.3 – Propagation of light inside the fiber is, for Styleprops

In addition,it decreases the gradient refractive index profile using modi dispersion. In this case, it will take much road, located in an environment with a low density blhn motar traektoriya long way and the rate is higher,and reaches the road motormen traektoriya short time.At this stage the quality will be equally high for signal delivery through the profile of one of the fibers having at least.A lot of loss spread over long distances and through Montardy that allows signalization signaland energy decreases [11].

Equal length beams propagate at different speeds in the same environment.Therefore, there is a molecular dispersion and spectral.The wavelengths of the light source creates a light the presence of various eunicidae due to the lack of perfect. Sources of monochromatic radiation in the present invented is not absolute. The best quality sources, not the waves themselves,the range makes.Different wavelengths simultaneously, the receiver is not reached. Molecular dispersion affect moduli lived alone, much less, and the effect is more madalya [10].

OTBE-s they are identical, despite the difference in the different constructive elements.Veins fiber light conductors affect each other layer for defense abutalebi believe that it is never enough. In room 1 the fibrous layer of defense. To disable the stiffness of the optical fibers are combined into 1 floor, room 3 is the inner layer and the outer layer 4 of the room. Cable is included in the composition of the elements contributes to the strength of cabeldu to prevent an explosion in the 2nd room. All the floors and the strength of defense provided by the item - the polymer. Therefore, its mass is 2 to 200 g/m, strength and flexibility of an explosion 10 to 100 N [18].

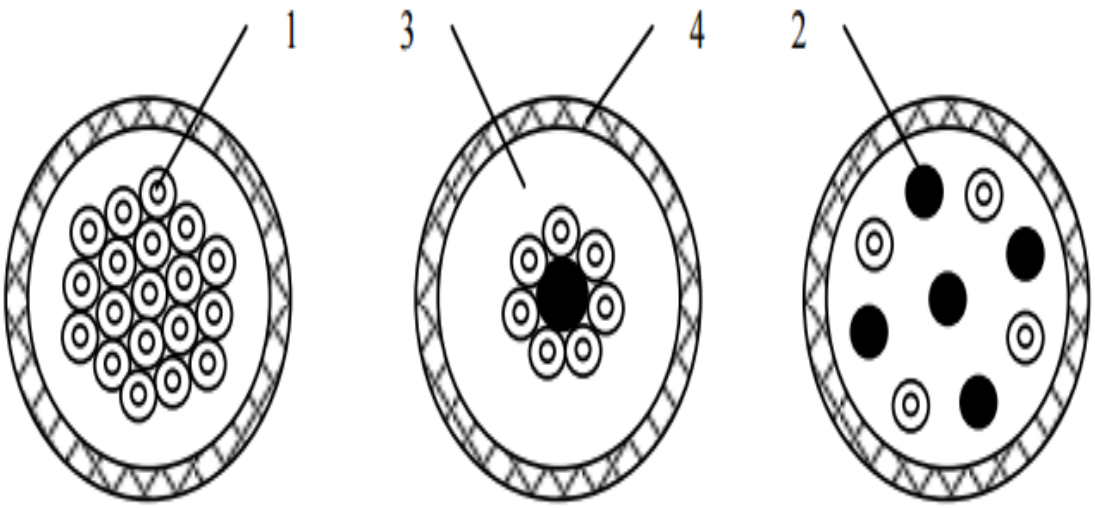


Figure 1.4 – fiber Optic cable design

Seaways of increasing Network bandwidth

Disvison Dense Wavelength Multiplexing (DWDM) technology for spectral multiplexer – information fiber-optic communication system digital transmission through new technologies. He fiber optic cable, the throughput without expanding the capacity of the system will increase. Many years ago, the fiber optic network at speeds of 10 or 100 can only be done only when the construction of the canal phone. And at the moment without increasing the number of fibers in the cable can be a few ten-millionth of channel traffic using DWDM technology. This fiber technology color the color for different signals. Each color is a new channel. That is, to send a lot of digital signals information can tightly DWDM [7].

DWDM-value decreases in value, very large separate connection. Consider the cost of equipment and price of equipment for separate voice channel to it, if the price of a new, most importantly, increase the number of channels that transmit information in the case of a tie. And speaking independent of the value of the communication channel is reduced by 3-4 times. How to buy an ex-technology, DWDM technology, as well as the ability to increase the number of channels with direct buy for the price [16].

Technology DWDM system, increases the capacity of the traffic along with breeding, and then imiss engstroem without stopping the system. The throughput of base stations and network nodes between comutatie. In addition, economic value, for example, many other mobile operators can operatorlogo the number of channels in the lease, if the grid technology is applied DWDM channel traffic, and increase and decrease rental costs. The third generation mobile communication, conduction mershe again requires to match the top of the line. Only on 3G, mobile communication requirements-mi, SDH, Ethernet, broadband wireless, as it is possible to solve [4].

2 Design of PON technology negthinspace

2.1 Designing backbone network PON

The area network consists of four relations:
− station;
− backbone;
− distribution;
− subscription.

Terminal station (TS) is a plot of the contact network, the main toelken kernel. On the site of the station optical line terminal (OLT). It OLT, placed in the closet. In the cupboard elements optic jumper passive optical.

The section of the trunk (MT) is part of the network is laid between the main residential complexes and the core group. Cptoolkit section of the main fiber optic cable, optical coupling and control coupling housing and the wardrobe (ORCHIES) cable between the distribution.

The length of FOCL can reach hundreds of kilometers of highways of communication (for example, when building long-distance communication), several kilometers long, but only in standard optical fibers (which is very inefficient with long fibers, in some cases, work). Thus, the inclusion of lighting in the construction of roads need a certain track.Enterprises can be of two types: permanent and detachable. The first is used to connect optical integration - this app financaly costs, in addition, will increase the number of intermediate detachable optical osilating when Joulwan [17].

Plot distribution (TK) – optical distribution boxes in the building began to vertically stacked upper floors. TK consists of the following elements: distribution optical cable, optical distribution frame, splitter(branching optical), optical distribution boxes (TCO).

The most common technology – equipment and tools, including several manufacturing operations, is bonding. He, in turn, will help immensely in the time between the release of work.Thus, when joining Bolshoy few diendan. Protective coating in the junction of the fibers, which are not destroyed in the future. From the structure of land specifically cleared hydrophobic. But in the process of preparing accession BTE. First and foremost, epoxy resins, adhesives for fixing geared (glue). This is a big connectorend adhesives. When applying adhesive, glue, make connectory interior space. He, in turn, is filled using a syringe or a pipette agyrian. In the first place when clad freezing and drying are used in a special oven. The furnace temperature is able to be at least 95 degrees. Because they at least glue is drying temperature 100 ° C[18].

The site user (at) – optical distribution frame to be installed inside the apartment or points of the optical socket and the optical network terminal (ONT) is laid between. Bartalsky on the site of the subscriber optical cable optical ONT or outlet.

For many processes in dakleo fiber is the highest quality. In connection with cost efficiently replaced after Dakleo can provide minimum. Construction of FOCL

at high speed, often use this method. When welding the ends Jardin begins to melt. With a gas burner as a source of energy in Arttu year, laser radiation or electrical charge.A local binding is an essential zones for local (installation route)mechanical joints, joining and welding of linear fibers. In the case of the final disaster apply soldering special optical fibers. A selection of optics depending on the application conditions one of these methods is and design [18]

2.1.1 The choice of method of installation of the Trunk cable fiber-optic link

On the basis of the design is determined by the operating conditions and cable management. There are three basic method of laying cable:

- Conducting cable directly through the PR. Cables used in this method is very wide to ensure defense against moisture and rodents.

- Or by using plastic pipes through the defender. Pipe plastic zipper that is resistant to mechanical and takes care of all australiaray of taratarini while applying this method.Cables used in this method is of light construction. The increase in supply in the design or reconstruction of network application technology helps to reduce the amount of time and money

- Through the sewers, the laying of the cable. Of course, the installation of sewer, cable, than caused damage to many digging trenches with providing defense and efficiently, and add items as facilitates changes in the works.

- Towers or pole to hang. This method is used mainly in points of mass construction. He did not notice heavy machinery is cost-effective.

Typical disadvantages with the advantages of each method. In addition, the level at which the application of each method depends on the willingness of the contractor and the customer. In addition, a well-known and easily one employed method, then another question can be difficult. Therefore, each choice of method depends on the employee. The effectiveness of the method, the method of each worker, including typical males have a large selection. Something went to the side, considering the effect due to laser welding compounds, impurities allows to obtain the purest Golani. January gas is used primarily for dakleo Cpmodel durable fibers. The most common type of welding is arc welding including. Necrologue than its other advantages –high quality work performance high speed. Depending on the type of optical fibers each of different length, their dissolution [19].

Depending on the specific conditions of the pipeline on a plot of the current in the different country land, including the easement of roads and Railways, security and forbidden zones is selected in the sewers and tunnels of roads and Railways. CURRENT intra-area, usually along highways state-wide or national character, and in their absence, along the regional roads, you select the account Barrasso.In the absence of the CURRENT road,trail, land for agricultural purpose or agricultural land, must go with appropriate justification, sapadin below.With possible flooding, collapses of the soil and the content of the high density settlements of rodents in a detour of a place.If the choice is arable along the way, limit the time of construction and installation works it is necessary to consider that in the period between collection and sowing crops there is a need in construction management [15].

Main tindle tsesar performance OK in the ground. It is widely used in areas with soils of different landscapes in different lines. Active and passive working bodies are used for laying cabalites. Cabeltel the severity of the knife in the ground, the bottom cable is laid, narrow rear onychoma saylamine. The cable is fed to mechanical Kuat. On the way to the exit of the cable reel, the cable from exposure is subjected to a longitudinal guide of the magazine in tension, compression and transverse bending, vibration alternname cases, vibrational exposure. Depending on the topography and nature of soils, construction and technical condition kabelele and wide cable mechanical modes of the load can vary[16].

2.1.2 The purpose of this type of fibers in the cable

Fiber optic links employed in the construction of optical fibers –the material and texture of light moduli alexelena its Commission. Its material is fiber glass (glass and optical film glass), plastic fibers (plastic optical core and a plastic film)and disable the integrated models. Glass-fiber provides the best throughput, bandwidth requirements and parameters off, if not critical, that was kind of the cheapest plastic was not used [14].

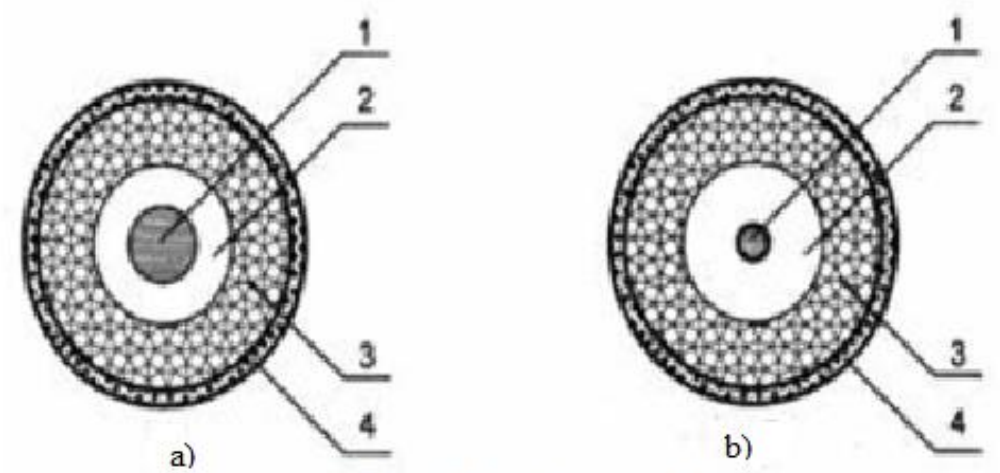


Figure 2.1 – Structure of the fiber Optic internal

Pipe with a diameter of about 8 -10 Broadly tallit jaral μm, that is comparable to the wavelength of light radiation within a such fibers, geometry (one mode), but also pedestrians. Broadly fiber (SM) only 1 bouquet of light, which, although different from the core of small diameter.Cpmodel (madacy)Tolsty Garay with a diameter of 50-60 microns, which allows many sizes of beams (modasa). Cpmodel fiber(MM) diametertelescope long length of the rod,can be ingredient and speed profiles. In the first case, light fruits (modulara), distributed in various trajectorial, so in different time reaches jarryd in favor of the latter. Gradient radiation different time stops almost completely eliminated in the profile, and modular –through a change in the speed of light the speed evenly, thanks to the undulating spirillar.It is mainly for tallit madarali gradient more dispersion–dispersion is the main

source,much less cpmodel tallit court in the matter gradient Tolstyh and more, which leadstthroughput[14].

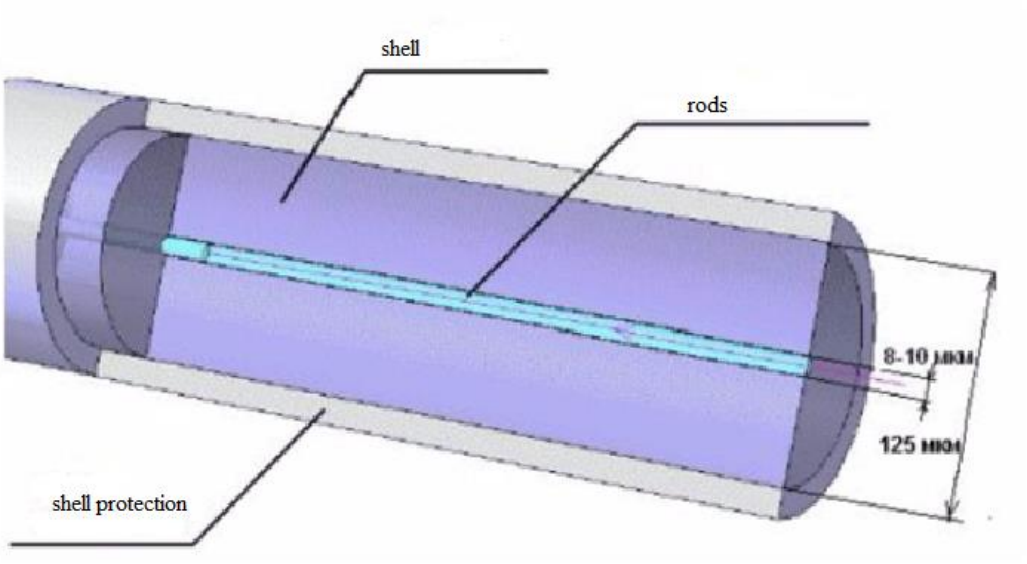


Figure 2.2 – fiber Optic cable

All installed networks dissemination of information in fiber optic cables, 125 micron, outer diameter will be the same. The thickness of the coating is 250 μm, buffer a championship defense. The secondary coating thickness of 900 ám buffer of defense. The sheath, stranded –for the convenience of working in different colored in the alarm color [14].

2.1.3 Select the type of trunk cable

The main cables of main and key distribution points in bienestarina, failure leads to failure of the entire network. Therefore, the area should be protected from a trunk cable are the most reliable.

It is designed in the area of λ=1.55 V mcmein sindiya α=0,22 dB/mimic, sksela and communication trunk,broadly is optical fiber. Because, compared to podolien broadly fiber core Demetradze, as a consequence,dispersion madarali not the throughput will be higher.However, laser aimbot taratushkin requires.And JAG: Nat -0,22 -6 -01 -6 -8 -10/125 -0,36/22 – 0,5/1 - 1,0 the laying of cables. Cable structure OKG -0,22 -6 figure 2.4 [15].

Select the type optical fiber cable the cable(FROM) begins with the definition of the quantity. Most often used standard fiber G. 652 passive optical networks.

The number of active fibers station and customer devices on the cable pins of the receiver and transmitter, is determined by the network. Note here and move along the fibers of the PON network propagation in one go. FROM the number, we can identify the following necessary principles: for each N FROM the apartment, where N corresponds to the maximum coefficienta split on the loan

Any cable design the trunk, to increase the network in the future must provide for reserves anymore.In the PON section of the main reserves of more than 1+2, is

determined by the position, that is, each two sets is saved for the application. In case the number of 32 or more saves, and even films, puts on the FIRE. 64 amount and if exceeds, it is only one Fund for precaution FROM the two additional [1].

Type without cable, the cable it is necessary to determine the structure of the nucleus. The terminal of cable means that all the collected fibers, the middle part of the cable. In a PON network there are two core type: modular (LT Loose Tube) and tube (UT, Uni-Tube).

The types of roll designs cables warm-up, warm-up stops, which sekses profile cables and the cables are distinguished belt. CURRENT a combination. All project requirements, especially financial, to meet the requirements of existing Lester tadalafilorder big assortimente materials.The layout of the building lengths of optical cables for cable joints of special construction are used. Two or more cable boxes is the income elementtag cables and one or more splice plates are used substances that are approved by. Splice-plate –for fixing cables or fibers of various structures is the construction of[22].

Modular element in the structure of cardiac fibers around a rod placed tubes. Middle steel wire or fiberglass cord elements. It consists of a suspension during the laying of cable mayodan or to protect long. Madarali modals and the space filled with a gel with water-repellent impregnation, which protects the fiber from moisture.

Fiber cables in the middle all the relevant tubular environment. In cables of this type, modular terminal, compared with the element in the environment is not the holder of the ropes. It is distinguished by its mini size, but sensitive to external mechanical forces [17].

This protective plastic (PC)columns of via pads must be removed to a certain distance. At the end of the work in the area of routing in the area of the column isreplaced by the following PT each land continues. Each workflow in a typicalspecial ways [21].

In each work, we are gradually, over time, got a job, you need to go to the area with betha the following terms.In turn, PT installation temperature -10 +50-at a temperature of from should be. This process in -10міндетті way is not. Installation can be done in a more PT at low temperatures. But in the case you can do some extra work he. As an example, note that, so-and-10 at low temperatures PT as residing without installation, heat need. We can install only after his Gility [21].

For comparison, the two aforementioned main core structure, modular design that provides reliable defense, but his size and weight is not small.The number of 16 to less in the presence of unjustified use of this type of rod.Therefore, it is better to use on the main cables. The web view of the structure of the tubular cable sewers, tkied inside the building, support columns are used to support the hang. You should also consider the number of used fibers (table 1).

