



## ПРОСПЕКТ СВОБОДНЫЙ-2015

МЕЖДУНАРОДНАЯ КОНФЕРЕНЦИЯ СТУДЕНТОВ,  
АСПИРАНТОВ И МОЛОДЫХ УЧЕНЫХ

ЭЛЕКТРОННЫЙ СБОРНИК МАТЕРИАЛОВ  
МЕЖДУНАРОДНОЙ КОНФЕРЕНЦИИ СТУДЕНТОВ,  
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Красноярск, 2015.

## **«English for Specific Purposes»**



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## PROSPECTS OF GEOTHERMAL ENERGY SOURCE

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### Introduction

Everyone knows that the environmental consequences of today's energy policies are potentially catastrophic. The global warming caused by burning fossil fuels will disrupt our world. The answer is in the development of renewable energy sources such as biomass, sun, wind, wave power, geothermal and others.

Since ancient times, mankind used energy of hot springs for bathing and cooking. Nowadays this energy has a very good potential and deserves attention.

There are 5 types of geothermal sources:

- Magma
- Hot springs
- Deposits of dry steam
- Hot rocks
- Wet steam sources

### Geothermal energy

Geothermal energy has always attracted mankind by its useful application. After all, people in their development process invented many useful technologies and are looking for the benefits and profits. Geothermal energy is the energy produced and stored in the earth. It exists due to high temperatures in the earth, which is heating groundwater. The first countries, which used this energy, were: USA, part of Europe and some other countries, although, the potential of total power of geothermal stations is the lowest in the world. But this direction has development because of very high energetic density in definite areas called "hot points", so it gets support from government. Geothermal energy has possibility to provide very high efficiency (almost 98%).

In 1973-1980 geothermal energy made a great step forward in its development. It became possible because of the development of geological science and need in energy in definite areas (after the first oil crises). Today geothermal energy becomes worldwide spread.

Geothermal energy can be used in two main ways - to generate electricity and to heat different objects. Geothermal heat can be converted to electricity, when the heat transfer agent temperature reaches 150 ° C. Use the inner regions of the earth is extremely efficient for heating. Direct geothermal heat in case of temperature can be used to heat greenhouses, buildings, swimming pools, drying of agricultural and fishery products, the evaporation of solutions, growing fish, mushrooms, and etc.

### Advantages of geothermal energy

At first, geothermal sources are reliable. Geothermal plants do not need other additional sources of energy for operating. The exploitation of geothermal station does not need additional investments, except for preventive maintenance or repair. They are independent on sun and weather factors. You can get energy 24 hours per day all year round. Also it has very low environmental impact. Besides, it can be purified and used for a drink.



### **Disadvantages of geothermal energy**

Technologies of getting geothermal energy need great investment. One should find a good place for building and agreement with local population, which can be problematic. Sometimes geothermal station can stop operating because of the movements in the earth tectonic plates. Besides, it can stop operating in case of bad place of building. Also, there are certain areas in the world, which can produce geothermal energy. Although, there is one more question, that is power transfer. In addition, some thermal waters have toxic chemical compounds; therefore you cannot drop it to natural water systems.

### **Geothermal energy in Russia**

With regard to our country, we have a unique landscape and natural conditions. Russia has the greatest potential for development of geothermal sources. The first geothermal plant was built in 1966 on Pauzhetskaya field on the Kamchatka Peninsula in order to supply enterprises and for the needs of the population. It had 250-350 MW power capacity.

There are some areas with geothermal sources in Russia, such as Kamchatka, Dagestan, North Ossetia, Chechnya and Ingushetia, Kabardino-Balkaria, Caucasus, Stavropol and Krasnodar regions, Kazakhstan and etc. but they are not highly developed.

### **The table of geothermal power worldwide distribution**

<b>country</b>	<b>Power, MW in 2007</b>	<b>Power, MW in 2010</b>	<b>The share of total electricity generation</b>
Iceland	421	575	30%
Philippines	1969	1904	27%
Salvador	204	204	14%
Costa Rica	162	166	14%
Kenya	128	167	11.2%
New Zealand	472	628	10%
Nicaragua	87	88	10%
Mexico	953	858	3%
USA	2687	3086	0.3%
Japan	535	536	0.1%
Russia	79	82	

As one can see, now Russia uses very small percent of geothermal power in comparison with some other countries. Of course, there are many other power resources in Russia, such as natural gas and fossil fuel resources, hydro and atomic energy, etc. But it is clear that in areas, which have geothermal resources, there is no need in other once. For example Kamchatka is the place of a lot of geysers, which represent a great potential of clean environmentally friendly cheap energy. In order to supply areas of Far North with electric energy and heat, people need great investments to construct infrastructure and a lot of troubles with power transmission (for example to lay a gas pipeline to the north areas). Why should people do it when they have a great energy source with high efficiency under their feet?

### **In conclusion**

It is necessary to point out that fossil fuel resources are exhaustible, it is estimated that they will come to an end in 100 years, people might leave further generations without energy, when worldwide oil and natural gas resources exhaust, renewable energy sources will replace fossil fuels, geothermal energy is one of them.



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**THE SKYSCRAPERS STYLE IN HIGH-RISING  
BUILDING INDUSTRY OF KRASNOYARSK**

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Skyscraper is a tall building with a load-bearing steel frame designed for people to live and work in.

Americans were the first to get an experience of high-rising building construction. In 1871, in Chicago, there was a big fire, and the situation with the cost of land in the central part of the city has changed sharply. A decision to build high-rising houses was made. The development of steel, reinforced concrete and plumbing, as well as the invention of elevators, allowed people to make buildings dozens of times higher than before.

The first skyscraper was considered to be Home Insurance Building which was built in 1885 in Chicago. The height of the 10-storeyed building was 42 meters. The author of the project, an American architect William Le Baron Jenney, introduced a new construction technology with a load-bearing steel frame with masonry cladding.

Soon a new school appeared in the American architecture called the Chicago School. Its leader was an architect Louis Sullivan. The Chicago school features were: multi-storeying, a lot of glass using, emphasizing of vertical facade elements and limiting of exterior ornamentation. The frame construction could easily be seen if looking at the facade of buildings. Sockle and cornice parts of the building were well proportioned.

That time was an architectural race which came to an end at the beginning of 1930s. The most noticeable sky-scrapers of that time were the Chrysler Building and the Empire State Building. It was the architecture of these two buildings that impressed us more. Due to them we were inspired to create a high-rise structure for Krasnoyarsk.



*Fig. 1. The Chrysler Building.*

The Chrysler BuildingThe Chrysler Building shows us an extraordinary height tug. Initially, an ex-senator bought a piece of land with the building. He wanted to erect a 67-storeyed building with a steel crown. However, he didn't have money to finish it so it was given to Chrysler. The skyscraper has 77 storeys and is 320 m high (including its spire). This is an example of Art Deco in architecture. A unique crown ornamentation repeats the pattern which was used on the Chrysler wheel hubcaps of that time.



*Fig. 2. The Empire State Building.*

The Empire State Building is a 103-storey skyscraper, which is situated in New York City on Manhattan island. It's an office building. Its height is 381 m. The tower got its name from the nickname of state of New York, which is called "the Empire State". It was made in a modest but elegant Art Deco style. The facade was designed in a classic style. Steel strips drew up on the grey masonry facade, upper floors made several setbacks. When just erected, the spire was supposed to be used as a mooring mast for airships.

To sum up we can say that the Chicago school contributed a lot to high-rising building industry. Reinforced concrete using, decorative elements, socle showing up, detail expressiveness are the characteristics of this school.

Our aim was to design a building which would remind of an American megapolis. Also we did our best to use the Chicago school features and experience. Here in Krasnoyarsk there have already been quite high buildings, such as 30-storeyed "the First Tower" Business Center with 120 m height, 29-storeyed KATEKNIUgol Tower with 105 m height and most of the buildings of the Vzletka district. We, the new generation, have to fill up this collection with fresh ideas. We've made an interpretation of a house using the Chicago school distinctive features.





*Fig. 3. The high-rise building for Krasnoyarsk.*

My object – a 55 m 17-storeyed block of flats, – has two important functions of our time: on the one hand, it is a shelter and on the other, it has a service area. Plenty of facade glass makes this structure similar to the Empire State Building, and the powerful spiral stairs resemble the upper part of the Chrysler Building. On the whole, the house is Art Deco. Its symmetry, bold geometrical shapes, rich colours, lavish ornaments and luxury create the impression of a great building, which could be showed off in Manhattan.

The zest of the building is its club rooms. On the facade they are shown as large compartments flanking the house, and they create a flying feeling. These areas are recommended to be used by the inhabitants of the house, for example as a gym, a storeroom or a children's playground. Steel trusses support these compartments. This element is similar to constructivism style.

The main part of the building is apartments. They have got a minimal living area and are mostly intended for young people and families. There are 1, 2, 3 bedroom apartments and also studio apartments. Two mirrored sections are designed in the house with their entrances in the side building parts. Each floor has got 8 apartments.

As service has become an essential part of our life, so we decided to combine a living area with a service one. The house dwellers could easily get the place they want just going downstairs. The service area is situated in the lower part of the building. It takes three levels. According to the Chicago school this part is marked out as a socle area. The facade of the service area is arranged in the ancient Greek style. Powerful canopies are covered with a dark-red meander which harmonizes with Cnossos columns. Here one can find a time café (“antikafe” in Russian), a clothes shop and a sport club.

A time café is a place which aims at providing a cozy area for people interested in their hobbies. Drinking coffee or eating are not obligatory. People can play board games, discuss books they read or use a karaoke. In this time café there is a small kitchen with a bar, staff room, toilets and several rooms located on two floors.

A cloths shop has got two-storeyed sales areas each having a changing room. On the ground floor there are utility rooms: unloading area, storerooms, staff rooms connected with a private entrance. A private hallway ends at a sale area.

The next service part is a sport club. Passing through the lobby with a reception area and a little sport shop the clients get into their locker-rooms. Each locker-room is equipped with



showers and toilets. Then, the clients can go either into a gym hall or to the other level using a spiral stairs where one can find other sport facilities, toilet rooms and staff rooms.

The overall view of the building has been designed with the main ideas of the Chicago architectural school, which are: symmetry, reinforced structures, decorative elements, marked out socle parts, and a lot of glass.

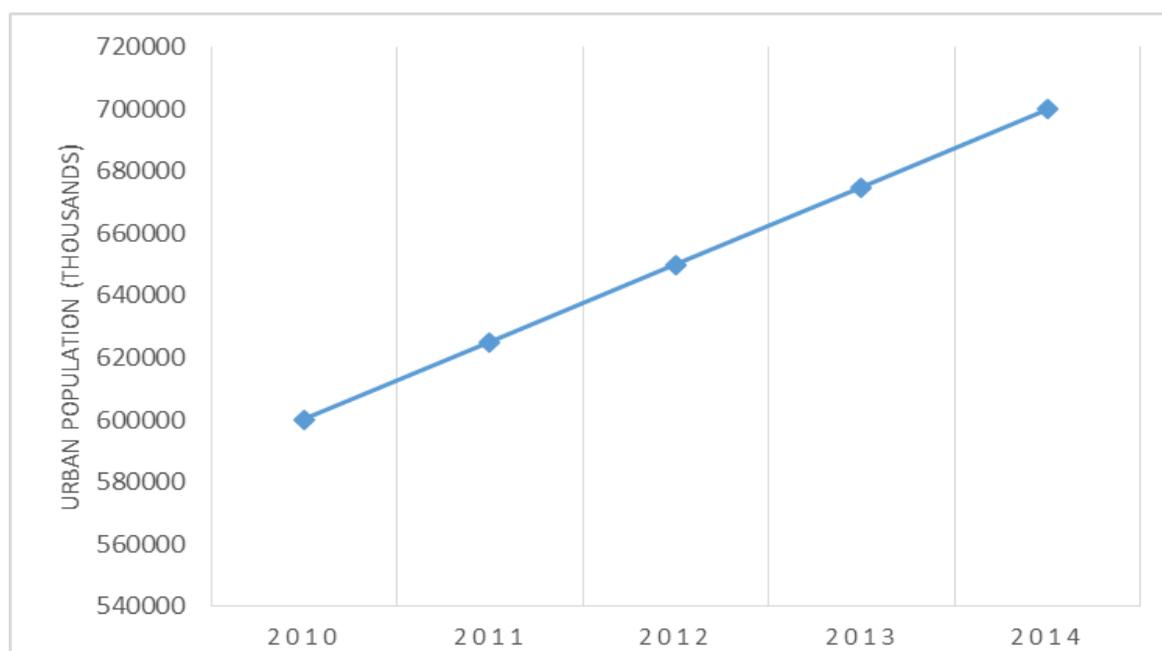
To make our city up-to-date, fashionable and modern as many American cities are, we need to create and develop new fresh images using and interpreting American experiences and schools which have become examples for the world high-rising building industry.



**BUILDINGS ENERGY EFFICIENCY IN CHINA.****A.S. Bakaeva,****Language supervisor: E.V. Anastasova***Siberian Federal University*

Buildings play a very important role in the energy demand sector as they account for more than ¼ of China's total primary energy consumption and are likely to increase to 35% by 2030. In order to decrease energy consumption of commercial buildings, there is a need for strong political will and implementation of strict building regulations.

China's construction speed is impressive and it is stimulated even further by the fast rates of urbanization. As it is shown in Figure 1. The urban population in China has been growing rapidly since 2010.



*Figure 1. Urban population in China.*

China has the largest construction volume in the world with about 2 billion square meters of new buildings completed annually. Currently about 80% of them are categorized as high energy buildings. China's Ministry of Construction estimates that China will add 4 billion square meters in new construction by 2020. More than 90% of new buildings are considered as high life-cycle energy buildings. Over the last several decades, China has added 1.8-2.0 billion m<sup>2</sup> annually, establishing the world's largest market for new construction. Total urban residential floorspace was 20.6 billion m<sup>2</sup>, rural residential floorspace was 24 billion m<sup>2</sup> as of 2010. In 2012 urban residential floorspace comprised 24 billion m<sup>2</sup> and rural residential floorspace reached 27 billion m<sup>2</sup>. And both areas are constantly growing.