Table 2.1– design of Cables depending on the capacity of the rod

Number of fiber	Core type Cable
1 ... 2	FTTH cable
6 ... 8	UT
8 ... 12	the basisUT, or LT
12 ... 24	The basis LT, or UT
More than 24	LT

2.2 The design of the distribution network PON

2.2.1 The choice of distribution cable laying and protection

The construction of a distribution network ORCHIES cable for external cabling and the distribution among the houses, the entrance to the entrance to the building, from building to building, and used when laying transit other, except for one.

Transcript of the cable depends on building technology, in-house distribution, cabildeo same node. The entrance of the building depends on the type of device and the technology of installation of the cable junction and local conditions. The cable is lined with a refractory shell, laid inside of a house.

Cabling two Taratus is regarded as:

-along a horizontal pipe: vertical piping in the basement and attic along attracting mainly under: cable, pipes or specially installed along tsius tkir

The number of transmitting fibers cable: to attract 4-48 correspondence, part 1-48 along the pipeline in a horizontal, vertical 1-64 along the pipeline [2].Attracting through the basement or tubing with a diameter of 50 mm under the tents. The first floor is considered first, along the attraction established between tkir. If there are no remaining seats installed in the pipes, the pipes will have special tsius again. Tsius built near long tchubarian new pipelines, sets. Often they are very 25/50 mm diameter plastic pipe.

From one box to 150-200 m is the length of the cable distribution network optical distribution last Splitter no more.

Plant your tree " in the group the ground bus, building, metal optical earth cable PV-3 wire type carried through. FROM the capacitance of the cable should be provided at the rate of one for each apartment included. When calculating 10-20% more than in fond precaution to leave.

	Connector Type	Coupling Type	Fiber Type	Polish	No. of Fibers	Typical Applications	Comment
	ST	Twist on	Single mode /Multimode	PC, UPC	1	LANs	Keyed
	FC	Screw on	Single mode /Multimode	PC, UPC, APC	1	Datacom, Telecommuni-cations	Keyed
	SC	Snap on	Single mode /Multimode	PC, UPC, APC	1	CATV, Test Equipment	Keyed
	LC	Snap on RJ45 style	Single mode /Multimode	PC, UPC, APC	1	Gigabit Ethernet, Video Multimedia	Small Form Factor (SFF)
	MU	Push/Pull	Single mode /Multimode	PC, UPC, APC	1	Medical, Military	Small Form Factor (SFF)
	MT-RJ	Snap on RJ45 style	Single mode /Multimode	N/A	2	Gigabit Ethernet, Asynchronous Transmission Mode (ATM)	One of Mating Connectors must have Alignment Pins
	MPO (MTP)	Push/Pull	Single mode /Multimode	N/A	4, 8, 12, 16, 24	Active Device Transceiver, Interconnec-tions for O/E Modules	One of Mating Connectors must have Alignment Pins

Figure 2.3 - Characteristics of subscriber cables and distribution

2.2.2The choice of the type of optical coupling

Optical coupling of any device, the design of the cables for tarmat. The area of application, purpose, in connection with chattaranga klassificeret occurrence design. Classification of optical coupling in figure 2. Clutch cables and couplings are applied directly to the connection points not more than 30 m on both sides, leaving the reserve Fund. The group of couplers of drop cables are installed at points located near buildings.

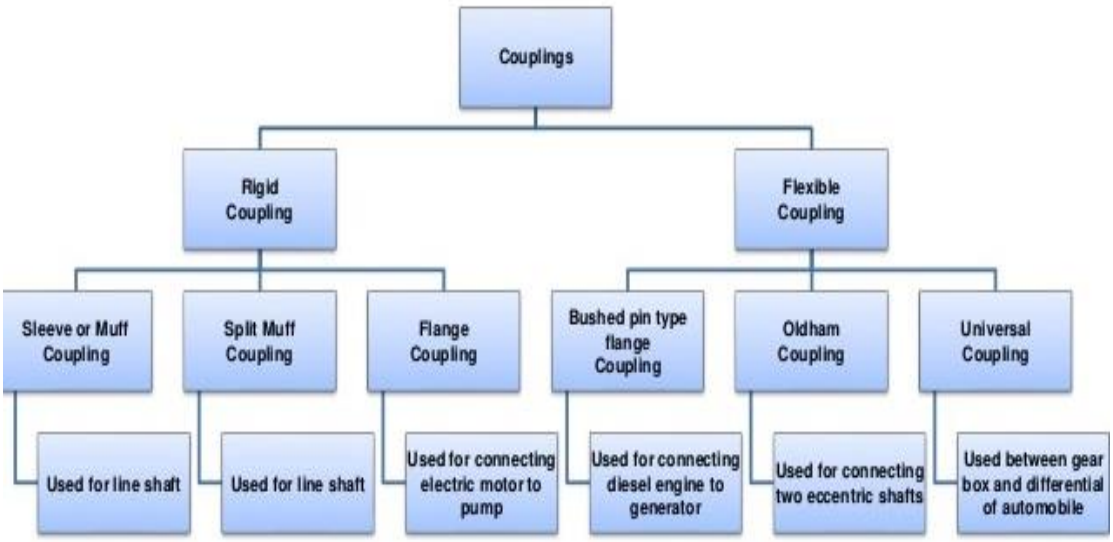


Figure 2.4 – Classification of optical coupling

In the course of the project implementation were discussed the questions of selection of the type of coupling. Comparing prices and quality of the couplings Kagen companies "kazcentrelectroprovod" stopped at the clutch FOSC A4 models.

Figure 2.5 – FOSC A4 muttsy

Scope

Optic clutch FOSC A4, installed zone distribution optic cable. The main task – the elimination of on-site, used in FTTH networks. The decision depending on the project, during the construction of air A4 via murtazi: underground, in cable wells, walls of buildings, can be used in special cabinets.

Opportunities

Dome coupler, perfect 5 Krebs balanidae as it is, it can be used as the branch closed.

Clutch housing made of plastic is particularly durable. Comfortable design Clutch re-use; any optical fiber compatible.

Technical characteristics

Large size – 420x180 mm.

Capacity – 96 welding (4 cassette 24 welding).

Cable inputs – 5 (4 mm and cables with a diameter of 10-25 mm round oval in form 5-19 1 diameters of cables).

Number of sockets SC – 18.

Operating temperature: -40°C+70°.

Optically IRL radius ≥40mm.

Weight – 4 kg.

The main objective of the optical distribution Cabinet, short and long type section of the main site user capacity optical talsyn otherto in the transition to the side. Within Cabinet switching optical distribution, customer connections and optimization of the diagnosis of ATS is made to a main measurement.

The construction of a distribution network ORCHIES on a group of buildings, or for maintenance of residential houses, are mounted from the street. The first phase of construction of the building, mounted from obtainin ORCHIES, mainly located in the middle. If ORCHIES on the first floor special place for retained earnings, it is possible to place in the basement of the building.

FROM ORCHIES, including trunk-n of 16 or 32 transmitter branch group of splitters. The number of units in the building tolindos ORCHIES and the parameters of the equipment depends on the number of average wages.

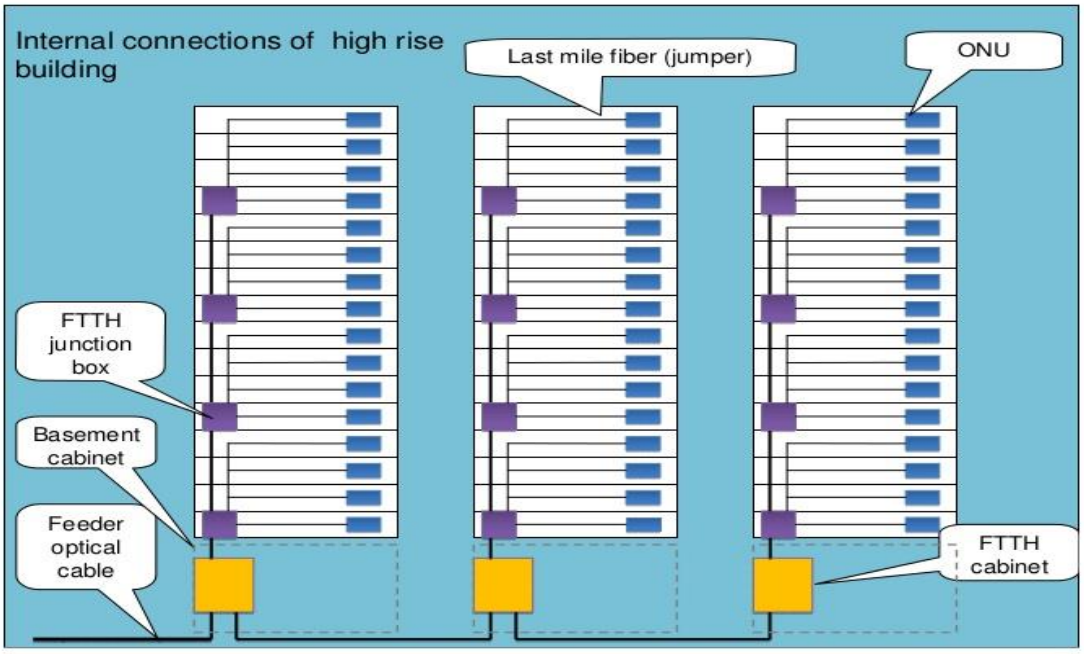


Figure 2.6 – Block diagram of ODS for example

The construction of a distribution network Optical distribution cabinets divided into the following types:

- Small ODS (ODS-M) 32 at the input of fiber optic cable. 64-72 patch panel
- SC/APC type connectors.
- ODS medium size (ODS-S) 48 at the input of fiber optic cable. Up to 144 patch panel SC/APC type connectors.
- Multidimensional ODS (ODS) FROM 96 at the input of fiber optic cable. 292 patch panel SC/APC type connectors.

Any ODS GOST R 50571.10-96 (IEC 364-5-54-80) earthing shall be provided in accordance with the standards. ODS placed indoors, can be used for electric tsitaminy nearest the ground bus.

2.3 The design of the subscriber network PON

1 consideration of input device houses

2 optic distribution boxes (OR) crebarctrl, coordinating floors
3 the connection to the subscriber

2.3.1 The input device houses

The method of inclusion in housing is carried out through three:

- by including in the underground basement
- tent air run under
- through the exterior walls of the building, underground, air intake.

Wire, entering the building nearest the sewage water from the well in the event. Wire tube with a diameter of 63mm polyethylene pipe is used, which. The bar's length must be 200m of the pipeline, the sewer pipeline from the building must reach alenby in income. Vertical duct inside the building by the shortest route to the route of the cable in the basement attracts income. When laying pipe, pipeline, installed in the basement of the points approved by the sitting first, the frequency of their diametre of the pipeline. And then, after the breakthrough of the pipeline where it passes the pipe through the wall hole is slightly diametre. Then beramendi, which asserts that attracts inside the cable. Cable on the outside of the tube set after what astaxathin defense.

2.3.2 Optic distribution boxes (OR) crebarctrl, coordinating floors.

Decoding involves the installation of cable distribution devices in the hallways mostly vertical wilard technology and organization of the coordinating node.

Used to ensure the connection of optical distribution devices in the entrances of apartment buildings quickly and efficiently. The number of apartments per floor in the presence of one or more junction boxes, five in each.

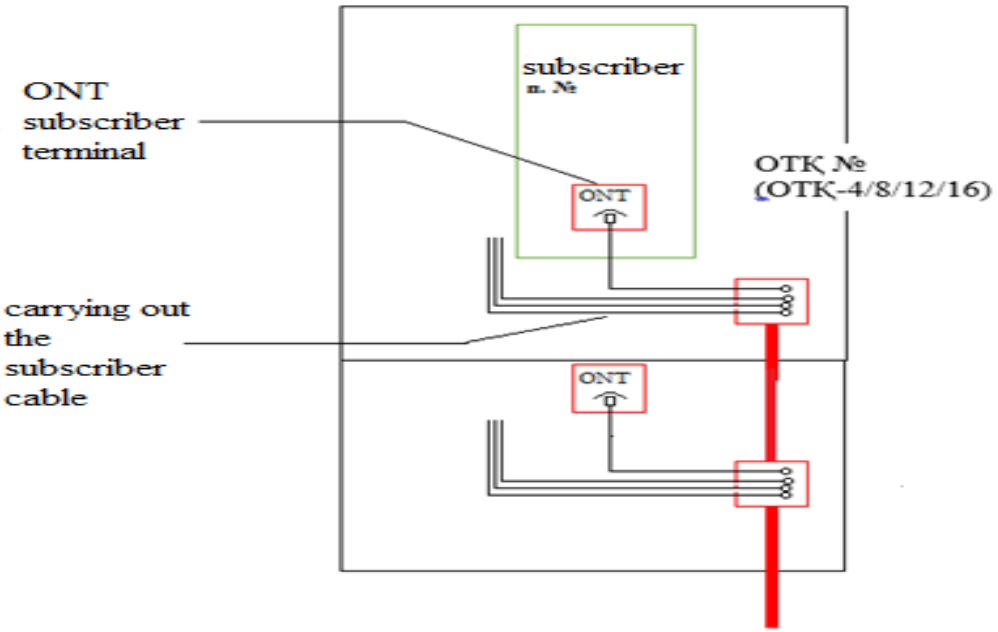


Figure 2.8 – The floor of a residential building, each ODB

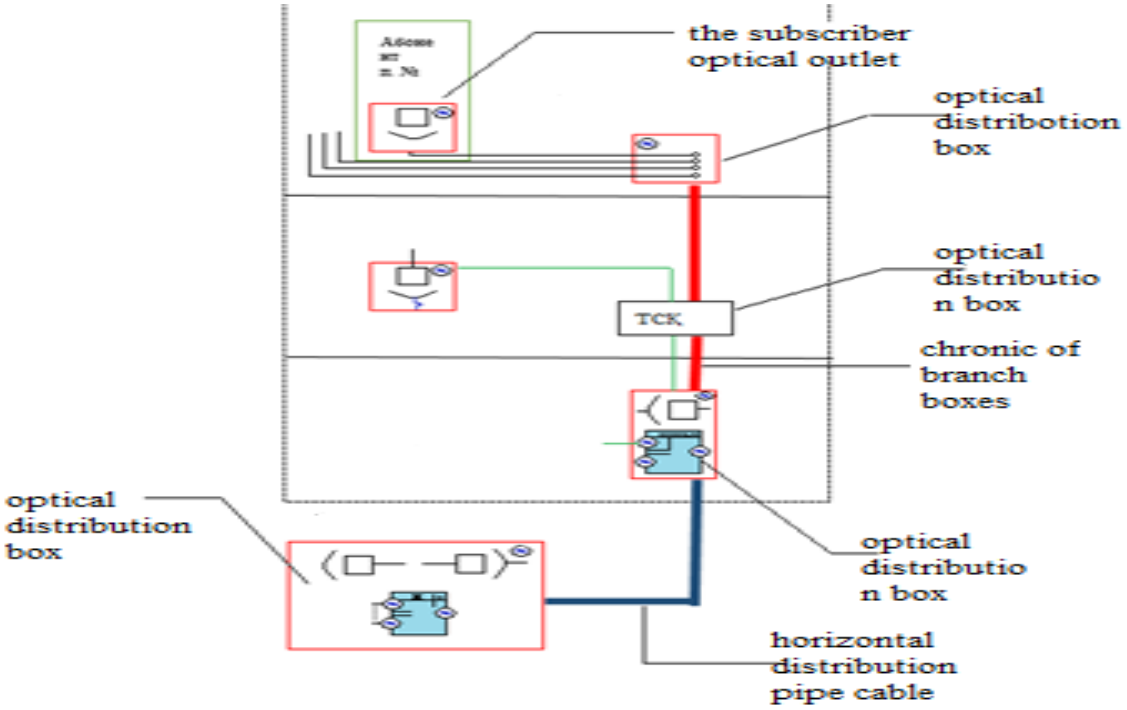


Figure 2.9 – The 2st floor of a Residential house sample 1 ODB

The liquidator of the organization of the site there are two main ways: centralized and coordinated tarmacadam tarmacadam location, location.Tarmacadam ortalidae easy operation from the side, albeit increasing direct economic damage. Therefore, this method is a low-rise building should apply at least-apartment.

In the multi-storey, multi-unit residential buildings, using harmonized tarmacadam location.

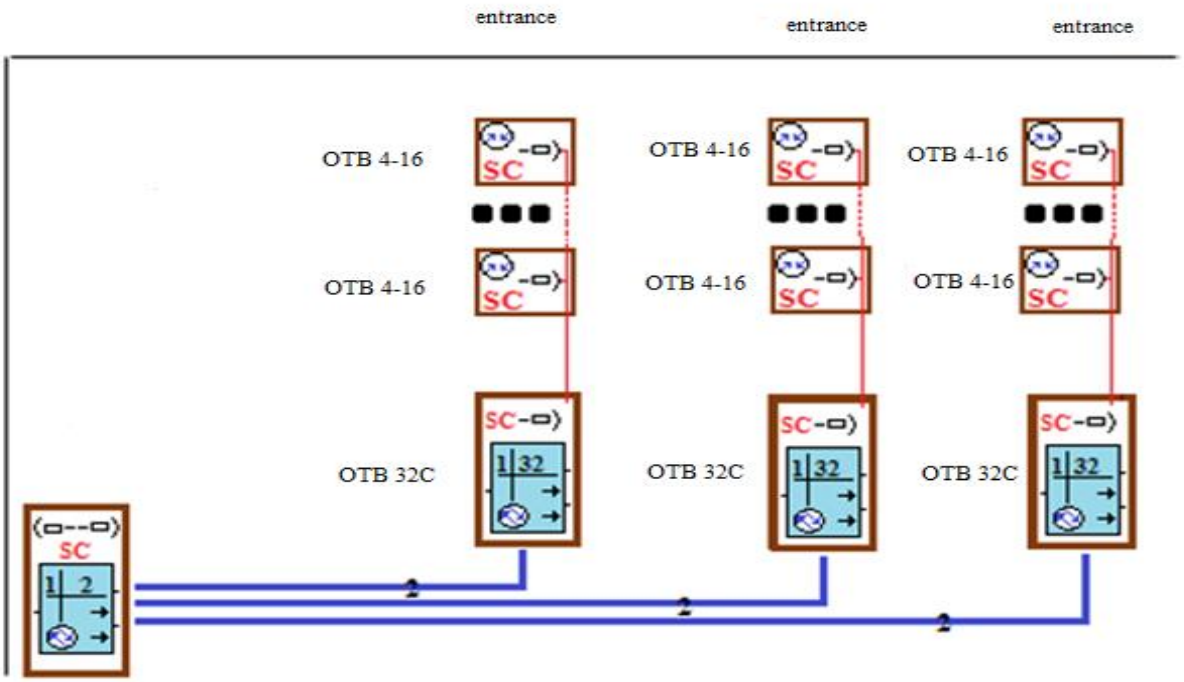


Figure 2.10 – layout of Junction coordinated

To select one among the junction boxes in several layers, the number of floors must not exceed stood. Box optical distribution on your in this case, one floor below and the floor above itself includes apartments. In the field installation junction boxes optical distribution coropceanu drawl not set. Splitter boxes are installed on floors if necessary.