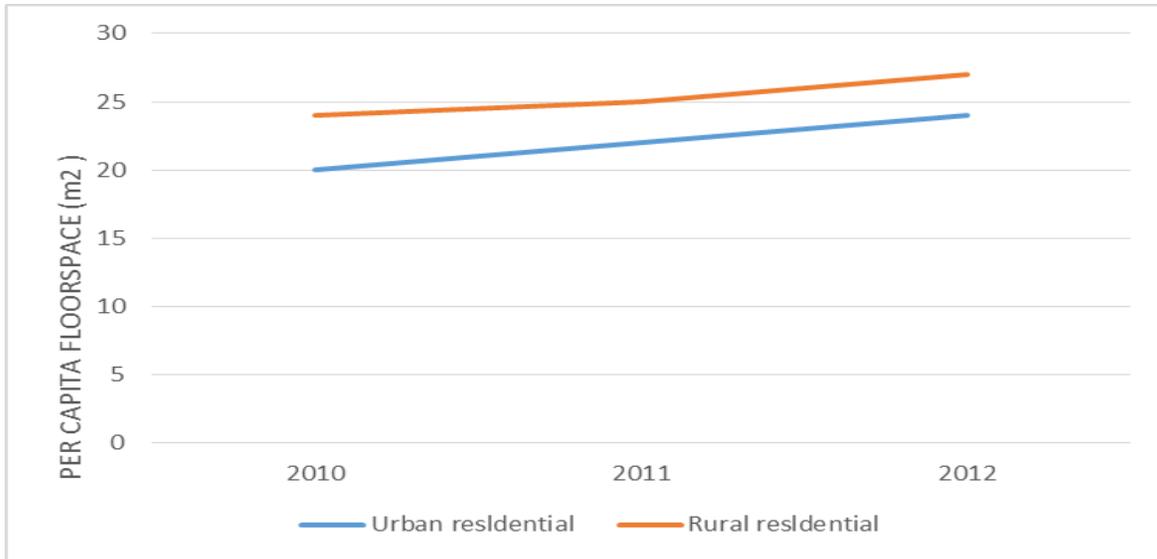


Figure 2. Floorspace of Chinese residential buildings growth

China's building stock is characterized by rapid new construction and demolition of older buildings, so China's building floorspace has grown. In particular, floorspace of urban residential buildings has grown. The growth in rural building floorspace has slowed down as rural residents migrate to cities; but floorspace of rural residential buildings is still significant with a total amount of around 27 billion m<sup>2</sup> in 2012.

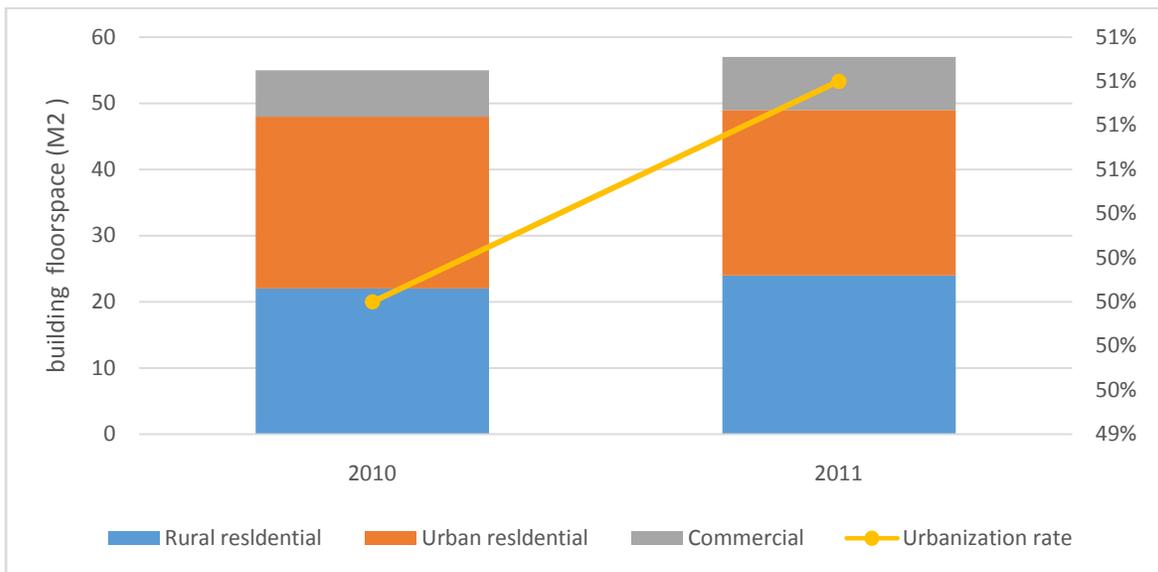


Figure 3. Growth in building floorspace.

China is developing and modernizing its technologies. Accordingly, China's foremost building energy efficiency priorities are ensuring that new buildings are built to high standards and improving the efficiency of equipment. Northern China is heated mostly with district heat. Improving incentives for conservation in district-heated buildings the country could achieve



considerable energy savings. Buildings energy efficiency covers the energy performance of building envelopes and of equipment inside buildings (such as HVAC units and appliances), and also touches on building use, customs, and energy pricing.

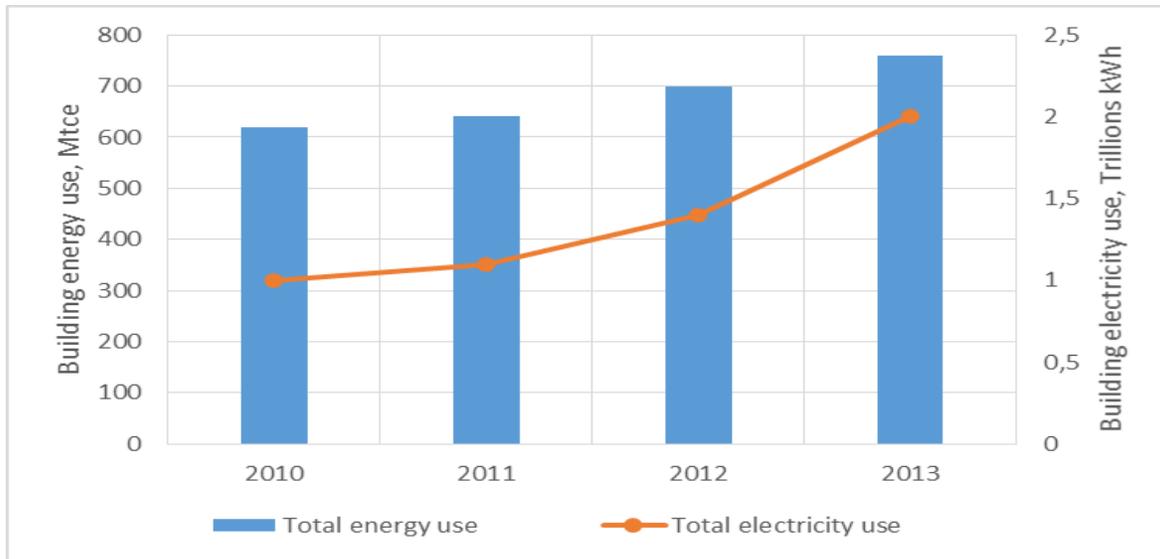


Figure 4. Building energy consumption

The Chinese government has issued many standards and codes in order to improve energy efficiency of buildings. In China energy consumption per building has decreased by 33%, and buildings have become more comfortable as a result of good thermal performance and insulation in most of China's buildings.

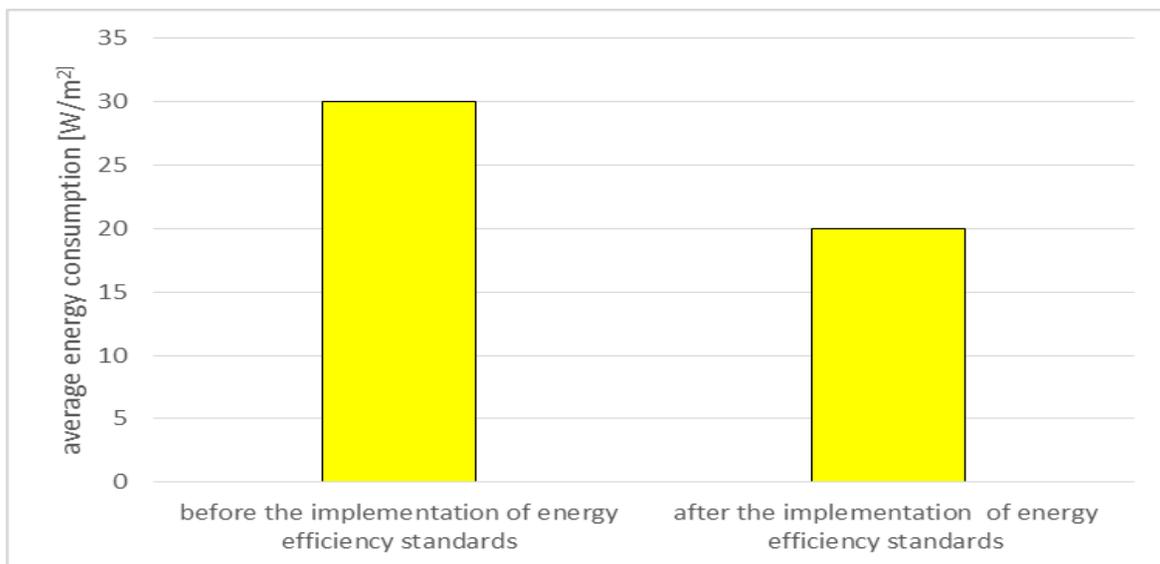


Figure 5. Average energy consumption, China



China's energy efficiency policy is largely defined and supervised at the federal level. China has made an effort to increase compliance with energy standards. At present they have created a model that projects how much energy can be saved with changes to China's building energy codes. The codes that regulate building aspects like insulation and lighting have been developed. It resulted in reduction of energy consumption in the country. It is estimated that improvements to these codes could reduce building energy consumption by up to 22 percent by the end of this century.

In December 2012, China began closing a gap in codes for rural buildings by instating a voluntary code. The voluntary codes are the first step in raising rural China to the same, mandatory standards as the rest of the country. About half of China's population lives in rural buildings, which often lack proper insulation. The codes in this study dealt with insulation, heating, ventilation, cooking and lighting.

These policies and programs together helped improve energy efficiency of Chinese buildings and expand the market for energy efficient products. The Chinese government sets goals to improve building energy efficiency during the 12th Five-Year Plan period, which will further drive the demand for energy efficient products.

China's greatest potential for energy savings is in ensuring high energy efficiency standards for new construction. With the dramatic increase in building stock and rapid urbanization, building energy consumption has already become one of the most critical issues for the Chinese government. The leadership in China has issued a set of policies regarding building energy efficiency to meet the national goal of a 40-45% reduction in carbon intensity by 2020. These policies not only make the national and local governments focus on building energy efficiency, but also create a huge market for companies working on building energy efficiency.



## THE FUTURE OF RUSSIAN NAVIGATION

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What is GLONASS? Global Navigation Satellite System (GLONASS) - Russian satellite navigation system, developed at the request of the Ministry of Defence. One of the two operating systems on today's global satellite navigation.

Development of GLONASS began in the Soviet Union in 1976. Beginning on 12 October 1982, numerous rocket launches added satellites to the system until the constellation was completed in 1995. After a decline in capacity during the late 1990s, in 2001, under Vladimir Putin's presidency, the restoration of the system was made a top government priority and funding was substantially increased. GLONASS is the most expensive program of the Russian Federal Space Agency, consuming a third of its budget in 2010.

The main contractor of the GLONASS program is Joint Stock Company Reshetnev Information Satellite Systems (formerly called NPO-PM). The company, located in Zheleznogorsk, is the designer of all GLONASS satellites, in cooperation with the Institute for Space Device Engineering (ru: ФНИИ КИ) and the Russian Institute of Radio Navigation and Time. Serial production of the satellites is accomplished by the company PC Polyot in Omsk.

GLONASS includes three components: constellation of satellites (space segment); ground-based control facilities (control); user equipment (user segment).

Completely deployed GLONASS constellation is composed of 24 satellites in three orbital planes whose ascending nodes are 120 apart. 8 satellites are equally spaced in each plane with argument of latitude displacement 45. The orbital planes have 15-argument of latitude displacement relative to each other. The satellites operate in circular 19100 - km orbits at an inclination 64.8, and each satellite completes the orbit in approximately 11 hours 15 minutes. The spacing of the satellites allows providing continuous and global coverage of the terrestrial surface and the near-earth space. The control segment includes the System Control Center and the network of the Command and Tracking Stations that are located throughout the territory of Russia. The control segment provides monitoring of GLONASS constellation status, correction to the orbital parameters and navigation data and control commands uploading.

User equipment consists of receivers and processors receiving and processing the GLONASS navigation signals, and allows user to calculate the coordinates, velocity and time.[1]

Over the three decades of development, the satellite designs have gone through numerous improvements, and can be divided into three generations: the original GLONASS (since 1982), GLONASS-M (since 2003) and GLONASS-K (since 2011). Each GLONASS satellite has a GRAU designation 11F654, and each of them also has the military "Cosmos-NNNN" designation

According to Russian System of Differential Correction and Monitoring's data, as of 2010, precisions of GLONASS navigation definitions (for  $p=0.95$ ) for latitude and longitude were 4.46—7.38 m with mean number of navigation space vehicles (NSV) equals 7—8 (depending on station). In comparison, the same time precisions of GPS navigation definitions were 2.00—8.76 m with mean number of NSV equals 6—11 (depending on station). Civilian GLONASS used alone is therefore very slightly less accurate than GPS. On high latitudes (north or south), GLONASS' accuracy is better than that of GPS due to the orbital position of the satellites.



Some modern receivers are able to use both GLONASS and GPS satellites together, providing greatly improved coverage in urban canyons and giving a very fast time to fix due to over 50 satellites being available. In indoor, urban canyon or mountainous areas, accuracy can be greatly improved over using GPS alone. For using both navigation systems simultaneously, precisions of GLONASS/GPS navigation definitions were 2.37—4.65 m with mean number of NSV equals 14—19 (depends on station). [3]

In May 2009, Anatoly Perminov the then director of the Russian Federal Space Agency stated that actions were undertaken to expand GLONASS's constellation and to improve the ground segment in order to increase the navigation definition of GLONASS to an accuracy of 2.8 m by 2011.[4] In particular, the latest satellite design, GLONASS-K has the ability to double the system's accuracy once introduced. The system's ground segment is also to undergo improvements. As of early 2012, sixteen positioning ground stations are under construction in Russia and in the Antarctic at the Bellingshausen and Novolazarevskaya bases. New stations will be built around the southern hemisphere from Brazil to Indonesia. Together, these improvements are expected to bring GLONASS' accuracy to 0.6 m or better by 2020. [2]

The system has advantages and disadvantages. On the one hand term service GLONASS satellites noticeably shorter than GPS. Also, to currently positioning accuracy GLONASS few lags behind similar indicators for GPS. The complexity of configuring the adoption and impact of the signal.

If we upgrade the equipment, then further work can highlight significant advantages. GLONASS has good stability, its equipment does not require additional adjustments for the duration of active existence, it is automatic system and cost-effective, the number of steps reduces, the work is performed several times faster.

At this point in Russian aviation ground equipment is used, such as locator beacons, lighthouses azimuthal rangefinder, automatic direction finders, but thanks to GLONASS we can abandon off them and at the same time to become in a favorable position.

We offer you the idea for the modernization of the Russian air force, as we hope for its development. Therefore, for graduation, getting a job in their specialty, have high hopes for what we are proposing this technology has been successfully implemented and we will be able to work well for the benefit of Russian aviation.

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## **CONSTRUCTION PLAN OF THE 29<sup>TH</sup> WINTER UNIVERSIADE IN KRASNOYARSK AND ITS INFLUENCE ON KRASSNOYARSK REGION**

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That is not a secret that in 2019 Krasnoyarsk will host 29<sup>th</sup> Winter Universiade. In 2013 Krasnoyarsk was officially selected as the capital of this event. It was the result of almost two-year active application company. During this years the idea to suit Universiade in macro-region of Siberia had been supported as by citizens as by direction of region and country.

For Krasnoyarsk successful organization of such great event it is not just large-scale sport action and possibility to create modern sport infrastructure, but a project that can stimulate new step of region development, connected with the transformation of social life and image of the city.

There are objects that are going to be involved into competitions during Universiade sport program:

- 7 existing sport objects, that will be reconstructed;
- 3 sport objects, that are just planned for construction on permanent bases;
- 2 existing reserve sport objects;
- 1 object that will be used during opening/closing ceremony;
- 4 residential complexes;
- 2 public buildings and multi-functional complexes;
- 4 healthcare objects;
- 5 transport infrastructure objects.

In total there are 28 items, involved into Universiade.

However, designing and building of sport structures is complex process, which requires careful planning. Despite the variety of sports facilities, there are few common features such as:

- large spaces and bays;
- the presence in the same building floors of different heights;
- restriction of creative freedom of planners because of safety requirements;
- the presence of additional supports;
- providing comfortable movement inside the building.

Moreover, such buildings often have to expand and refurbish. And during the designing this fact should be taken into account.

But the main property of the sports complex is its functionality, which is made up of several factors:

- specific design
- the use of high-quality construction and finishing materials
- the use of universal engineering systems

It may seem that the construction of such objects takes many years. However, the use of the modern technology allows to speed it up. Often for this purpose are used pre-fabricated structures made of metal, lightweight, easy to assemble, which allows further dismantle part of the building or the entire building are used.



And this factor plays the most important role in building objects for Universiade. During 5 years about 28 items should be built or reconstructed. Though all the plans and construction technology were not disclosed, we can already see how quickly new facilities are building.

Universiade is an event associated with a great construction plans. Sometimes not all plan can be realized on time. The example is recent 27<sup>th</sup> Winter Universiade in Granda, Spain: construction plans included expansion of the skiing tracks, a stadium for cross-country skiing and biathlon, a new village for 3,000 athletes and representatives. At all sites were installed system for producing artificial snow; new ski center and ice rink were also planned; but during the examination of objects in 2014, the commission revealed that stadiums in biathlon and cross-country skiing in Puerto de la Raga are not ready for Universiade, so competitions in this sports were transferred to Slovakia. According to the plans of 29<sup>th</sup> Universiade, all the objects will be completed just in time, so the city won't suffer the fate of Granda.

Speaking about Universiade in Russia, we can compare Krasnoyarsk and Kazan that held Summer Universiade in 2013. The Universiade Village was constructed in 2010, before and after the Universiade it is used as campus and center for preparing Russian national teams in summer sports. Almost all Universiade objects were constructed long before the Universiade (2 and more years); just Kazan Arena and Palace of Water Sports were built for Universiade.

So, Krasnoyarsk Universiade has the most massive construction plans among Universiades in Russia, and probably will enter world list of most wide constructions for sport events.

Here is a list of some Krasnoyarsk objects.

The winter sports academy: it's a complex of 10 objects that have been constructed since 2012 and will be finished in 2017. The academy will be able to suit more than 5000 people. It includes the multi-functional complex "Sopka", sports-training unit "Snezhniy", halfpipe complex, skiing complex, administrative and coaching unit "Freestyle", snowpark, multi-functional complex "Raduga", sports-training unit "Lyzhniy", start-complex with the skiing stadium, ski-roller track with lighting and snowmaking, sports-training unit "Gorniy".

Skiing Centre "BobroviyLog" will be reconstructed; it is situated in 20 minutes from city center and can suit 5000 people. Was put into operation in 2006. There are 15 skiing tracks with various complexity. 7 tracks are certified by the Technical Committee of International Ski Federation, which gives the possibility to make competitions in all disciplines of skiing within the Universiade-2019. Total length of trails is about 10 km. The complex is 520 meters above the sea level.

Ice arena "Tihiezori" that will have been finished in 2017, now in this location just construction site, but according to the plans there will be ice arenas 60x30 meters. Besides, there are going to be 10 lockers for men and women, rooms for technical delegates, judges, staff, off-site locations for the press and media.

Ice Palace "Rassvet" is a rebuilding training unit that will open its doors for champions in 2017. Building is designed as two separate blocks, one-storey block with an arena-skating rink and abutting two-storey unit with administrative and living rooms. There are an Ice Arena, strength training room, acrobatic hall and choreography hall, auxiliary and administrative offices. Almost 300 people can train there at a time.

Skiing center "Filaretovkluch", Divnogorsk. This reserve sport object is situated in Krasnoyarsk region in town Divnogorsk. From the mountain you can see a great view to the Altai Mountains and Yenisey. This base will be used during the Universiade as the reserve sport object, but tourists should visit it to get great experience.

Krasnoyarsk Central Stadium. The Central Stadium is one of the largest sports complexes in Siberia and the Far East. 25 thousand people can watch the ceremony there. The



stadium was built in 1965. Now the complex comprises a large sports arena, which includes a football field with a heating, stands for 25 thousand spectators and staff rooms under them. Also there is a hotel complex for 105 people.

Technical constructions of the stadium will be reinforced, all tribunes will be replaced, besides, the interior will be redesigned for the needs of the Universiade opening ceremony. In 2019, just before the event, finishing works are planned.

Residential complexes “Perya”, “Vuzovskiy”, “Universitetskiy” by the Siberian Federal University. All this complexes will be ready to invite guests in 2018. They can host 1700, 750 and 1300 people respectively. The first and second complexes are for the volunteers, the last one is for sportsmen, as the residential complex of the Siberian Federal University campus that will be used for the Universiade too, it is for 1850 people.

The Siberian Federal University as the base for the Universiade will construct few buildings.

For example, there is SFU Community Centre. It will be used as international information center (IIC) of 29<sup>th</sup> Universiade. According to the plans the construction will be completed in 2018.

Another building is SFU multi-functional complex that will be used for organizing of catering services. The construction will be finished in 2019 as well.

And it is only a small part of what will be built in Krasnoyarsk. Universiade will have a profound impact on our city. Its implementation will improve infrastructure, health care and more. And in general, it will set the stage for comprehensive development of the whole region.



## **THE CONSTRUCTION AND ITS IMPACT ON THE ENVIRONMENT**

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Nowadays the industrialization of society covers the whole world. It means that the construction industry is developing too. Like all creatures a man is a part of nature. Animals are adapted to the external environment but humans use the environment to change it in their own purposes. At present, the development of industrial production requires the establishment of a huge number of mining non-renewable raw materials, of creating powerful sources of energy, materials, water and other resources that lead to the depletion of some minerals. Furthermore, the problem of environmental pollution has arisen due to the waste in industry, agriculture, transport and construction, which increase air, water and soil pollution.

Changes, which take place in nature now(as a result of human activity), have become global and created a violation of natural balance. This situation is an obstacle to the further development of human society and it raises doubt about the possibility of further existence of humanity. Negative changes showed the need to review the relationships between human and nature. In recent time the pace of construction is growing rapidly, reducing the amount of free space. In this regard, many dilapidated and old buildings should be destroyed to make space for new buildings. At the same time the problem arises because of the material that was obtained from debris during the dismantling of buildings.

In the recent past people blew up buildings to destroy them and took out what was left. After that, a huge dam of concrete, metal, glass appeared. Dump trucks were used for rubble, dump trucks were transporting waste for disposal in waste facilities. Garbage removal is a problem due to the increasing rate of construction and demolition of dilapidated buildings. Aside from the fact that today dumps are filled up to 90%, their presence has a negative impact on the environment.

In addition, it is not rational action, as waste can be recycled and thus environmental pollution can be avoid. Recycling will be an essential step in the implementation of the demolition of any building in the near future. Many materials are given new "life" after appropriate processing of construction debris, for example, the wood, concrete, scrap metal, plastic, glass, brick battle and many other materials. Savings achieved in the processing of construction waste excluding the cost of loading, transporting and unloading of construction waste from the place of their location.

On the one hand, the construction of new buildings, planting trees and bushes can ennoble the territory. On the other hand, a large amount of wood is required every year for the construction. Deforestation, rafting are attendant circumstances to wood finishing products. They are associated with the violation of landscapes, air pollution, water and soil of different types of waste.

The degree of impact on the environment depends on the materials used for the construction, the technological equipment of construction, the type and quality of construction machines and vehicles, the types and power of their engines and other factors. The degree of impact on the nature is largely influenced by the process of organization and production technology. Buildings become a source of contamination of adjacent areas, emissions and engine noise machines, waste incineration. Water is widely used in the construction process - as a component of solutions, as the heat carrier in heating systems after use it is reset, contaminating groundwater and soil.



However, the construction itself is the process that is relatively transient. Much more difficult is the case with the impact on the nature of the objects, which are products of construction - buildings, structures and their complexes. Their impact on the environment is studied not enough, so virtually all environmental measures are advisory in nature. As for the current results, then: number of trees decreases, water and soil are polluted due to industrial emissions and accumulation of municipal waste, dust, gas and thermal pollution of air occurs, which leads to a changes in the level of radiation, precipitation, air temperature, wind direction, i.e. artificial conditions in the urbanized area are created.

Negative influences manifest themselves as a result of various influences - time, climatic and operational of buildings and structures: stone and metal structures are destroyed, paint fade and disintegrate, sculptures and ornaments destroyed, roof and truss bridges corrode and so on . The substance is likely to fall in case of complete elimination of the object in the current conditions The construction waste a negative impact on the environment, for example, different types of plastics, phenol, formaldehyde, etc.

Pollution of air, water and soil is the result of industrial production and transport operations. Their number is growing in the modern city . Construction of plants creates an additional environmental burden and entails the deterioration of human health. Existing buildings and facilities also have a negative impact on the environment existing buildings and structures also have a negative impact on the environment, they changed the relief , changing vegetation, replacing natural landings come artificial.

It is said that the process of development is irreversible. It is the transformation of the built-up areas of relief, changing the nature of the surface waters, foundation, overlapping the existing groundwater flow, violation of the surface runoff and evaporation, installation of utilities are causing rise in groundwater levels. Waterlogging of soils affect the seismicity subject to a flooding of territories, which raises the cost of increasing the earthquake resistance of the building.

Everyone understands in order to exist and develop, mankind must actively use all the resources of the earth, for example, forests, minerals, water or air space. Until the mid-twentieth, this exploitation were some damage to natural ecosystems, but it didn't lead to a global environmental catastrophe. The changes introduced by human activities in the economic area were mostly insignificant or completely reversible, either a natural ecosystem is simply replaced by another. But with the increasing urbanization of the same, the development of the industry, by removing waste in natural ecosystems, the environment does not begin to cope with large amounts of harmful substances. Person ceases to be a harmonious part of the natural complex and turned into mindless oppressor and simply, the enemy and the murderer of his mother Earth. The problem of the influence of industry and construction on the environment is global in nature, and that led to its importance.

For example, the government wanted to build Ferosplavny Plant in the city of Krasnoyarsk, but people reacted to this idea rather ambiguously, it was initially planned to use cleaning filters of high quality in the construction of the plant not to release waste into the atmosphere and not pollute it, but most people did not believe this. They began collecting signatures to ban the plant in the city, I think they did the right thing because it is necessary to protect human health from harmful waste.

However, you can minimize the damage caused to the environment. To do this, you must carry a compulsory accounting of decisions, major construction companies have a staff of qualified ecologist, time to implement environmental measures.

Appearance, function and possible elimination of the building must be considered when designing them, because then they can affect the environment. We must not forget about the close connection between humanity and the environment. Especially, to destroy themselves for the sake of someone's profit.



**WINTER UNIVERSIADE VILLAGE VENUES CONSTRUCTION 2019****A. V. Gabaydulin****Language supervisor: Tatyana V. Zhavner***Siberian Federal University*

The World Winter Universiade 2019 will be held in Russia, the city of Krasnoyarsk. Such a great event will be definitely a big step for developing our region in different spheres. In this article we will consider aspects that are connected with construction, especially civil engineering.

As a host-city, Krasnoyarsk needs different types of buildings such as sport objects, residential, medical and social venues. A special work group is gathered to accomplish all the tasks connected to the city's construction. Moreover, there is an area that is responsible for infrastructure development. It coordinates the matters of the construction process and matters future usage of the venues. [1]

For the accommodation of guests of the city it is planned to build four residential buildings and two public and multifunctional venues. The plan is proved by the Venues Management Department, the main regulator of preparing, managing, coordinating the construction of social buildings.