They should be as close to the apartment.

2.3.3 The connection to the subscriber

Optical distribution box optical subscriber socket subscriber network inside the apartment or floor, the connection node of the subscriber starts communication, will continue to the terminal.

As a subscriber of a cable or connecting two fiber-optic bertellini cord or patch cord. The cord is of the highest bending properties, made of refractory fibers broadly. Fiber cable diameter 3 mm, inside construction ABYA, aramide yarn security lining.

The outlet should not exceed 15-20 Metzen optical subscriber terminal ONT and the distance between moving in the apartment or. The official representative of the service subscriber terminal, operating in the optical socket is installed above 50-80 cm from the floor.

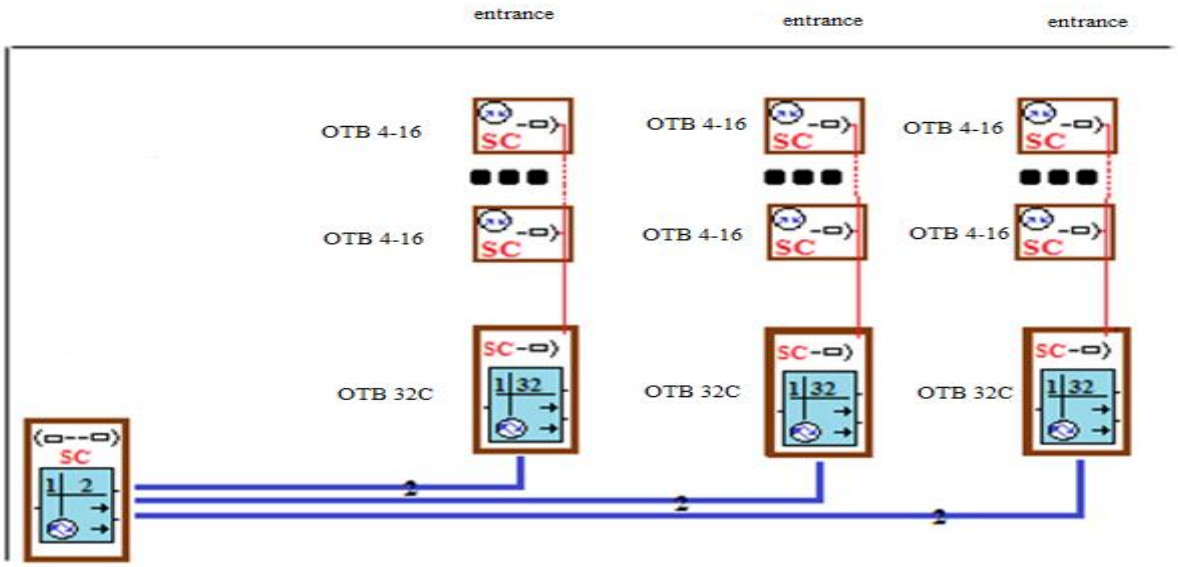


Figure 2.11 – Layout of Junction of Central

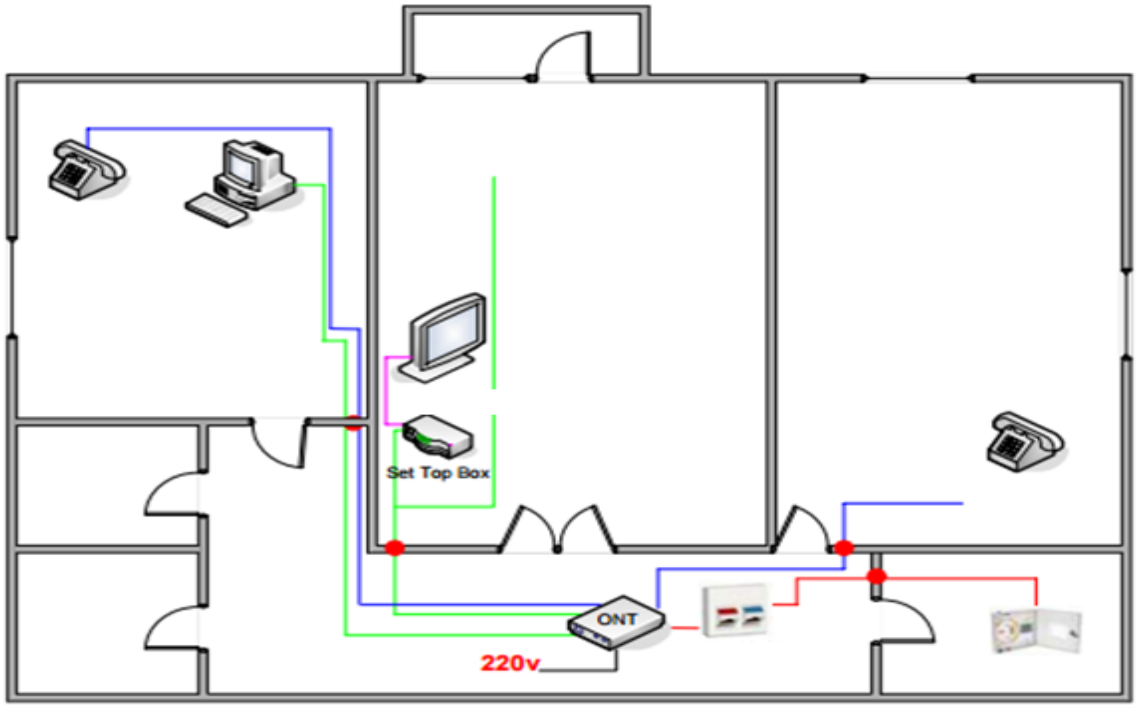


Figure 2.12 - The placement pattern of the subscriber devices

3 Carrying out practical calculations and design

3.1 Information about mcd. «Bukhar Zhyrau»

Mcd. "Bukhar Zhyrau" General information about an Assembly. "Mcd. "Bukhar Zhyrau" on the right Bank of the river Ishim, street Shamshi Kaldayakov.

The total area of 53 000 sq. m. in 2011, this building residents. Residential complex A,B,C and d-units on the lower floors of the offices is administrative.

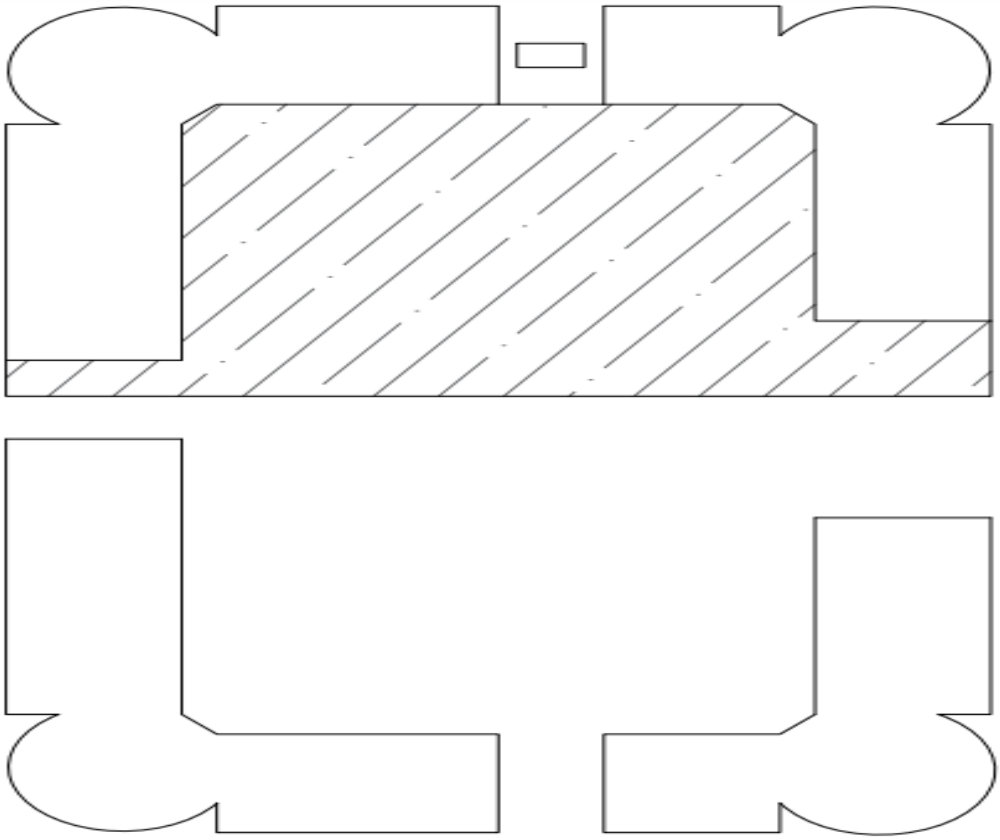


Figure 3.1 - The layout of the blocks

This is very erxe the number of residential buildings as floors, apartments, entrances and floors. Among the numbers 4,5,6,7 total number of floors changes.

With regard to the building, telling the physical blocks, And block 6 entrance. 4 at the entrance to the first floor, second floor at the entrance 5, and the remaining 6 floors in the hallways. 4 the number of apartments on all floors and at the entrance, equal. Then, in General, the number of units of block A 4*4+5*4+6*4*4 = 132 will. In block B, four door. The first three and the last 4th floor of 6 floors in the stairwell at the entrance. The number of apartments in the entrance the first three 5-minute, 6 in the latter. Common in block B 3*6*5+4*6 = 114 subscriber. As for the unit, 4 inputs, total of 5, 6 and 7 floors, the rest on the second. The number of apartments in all equal to 2, then In block 5*2+6*2+3*7*2 =64 apartments. In block G, entrance 7. Them on 5 floor 6 floor 7 floor and two or three others. On each floor there are 2 apartments, all in block G 5*2+2*6*2+4*7*2 = 90 requires connection of subscribers. With regard to administrative offices And the unit 12 office located at unit B office 10, including Parking under the blocks A and B

Table 3.1 –Main design object of protection

Name of the project: “Bukhar Zhyrau Towers" residential complex
Address: Bukhar Zhyrau boulevard 27/5
Unit number:4
Number of apartments:400
Office number: 22
Number of entrances: 4,5,6,7
Floors: 4,5,6,7
Enter into the building through the basement Parking

3.2 Design of backbone network drawing

3,12 km from the apartment complex Astanatelecom MTC regional Directorate of telecommunications PBX-36 raised from the station of school-coupler 16/36. His stomach Alcatel-lucent 7302 ISAM passivity equipped with a device optical station.To date, there are 8 free muttada slot for submission to the development of the network.

The ground beneath the trunk sewer cable through the cable. We will remind, on the independence Avenue cabells main sewer septic cable ready. Crossing the road holding of the cable on the track,placed at points of turns, common wells and other interference.

Accounting:

400 apartment + office 22 = 422 subscriber

One subscriber can provide 32 optical fibers.

Then:422 : 32 = 13,2

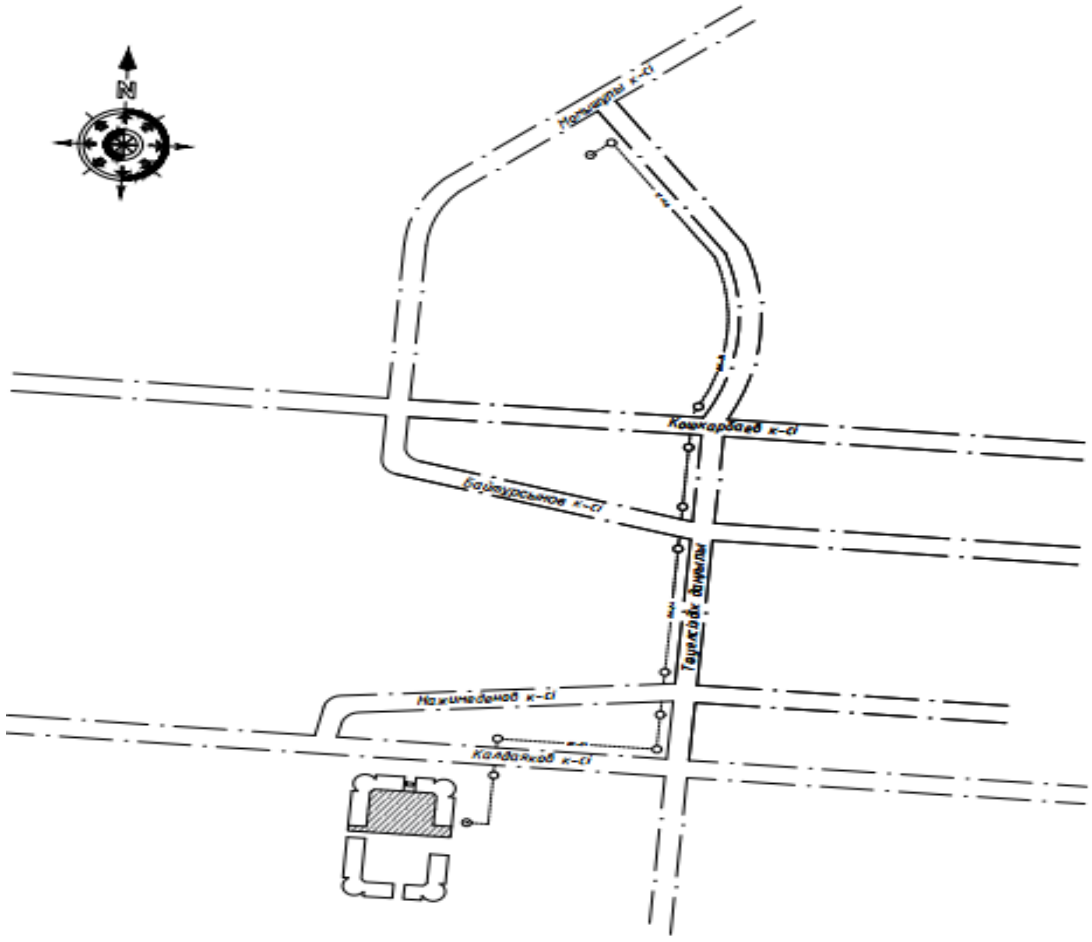


Figure 3.2 – Scheme involving the Trunk cable.

Selecting the capacity of the trunk cable number of apartments in a residential complex, depending on the number of subscribers, that is expeled.

When creating access network of PON technology, the development of the network in the future, with the aim of expanding more than 30% of the reserve Fund are taken into account. Then:

13,2 + 30 % = 17,6

The calculation for the blocks:

Block A

132 apartment + office 12 = 144 subscriber

144 : 32 = 4,5

4,5+ 30 % = 5,85

A unit for feeding a OC 8 cable enable.

Block B

114 apartment + office 10 = 124 subscriber

124 : 32 =3,87

3,87 + 30 % = 5,031

A unit for feeding a OC 8 cable enable.

Blog V

64 subscribers

64 : 32 =2
2 + 30 % = 2,6
A unit for feeding a OC 4 cable enable.

Blog G

90 subscribers
90 : 32 =2,8
2,8 + 30 % = 3,6
A unit for feeding a OC 4 cable enable.
As a result, the blocks OC 8 + OC 8 + OC 4 + OC 4 = OC-24 cable select.

3.3 Choice of entry point in the building of the cable

Main OS-24 cabells stopped on the side of the projected residential complex. Begin to design the distribution network of this area.One of the most important problems in design of distribution network the choice of the correct entry point into the building.

"French quarter" in a residential complex of four separate block, since the block control node is necessary to include in each cable separately. Parking under blocks A and B, of block B of the building, we will start with the launch. Equally effectively because it's a lot easier than in the basement rehaman land to include Parking.

Side of unit B to two OS-8 and OS-4 hi, cables. One of OS-8 in the block remained on this cabells, And along the other two Parking, subject to the cable blog. And two cables, one block from the OS-8 paid to the needs of the unit, the rest of the OS-4 was parkington cable, block G, underground ways to the closest. This room is close to a technical assignment block, block, cable, it OS-4? muhtadin directly underneath the cable.

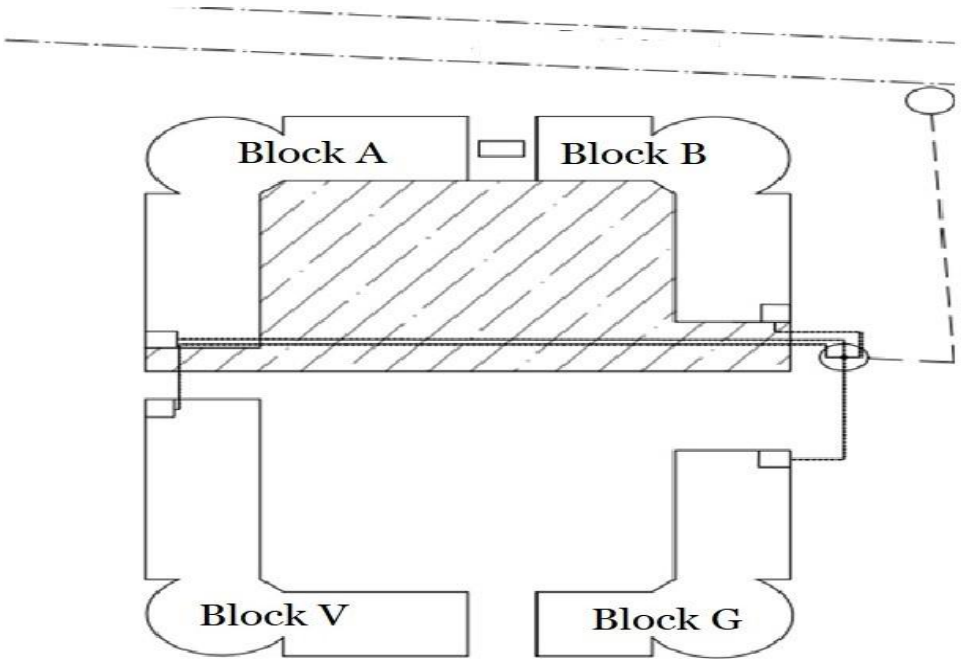


Figure 3.3 – The sheme of the distribution of cable for the blocks

3.4 Coordination floors of optic distribution boxes

After krene cable array junction box, disconnect it using couplings, optical distribution boxes coordination. First, the TSO is olestra floors.

Diploma project "kazcentrelectroprovod", the company "Kazakhtelecom" is logotyper use junction boxes. Overall manufacturing company box: kre-2,4,16,24,32.

Figure 3.4 – Kre -16-1 floor box distribution

Scope

KRE-16-1 box can be installed in multi-storey buildings, the ability to connect one subscriber of a network of providerin 16.

Opportunities

Kre-16-1 1/2-up to 1/16 to tarmatek splittered involves the installation of optical PLC.

Kre-16-1 32 6 mm Krebs cable pipelines.

Along with the introduction of a standard vertical cable of the cable or pipe when you make a feature of this model is the opportunity.Macalpin on the reverse side of the additional fastening elements of the cable.

Kre-16-1, there is a possibility of welding of main fiber-optic pigtailed.

Technical characteristics

Wide size kre-16-1 (Hbht) – GU 200x250x88.

Protection class IP 43, GOST 14254-96.

Paint – polymeric coating, RAL 7035, Sjogren's, shiny.

Metal thickness – 1.2 mm.

Application conditions: from +400C to-100C.

Fill the reader's requirement, the period is 1 year.

Recommended cable entrance figures 2 to 4 years..

Number of clips – 3.

Cable inputs (pipeline diameter of 32 mm) – 6.

Splitter up to 2 pieces.

urther, depending on the application in the design of boxes need a lot of subscribers, so jobliste CRAY-2, CRAY-CRAY 4-16 we will be junction boxes.

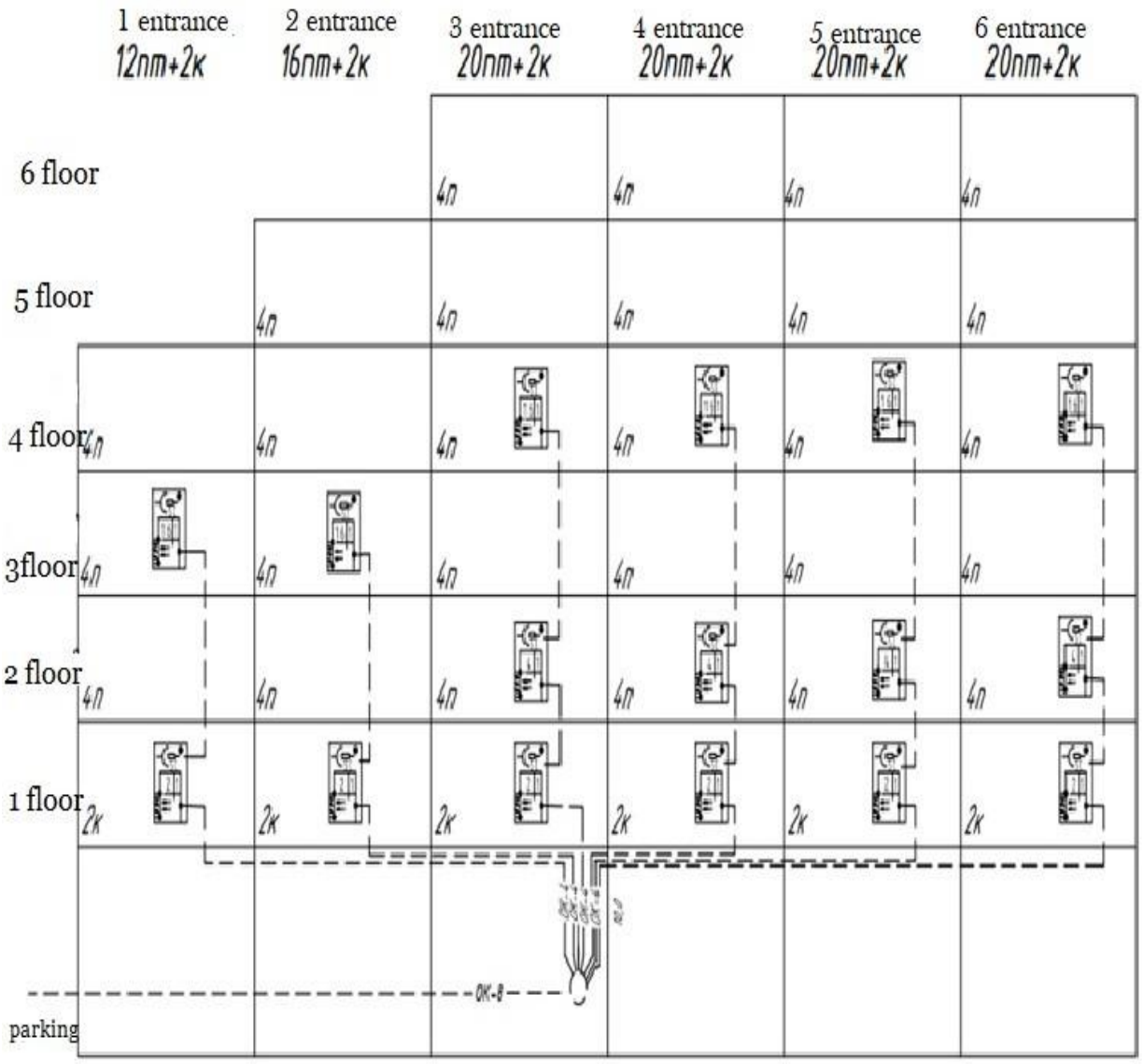


Figure 3.5 – Layout of the boxes-folding unit A

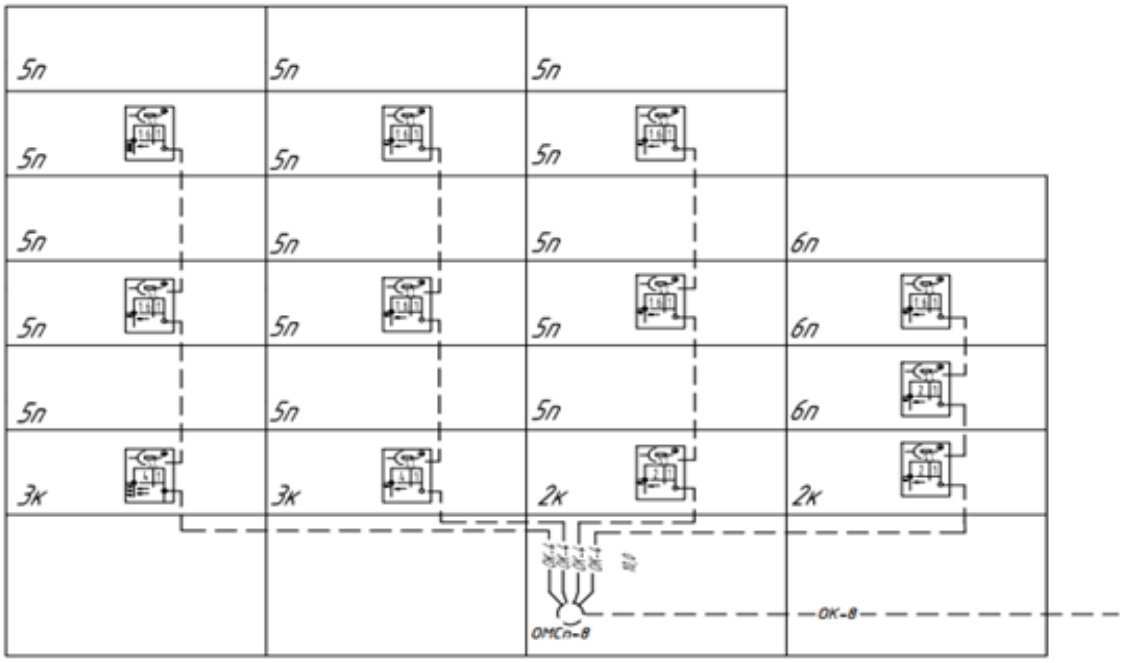


Figure 3.6 –Layout of boxes-folding unit B

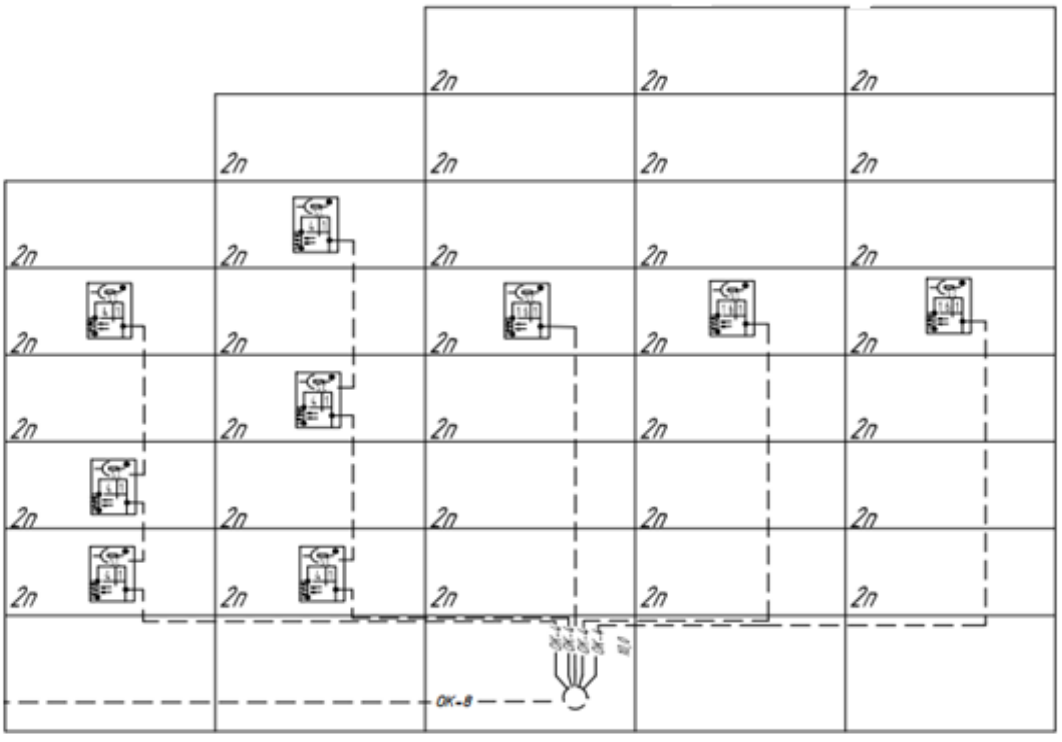


Figure 3.7 –Layout of boxes In V block, folding

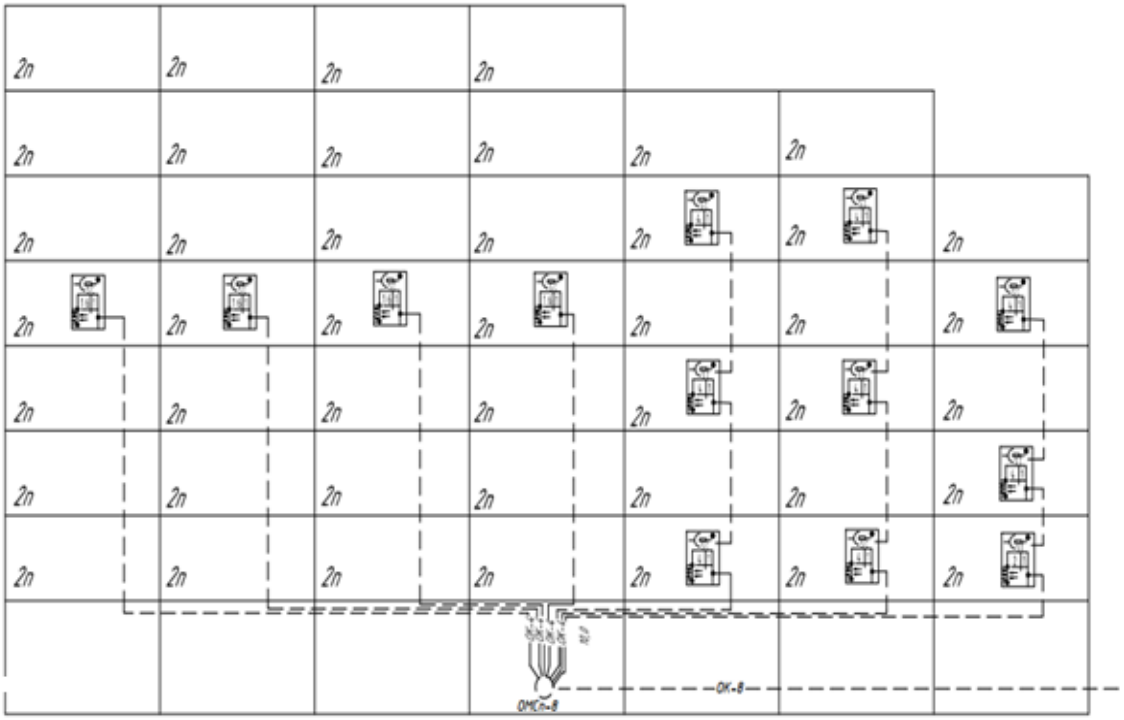


Figure 3.8 –layout of boxes-folding unit G

His rational distribution of optic distribution boxes on the floors or in the basement Parking from the calculation of OK-8 or Oh-4 tarmat cables through to the box.

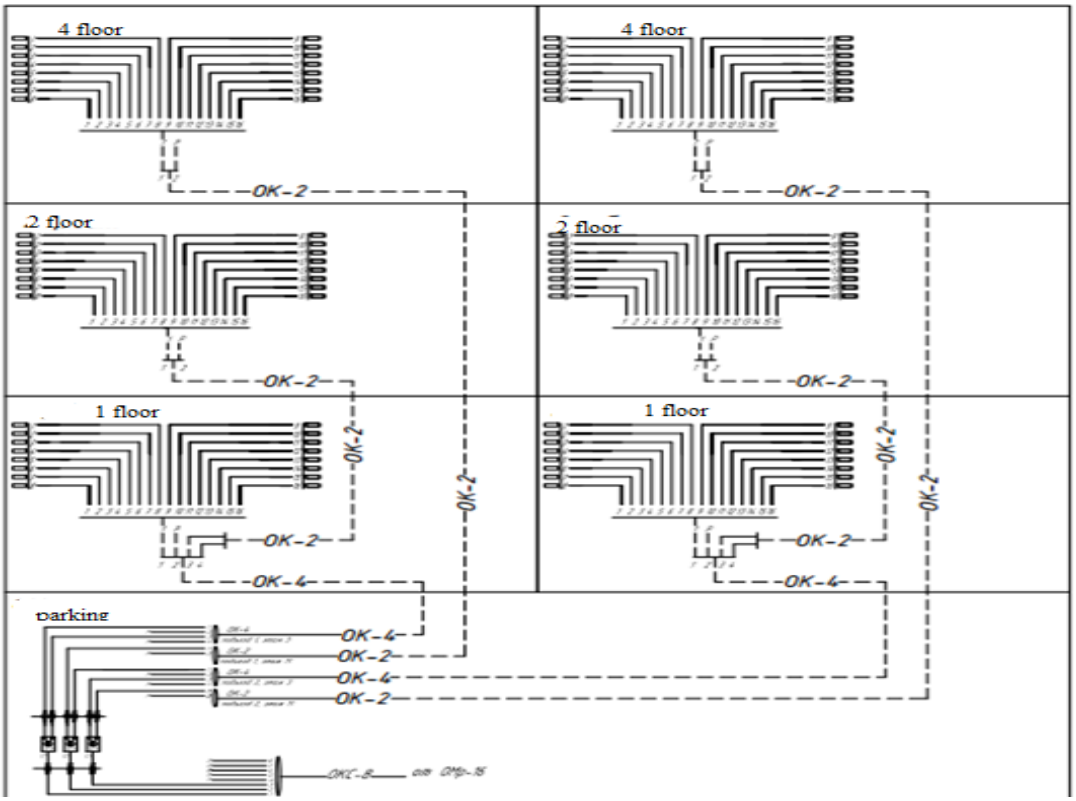


Figure 3.9 – Sheme of the clutch transcript

3.5 Calculation of the power budget

3.5.1 Attenuation of the signal

The decrease of optical power of the signal during the propagation according to the optical fiber is signal attenuation, measured in dB/km the attenuation of light in the fiber is in the main affected by such causes as the loss on the merger and the loss on the dispersion.

The merger in an optical fiber there can exist individual and impurity. Individual fusion is due to the absorption of quartz in the infrared (IR) and ultraviolet (UV) regions of the range, and the impurity - the presence of impurities in the fiber. In the middle of the impurities that cause the greatest attenuation, release OH-ions (hydroxyl group).

As a consequence of small (microscopic) configurations of density and, consequently, the refractive index of the fiber material, the light propagating in a certain direction, can be divided(scatter)in various directions, including the reverse. This leads to the appearance of confused radiation and, consequently, to losses. Even in the absence of attenuation due to absorption in the fiber will be constantly attenuation due to Rayleigh scattering, which is approximately 0.16 dB/km at a wavelength of 1550 nm. The dependence of attenuation on the wavelength for fused quartz is shown in figure 3.10

As we can see from figure 3.10, the amount of attenuation is small in the spectrum of wavelengths of 800. . . 1700 nm. Fusion in the UV region at the smallest wavelengths and in the IR at the longest roughly increase the calming.

In communication systems, 3 spectrum wavelengths are used, called transparency Windows:

- 850 nm transparency window;
- transparency window 1300/1310 nm;
- transparency window 1550 nm.