Winter Universiade 2019 Village will be located in the Siberian Federal University campus in close proximity to Nikolaevskaya Sopka and the majority of the Alpine skiing venues. It is planned to complete the existing infrastructure with three new venues. [2]

The residential complex «Perya» will comprise four 18-storeyed buildings where the auxiliary premises and a sports stadium will be situated and volunteers will live. The capacity of the complex is 1700 people and it will be commissioned in 2018.

Another residential complex “Universitetsky” will consist of three 18-storeyed buildings and a complex of auxiliary premises. 1300 athletes will live there during the Universiade. It is planned to finish in 2018 as well.

The Multi-Functional Centre will consist of a sports training block with a food production facility, gymnastic areas, training and game halls. One of the halls shall be easily transformed into a dining hall for 700 people. In addition, the venue provides for a sports hall for athletes warm up and trainings. [2]

Besides the construction of new houses, there will be renovated existing ones: the “Vuzovsky” residential complex, comprising two 18-storeyed buildings, for 750 volunteers and the residential complex in the campus of Siberian Federal University, where 1850 athletes will live.

The International Information Centre (IIC), commissioning in 2018, will be a place for media and broadcasting.

Speaking about the construction itself, we should point that practically all the buildings will be made from composite panels. And these prefabricated houses with upper ventilated facades will be constructed from the high-quality materials which are flame retardant and weather resistant. [3] Rockwool will be used as an insulation material. [4] According to the safety codes, it is regarded as low combustible material which means that it can be used during the construction process. [5] Furthermore, this insulating material will save money on heating, ventilation and air-conditioning (HVAC), it will create a conducive and comfortable environment for occupants and preserve the appearance of the facade for the next years.



As for the amenities of the venues, it must be said that the buildings will have continuously glazed facades on the balcony outwards and furniture, electronics, sanitary units – inwards. The territory around the venues will be provided with utilities and power stations for a better power supply.

As you see the latest achievements and innovations in technology, organization and management will be used in preparing and hosting a successful and unique Universiade.

Social infrastructure venues, such as the Universiade Village, International Information Center, Medical Center at the Universiade Village will contribute to the development of the social sphere of the host city and the health sector. Therefore, Krasnoyarsk will become a developed city with modern infrastructure and this heritage will definitely push it forward. Let alone the Siberian Federal University that will precisely become one of the best Russian universities and as a student of SFU I would be very proud of it.

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## DECENTRALIZED POWER SUPPLY SYSTEM USING A WIND-DIESEL SYSTEMS

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Optimal use of the renewable energy sources is of great importance for the regional energy policies. The problem of energy security is an urgent one for many countries, it is transformed into energy safety of the areas of Russian Federation, especially those that are with an independent power supply. In some cases the expenses on the purchase and delivery of diesel fuel for the diesel power plants of the northern villages is over 60% of the costs for fuel. The total cost of electricity in these areas is much higher than the world price level and reaches 25 rubles per kW·h.

When substituting the diesel fuel with electricity generated at wind power plants, fuel costs are significantly reduced. Eventually, after a few years you can start saving money spent annually on the purchase and delivery of expensive diesel fuel to the remote villages in the area of decentralized power supply. The development of renewable energy sources and wind energy in particular, is a promising direction in the development of the energy sector, and is actively supported by the Government of the Russian Federation. Involvement wind turbines into the energy balance of the Northern areas of Krasnoyarsk Territory in order to increase the reliability of power supply and energy efficiency by the displacement of the imported fossil fuel from energy balance of the autonomous power supply system is important.

The object of this research is stand-alone power supply system of the northern villages, in particular that of Nosok and Karaul settlements, this system technical and economic parameters, taking into consideration the wind energy potential. The subject of the research is the ability of an isolated power system and its individual elements to provide a cost-effective electricity for the northern consumers. Methods of calculating reliability and optimization of the wind-diesel power energy system.

Low population density and weak economic activity in some parts of Russia determine the autonomous of energy consumers. In reality, the only way to build decentralized power supply system is the use of diesel generators. However, the analysis of the energy-saving stand-alone systems showed that the most urgent problems facing low energy were:

- 1) deterioration of reliability in operating of the autonomous energy saving systems high wear and tear caused by the power equipment and interruptions in the delivery of fuel;
- 2) limited use of the local energy resources, including non-conventional;
- 3) low efficiency of production, transportation and consumption of energy resources;
- 4) high production cost of energy generated;
- 5) staffing;
- 6) environment protection when using power equipment.

The need to improve the technical and economic characteristics of decentralized power supply systems determines the interest in the combined in particular wind-diesel plants. Such wind-diesel systems are universal in application, have good technical and economic characteristic, provide reliable energy supply of various autonomous consumers. [1]

The energy efficiency of the wind-diesel systems depends on several factors: the wind condition, load-time dependence of decentralized power supply systems, the relationships



between the designed capacity of wind power and diesel power, the degree power plants structure perfection of autonomous power supply system and control laws for energy sources that make up the power sector.

Selecting power for a wind farm is an important task in design insulated power supply system. The problem is that the average coefficient of installed capacity can vary from 20% to 50% depending on the construction of wind turbines and wind power potential capacity of the region.

When constructing the wind farm with the installed capacity significantly less than the consumer minimum load the displacement of fuel component from the energy balance of the system is small and the introduction of wind turbines will be ineffective. The installation of wind turbines matching the power of the maximum load of the system or even that exceeding the maximum system load will lead to the fact that not all of the electricity produced by wind turbines will be spent. With a large amount of excess electricity of wind turbines a part of the, is to be stopped for a period a good weather. Hence generation is reduced, which leads to an increase of the electricity production cost.[1]

Therefore, to select the wind power station it is essential to know the load graph of consumers, the composition and characteristics of the diesel generators in the diesel power plant, the characteristics of wind energy potential in region, under consideration as well as some climatic and geographical characteristics that affect the distribution of the load graph.

The construction of wind power plants in ethnic villages of Taimyr Dolgan-Nenets Municipal Area will be promising in case that the experience of construction in village Dixon is positive. Unlike Dixon, Nosok and Karaul don't have the developed transport infrastructure. To organize the delivery of personnel and equipment to these villages is possible only in the period from May to September. However, there is a great deficit of energy supply though they have a good wind power potential.

Nosok is located in the northern part of the Krasnoyarsk Territory of the Taimyr Dolgan-Nenets municipal area on the banks the Ushakov girt in the Yenisei mouth. During summer navigation many riverboats enter this girt. Is one of the largest villages of this part of the banks of Yenisei in the lower reaches. Reindeer herders, hunters and fishermen of the village are nomadic. Their children live in a boarding school, which is located in three buildings, besides there is a bakery, a sauna, a hospital, a school, a kindergarten, a post office, a cultural center and church. On the territory of the villages there is a helipad.

The main sources of electrical energy is diesel power stations. Delivery of diesel fuel was 140 tons in 2013. The selling price for electricity was 21.15 rubles per kW·h.

It is suggested to build wind power stations in the village basin on several variants of wind turbines: Nordwind NW 24-180, Vetrox-50, Nordtank-130. These wind turbines are recommended to be located in the close proximity to the village connecting to 0,4 kV network.

Karaul is a district center of the Ust-Yenisei area. The village located in 70 kilometers from the Ust-Port village on the right bank of the Yenisei River.

The climate is severe, the village is located in the tundra zone, farming is impossible, even in summer the frosts are common phenomena and summer daytime temperature is usually 10-12 °C and in winter it is very often -40 °C or a bit less. Karaul territory is hilly, steeply sloping, waterlogged; there are numerous lakes, small shallow streams. There main river is the Yenisey, the main traffic artery not only for villages, but also for all the Taimyr Municipal Area.

The village has a kindergarten, a secondary school, a cultural center, two libraries and hospital for 25 persons. Karaul has a workshop for processing and smoking fish the capacity of about four tons per month.



The main source of electrical energy is diesel power stations. The annual delivery of diesel fuel is 3390.76 tons per year. The annual delivery of coal is about 700 tons per year. The selling price for electricity was 21.15 rubles per kW·h.

It is suggested to build wind power stations in the village basin on several variants of wind turbines: Nordwind NW 24-180, Vetrox-50, Nordtank-130. These wind turbines are recommended to be located in the close proximity to the village connecting to 0,4 kV network.

As mentioned above, this project is still at the design stage. At this stage the following problems have been performed:

- 1) the wind energy potential of the Far North and the necessary characteristics have been calculated;
- 2) the necessity and feasibility of installing wind power station have been grounded;
- 3) the choice of wind turbines from different manufacturers have been made;
- 4) the costs for the project financing plan have been determined (Table 1);
- 5) the calculation of technical and economic indicators for all types of wind turbines have been produced (Table 2);

Table 1. Capital construction costs for a wind power station (WPS) with wind turbines (WT) of various models in Karaul village

Specification	Nordwind NW 24-180 (Germany)	Nordtank-130 (Denmark)	Vetrox-50 (Russia)
Cost of 1 WTC <sub>WT</sub> , mln. roubles.	34	10	3
Recommended number of WT n, nubr.	3	4	14
Cost of 1 WPS C <sub>WPS</sub> , mln. roubles.	102	40	36
VAT(18%), mln. roubles.	18,36	7,2	6,48
Insurance Z <sub>INS.1</sub> , mln. roubles.	3,06	1,2	1,08
Customs payment Z <sub>cust</sub> , mln. roubles.	5,1	2	1,8
Delivery Z <sub>delivery</sub> , mln. roubles.	6	8	12
Designing Z <sub>project</sub> , mln. roubles.	10,2	4	3,6
Foundation building Z <sub>f</sub> , mln. roubles.	7,14	2,8	2,52
Mounting operation Z <sub>mop</sub> , mln. roubles.	10,2	4	3,6
Insurance during mounting operation 2% Z <sub>INS2</sub> , mln. roubles.	2,04	0,8	0,72
Construction of substation and power lines Z <sub>PL</sub> , ,mln.	7	7	7



roubles.			
Purchase of machinery $Z_{\text{machinery}}$ , mln. roubles.	5	5	5
Risks $Z_{\text{risk}}$ , mln. roubles.	20	20	20
Lifting device $Z_L$ , mln. roubles.	2	2	2
Capital costs for the construction $K$ , mln. roubles.	198,1	139,0	101,8

Table 2. Economic efficiency indices for a wind power station (WPS) with wind turbines (WT) of various models in Karaul village

Indices	Nordwind NW 24-180 (Germany)	Nordtank-130 (Denmark)	Vetrox-50 (Russia)
Annual output of a electrical energy one WT $W_{\text{WT}}$ , MW·h	770,3	300,5	104,2
Annual output of a thermal energy one WT $Q_{\text{WT}}$ , Gcal	662,5	258,4	89,6
Annual output of a WPS $W_{\text{WPS}}$ , MW·h	2311,0	1803,0	1459,0
Annual expenses of WPS $E_{\text{WPS}}$ , mln. roubles/year	28,5	28,5	28,5
Electrical energy prime cost of WPS $C_{\text{WPS}}$ , roubles/kW·h	20,9	23,5	27,1
Dimension of «extruded» diesel fuel $V$ , l	693300	540900	437640
Diesel fuel cost $C_{\text{DF}}$ , roubles/l	48,0	48,0	48,0
Money equivalent of «extruded» diesel fuel $Z_{\text{DF}}$ , thsd. roubles	33280	25960	21010
Output coefficient of installed capacity $K_{\text{IC}}$ , rel. unit	0,489	0,264	0,091
Specific output of one WT $W_{\text{SO}}$ , kW·h/ kW	4279	2312	801,5
Construction cost per unit $Z_{\text{C}}$ $Z_{\text{PU}}$ , roubles/ kW	366900	178200	61040
Electrical energy prime cost of wind-diesel power	26,9	31,2	34,5



station $C_{CPS}$ , roubles/ kW·h			
Commercial extra charge H(20%), thsd. roubles	8820,0	5939,0	3743,0
Payback period $T_{PP}$ , years	5,6	5,9	7,4

The project is still under construction and there is a necessity for a large number of problems such as reliability of wind-diesel power supply system, construction of distribution substation, the choice of power supply scheme for consumers, and thus to prove the feasibility of decentralized energy systems in villages with wind turbines as a main source of energy.

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## NANOTECHNOLOGY IN CONSTRUCTION

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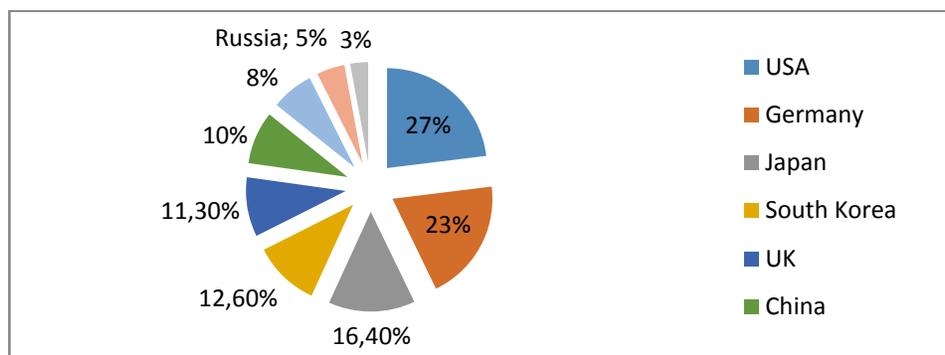
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Nanotechnology is the use of very small particles of material either by themselves or by their manipulation to create new large scale materials. Nanotechnology is not a new science and not a new technology. It is rather an extension of the sciences and technologies that have already been in development for many years and it is the logical progression of the work that has been done to examine the nature of our world at an ever smaller scale.

Last few years nanotechnology has become a part of a breakthrough in many areas of life - from telecommunications to medicine. They are also used in construction. Almost a fifth of construction companies in advanced countries use materials produced with nanotechnology in their work. The latest building technologies and materials can offer significant advantages in the construction industry for many projects. The application of nanotechnology will make a revolution in industrial and civil construction. The fact that it can be used not only to improve the quality and properties of various materials, but also to create entirely new substances, unprecedented in their characteristics and methods of using, which also will be safe for human health and the environment. In the near future we will be able to make building materials, which will be resistant to fire and water. Materials produced with nanoengineering and new fiber and structural technologies are characterized as "extra". They are heavy-duty and superconductive. Preliminary results based on special calculations guarantee that construction projects based on nanotechnology will become three - five times stronger and more stable so descendants will see them in five centuries.

It is interesting to analyze the nanotechnology used by developers in other countries and the applications of these innovations in the construction industry. As one can see at the bar chart, global leaders in science, technology and the degree of industrial development of the nanotechnology are the United States, Germany, Japan and South Korea. The level of nanotechnology development in the UK, China and France is a bit lower. The most fast-growing and promising is the Asia-Pacific region. Russia is behind the world leaders in this field because we began developing the nanotechnology 7-10 years later than our competitors.



*Fig.1. The volume of nanotechnological projects.*



Long-term work of scientists in the field of nanotechnology in construction has already given its results. Nanomaterials which greatly improve the quality of construction have been created. High-strength concrete, high-strength steel, composite structures, nano-coatings, innovative membrane, nanocomposite pipe, fiberglass composite rebar are the examples of such materials. Currently new projects of buildings with unusual designs are being developed. Such buildings are self-reacting to climate change: the power of the wind, the temperature change and the time of day. In some countries (Israel, the United States, Vatican City, Sweden and others.) there already are well-functioning buildings. A good example of the application of innovative technologies is a National Center for the Performing Arts in Beijing. Transparent surface of the building made in the shape of a sphere was built using the latest innovations in the field of nanotechnology. The technology with a beautiful name «lotus effect» was used for building it. The basic idea is that the surface becomes like the lotus leaves with a unique structure, allowing them to stay clean, and nanocovered dome over the building is resistant to dirt. This is achieved due to high density of particles which makes water drops and dirt roll away from it.

In construction the most popular materials are self-cleaning nano-coverings and paints for walls and fences, which have a long and excellent durability to climate extremes and also have the ability to strengthen themselves over time. In China (Shanghai) nanomembranes appeared on the windows of houses. They were able to accumulate energy from the sun during the day and give it out as free and economical lighting at night. In Shanghai Museum of Science builders covered walls with nanomembrane, providing "thermos effect". Energy-saving ability of nanomembrane was overwhelming and it was decided to distribute this method further to construction companies.

Innovative technology is a system of integrated approach to the construction and reconstruction of buildings, based on effective thermal insulation, use of alternative energy sources, organization of smart lighting systems and so on. Such systems have been used worldwide for a long time. Though Russia is not at the first position in the implementation of nanotechnology in construction, our scientists are trying to catch up with their European counterparts, offering new developments. And in recent years the authorities focus on the development of applied nanotechnology and investing in new projects.

Good examples of the use of nanotechnology in the construction industry in Russia are the Olympic facilities in Sochi. During the construction of the stadium "Fischt" a variety of innovative solutions which made the Olympic Games comfortable, safe and environmentally harmless were used. For example:

- Heat Mirror energy-saving glass, which was used at the construction of Stadium, has an increased strength and provided the 30% economy of thermal energy.
- Bactericidal paints, which contain nanoparticles of silver, reduce the level of infectious effects in crowded places.
- LED lighting system which allows to reduce the cost of coverage by half due to increased serviceability and low power consumption.
- System of cleaning and decontamination, which is able to clean the air from all types of microorganisms, even from viruses.

In Russia, nanotechnology is used not only for the construction of the worldwide import objects, but also in civil engineering. Aluminum composite panels from plant "KRASPAN" of Zheleznogorsk were used for the installation of some facade systems. Ventilated facades with their physical qualities are the most effective multi-layered systems having wind and rain barrier. Being produced with advanced technology they provide long-term functional reliability of



buildings. Fitness center "Excellent", business center "Panorama", educational building of the Reshetnev SibSAU, SFU student dormitories can be examples of such buildings.

The popularity of the use of nanotechnology in construction increases. The development and production of such materials bring profit due to their unique properties. And today these innovations should be implemented in the construction industry in Russia. Nanotechnology is our way to development and success.





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## INFLUENCE OF DETONATION NANODIAMOND CONCENTRATION ON THEIR HYDROSOLS' STRUCTURE FORMATION

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Sols of detonation nanodiamonds (DND) are widely applied in different areas. They are the basis of diamond coatings, DND insertion improves lubricant compositions and polishing pastes, DND have been used in electrochemical coating for decades. Dimensional and surface DND characteristics make their application in biology and medicine varied and possible.

For effective use of DND it's necessary to study the laws of their sediment stability.

To scrutinize DND hydrosols sedimentation the volumetric method (a classic method of interface and colloid science) was used in this work. The method consists of measuring a volume of seceding dispersed phase precipitate ( $\overline{V}_{rel.}$ ).

0,1-1,5 mass % nanodiamond aqueous suspensions were used for the study. They were obtained by three-minute ultrasonication at 22 kHz. Produced on the CSC SB RAS and SFU joint section the nanodiamonds cleaned from non-diamond carbon by heat treatment in the air in the presence of boron trioxide  $B_2O_3$  were studied. Such sols were shown to be sedimentation stable in the absence of electrolytes for a long time. The average size of particles or of their solid aggregates in the aqueous medium is 13 nm. The size of most particles ranges from 10 to 100 nm (disk centrifuge CPS 24000).

The DND hydrosols were observed in the presence of 0,2 M potassium chloride KCl solutions. According to calculations of particles interaction energy, based on the Derjaguin-Landau-Verwey-Overbeek's theory (DLVO), the potential barrier, which prevents particles aggregation, is completely suppressed at this electrolyte concentration.

The volumetry results are shown on Fig. 1. Fig. 1 plots that the velocity of DND particle sedimentation decreases with the rise of dispersed phase concentration. Besides in the initial period of time the qualitative difference of graphs is seen between low-concentrated hydrosols (0,1 and 0,2 mass %) and systems with higher DND content (0,3-1,5 mass %). In case of low DND concentration sharp decline of sedimenting precipitate volume is observed whereas in other cases sedimentation appears to be gradual. It can be interpreted as follows: at low DND concentration aggregates settle structureless. But at  $c \geq 0,3$  mass % continuous coagulation structure forms almost immediately. For such structure fast definition of precise frontier between settling dispersion and continuous medium is typical.

To understand the correlation of DND concentration and structure formation (Fig. 2) the solid phase volume fraction  $\varphi(t)$  in precipitate was calculated using experimental data and such initial parameters of the system as continuous medium density (distilled water;  $1 \text{ g/sm}^3$ ) and solid phase density – DND pycnometric density ( $3 \text{ g/sm}^3$ ):

$$\varphi(t) = \frac{V_{s.p.}}{V(t)} = \frac{m_{s.p.}}{V(t) \cdot \rho_{s.p.}} = \frac{m_{s.p.}}{\rho_{s.p.} V_0 \overline{V}_{rel.}(t)} = \frac{\rho_0 c}{\rho_{s.p.} \overline{V}_{rel.}(t)},$$

where  $V_{s.p.}$ ,  $m_{s.p.}$ ,  $\rho_{s.p.}$  – volume, mass and density of solid phase in hydrosol,

$V_0$ ,  $\rho_0$  – continuous medium characteristics,

$V(t)$  – precipitate volume,

$c$  – hydrosol's mass concentration.



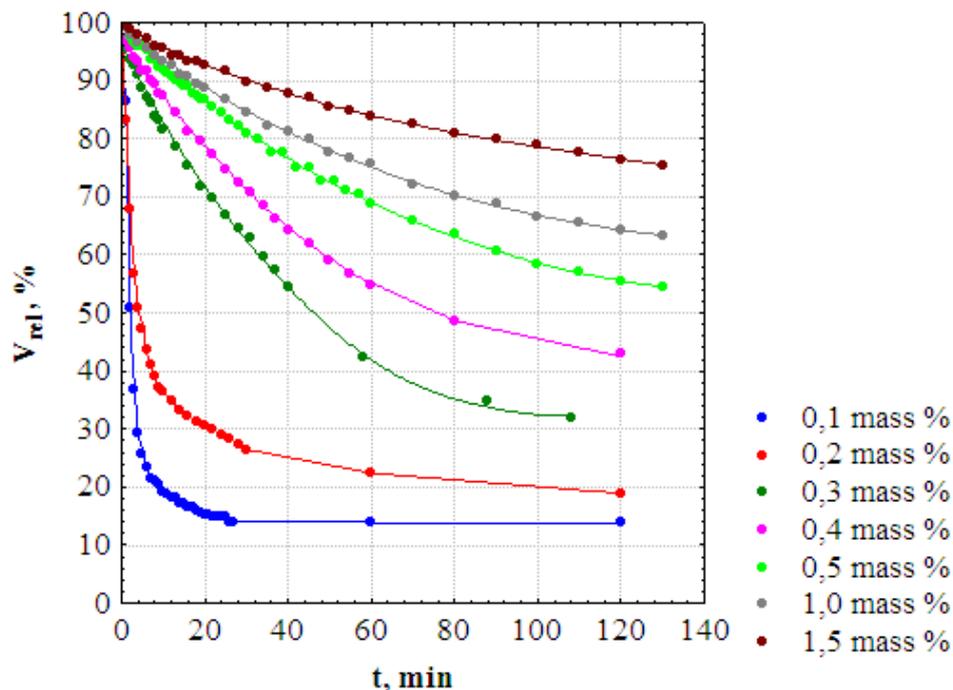


Fig. 1. Volumetry of DND hydrosols of various concentrations

Data from Fig. 2 graphs also confirm the formation of dense aggregates at early concentrations (to 0, 2 mass %), which sediment in precipitate actively. Increasing dispersed phase concentration leads to precipitation of loose aggregates due to formation of coagulation structure, where growing aggregates settle gradually from sol above the precipitate. The gain of sedimentation volume density at further increase of concentration is determined by growth in the number of particles in the volume of the continuous medium and corresponding rise of interparticle contacts. Coagulation decelerates due to the upgrowing hardness of the lattice.

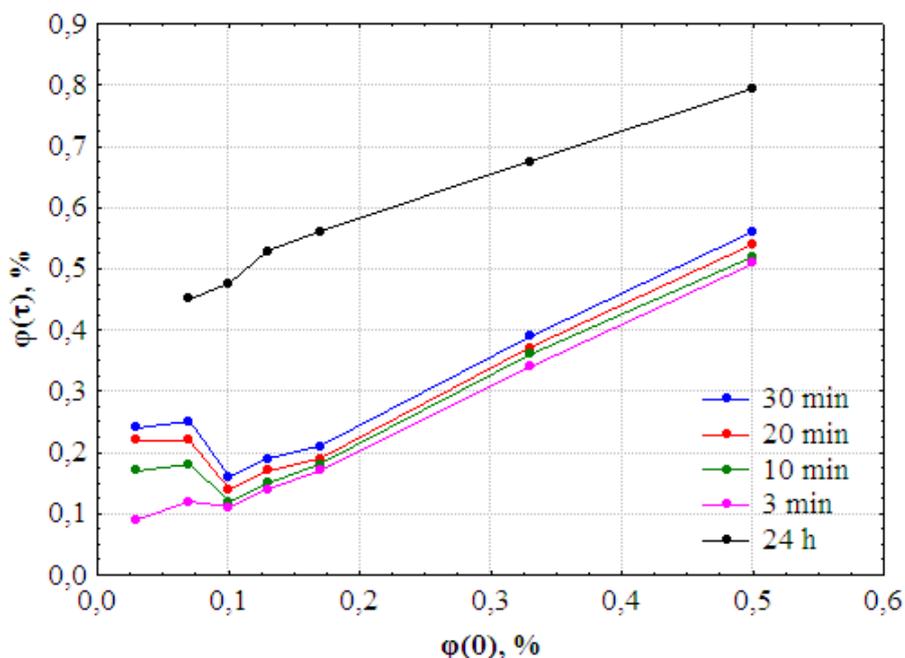


Fig. 2. The dependence of solid phase volume fraction in sedimentation precipitate on original solid phase volume fraction in the system at different settling time ( $T = 299 \text{ K}$ )



The experiment similar to this but without electrolyte was conducted in [1] – Fig. 3.

The comparison of two experiments shows that the insertion of electrolyte in the system reduces solid phase volume fraction by several times and changes the dynamics. Without the electrolyte at the set time (24 hours) and DND concentration higher than 0,15 % the equilibrium shifts towards the formation of big loose aggregates, which consolidate gradually losing the volume. Whilst in electrolyte presence coagulation structure forms and has been constructed from sedimenting aggregates.

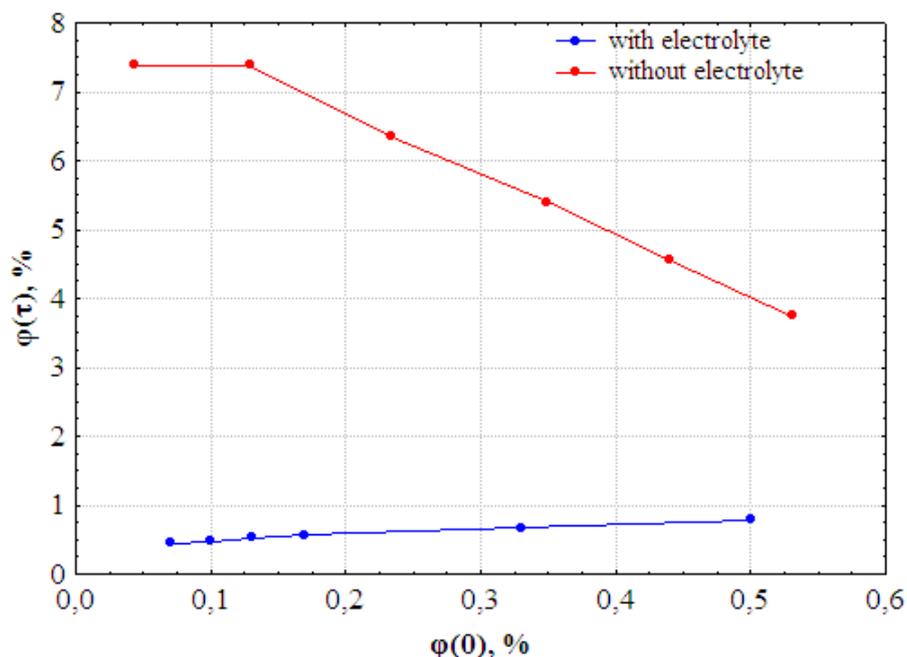


Fig. 3. The dependence of solid phase volume fraction in sedimentation precipitate on original solid phase volume fraction in systems with and without electrolyte ( $T = 299 \text{ K}$ )

Obtained results on the issue of aggregative and sediment DND hydrosols' stability can be used for optimization of polishing pastes and DND-based suspensions consistent [2, 3]. Thus, in [3] it was reported, that essential condition of polishing pastes' high performance properties is aggregative instability leading to the formation of sedimentary stable coagulation structure. However, increasing dispersed phase concentration leads to the creation of mechanical defects on the polished surfaces in the form of diamond scurf. Thereby it looks quite promising to consider the application of relatively low amounts of DND with simultaneous injection of electrolyte, which would ensure coagulation structure formation.