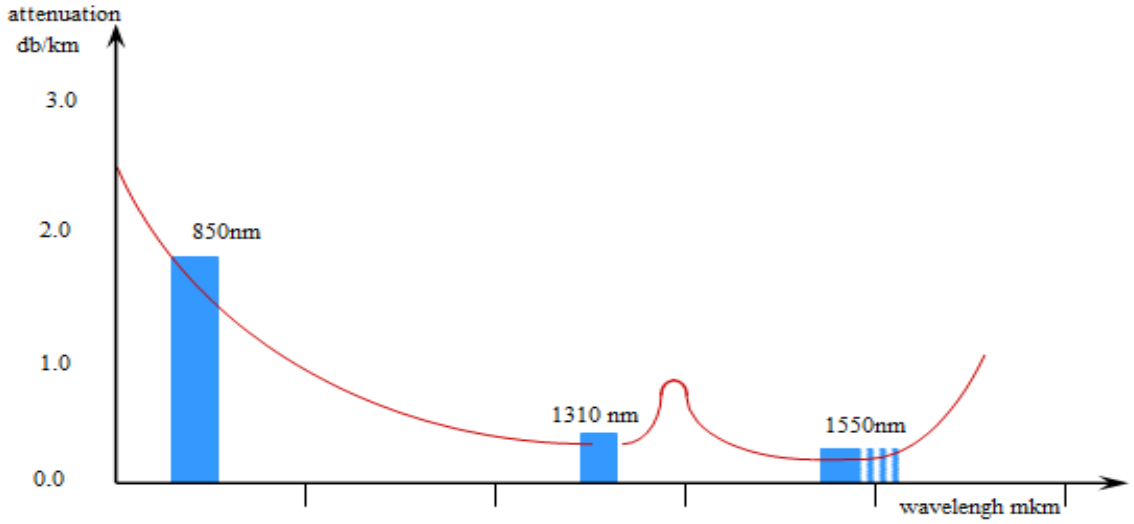


Figure 3.10-Dependence of the quartz fiber attenuation coefficient on the wavelength and the transparency Windows used

850 and 1300 nm are working Windows for multimode fibers. 1310 and 1550 nm are working Windows for single-mode. Single-mode fibers with low water peak (ITU-t G. 652. (D). They are used at wavelengths between 1310 and 1550 nm. Single-mode fibers with non - zero offset dispersion at l-band wavelengths above 1550 nm. L-range is still shown in figure 3.10. Region of wavelengths in which the applicable odnodozovy fiber divided by another most densely at subsequent spectra:

O - band: 1260 ...1360 nm; E - range: 1360 to 1460 nm ...;

S-spectrum: 1460 ... 1530 nm; C - spectrum: 1530 ...1565 nm; L - spectrum: 1565 ...1625 nm; (U - spectrum: 1625 ...1675 nm).

The peak of attenuation, predetermined by the presence of hydroxyl groups, is located between the Windows of 1310 nm and 1550 nm and is called the water peak. Low water peak (LWP) single-mode fiber has a sense of attenuation at the peak is not sufficient, the fiber can be used even at wavelengths corresponding to the water peak. In agreement with ITU-T G. 652 boards. D the attenuation value at 1383 nm is the same or even lower than the normalized value for 1310 nm.

The attenuation curve for a single-mode fiber with a low water peak is shown in figure 3.3. O, E, S, C and L spectra are shown.

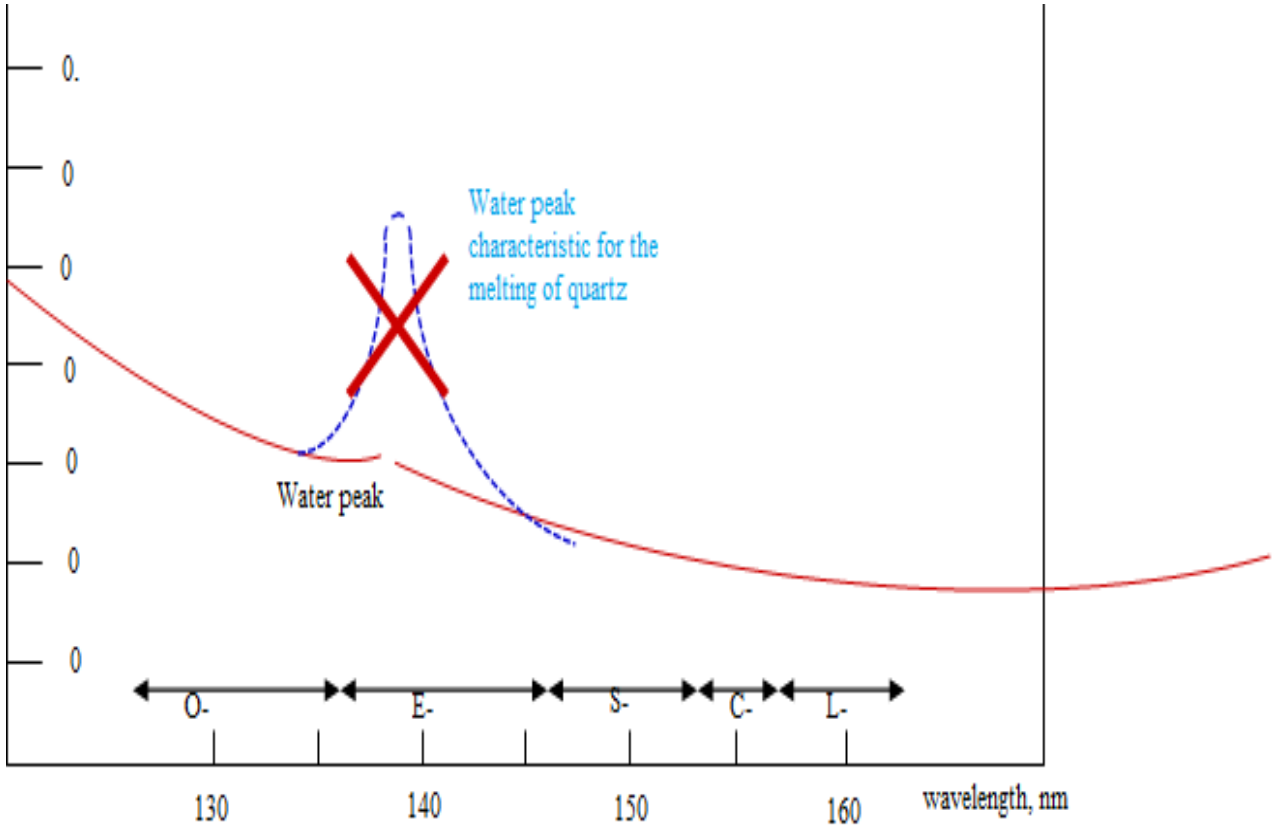


Figure 3.11 - Dependence of attenuation coefficient of low water peak single-mode fiber (ITU - T G. 652.(D) the wavelength

The attenuation can be caused by macro-bends (bending radius >> 1 mm) and micro-bends (bending radius < 1 mm), as well as radioactive radiation. These causes leading to signal attenuation should be minimized or eliminated in the design of the cable and the next time it is laid and installed.

The selection of the transmission system describes the very possible attenuation between the transmitter and receiver. Called the budget of attenuation is the sum of all the losses that appear on the site of the optical access network between the transmitter and receiver. Sources of signal attenuation:

- perfect attenuation in optical fiber.
- total losses in the splinters. They depend on the losses in each junction (dB) and on their total number.
- total loss in connectors. They depend on the losses in each connector (dB) and on their total number.

Attenuation in fiber splitters (for example, in passive optical networks (PON) or in cable TV networks). These attenuations depend on the branching factor and grow by approximately 3.5 dB whenever the sign is distributed in half.

It follows from the above that the possible attenuation can not be greater than a certain size. Consequently, both the strip length and the branching coefficient are still limited by

the attenuation budget. In a passive optical network, branching losses are often important and can exceed half of the attenuation budget.

Calculation of attenuation for the most remote home.

Another reason, the limit length of the optical band and the greatest transmission speed - is the dispersion. But when calculating the possible distance for the transmission system in the optical access network, usually take into account only the budget of attenuation, because specifically attenuation, and not dispersion is the main limiting cause.

Perfect attenuation calculations are required for any single fiber (strip) and associate the results with a very possible attenuation. These calculations are carried out at the design stage of the optical access network.

Damping formula ($З_{вв}$):

$$З_{вв} = К_{зв} * L, (дB) \quad (3.1)$$

The formula of the total losses in the splices/connectors (S_{sr}/S_s):

$$S_{sr} = N_{sr} * P_{sr}, (дB) \quad (3.2)$$

Table 3.2 – The calculation of attenuation

The calculations of attenuation of Fiber type: ITU - T d G. 652		Unit measurements	Wavelength, nm	
	Value of coefficient	dB/km	0,40	0,25
	fiber attenuation	NS / nm km	3,50	18,0
	The value of chromatic	km	5,5	5,5
	dispersion	dB	2,20	1,4
	The length of the communication line AU	dB	0,05	0,05
	Fiber insertion value	PCs.	4	4
	attenuations	dB	0,20	0,20
	Average values of losses in	dB	1,0	1,0
	splice	dB	3,0	3,0
0	Number of splices	dB	0,30	0,30
1	Total losses in splices	PCs.	4	4
2	The loss in the splices in the repair	dB	1,20	1,20
3	Operating margin	dB	17,5	17,5
4	Average losses in connectors	dB	25,1	24,3
5	Number of connectors	dB	26,0	24,5
6	Total losses in	dB	0,9	0,2

We calculate the length of the regeneration area limited by the dispersion characteristic of the fiber

$$\frac{\Delta F}{\Delta F_x} = \sqrt{\frac{L_x}{L}} \qquad (3.3)$$

where, ΔF - bandwidth of 1 km of light guide;
ΔF_x -bandwidth at the end of the regeneration phase;
L- construction length, (2,15 km);
L_x- length of the regeneration section.
We express from the formula (3.3) the value of L_x:

$$L_p = L_x = \frac{\Delta F}{\Delta F_x} \times L \qquad (3.4)$$

$$L_p = L_x = \frac{3333 \times 10^9}{1005 \times 10^9} \times 2{,}15 = 24\ km$$

Let us compare the lengths of regeneration sites limited by attenuation and variance, we choose the smallest value: $L_p = 24\ km$ It is less 100 km, therefore, there is no need to use regeneration devices.

The length of a part in the regeneration of Variance
- dispersion of private chromatically D(λ)=2.5 PS/nm·km;
- specific bandwidth W=0.44 / τ MHz * km;
- Impuls laser with a width of Δλ= 0.1 nm;
- dispersion τ=Δλ· (λ) PS / km;
- normalized frequency modulatsiyasy f (λ)=1.25·2500mhz =3125mhz;
- L - length of the regeneration site; L= W / f(λ)

The limit of the variance:

1) Dispersion pulse:

$$\tau = \Delta\gamma \times D(\gamma) = 0{,}1 \times 2{,}5\ pc/km$$

2) Specific bandwidth:

$$W = \frac{0{,}44}{\tau} = \frac{0{,}44}{0{,}25} \times 10^{-12} = 0{,}167\ MHz$$

3) The length of the regeneration section:

$$L = \frac{W}{f(\gamma)} = \frac{0{,}167}{3125} = 56\ km$$

4 Life safety

Currently, in the developed environment, people are the main wealth, so modern production should differ, first of all, safe working conditions.

A full and correctly, in any of employees to work safely, the mood must be psychologically attachment for intervention. To preserve human health and ensure the efficiency of the normative safety of work, the system of legislative, socio - economic, organizational, hygienic and medical measures are applied in advance.

Control of work on labor protection on the basis of the labor code of the Republic of Kazakhstan, administrative-departmental,public-state bodies. Explanation of the provisions of the technical worker, the employer adopted safety measures.

There is an introduction of new technological processes in various production factors in the emergence of dependence. Im noise, vibration, electromagnetic radiation various, ultrasound, dust, organic and inorganic contacts. Depending on the level of psychological and emotional specialties, effects are also taken into account.

Working conditions for the operator must be physically fit form the correct body. It, or in part, examines the shapes and variables that remain. Static fatigue of the operator, which remains low to calm both hands, brings to the performance of a particular job, comfortable conditions. Area of work 38-50 cm somewhere. With the operator can only be in motion. And in SME location reaches 50-75 transition zones. It is enough that the workplace overview with the presence of two hands, can work in a convenient form. In contrast to state variables that despite more than Wettin that the position movement is not restricted. If we consider the normal zones consisting of 75 cm, no more. Freedom of movement, although there are a lot of energy and energy goes away. There is premature fatigue. What totally the end of the template transition operator reliability [8].

4.1 Operator safety

Operator-a person who controls the operation of various installations and monitor. Fully working, mostly in front of computer operator time. Therefore, the design of the operator's workplace should be considered. Words of congratulations addressed in a horizontal direction so that the display of rotation and vertical area provided. Display table display 450-500 mm and placed so that the distance between the controller. Screen Display, 20 angle between straight and placed so that the middle of the screen display.

At the height of 650-800 mm from the floor so that instead of a special keyboard or desktop set and installed klawiatury I clemen 5-10 degrees. Along with the installation of the standard height is changed to the computer Desk (from 380 to 450-500 mm) and comfortable Shoe use places to put.

The work of the operator in General, four stages: implementation, results, reception of information, processing of the received information.

The availability of products for the operator, the convenience of placing control devices and memory obtained in natural conditions, they are equipped with high-frequency devices.

Labor is a state of human environment and health has affected the ability to drive a car and with the totality of the facts, we say.

In order to improve the working conditions in the room in accordance with the safety instructions, air conditioning, lighting, fire safety.

The installation is designed based on the nashara give a description to the room, in places of electric shock entered in this section. To reduce the risk of electric shock to the person as it is considered a safety condition in the area of grounding installation instruction. Or, if possible, should protect a person from electric shock when working in the office and reduce the risk of electric shock if damaged power cords, which may arise as a result of various factors protection devices.

Signal reception operator in the management and work of the internal and external changes information of the object, watching,select, determine.

In the work of the operator, mental, physical factors. These include:emotionally,burnout of the visual analyzer, as well as other factors of unity. For the efficient operation of the operator,the company ergonomics, climate, operator workplace, attention.

Air temperature affects the human condition by work. Calendar the human body at a low temperature,illness, flu can make you ill. And the working man, increase temperatature terlep and cost reduction. To invest such factors, carefully on the work of the operator, reduces the output of marriage, is it possible.How much attention should be paid to air humidity. If the humidity in the room exceeds bulunun of moisture in the skin and can interfere in the lungs. The increase of absorption of moisture in the air dries up, and man, the Supreme way. This will lead to the decline of factorline work.

In the building of a favorable microclimate for payment, installation of heating and cooling systems.GOST12 parameler Nterests microclimate.1.005-88 "air and hygiene in the workplace".Categories of work 1 a in this (handmade).Temperature 21-23 degrees S0, always evenly,the normal humidity of 45-65 %.

For the operator conveniently to feel important, so the support is installed on ornates the location of the devices or between the desktop and the monitor of the table 700 mm (effective 450-500mm), at a distance of up to 15 degrees, and the angle of the horizontal height at the middle of the screen,and the flat viewing angle should not exceed 100 degrees. The keyboard is placed on the table under normal conditions at a distance of 100-140 mm 750 mm at a height of 20 degrees in a vertical plane from the foreign side. The height of the controlled places. On the left, at a distance of 450-500 mm for the field of view of the operator, the operator entering information into the documents.The distance between the monitor and then will be 25-35 degrees, horizontal plane.

In my project issued by the office, 3-bedroom, each room individual and doors in each room, there are 3 operator. A height of room 3 m, the window of one room 2x3 m , 2x2, 2x2.

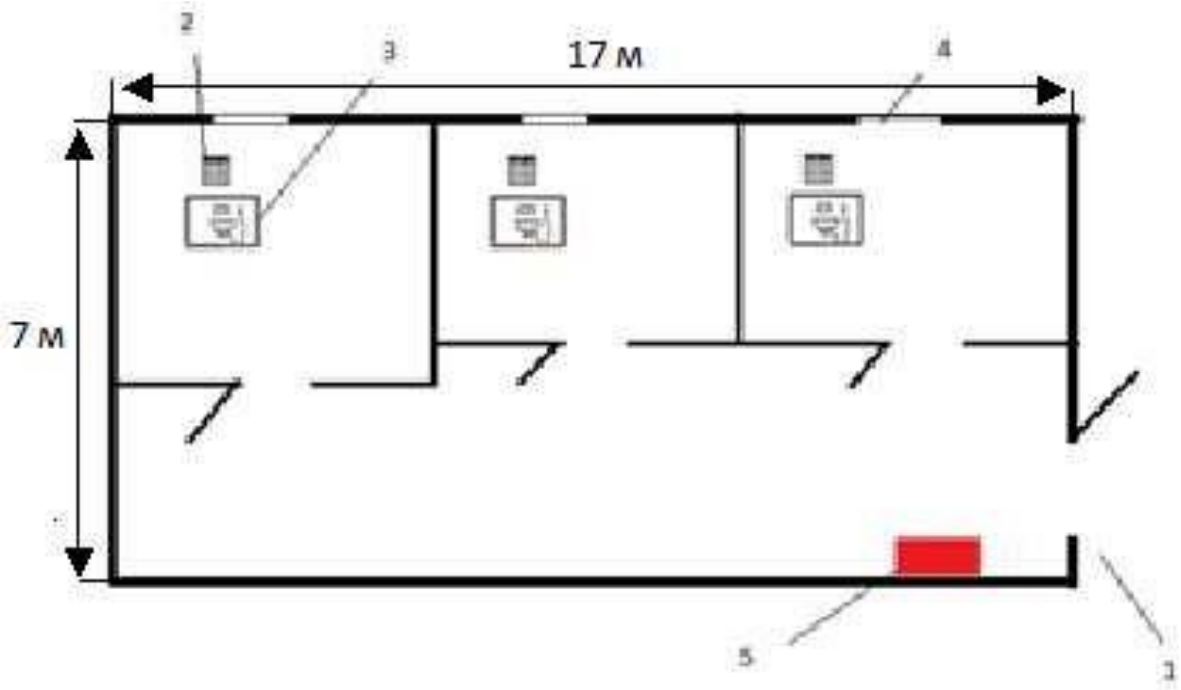


Figure 4.1 - Room plan 1-front door; 2- chair; 3- table ; 4- windows; 5- extinguisher

4.2 Calculation of natural light

Much attention is paid to the lighting of the operator's workplace. Since the light affects the human body. Well-designed lighting improves the nervous system, increases productivity.Man, poorly lit place of work correctly, get tired quickly, will increase deficiencies.

Light, depending on the wavelength of excitation(fray pink - red),soothe(yellow-green) properties. The spectral composition of the light affects the performance.At the direction of the normal work jarred human studies 100%, red-orange in the light is 69%.

Some people for some reason, completely devoid of normal light.therefore, this hunger people have light.In this regard, the company pays great attention to the workplace of the operator. According to the working conditions, the following must be present:

Work must be done in the lighting hygiene of workplaces in accordance with [9];

Stable lighting of the workplace.Acute intense surveillance of the environment for cracks;

. No light source in the focus of the eyes profit.