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## COMPARATIVE ANALYSIS OF DIFFERENT TYPES OF HOUSES

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Modern cities are growing rapidly. But the same problem with the choice of materials arises every year. Unfortunately there is no ideal material. They all have its advantages and disadvantages. Let us consider some of them.

One of the most rapid and simple technologies is frame houses. These houses are built on the basis of the framing from wood or metal. Basalt wool and mineral wool insulation serves in the construction of frame houses. The simple design of such houses allows the use of any materials. Modern production technology and the construction of frame houses are sometimes even better than brick or concrete houses thanks to their reliability and durability. These houses have a number of advantages.

Frame houses do not shrink unlike stone and brick houses. They are light. They do not require massive base, so the cost of the house is reduced significantly. Frame houses are incombustible when built from non-combustible materials. Because they prevent the fire from inside the house

On the other hand frame houses have some disadvantages. They have a bad air exchange. Such houses are cold in winter and they are hot in summer. Frame houses are not earthquake-resistant, unlike brick houses. Sometimes instability leads to loss of rigidity of the entire structure.

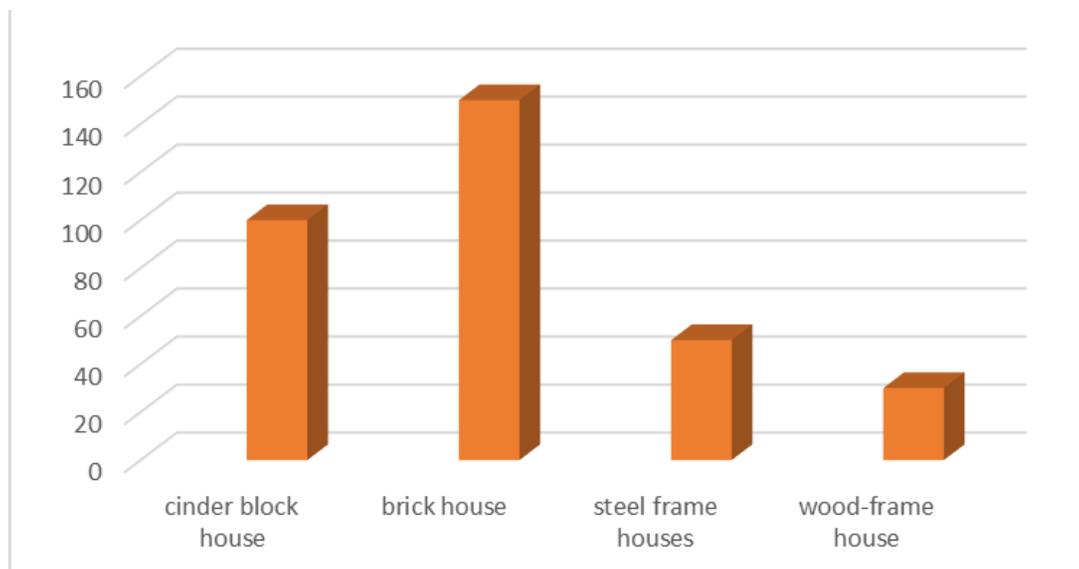
Brick has been used in construction for thousands of years and still represents a popular building material for houses. It can withstand heavy physical stress. A brick house needs a proper concrete foundation. Therefore, the foundation will be more expensive as compared to other construction systems, as it needs to support more weight. In addition, you need to install more reinforcing bars in the foundation, pillars and in the ceiling, as to bond together the walls in one rigid structure. In summer, this means that the hottest temperatures of the day won't hit the inside of your home as quickly as they would in a house made of more lightweight materials. In winter, the interior side of the wall absorbs and redistributes the heat inside the house. Brick walls block out noises from outside more effectively than other building materials, thus creating a peaceful and calm atmosphere inside.

Of course brick has negative effects as well. Brick is unable to sustain years of extreme changes in temperature and can start cracking. Snow and water can get into the pores in brick and mortar and then expand when it freezes. This causes a gradual breakdown of the brick that will require replacement over time.

Cinder blocks are used to fill the frame with reinforced concrete monolithic housing construction, the construction of cottages, garages, repair and reconstruction of buildings. Cinder blocks are durable material. In areas with severe weather conditions builders may use cinder blocks to protect construction from hurricanes and tornadoes. Cinder block walls withstand strong winds. It can also endure the effects from earthquakes and fires. Concrete blocks are highly resistant to cracking and crumbling in extreme temperatures.

Apart from advantages that we mentioned above, there is a number of disadvantages. Cinder blocks are very sensitive to moisture. Without external finishing cinder block walls cannot serve long. Therefore, their cheapness as building material can be overridden by the cost of exterior cladding.





*Figure 1. The lifecycle of different types of houses by year.*

The bar chart in Figure 1 shows the lifecycle of different types of houses by year. A brick house stands in first place on the strength. It serves for about 160 years. The cinder block houses take the second place. Steel frame houses and wood frame houses have the shortest lifecycles. So we can say that the lifecycle of brick houses is the longest of all other houses.

Currently the construction technology based on frame dominates on the primary housing market in the city of Krasnoyarsk. Because such houses are built quickly. The houses from brick take the second place. Another situation is in the market of low-rise housing. In this sphere brick is used for construction. Cinder blocks are rarely used. There is no doubt that the technology of frame houses construction cannot displace the construction of brick. Brick houses occupy 39% of the total area of the Krasnoyarsk Territory. Five brick plants provide 90% of the production of building bricks of the Krasnoyarsk Territory. Local producers meet the needs of construction companies in the brick completely. This reduces construction costs significantly. Because construction companies do not have to deliver bricks from other countries and cities.

We have considered the advantages and disadvantages of three types of buildings. People assessing their financial abilities and durability of construction can choose a more suitable type of house for themselves.

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**CALORIC EFFECTS IN FERROICS****Gudkov Vladimir****scientific supervisor & language advisor T.V. Stupina***Siberian Federal University*

Due to the rapid technical progress, modern society more often faces with problems which are related with questions about cooling of different devices and equipment in industry or daily life. Most cases of cooling on medium and low-temperature level are realized with the help of liquefied gases which are produced on really huge liquefaction machines. Such methods are often irrational and sometimes conflict with such requirements as reliability, compactability, quiet, environmental safety, low cost, etc.

Lately the most effective methods of cooling are methods based on using caloric effects (CE) in solids, particularly, solids which undergo phase transitions. In general CE relate to the reversible change of entropy or temperature of a thermodynamic system when the external fields (power, magnetic, electric) change in adiabatic or isothermal processes [1-3].

Caloric effects can be realized in any solids, but the maximal changes of entropy or temperature can be reached in materials called ferroics which include ferromagnetics, ferroelectrics and ferroelastics. According to the nature of material magnetocaloric (MCE), electrocaloric (ECE) and barocaloric (BCE) effects are distinguished. There are 2 groups of methods for their measurements: direct (with thermocouples) or indirect (getting different temperature dependences).

Nowadays great number of different materials and compounds have been investigated and notable values of CE have been obtained. In particular, figure 1 demonstrates the results of research the MCE in some solids ( $T_c$  – the temperature of phase transition). It is evident that changes of temperature for certain materials have been received from 5 to 20 degrees at room temperatures. However, this result requires very large magnetic fields.

At the same time there are substances which are induced by two effects simultaneously: MCE and BCE, ECE and BCE. Such materials are called multiferroics. Their properties can be controlled only by one of the external field. Moreover, there is double CE which occurs when a sample is applied to two external fields simultaneously: electric and force, magnetic and force. It has been found that the value of a double CE has advantage over the value of a monocoloric effect.

On the basis of caloric effects closed refrigeration cycles can be realized, on their basis – cooling devices. Let's consider one of the existing magnetic refrigerators. Refrigerant (gadolinium in the form of beads or foil) is located in four cells on the ring which rotates between the heat exchangers. This device uses the permanent C-shaped magnet (Fig. 2). Each cell sequentially enters the magnetic field, and simultaneously due to the MCE the refrigerant temperature increases. At the same time the cell is in the thermal contact with hot heat exchanger (from which the heat outflows to the environment), and thereby the temperature of the refrigerant decreases at least up to the initial temperature. Immediately after the cell gets out of the magnetic field, the temperature of the refrigerant decreases further (due to MCE) and becomes lower than the initial. Upon further rotation of the ring the cell interacts with a cold heat exchanger (cooled object) and the temperature of the refrigerant grows up due to the heat extraction from the cooled object. Operating temperature range is 20 K.



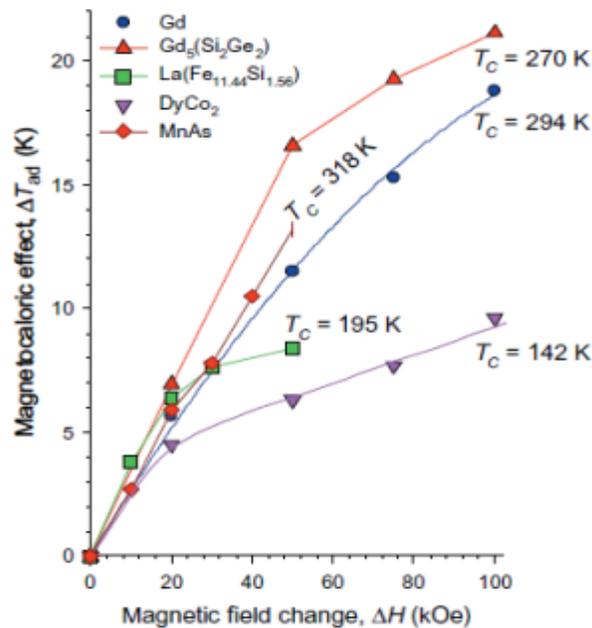


Fig. 1. Dependence of MCE in adiabatic conditions as functions of magnetic field [4].

The main advantage of refrigeration devices based on the use of caloric effects is a big density of a solid in comparison with a density of steam or gas. That's why the use of dielectric or magnetic material as a working medium provides the possibility of creating significantly more compact fridges. Besides, solid coolers have the important features:

- 1) convenience and ease of operation that allow to create unattended equipment in space, sea and hard to reach areas of land;
- 2) noiseless work;
- 3) spatial orientation independence;
- 4) ability to use an integral version, for example, when a cooler and electronic functional scheme are produced in one technological cycle.

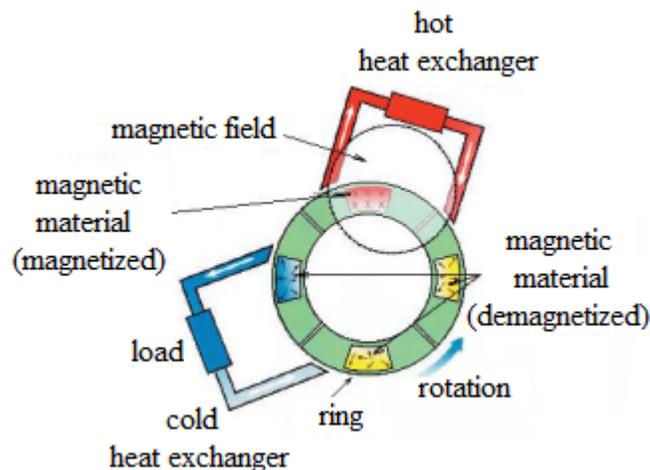


Fig. 2. Magnetic refrigerator with a stationary magnet [5]

Significant disadvantages of solid-state refrigerants are:

- 1) impossibility of a good thermal contact with the cooled object;
- 2) impossibility to use MCE without large magnets (which must be shielded), especially in the field of room temperature. ECE and BCE need high electric voltage and pressure, which require additional means of safety;
- 3) relatively high price of solid-state materials with a significant caloric effect.

In conclusion, we can say that the investigation of CE of different physical nature is a very perspective direction, contributing to the development of fundamentals of CE and their practical use by creating solid-state coolers. That's why lately there is the intensification of research of CE, and further progress largely depends on the success in the field of materials. But now materials with significant values of monocaloric effects have been already obtained, and it allows us to consider them truly effective for application as solid-state refrigerants.

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УДК 72.009

## **INNOVATIVE ECO-CONSTRUCTION APPROACHES FROM THE CUSTOMER'S POINT OF VIEW.**

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**Language supervisor: T. V. Zhavner**

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Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. In other words, green building design involves finding the balance between homebuilding and the sustainable environment.

Building construction and operations can have extensive direct and indirect impacts on the environment, society, and economy, which are commonly referred to as the 3 P's ('People', 'Planet', 'Pocketbook'). The field of sustainable design seeks to balance the needs of these areas by using an integrated approach to create 3-win design solutions.

The notion of green building varies depending on the specialist. For eco-builders, it means a clean building, using natural materials. They consider that a building must above all adapt to humans, the well-being of its occupants being capital. These partisans of green building condemn the use of toxic substances in the industrial manufacture of construction materials. Experts in energy savings aim to limit the negative impact of human habitat on the environment through ultra-modern technologies and to reduce the amount of energy consumed by buildings, houses and apartments. They recommend enhanced thermal insulation and leading-edge construction techniques. Eco-builders consider a building over its whole lifetime. Not only do they integrate energy savings, they also take into consideration the origin of the materials used and their management (elimination, recuperation) at the end of their life.

But what is green construction for customer? There were many words about green architecture, but one theme is rather rare – customers still prefer conventional construction methods.

It's necessary to do a lot of efforts to promote an eco-architecture in our society. Today the majority of people recognise the term Green Building and most of people consider it with a positive meaning. Among those people who consider an eco-construction positively, most of people do not know the features and peculiar properties of such construction. People often ignore what can distinguish them from common construction methods, how they can be integrated in residential construction and which selection of the ecological options should be implied by the companies and acquirers.

Therefore within the population there is a lack of information, combined with the circulation of several misconceptions. In fact, most people associated a particular architectural style with eco-construction, something modern and contemporary, with the addition of complex systems such as solar panels and water heaters, geothermal systems or green roofs. Promotional communication should accentuate the fact that it is possible to build a high-performance eco-home which nevertheless has traditional aesthetics. What is more, subtle or even invisible measures, such as low-emission windows, high-quality ventilation ducts and suitable insulation make a significant contribution to the energy efficiency of a home without changing its physical aspect or rendering the construction process overly complicated.



For optimum operation, ecological methods and technologies must be integrated into a coherent design. The expectations of today's owners and occupants in terms of maintenance, operation and comfort are very high, which results in corresponding technological and energy costs. An important vector for promoting ecological construction is construction regulations.

Other problem of green architecture is its cost. Or stereotype about its cost.

Usually, the ecological properties of a building are considered as an additional cost. In this vision of things, the construction of a green building is inevitably more expensive than a less eco-efficient solution, as it implies the use of high quality materials, high efficiency materials and a more complex work flow. The approach that consists in considering that the payment of a supplement is inevitable to make a project eco-sound is now fading away to allow more holistic designs and a global vision of project costs and benefits.

Today, research scientists, architects and owners observe that a program that is oriented to sustainable development from the outset may enable us to discover techniques that will bring environmental and social benefits without additional costs. For example, by simply orienting a building to exploit its windows and capture passive solar heat as much as possible, promoters and architects can create their designs with a mind to consume less energy, increase the sustainable development aspects and improve daylight penetration, which can increase employee productivity without incurring additional construction costs.

A green building can even help the owner to eliminate expenditure from the outset. The choice of cooling equipment is a good example. In this way, if heat losses of an eco-construction project are reduced to a minimum through efficient lighting and the building envelope is eco-efficient, the building will need a comparatively smaller cooling capacity. This can therefore avoid to install an additional cooling system and can even reduce the project budget significantly.

Only few customers are ready to pay for the mythical environmental aspects. And at the design stage the task of the architect is to explain why the green building is not so greatly important, but it is also useful for the consumer.

The construction of a green building may generate only few additional costs, even none, but that is not due to spontaneous generation. The required evolution in processes is to design and construct a building with an integrated approach which requires a great deal of effort and must be perceived as having sufficient added value to be adopted by the industry. Rightfully so, the owners and promoters wish not only to be assured that a green building will not cost them much more, but they also wish to be sure that it will produce substantial benefits that will justify their efforts. Of course, one of the benefits of a green building is to be able to use it as a showcase for public relations. People interacting with companies and organizations now expect to see a certain degree of environmental action. A green building conveys a physical and permanent message on a company's commitment in terms of stewardship and environmental responsibility.

Concerns due to climate change encourage governments to enact laws that impose measures to reduce carbon emissions. Similarly, shareholders are increasingly demanding that businesses manage their environmental and carbon footprints responsibly, as well as anticipating the risks of climate change to which they are exposed. The construction of a green building can help owners to comply with these requirements.

These advantages help to demonstrate the value of a building, but they do not always suffice to motivate an owner to adopt an eco-construction approach. As with any financial decision, the return on investment is crucial. However, in many cases, eco-construction is a byword for energy savings and potentially significant savings can help the owner to cross the eco-construction line.



When a green building is designed to optimise efficiency and reduce the use of resources to a minimum, it must produce a lower energy bill. It is commonplace that the energy bill is half as much as that for a building built according to minimum standards. This bill will drop even further when on-site generation of renewable energies is included in the project.

Nonetheless, these energy savings generally benefit the building occupants and not the architect or the entrepreneur. To alter this erroneous perception of the cost/benefit ratio, recent studies have attempted to quantify the value (for the owner) of a green building, using measurements done by the whole property sector. Below are some of the conclusions drawn by this study:

- Ecological buildings sell at a higher price. McGraw Hill measured the price premium on the sale of Energy Star buildings and obtained a result of 12%. Another study estimated the price premium on LEED-certified (Leadership in Energy and Environmental Design) buildings at 31%.
- Rents on ecological buildings are higher. By comparing lease contracts on Energy Star buildings with those on non-Energy Star buildings, researchers at Maastricht University observed that rents on eco-efficient buildings were 3.5% higher than others.
- Ecological buildings are more attractive for occupants. The same study revealed an occupancy rate 6% higher for Energy Star-certified (Energy Star – international standard for energy efficient consumer products) buildings.

Given that available data is increasing and that building owners are succeeding in assessing the benefits of a green building more effectively, an increasing number of projects will follow this path. As part of a new integrated design approach, it is possible to reduce the additional cost of ecological buildings to a negligible level. What is more, the benefits are increasingly visible and tangible. The two variables of this equation are progressively but inevitably leading us towards an era of construction of sustainable buildings. Real estate professionals have realised this and the increase in eco-buildings will result in more sustainable urban habitats all over the world.

By ensuring the continued improvement of the methods of selecting construction locations, design processes, construction methods, operating methods and modernisation techniques, political leaders should support the green building approach. The application of leading edge eco-efficient techniques may generate enormous reductions in the demand for fossil fuels and in greenhouse gas emissions. Design and construction best practices can also assist in resolving environmental problems related to the exhaustion of natural resources, the elimination of waste and the pollution of the air, water and soils. The growing “ecologisation” of the building industry may help to improve human health and prosperity.

Thus, the green building is beneficial not only from a global point of view, but also from the consumer’s point of view, and one of the tasks of the architect is to bring this idea to the customer.



**QUANTUM COMPUTERS. APPLICATION AND IMPLEMENTATION ISSUES****A. Kargapolova,****Language supervisor: A. Alekseeva.***Siberian Federal University.***Introduction**

Computers of all kinds play an important role in our life, starting with daily living needs and ending to space programs. We intrust our lives to them in hospitals, let them store all valuable information about us, they help us to discover world around us. The complexity and number of tasks are increasing insanely fast, so we have to find a new method of processing information in a fast, effective way. These machines will harness the power of atoms and molecules to perform memory and processing tasks. Quantum computers have the potential to perform certain calculations significantly faster than any silicon-based computer.

**What is quantum computer?**

In the classical model of a computer, The Turing machine, developed by Alan Turing in the 1930s, is a theoretical device that consists of tape of unlimited length that is divided into little squares. Each square can either hold a symbol (1 or 0) or be left blank. A read-write device reads these symbols and blanks, which gives the machine its instructions to perform a certain program in a quantum Turing machine, the difference is that the tape exists in a quantum state, as does the read-write head. This means that the symbols on the tape can be either 0 or 1 or a superposition of 0 and 1; in other words the symbols are both 0 and 1 (and all points in between) at the same time. While a normal Turing machine can only perform one calculation at a time, a quantum Turing machine can perform many calculations at once. Today's computers, like a Turing machine, work by manipulating bits that exist in one of two states: a 0 or a 1. Quantum computers aren't limited to two states; they encode information as quantum bits, or qubits, which can exist in superposition. Qubits represent atoms, ions, photons or electrons and their respective control devices that are working together to act as computer memory and a processor. Due to the fact that a quantum computer can contain these multiple states simultaneously, it has the potential to be millions times more powerful than today's most powerful supercomputers.

**Application**

It has been shown in theory that a quantum computer will be able to perform any task that a classical computer can. However, this does not necessarily mean that a quantum computer will outperform a classical computer for all types of task. If we use our classical algorithms on a quantum computer, it will simply perform the calculation in a similar manner to a classical computer. In order to show its superiority a quantum computer needs to use new algorithms which can exploit the phenomenon of quantum parallelism.

Such algorithms are not easy to formulate, but once discovered they yield spectacular results. An example of one such algorithm is the quantum factorisation algorithm created by Peter Shor of AT&T Bell laboratories. The algorithm tackles the problem of factorising large numbers into its prime factors. This task is classically very difficult to solve; in fact it is so difficult that it forms the basis of RSA encryption, probably the most popular method of encryption used today. Shor's algorithm cleverly uses the effects of quantum parallelism to give the results of the prime factorisation problem in a matter of seconds whereas a classical computer would take, in some



cases, more than the age of the universe to produce a result.

### Implementation

The problem is, that in real life quantum computers can manipulate only 512 qubits, what makes them not very useful. Modern computers can solve a Sudoku puzzle, but it is too early for them to deal with encryption or complex calculation issues. The technology required to build a quantum computer which could outperform a classical computer, is currently beyond our reach as the coherent state, fundamental to a quantum computers operation, is destroyed as soon as it is measurably affected by its environment. All the attempts to solve this problem have had little success, but the search of a practical solution continues.

There are several quantum computers created nowadays. The first one was constructed in 2001 by scientists from IBM and Stanford University. They demonstrated Shor's algorithm on a 7-qubit computer. In 2015 the highest results were achieved by the Canadian company D-Wave. They created their first quantum computer in 2007. D-Wave Two is the second generation of quantum processors sold by D-Wave Systems. Containing 512 quantum bits (qubits), the D-Wave Two processor was designed specifically to perform a process called "quantum annealing", which is a technique for finding the global minimum of a complicated mathematical function. However, a quantum annealing processor is not a universal computer like a PC and cannot be programmed to perform a range of tasks.

### Conclusion

If large-scale quantum computers can be built, they will be able to solve certain problems much faster than any of our current classical computers. They are more productive, though they have the potential to perform a range of operations on data similar to traditional computers, on condition the latter provided enough time and memory. A Turing machine can simulate these quantum computers, but it could never solve such insoluble problem as the halting problem. The existence of "standard" quantum computers does not disprove the Church–Turing thesis. It has been speculated that the theories of quantum gravity, such as M-theory loop quantum gravity, may help to produce even faster computers. Currently, defining computation in such theories is an open problem due to the problem of time, i.e., there currently exists no obvious way to describe what it means for an observer to submit input to a computer and later receive output.



**THE PROBLEM OF TRANSMITTING MESSAGES THROUGH  
A COMMUNICATION SEISMIC CANNEL**

**E. A. Kohonkova,**  
**language advisor I. V. Alekseenko,**  
**scientific adviser Dr. Sci. G. J. Shaidurov**  
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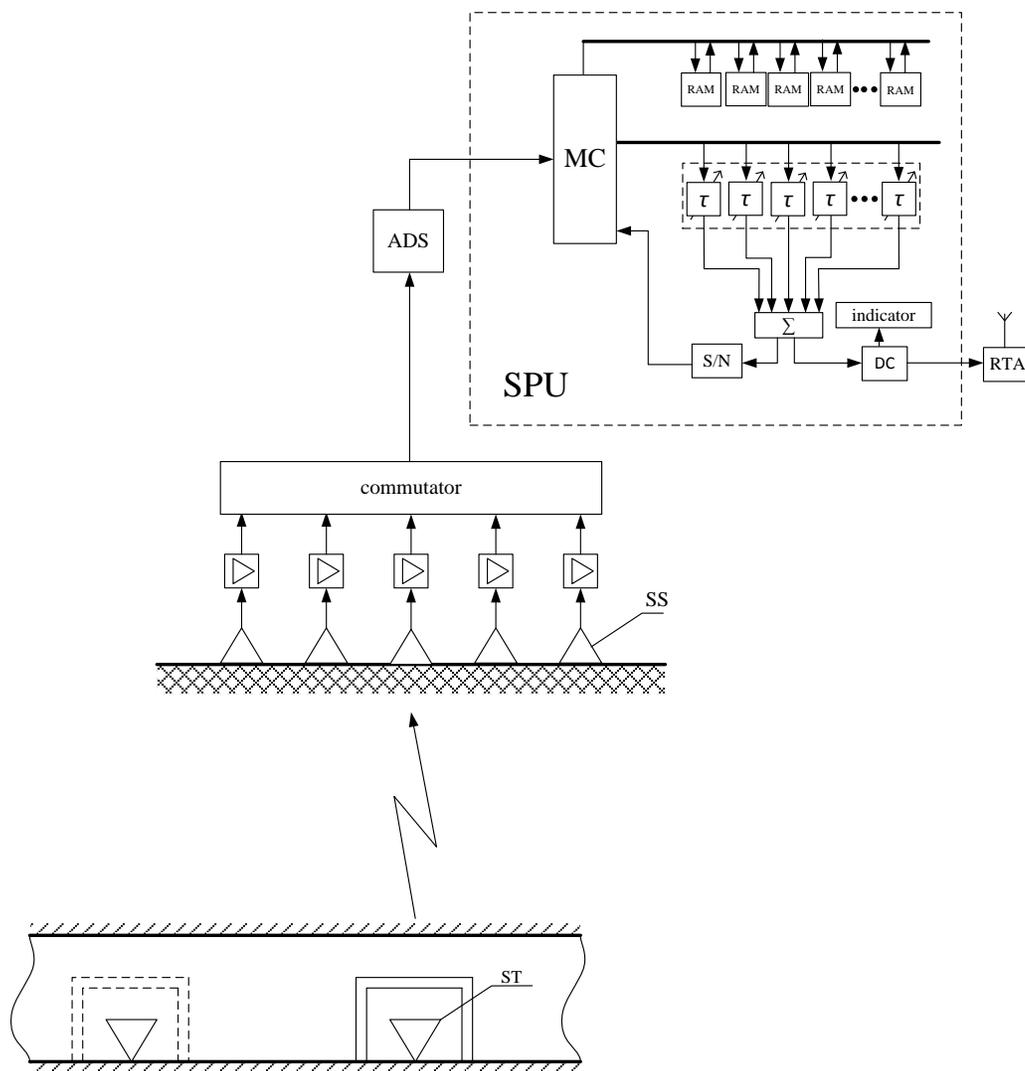
The article describes features of the seismic waves passing through the rock. Due to these seismic waves it is possible to supply wireless communication and alarm systems in underground mines, and also to prevent all chances of emergency conditions in case of accidents in mines.