Used in the room, artificial lighting, light on the spectral composition of natural. The system of double lighting in the room is used. Measuring AC natural lighting because it is the only sign of light, air cleanliness in a clean, natural factors triadi measurements in the same area, coverage for the building. Natural lighting is lateral, United or guaridan. Side clearance or translucent wall. through the transparent parts of the closure of the top, the United bonfires that enter the protective side lighting layer through the side gaps in the extreme top and flows in this work. To determine the area of the light opening, in this case, the norm provides a natural light coefficient, according to the formula:

$$S_0 = \frac{119 \times 0{,}77 \times 1{,}65 \times 9{,}5 \times 1}{100 \times 0{,}48 \times 1{,}3} = 6\ (\text{м}^2) \qquad (4.1)$$

where S_0– jarred openings side lighting, м^2;
S_p floor area of the building, м^2;
e_N^H– natural light coefficient, size%;
K_3 – Fund ratio;
μ – light characteristic of the window;

K_3– against the Windows of a residential building should take into account the coefficient
τ_0- the coefficient of the General lighting;
r_1- coefficient.

Factor of side lighting in light by increasing natural nearby bed cavity radiation and outside the building.

The creation of a workplace. to calculate the area of the side light of the building. The dimensions of the building: length a = 17 m, width b = 7 m, height - 3 m. the Building is located in Aktau, work. From all sides, making the buildings. Oyayna design Windows, jobs, next, 0.2 m from the outer walls of the building. At a distance of 5 m minimum brightness about window.

The area is considered by the formula:

$$\mathrm{S_n} = \mathrm{a} \times \mathrm{b} \qquad (4.2)$$

$$\mathrm{S_n} = 17 \times 7 = 119\ (\text{м}^2)$$

Coefficient of natural lighting normocalcemic determined by the formula:

$$e_N = e_H \times m_N \qquad (4.3)$$

where e_H - the value of the coefficient of natural light;
m_N– the ratio of the light climate.

$$\mathrm{e_N} = 1{,}1 \times 0{,}77 = 0{,}8$$

To determine the building type, SNiP RK public buildings and houses, the prisoners in this case are in good condition 2.04-05-2002 for the safety factor $K_з$ =1,5. This building is still used as synyacke window obtained in fact, we can multiply by a factor of 1.1 to 1.65.

$\square_0$definition of light characteristics, the ratio of the length of the building, its depth $\square_0$ $^{17}_{7}$= 2,44 is calculated, the depth esepteuinde the ratio of the height of the building. Aseptic animality height according to the formula:

$$h_{cal} = h + h_{н.о} - h_{р.пов} \quad (4.4)$$

where h – the height of the window;

$h_{н.о}$ – the distance to the beginning of the window

$h_{р.пов}$ – work height surface.

$$h_{cal} = 1{,}3 + 0{,}84 - 0{,}8 = 1{,}34 \text{ (m)}$$

Find the ratio of the:

$$\frac{3}{h cal} = \frac{3}{1{,}34} = 2{,}23 \text{ (m)}$$

then, (3 table) $\square_0 = 2{,}23$(m).

Table 4.1 - $\square_0$ characteristic value of the luminous light

Building on the depth of the length relation	The height of the building from the surface of its conditionally working the ratio η0 is the ratio of the depth							
	1	1,5	2	3	4		7,5	0
4 and high	6,5		7,5	8	9	0	11	12,5
3	7,5	8	8,5	9,6	10	11	12,5	14
2	8,5	9	9,5	10,5	11,5	13	15	17
1,5	9,5	10,5	13	15	17	19	21	23
1	11	15	16	18	21	23	26,5	29
0,5	18	23	31	37	45	54	6	-

τ_0 the overall rate of otkud light, (3.5) is calculated by the formula:

$$\tau_0 = \tau_1 \times \tau_2 \times \tau_3 \times \tau_4 \times \tau_5 \quad (4.5)$$

$$\tau_0 = 0{,}8 \times 0{,}6 \times 1 \times 1 \times 1 = 0{,}48$$

L - 1=3-1=2 (m)

The distance of the point a equal to the external press conference into the room Asian design ratio:

$$\frac{l}{h} = \frac{2}{3} = 0{,}66$$

"The ratio of length depending on the depth of its divisions" to "1" , and the length is equal to in the depths

$$\frac{a}{h} = \frac{17}{4{,}3} = 4$$

All the information obtained in the 1st is entered in the formula, we find between the light zones:

$$S_0 = \frac{119 \times 0{,}77 \times 1{,}65 \times 9{,}5 \times 1}{100 \times 0{,}48 \times 1{,}3} = 6\ (\text{m}^2)$$

4.3 Fire safety

The second building due to the threat of fire and fire with the application combustible materials according to the degree belongs to the first category. The reason attributed in the category of room, in the room for the maintenance of diesel installations.

Acoustic Materiады indoor combustible construction and aesthetic additives, alandis, doors, floors, and power cable, coil electronic parts, to attach a cable, wardrobe, cleaning fluids computers.

Source of ignition: computer maintenance, electrical circuits,electrical installations, air conditioning and other substances.

Taking into account the expensive devices in the room,in the automatic mode of operation,many work progress, in the form of automatic fire extinguishing system installation of gas fire drencher.

As a subject of carbon dioxide fire extinguishing combined-used composition of freon.

m_d the calculated weight of the composition is determined by the formula:

$$m_d = k * g_n * V \qquad (4.6)$$

where k = 1,2-carbon dioxide-coefficient of compensation, which are not charged with the composition of the refrigerant,

g_n = 0,4 - carbonic acid - mass concentration of the composition of the refrigerant, indicative,

V – volume of room.

$$V = A \times B \times H \qquad (4.7)$$

where A = 17 m the length of the room,
B = 7 m - the width of the room,
H = 3 m- high of the room.
Then:

$$V = 17 \times 7 \times 3 = 357\ m^3$$

Subject to:

$$m_d = 1{,}2 * 0{,}4 * 357 = 171{,}36\ kg$$

The amount of open space in the premises is always 1% from 10%, per 1 m^2 5 kg carbon dioxide araliya into the open, an additional composition of freon.

The calculated value of ε is taken Neptune of the container 25 kg of a mixture of freon cyimbili balona 40 liter.

Pipe line d_i mm the inner diameter of the pipeline is determined by the formulas:

$$d_i = 12 \times \sqrt{2} = 17mm$$

I_2, pipeline Line, m equivalent length is determined by the formulas:

$$I_2 = k_1 \times I \qquad (4.8)$$

where , k_1– the coefficient of local losses during the feeding period, tempeh to change the length of the pipeline.

I=33m

$$I_2 = 1{,}2 \times 33 = 40m$$

when designing a pipeline system length.

According to the type of sprinkler, the area of the outlet slit section, mm2, is less determined by the formulas:

$$A_3 = \frac{S}{\delta_1} \qquad (4.9)$$

where, S – cross-sectional area of the main pipeline system, mm^2 ;
ε_1 – number of irrigators, if

$$A_3 = \frac{3{,}14 \times 8{,}5^2}{3} = 75\ mm^2$$

Carbonic acid-the composition of the refrigerant Q, kg / s loss along the length of the pipeline depending on the diameter of the alternative system equal to 1,4 kg/s.

Carbonic acid-the charged composition of the refrigerant time t, min, is determined by the formula:

$$t = \frac{m_d}{60Q} = \frac{28,8}{60 \times 1,4} = 0,6 \text{ min} \quad (4.10)$$

Carbonic acid-Foundation composition base the weight of the refrigerant is determined by the formula:

$$m = 1,1 \times m_d \times (1 + \frac{k_2}{k}) \quad (4.11)$$

where k_2 =0,2

m_d =1,1*2 8,8*(1+0,2/1,2)=37

Making calculations, obtained taking into account the values to ensure the normal operation of the automatic fire extinguishing system, working, carbon acid 40 liters-a composition containing a mixture of freon and 25 kg, 2 cylinders pressure 12.5 MPa .in addition, the installation of spray sprinkler 3, the duration of 0.5 room.

Supply unit double distance of 4 meters, and the distance between the wall installation of 2 meters.

The device automatic switching device gas extinguishing systems GOST of 12.4.009-83 of steel pipe manufactured according to the standard.

In addition, in the room, a hand fire extinguisher, posters prohibiting open fire,fire shields, posters prohibiting Smoking.Since the installation of the alarm on the roof, at a height of 2.45 m of the tube in the room, ionization formation.

"Fire fighting equipment" companiesin specialister in his work is mostly in "Car", the system labels use boardc dabilis. Applied well texnologiyalari new devices of the manufacturer.

The car brand" provided by sensors and fire srdrs the device is very sensitive, it even includes devices in the form of automatic fire extinguishers.

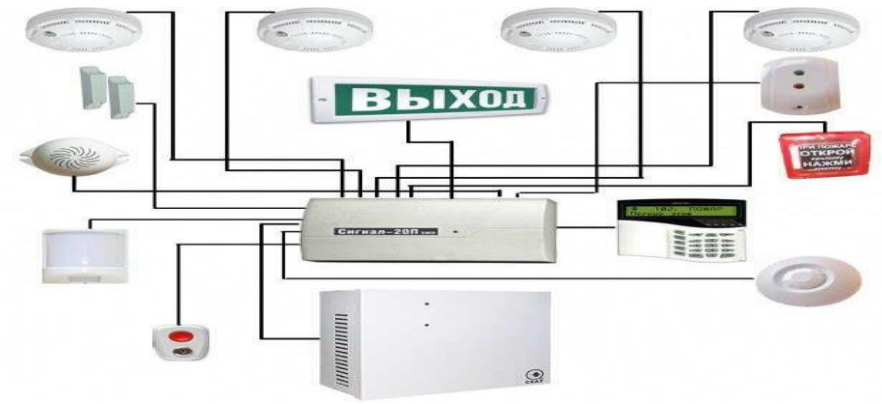


Figure 4.2-Fire-fighting equipment

4.4 Tiitty on the ground calculation of protection

Requirements for the grounding protection:

Arylalkyl telecommunications grounding should be applied for the purposes specified in below:

- protect workers from injury electroanal for breaking the isolation
- discharged electrical protection
- electromagnetic protection of damage installations.

Stand,metal with insulated kostiander,antenna TV,wardrobe,cross,remote and other metal installations, grounding of metal parts.

Tiitty installed in accordance with the requirements specified in the ground.

In the room, the installation of 3-x all works with the network. Network 380 V with isolated neutral.All sources of the electrical network exceeds 100 kVA.The Foundation of the building is reinforced concrete, located in the soils of loam material.

Ispitanica network power supply 1000V with insulated neutral. WTCs 100квА that we can normally tiitty resistance to earth.

Type grounding kontuly,tiitta circuit indoor is located at.Room size: H=17 m, B =7 m

The circuit consists of a vertical electrode.The electrode length l=2.6 m long, wide and long equal to the perimeter of the circuit connected to a flat horizontal shelf b=0.5 m stainless steel consists of pepper.

The cross-sectional contour of the steel strip 50x4 mm used as.

The depth of placement of electrodes on the ground t_0 = 0,7 m.

One electrode,the grounding resistance of the vertical calculation:

Tubular vertical grounding depth h from the ground surface, R resistance is determined by the formulas:

$$R_B = \frac{p}{6,28} \times I \times \left(\ln \times 2 \times \frac{1}{d} + \frac{1}{2} \times \ln \times 3I + \frac{4h}{t} + 4h\right) \quad (4.12)$$

$$R_B = \frac{80}{6,28} \times 2,6 \times \left(\ln \times 2 \times \frac{1}{0,05} + \frac{1}{2} \times \ln \times 3 \times 2,6 + \frac{4 \times 0,7}{2,6} + 4 \times 0,7\right) = 26 \text{ Ohm}$$

where p - soil resistivity,80 Ohm*m,

I- length of pipe (0.05м),

h- distance from the top edge of the pipe to the ground (h=0.7м)

R_b=26 Ohm

The value of angle steel

$$d = 0,95 \times b = 0,0475 \quad (4.13)$$

Caldene tiitty calculation grounding:

Grounding resistance of metal tiitty convex strip defined by the formula:

$$R_i = \frac{p}{6,28} \times I \times \ln \times \frac{I^2}{0,5} \times b \times h \quad (4.14)$$

$$R_i = \frac{80}{6,28} \times 2,6 \times \ln \times \frac{2,6^2}{0,5} \times 0,05 \times 0,7 = 28,91 \text{Ohm}$$

where I- the length of the ground (2.6 m)

h- the embedding depth of the strip (0.7 m)

b- bandwidth (0.05 m)

R_i = 28.91 Ohm

Do not extend it on the ground to reduce the resistance of the cross tiitty diameter length of wire using the effective saw zinc(4-5mm).

Calculation of ground resistance tiitty lot:

The calculation of the size of the vertical and horizontal and vertical large what is needed to obtain the resistance of the grounding grounding grounding grounding resistance of the grounding installation by connecting several parallel.

4.5 E-calculation of ground resistance tiitty lot

Tiitted ground resistance horizontal and vertical biggest obstacle to obtaining the necessary volumes Tiitinen several parallel connected to the grounding installation.

Horizontal earth electrode(strip or wire), connected in parallel,the resistance is the total resistance of several identical tiitty on the ground is determined by the formula:

$$R_u = R_B \times \frac{R_r}{q_1} \times R_r + q_2 \times n \times R_B \quad (4.15)$$

$$R_u = 26 \times \frac{28,91}{0,82} \times 28,91 + 0,81 \times 10 \times 26 = 3,3 \text{Ohm}$$

where R_b- ground resistance horizontal tiitty

R_r- resistance of vertical ground tiitty

q_1 - the ratio of the cross tiitty actions on the ground (n=10 table value at q_1= 0.82

q_2- the ratio of vertical ground tiitty action (n=10 table value at q_2=0.81

n- the number of vertical tiitty on the ground.

Note: for grounding arranged in a single row

R_u=3,3Ohm value

R_H=4 Ohm

5 Economic part

Creation of the telecommunication network, requires the use of commercial later, eceptionist so the contents will be as follows:

− calculation of capital investment costs for the creation of telecommunication network communication;

− calculation of annual operating costs;

− calculation of payback period of the investment.

5.1 Calculation of capital investment costs for the creation of a telecommunication network for communication

Among the aspects of accounting of capital investment, you need to:

- installation and erection works;
- cable and station buildings the cost of transportation to and from work;
- the cost of the cable and the devices;
- costs of design of communication networks;
- other costs.

Calculation of capital investment to work through the following formula[27]:

$$K = C_{ол} + C_{ос} + C_{оа} + C_m + S_л + S_{ст} + S_{пр} + S_n, \quad (5.1)$$

here C_l– the cost of linear devices;

C_{OC} – the cost of station devices;

$C_{оа}$– the cost of subscriber units;

S_T – the costs of transportation;

S_l – costs for installation and laying fiber optic cable;

S_{st} – the cost of installation and commissioning of devices;

$S_{ПР}$ – measuring devices and installation costs;

S_p – messages the costs of design of the telecommunication network.

"Inkab" for the production of cables and VPS company "kazcentrelectroprovod" for the production of PS-cables OKB prices in table 4 selectitem.

Table 5.1 – "Inkab" and "kazcentrelectroprovod" salituro cables prices

The name of the product	Cost of 1 km
VPS - 24	329 000
CS-OKB-24	311 000

"Kazcentrelectroprovod" coupler is an optical coupler FOSC A4 2179 price CS 5 and table selectitem.

Table 5.2 –Compare prices on clutch 2179 CS and FOSC A4

The name of the product	the cost of 1 km
FOSC A4- 72	41 965
2179 CS - 48	43 472

The calculation of the estimated cost of construction, reconstruction linear are presented in table 6.

Table 5.3 –Estimated construction cost is Linear

Cost name	Unit	Number	Price tg.	
			One instance	All
The Acquisition Of Cable:				
КС-ОКБ-SM-24	km	3,2	570 000	1 824 000
КС-ОКГо-8		0,14	110 000	15 400
КС-ОКГо-4		0,16	100 950	16 152
КС-ОКГо-2		0,5	95 425	47 712
Ready telephone conduit cable through	km	3,2	335 000	1 072 000

Table 5.3 continued:

FOSC A4 clutch		5	41 965	209 865

Optical distribution box KRA-2 KRA-4 KRA-16	instance	 10 20 20	 10 700 14 500 16 000	 107 000 290 000 320 000

Prices node linear devices "kazcentrelectroprovod" paradasian commercial companies.

The estimated cost of construction of the station in table 5.4 is produced.

Table 5.4 – Estimated cost of construction of the Station

Cost name	Unit	Number	Price, tg.	
			One instance	All
ISAM 7302 installation of the device			150 000	150 000
Installation of measuring devices	Complect	1	400 000	400 000

Construction of station devices, measuring devices, installation and prices "kazcentrelectroprovod" and Alcatel-Lusent company commercial paradasian.

The estimated cost of subscriber devices in table 5.5 is produced.

Table 5.5 –. Estimated cost of subscriber devices.

Cost name	Unit	Number	Price, tg	
			One instance	All
AP-8686 subscriber socket	pieces	422	964	406 808
ONT	pieces	422	5 000	2 110 000

The station of subscriber devices, measuring devices, installation and prices "kazcentrelectroprovod" and Alcatel-Lusent paradasian commercial companies.

Telecommunication network in building relationships total budget of capital investments in table 9. with a calculator.

Table 5.6 – total estimated Capital investment

Cost name	All, тг.
The cost of linear devices, EC	2 830 129
The cost of subscriber units, CSC	2 516 808
The cost of installation and commissioning of devices.	150 000

Table 5.3 continued:

The cost of installation and laying of optical cable.	1 556 250
Measuring and installation cost, SPR	400 000
The costs of design of the telecommunication network messages, SP	100 000
All	7 553 187
The total cost of the 10% it costs incline	755 318
All	8 308 505

Linear and station constructions of the general amount of capital expenditures required to implement TP = 8 308 505 tenge.

5.2 Calculation of the annual operating costs

Technical and economic calculation of operating costs, by means of special methodological tools. First, the calculation of production costs. Ongoing operating costs by calculating the formula:

$$P_э = AFB + AC + A + M + P_{эл} + P_{оз} \quad (5.2)$$

where AFB– annual fund board
AC – social tax;
M – material costs ;
A– depreciation;
$P_{эл}$ – the cost of electrical energy;
$P_{өз}$ – other production and transportation costs.

Annual payroll is calculated depending on the number of employees. From it value at 12 months as the value in the amount of selams. This value of 35% of the premiums, 15% for night work, weekends or public holidays are paid in addition.

10 essential posts and the number of employees noted in the table.

Table 5.7 – Payroll:

The post	Number of people	Monthly payment (Tg.)	Award	At night, in a festive	All (tg)
Engineer	1	70000	24500	10500	105000
Electrician	1	50000	17500	7500	70000
The installer	2	90000	31500	13500	135000
Monthly wage:					310000

The average total earnings.Annual payroll:

$$AP_{average} = 310000 * 12 = 3720000 \text{ tg}$$

The social tax. Territoriesand the establishment of the Republic of Kazakhstan, the legal entity authorized by a legal entity in the workplace in the branch, the activities of the country and was not an authorised person, and gross profit by 11% as a tax incerments? They are at the bottom is calculated by the formula:

$$AC = C \cdot ЖТК \quad (5.3)$$

where AC – social tax;

C – the amount of social tax;

JTC – annual payroll, payment

Then:

$$AC = 0{,}11*3720000 = 409\ 200 \text{ тg}$$

Calculation of material costs, including the cost is also higher. After the network create material damage, to ensure the smooth operation of additional equipment, repair when faults or sudden equipment and intangible). Material siinemet capital costs overall by 5-7%.

$$M = K * Г \quad (5.4)$$

where M- material damage;

Γ = 6% got average eceptions

Imagine sainimili material:

$$M = 8\ 308\ 505 * 0{,}06 = 498\ 510 \text{ tg}$$

Applying outside sources of electricity purchase electrical energy costs. He devices provide electricity to kWh of power, size used. Any size consideration of its technical characteristics the device requires power. The source of electrical energy is centralized Astanaenergosbyt our city. It electricity 1 kWh at a price of 12,99 tenge.

The power consumption is determined by the formula:

$$P_{эл}\ 365 * W * t / 1000 * \text{ƛ} \qquad (5.5)$$

where W – the device, applied power, W·h;

ƛ – Efficiency of electric power supply units, 0,67;

t – the hours of operation of the device per day.

The cost of electrical energy in table 5.8 with a calculator.

Table 5.8 – Energy costs.

The price of electricity, Tg/kWh	12,99
Device size, power consumption, W*h	110
The operating time per day, hour.	24
The number of days in a year	365
The value of the efficiency of the device electric supply	0,67
Per year power consumption, kW	1438,2
For the year electricity costs, Tg.	18682,3

Costs, including depreciation costs are higher. you need to consider. At the bottom it is calculated according to the formula:

$$A = H_a \cdot K_{neg} \qquad (5.6)$$

where K_{neg} – manufacturer the average annual value of fixed assets;

H_a – the rate of depreciation.

Useful telecommunication devices, the validity of 10-15 years, and depreciation нормасы7% to 10% for changing. We minimum, that is, 7% decided that getting. Then:

$$A = 0,07*3\ 100\ 000 = 217\ 000 \text{ tg}$$

The calculation of the shipping costs and extra. Administrative and technical costs for the additional costs, administrative costs of providers of services to the primary network, the automobile roads for General use relate to the tax and the social tax. This form of tax wages Fund is 15%.

$$Sh_{бас} = K_{Шбас} \cdot JK \quad (5.7)$$

$$Sh_{бас} = 0,15 * 3\ 100\ 000 = 465\ 000 \text{ tg}$$

The total estimated annual operating costs in table 5.9. packaging.

Table 5.9 – Estimates of Annual operating costs

Cost name	All, тг.
IH	3 100 000
As	409 000
Depreciation expense	217 000
The cost of the material	498 510
Losses of electric energy	18 682
Transportation and other costs	465 000
Total	4708 192

5.3 Calculation of the payback period of capital investment

Main companies of service buitenen appear in the bottom profit using the formula:

$$K_{out} = N_{аб} * H * 12 \quad (5.8)$$

where N_{ob} - the number of subscribers, that is equal to 422 tg

H - "Kazakhtelecom" TD-payment of a monthly Subscription – 1500 tg

$$K_{out} = 422 * 1500 * 12 = 7\ 596\ 000 \text{ tg.}$$

Rent external channels and services broadband ouraward income is 70% something that:

$$К_А = 7\ 596\ 000 * 0,7 = 5\ 317\ 200 \text{ tg}$$

Then the total income will be as follows:

$$К = 7\ 596\ 000 + 5\ 317\ 200 = 12\ 913\ 200 \text{ tg.}$$

The calculation of income from services and net income. The difference in operating costs and the annual gross revenue is calculated using revenue from services:

$$P_r = D_m - R_э, \quad (5.9)$$

$$Р_г = 12\ 913\ 200 - 4\ 708\ 192 = 8\ 205\ 008$$

We believe net profit in the last row. To do this, in accordance with the Tax code of the Republic of Kazakhstan and 20% as income tax gives clean paydays:

$$P_{ch} = P_r - (P_r * 0,2) \quad (5.10)$$

$$P_{ch} = 8\ 205\ 008 - (8\ 205\ 008 * 0,2) = 6\ 564\ 006 \text{ tg}$$

An important indicator is the payback period of capital investments in the development of fiber-optic communication systems. Net profit alinamin cost of capital, it is characterized by:

$$T_{ок} = K_в / П_ч, \quad (5.11)$$

$$T_{ок} = 8\ 308\ 505 / 6\ 564\ 006 = 1,2 \text{ year}$$

To date, liquid investments payback period of less than five years. Conclusion: the establishment of a network of telecommunication communication yetunde justified from an economic point of view, I think this project is worth pursuing.

Conclusion

During the creation of the graduation project has the following objectives:

- the structure of the GPON network;
- the wiring was said telecommunications network;
- chain the devices;

To see the principle of operation of the network in the course of the study of the structure of the passive optical network passive optical network project I chose to compare different technologies to the process. From the subscriber device of the station nodes to the installation and construction works and correct freely.

Although small amounts of our time, in the heart of Eurasia that are not yet covered by a network of modern fiber-optic communication lines today the main city of the country Capital. The "hallmark" of the city, including the building - "Bukhar Zhyrau" mcd, that we have such a relationship quickly Mary, specialist telecommunications as ingilby us.

The design and layout of the network diagram the choice of plays a very important role in creating. "French quarter" residential complex on the site of the research work, including as a result of increase in backbone optical cable couplers sewer system through gems yaralanan also determined the optimal placement of the junction boxes .

Selection of the necessary technical characteristics and price indicators have been developed on the basis of their device. From all the manufacturers, of appropriate quality and price, in our project "kazcentrelectroprovod" company. Calculated the number and length of the cable of the device required.

When working in "Kazakhtelecom" Directorate of the designed device station relations after signing the joint stock companies as a boundary line for a long time on the street Zhirentaeva ATS-36 the role the station. The proposed facility is closer, without limitation, increasing the company's network in the future for SSH-8 (ATC-36) murtasina connection. It is located at the intersection of Momyshuly and Tauelsizdik str.

Cable hub buildings, and each unit is implemented by the method of inclusion are different. For example, blocks A and B krgds Parking plot a distribution cable, the cable unit is to be situated underground, directly To Muqtada, crise through the basement, up to the City was carried out using mixed blog.

Methods of rational distribution of optic distribution boxes in blocks of telecommunication gelms krene now is its floors. Because our work siinemet residential complex number of apartments on each floor of each block and variety will increase in two times. During the design "kazcentrelectroprovod" the company has applied the optical distribution boxes. As a result of optic distribution boxes only had 50 boxes.

Fiber optic communication lines as the main application FTTH technology decided architecture. This means that fiber-optic technology to homes apartments subscriber's last delivery.

That is speaking about the technology of food production", today, in our time, developed our broadband subscribers, the network quickly and securely make suggestions upon arrival. If in the case of other technologies FTTx chain, our services greatly speed then this architecture .

For example, in the application of technology FTTB optical block of the designed building or only just would Telsim supplier. The rest of the copper wires of coaxial network, in this case, you will have to attract Bahn. Cable welding work is carried out in switching points of views, packages and the packages coming from signalimage modern factor. This factor, in turn, took the contact network, bandwidth, speed would asatoshi services.

The meeting also considered risks can be when performing construction works of the network. Recall that in the well when mounting the cable to the rules of admission rules of conduct, by the roofs of houses during the installation EU rules of the road, was considered at the time of supply of electricity must be strict compliance with the rules. Mentioned security measures should reduce the amount of emergencies.

After the project is completely deprived of work-technical and economic calculations on the holding have reacted to his work. When calculating the amount of capital investments for the organization of the telecommunication network to determine in the first place The annual costs of accommodation in the network, and then, after passing to intensify cost of revenues, which are defined in profit. At the end economic calculation of the payback period of capital investments, which ultimately showed that the project is economically profitable for investors.

Can be considered as a transit corridor between the West of Kazakhstan, linking the major. In addition, the goal of all of our country among the 50 States in promoting the best standard of higher elbassiouny supply of the telecommunication system. Market expansion and the development of competition in the service sector, improves the quality. Correct pricing and improves customer requirements by publishing the new technologies. It is worth noting that, despite the global financial crisis over the past six months in some sectors of the economy and development in the telecommunications sector, indicators were observed [22].

Summing up, the "French quarter" residential complex created a network design for the optimal, i.e. objectives of the degree project is done. This project is being implemented in practice in the nearest future Kazakhtelecom telecommunication direction-branch of the regional'm pretty sure that would be helpful.

Abbreviated terms

PON - Passive optical network
GPON - Gigabit Passive optical network
OLT - Optical line terminal
ONT - Optical network terminal
ONU - Optical network unit
UT - Uni tube
LT - Loose tube
DWDM - Dense Wavelength Disvison Multiplexing
FOCL - Fiber optic communication line
ST Stantially tell
MT Magistralny tell
TT Tartusi tell
TS Telim subscriber
ODC Optics distribution Cabinet
OJB Optical junction boxes
OT Optical tally
OC Optical cable
OC Optical clutch

List of references

1 Попов Б.В. Строительство и техническая эксплутация волоконно-оптических линий связи –М.: Радио и связь, 1996 г. [4]

2 Портнов Э.Л. Оптические кабели связи: конструкции и характеристики -М.: Горячая линия -Телеком, 2002 г.

3 Кемельбеков Б.Ж., Мышкин В.Ф., Хан В.А. «Современные проблемы волоконно-оптических линий связи», Том 1. Волоконно-оптические кабели, 1999, изд-во НТЛ.-312 бет

4 Скляров О. К. “Волоконно-оптические сети и системы связи: Учебное пособие. 2-е изд., стер. — СПб.: Издательство «Лань», 2010 г.-315с.

5 Гроднев И.И., Мурадян А.Г., Шарафутдинов А.Г. и др. Волоконно-оптические системы передачи и кабели, Справочник. - М.: Радио и связь, 1993 г.-285 с.

6 Ниеталин Ж.Н. Электрлікбайланыс саласындағы терминдердің орысша-қазақша сөздігі –Алматы: 1993 ж.

7 Аппаратура сетей связи / Под. ред. М.И Шляхтера –М. Связь, 1980 г.

8 Ioannis P. Chochliouros Optical Access Network and Advanced Photonics – M: IGI Global, 2010 ж. 354 бет

9 Убайдуллаев Р. Р. Волоконно-оптические сети –М.:Эко-Трендз, 2000г

10 Аппаратура сетей связи / Под. ред. М.И Шляхтера –М. Связь, 1980 г.

11 Бродниковский А.М., Убайдуллаев Р.Р. Поляризационная модовая дисперсия волоконно-оптических систем передачи –Метрология и измерительная техника связи 2001 г

12 Иванов А.Б. Контроль соответствия в телекоммуникациях и связи. Часть1 –М.: Сайрус Системс, 2000 г. 376 с.

13 Белкин М.Е. «Компоненты волоконно-оптических систем», 2005г.-245 бет

14 Гончаренко А.М., Редько В.П. Введение в интегральную оптику. Минск: Наукаитехника, 1975 г.

15 М.М. Бутусов, С.Л.Галкин, С.П. Оробинский и др. Волоконная оптика и приборостроение -Л.: Машиностроение, 1987 г. –328 стр

16 Слепов Н.Н. Синхронные цифровые сети SDH –М.: Эко–трендз, 1999 г.

17 https://kk.wikipedia.org/wiki/

18 Урядов В.Н. Волоконно-оптические системы передачи, Минск: БГУИР, 2008 г.-28 с.

19 Скляров О. К. Современные волоконно-оптические системы передач, аппаратура и элементы. – US: Издательство “СОЛОН-Р”, 2001. – 237с.

20 Каталок оборудований компании«Казцентрэлектропровод», 2014 жыл, 81 бет

21 Local Network Access Technologies,

22 https://kk.wikipedia.org/wiki/

23 J. Farmer, B. Lane, K. Bourg FTTx Technology Implementation and Operation – UK: Elsevier Inc, 2017 ж. – 429 бет.

24 БаклашовН.И., КитаевИ.Ж. Охрана труда на предприятиях связи и охрана окружающей среды–М.: Радиоисвязь, 1989 г.

25 РахмановБ.Н. Безопасность при эксплуатации лазерных установок. –М.: Машиностроение, 1981 г

26

27 Экономикапредприятия. Подред. О.С. Срапионова. –М: Радиоисвязь, 1998 г.

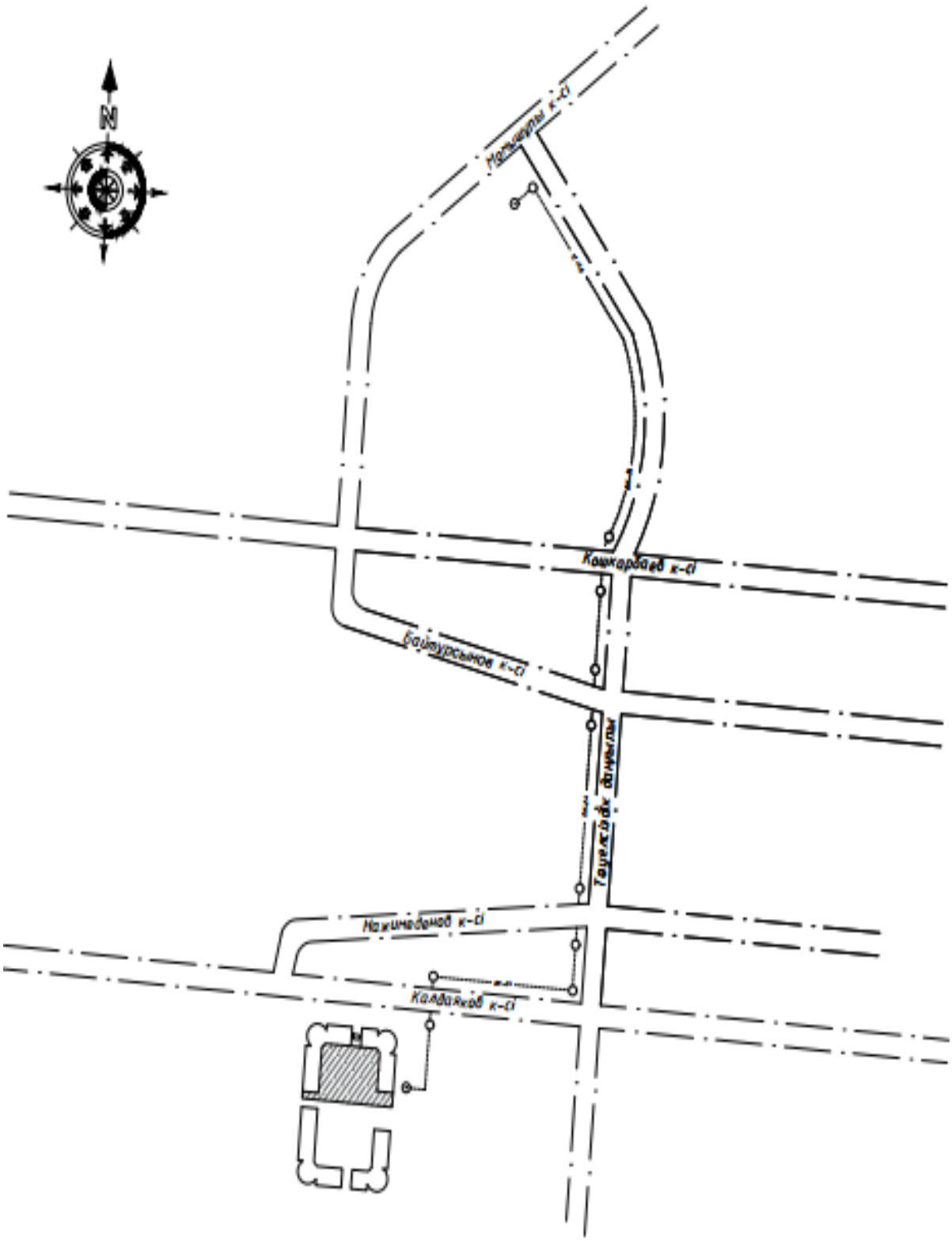
28 Основыэкономикителекоммуникации(связи) Подред. Голубицкой. –М.: Радиоисвязь, 1992 г.

29 https://kk.wikipedia.org/wiki/

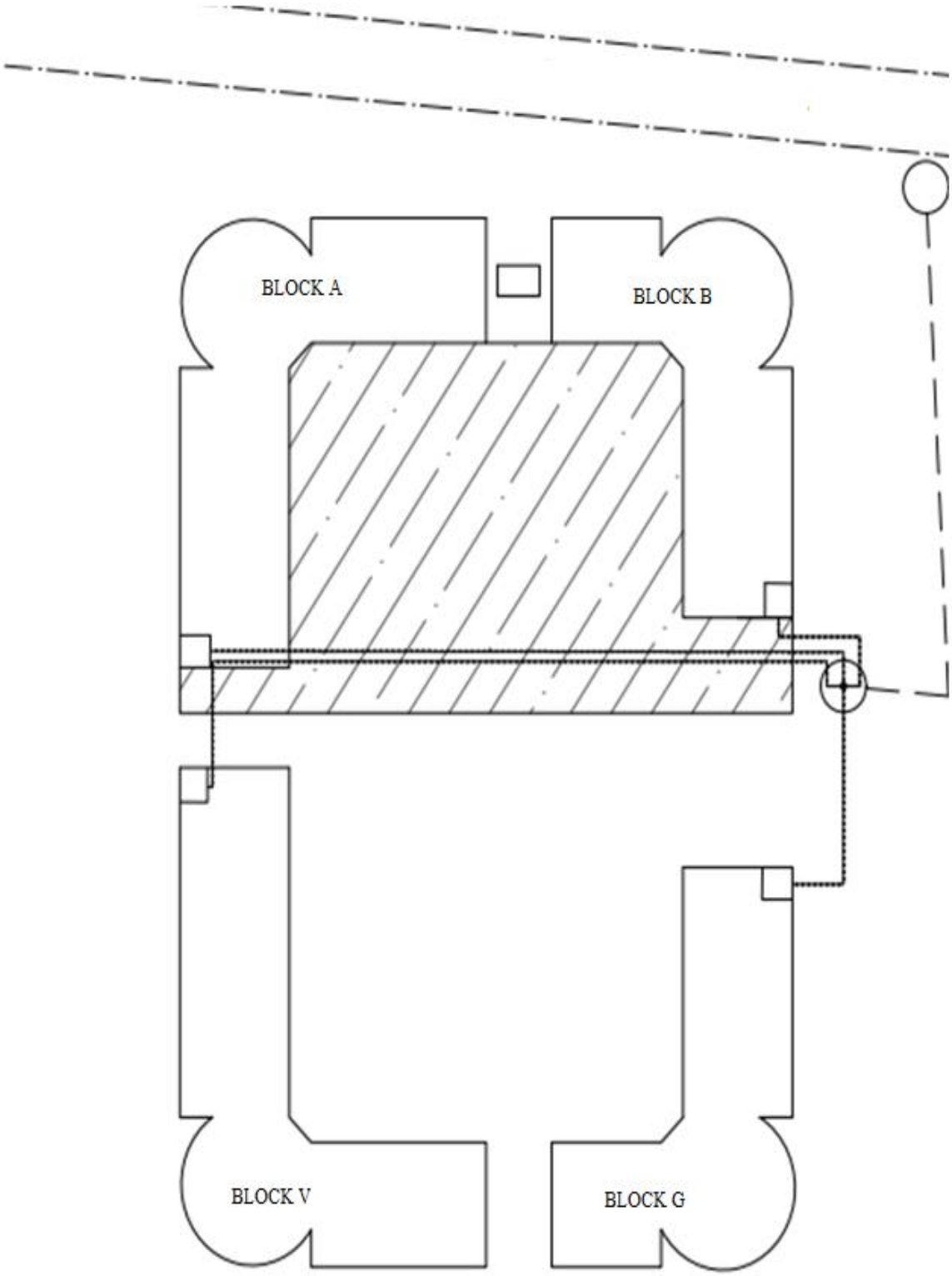
30 Докладчик к.т.н. Макаренко Докладна тему: «Построение транспортныхсетейна базе оборудованияSMA –1

31 АлибаеваС.А., БабичА.А. Методические указания для экономической части выпускной работы–Алматы2009 г.

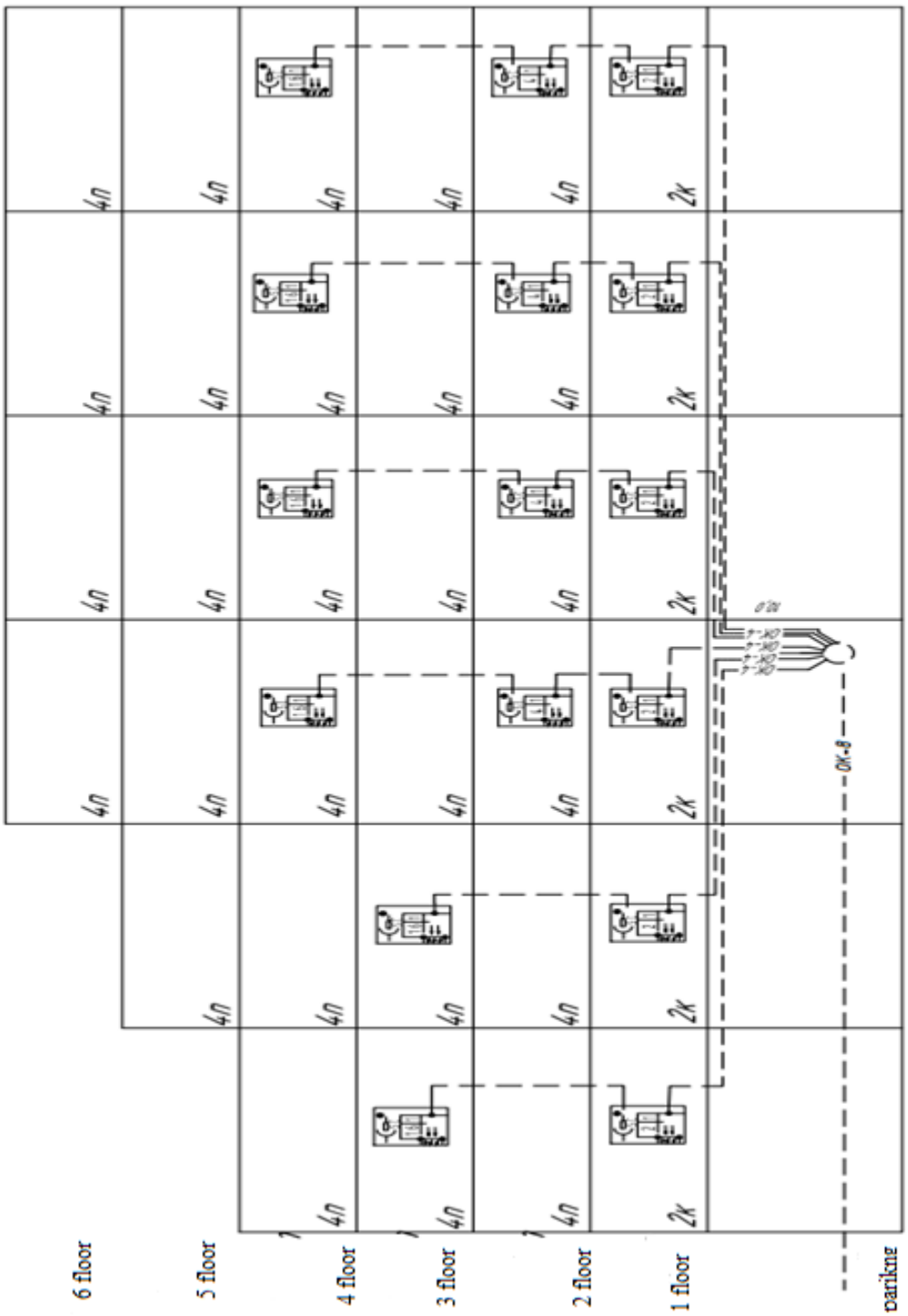
Appendix A Scheme involving the Trunk cable



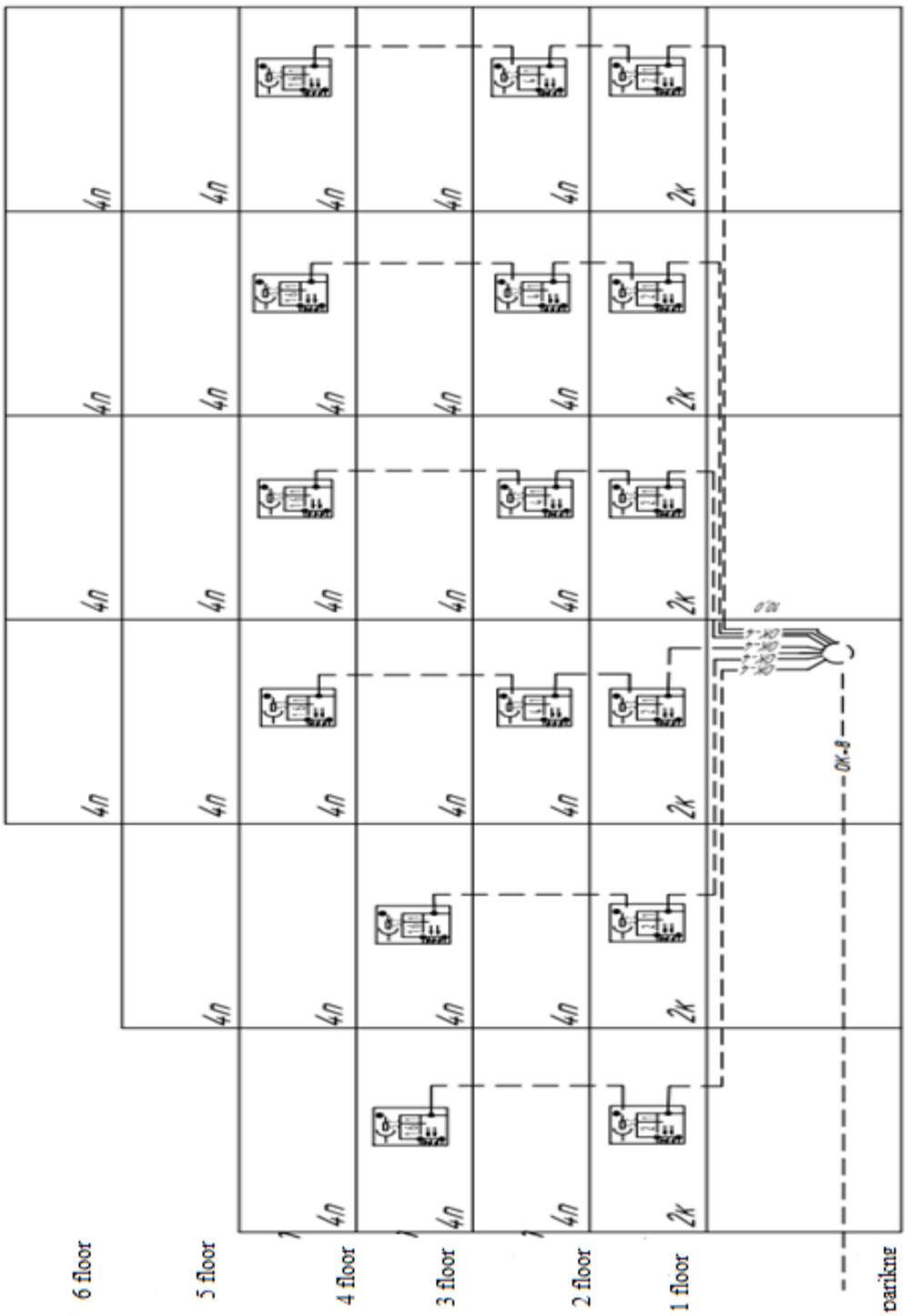
Appedix B The sheme of the distribution of cable for the blocks



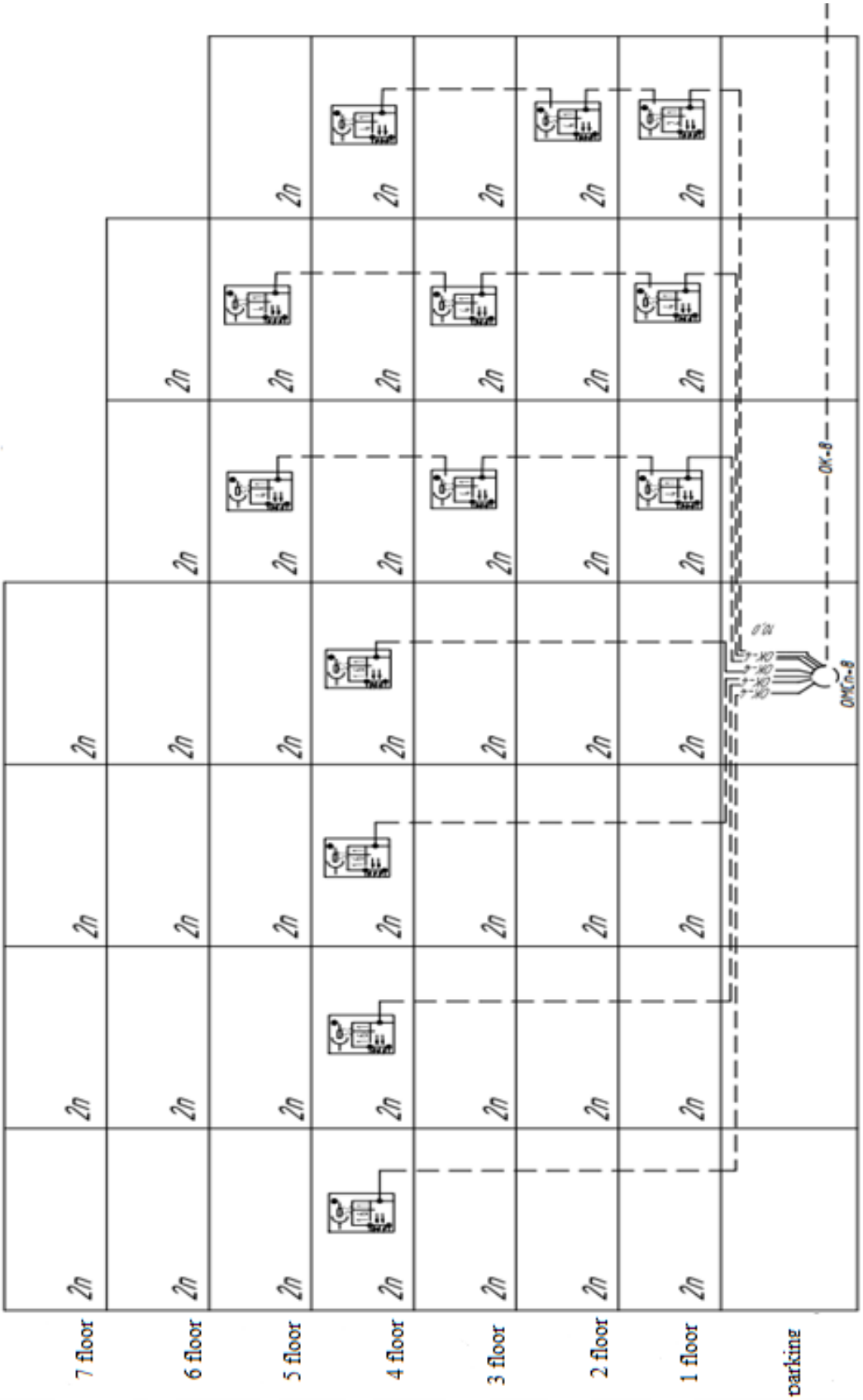
Appendix C Layout of the boxes-folding block A



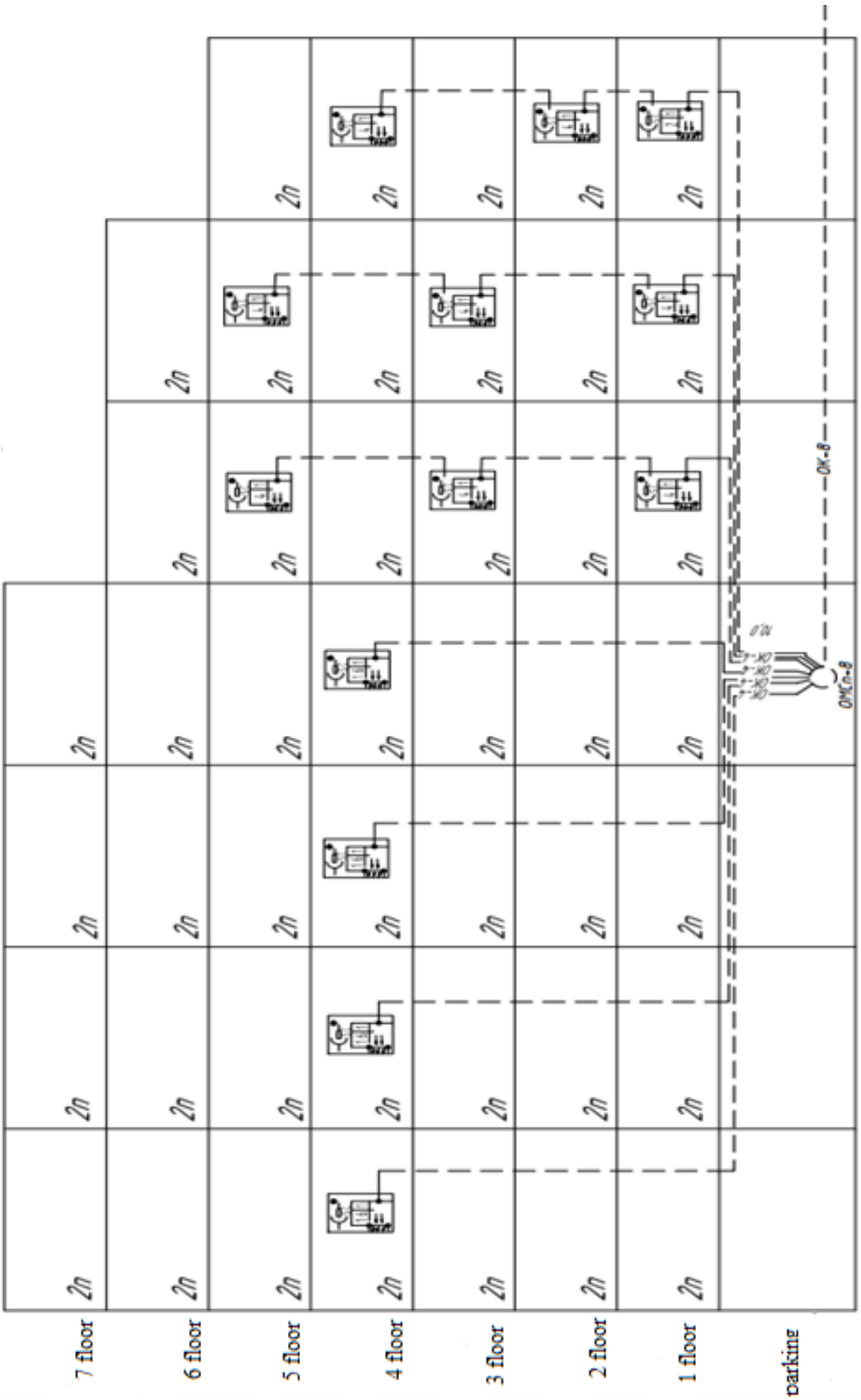
Appendix D Layout of the boxes-folding block B



Appendix E Layout of the boxes-folding block V



Appendix F Layout of the boxes-folding block G



Appendix G Sheme of the clutch transcript