We know that, mining is the process of extracting useful minerals from the earth's crust – the land and the seas. The process involves the physical removal of rock and earth. Mining is an extremely dangerous activity. The health and safety of mine workers and the protection of the public are achieved by regular mine safety audits and mine site inspections.

We consider the most challenging technical problem is the transmission of signal from the bottom of the mine up to the Earth's surface. The reason is that the installation of transmitting antennas is not possible because of space limit in mines. The US Patent [4] describes a system of such seismic commutation which is based on the excitation of acoustic waves with the help of special seismic sources. As we know, there is no any information about the implementation of this system into working process.

The transmission of seismic waves through the underground formations can be used for communication system and transmitting information through the rock. The system includes the seismic transmitters (ST), located in protective chambers for the personal use in underground mines, and the seismic receiver, located on the Earth's surface. In a case of emergency the seismic transmitter radiates a seismic signal through the rock. The phased antenna lattice (PAL), which has seismic sensors (SS) and is located on the Earth's surface, covers a seismic signal in to an electric signal. These electric signals are amplified by low noise amplifiers. After passing through the commutator the analog signal is converted in to a digital one, in an analog-digital converter (ADC), and then gets to the microcontroller (MC). The microcontroller is connected with the random-access memory (RAM) in accordance with the number of seismic sensors. The digital line of delays ( $\tau$ ) is connected with the second tire. This process occurs due to the co-work of the microcontroller, the adder and the device, which measures a relation of signal to noise. This digital line makes fine tuning of delays for seismic sensors to reach the maximum relation of signal to noise. After the appropriate turning of the system, the signal and the message are accepted and accumulated in the RAM. After the completion of reception of the message, it is processed in the decoder and transferred to the indicator, and to the radio transmitting device.





*Fig. 1. Block diagram of the system of seismic communication*

As a result, this method of wireless communication system can be useful in any emergency conditions in the case of accidents.

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**ORGANIC BUILDING MATERIALS**  
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It is generally agreed that, organic building materials are the first building materials used by human beings in the process of building. They come from renewable resources and can be easily extracted by humans. The main benefits of these materials are their cheapness, prevalence, and excellent insulation properties. The first thing that needs to be said is that, the global market for green or organic building materials is categorized into the following material types: insulation, exterior siding, framing, roofing, interior finishing and others. It is understood that, the most popular green building materials are steel, metal, glass and wood. These materials were used in ancient times and are used nowadays.

Compared to the other construction materials, green building materials offer specific benefits to building owners and building occupants. Green building is not a simple development trend. It is an approach to building suited to the demands of its time, whose relevance and importance will only continue to increase. The benefits of green building materials may be divided into several categories. First, let us try to understand what the advantages of green materials are:

- Emissions reduction. Pollutants released by fossil fuel fired electricity contribute to global climate change, cause air quality issues such as acid rain and smog, and pose risks to human health.
- Water conservation. Recycling rainwater and greywater for purposes like urinal flow and irrigation can preserve potable water and yield significant water savings.
- Temperature moderation. The heat retention properties of tall buildings and urban materials such as concrete and asphalt are the primary causes of urban heat island effect. These conditions may be offset by conscientious building design and site selection, as well as planting trees to accompany new developments.
- Energy and water savings. The resource efficiency provided by green design and technology leads to drastic reductions in operation costs that quickly recoup any additional project costs and continue to offer dramatic long-term savings. Money previously directed toward utility costs may be used for other purposes.
- Increased property values. With energy costs on the rise, the low operating costs and easy maintenance of green buildings make for lower vacancy rates and higher property values
- Healthier lifestyles and recreation.

It should be noted that, green products made from organic materials, salvage products, certified wood products, rapidly renewable products, products made from agricultural waste material are also green building materials.

In Russia, quality is still associated with expensive materials, regardless of their environmental qualities. Europeans realize that the quality of housing depends on many factors including minimum amount of natural resources used in construction, avoidance of artificial materials and materials requiring a lot of energy for processing. Energy-saving technologies are also crucial for creating high quality residential environment. This tendency has not yet become fashionable and has not become an essential part of Russian lifestyle. From the social point of

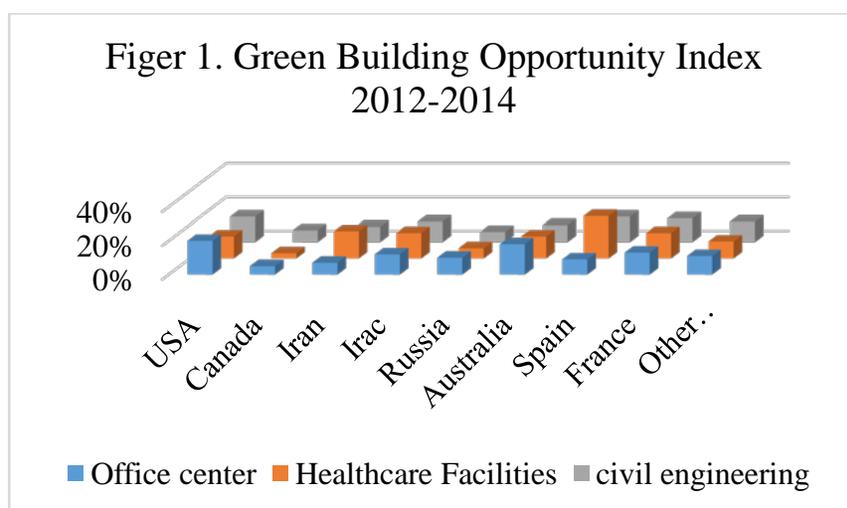


view, wealthy people who can afford such homes do not buy them just because they are not trendy.

However, green building materials are used in Russian construction not only in civil engineering, but also in the construction of unique buildings. Olympic facilities of various types (indoor and outdoor sports arenas, cottage village, university, office buildings, hotels and spa resorts as well as a railway station) in Sochi were certified on individual criteria, developed in accordance with the logic BREEAM Bespoke International 2008–2011 standards. These standards determine the principles, categories, evaluation criteria, sustainability indicators of habitat, as well as weighting for ratings for buildings; provide a framework of basic indicators, which, when necessary are corrected or supplemented by coefficient parameters to reflect regional or local climate, energy, economic, social and even bespoke features, establishes classes of sustainability for the built environment, including renovated residential and public buildings, for both the building and project documentation.

It is a well-known fact that, the most popular topic in Europe is the application of green building materials. Buildings have extensive direct and indirect impacts on the environment. During their construction, occupancy, renovation, repurposing, and demolition, buildings use energy, water, and raw materials, generate waste, and emit potentially harmful atmospheric emissions. These facts have prompted the creation of green building standards, certifications, and rating systems aimed at mitigating the impact of buildings on the natural environment through sustainable design. A green building may cost more, but can save money over the lifecycle of a building due to lower operating costs. Europeans understand the effectiveness of the use of green building materials.

It would be unfair not to mention the fact that the use of green building materials can be very cost-efficient mainly because you can look for them in demolished infrastructures or you can buy them at a cheap price. Because of that, it will greatly satisfy the financial objectives of your project. Such buildings are also efficient in terms of energy as builders can use solar energy as an alternative source for heating systems. Floor plans should be done by positioning rooms that make the best use of sunlight and shade, which can greatly reduce the consumption of energy.



This figure shows the use of green building materials in the world. We should mention the fact that Russia is not the leader in the use of green building materials. In recent years, European countries are actively using new technologies of green building preserving the environment

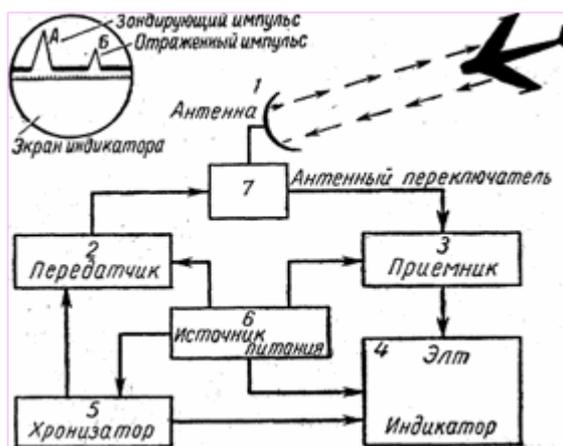
To draw the conclusion, we should notice that, the greening and dematerialization of building involves the whole economy. It must take place on every level of production, consumption and regulation. Green initiatives have to begin everywhere. We live in a world in which, the increasing world population has greatly affected the cleanliness of the environment we are living in. Some scientist would argue that climate change or global warming has resulted primarily from environmental pollution. This is the reason why green organizations, advocates of cleaner environment promote the use of green building materials.



**MODERN RADAR SYSTEM TECHNOLOGIES****Krivoruchko Y.A.****Langauge supervisor E.S. Latynina***Siberian Federal University*

Radar, an acronym for Radio Detection and Ranging, is used for various purposes both military as well as civilians. Radar is an object-detection system that uses radio waves to determine the range, altitude, direction, or speed of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain.

As early as 1886, German physicist Heinrich Hertz showed that radio waves could be reflected from solid objects. In 1895, Alexander Popov, a physics instructor at the Imperial Russian Navy School in Kronstadt, developed an apparatus using a coherer tube for detecting distant lightning strikes. The next year, he added a spark-gap transmitter. In 1897, while testing this equipment for communicating between two ships in the Baltic Sea, he took note of an interference beat caused by the passage of a third vessel. In his report, Popov wrote that this phenomenon might be used for detecting objects, but he did nothing more with this observation.

*Radio locator**Picture 1. Radar diveses and its uses.***Different types of radar systems**

**Multifunction Radar.** The multifunction radar is based on electronically steerable phased array antenna. It can simultaneously perform surveillance, target designation, multiple targets and missile tracking, and guidance. The radar ideveloped as the primary sensor element at the firing unit level for the surface- to-air missile weapon system.

**Picture 2. Roll-in multi-function radar.**

**Low-level Lightweight Radar.** The LLLR has been developed to protect valuable assets in the mountainous regions against aerial threats. It is a quadripod mounted fully outdoor shelterless equipment, rugged enough to operate in harsh environment, temperature extremes, and in strong windy conditions. The main constituents of the radar are: composite antenna comprising primary radar antenna and secondary surveillance radar antenna; pedestal to rotate the antenna, a quadripod, and conduction cooled central unit that houses most of the electronics and remote Commander's Display Unit (CDU).



*Picture 3. Type of LLLR*

Pulse compression radar system. Pulse compression Doppler radar (PCDR) is a fully coherent, 2D, transportable surveillance radar developed to meet the air defense role of the IAF for ground-controlled interception of targets. The radar is capable of detecting air targets with low and medium altitude coverage. A mechanically rotating, doubly curved parabolic antenna with pencil beam in azimuth and cosecant squared radiation beam in elevation illuminates the space and covers 360° in azimuth. The high gain corrugated horn antenna with fairly low side lobe levels supports horizontal polarization. The role of IFF is achieved through an integral vertically polarized radiating element.



### 3D-PRINTING TECHNOLOGY IN CONSTRUCTION

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3D-construction is one of the most promising new trends in 3D printing. Construction companies from all over the world are interested in the 3D-construction. They want to be the first to create new technologies and materials.

3D-printers use a method of layer-by-layer creation of tangible object on the basis of virtual volumetric model. This method is used in 3D-construction. The 3D-printer allows to increase a production efficiency 10 times. 3D printing technology saves about 45 percent of building materials, shortens production by about 60 percent and decreases labor costs by 50-80 percent.

Architects and engineers from different countries are developing advanced technologies in 3D construction. The USA, China, Netherlands and Russia take a huge part in the progress of 3D construction.

3D-construction has started with the project of the American professor Behrokh Khoshnevis from the University of Southern California. He presented a 3D printer that prints walls with special concrete. One of the technology's features is to form a structure by squeezing out new layer of mixture on the top of a previous one. The printer lays out the base, walls, wires, pipes stage-by-stage, and creates a frame of a building. The equipment is capable to move horizontally and vertically. Moreover, Behrokh intends to reduce the cost of construction of the houses by shortening the amount of time spent on the erection of buildings.

The Russian architect Andrey Rudenko, who lives in Minnesota, also deals with the development of 3D construction in the USA. He designed the world's first 3D printed castle. He uses a mixture from cement with various additives and avoids expensive and rare components. The device consists of a printer and a crane-beam. The printer moves on rails which can be extended over about 100 meters. The crane-beam can be extended up to 10 meters. Now he is developing plans of 3D Print of a 2-Story "Zero Energy" house, which can be built within 5 days with the help of advanced 3D printer. He has come up with a "new revolutionary system of construction", that uses 3D printing as well as a way of insulating the building, and heating it with the help of solar energy. His method also covers the problem of conservation of the heat.

In East China, in the city of Suzhou, the company WinSun has derived the formula of 'ink' for the printer. The basis of "ink" consists of recycled rubble, fiberglass, steel, cement and binder. It also dries up within 24 hours. The company produces waste from the recycling construction that produce a lot of carbon emissions are made into brand new building materials. Chinese engineers invented a new technology of a 3D printer. Waste from recycling construction produces a lot of carbon emissions, but with 3D printing, the company has turned that waste into brand new building materials. The printer, which builds houses, has the height of 6.6 meters, the width of 10 meters and the length of 150 meters.

Dutch architects prefabricate elements for building a house with a 3D-printer, they do not need the printer on a construction site. The 3D-printer has a height of 6 meters. Ready-made parts are joined to each other on a «lego» principle. The building material consists of bioplastics that contains 75% of vegetable oil. The material is possible to be subjected to secondary processing by the method milling it into powder. This technology will reduce the unhealthy environmental



impact. Building blocks have cellular internal structure that at the end of construction will be filled by foam. The structure can be compared with concrete by weight and can give support to the house.

Currently, Russian architects of the State Technical University in the city of Tver are developing a material that can be used for architectural 3D printing. The idea of the Russian architects differs from others because of mixture that consists of the water resistant gypsum and solid waste, which provides instant hardening. It can be used in special structures, which will shape the structural elements of the complete buildings. In this case, working with a mixture of gypsum and MSW (Municipal Solid Waste), the cost of erection and the construction speed are reduced. This technology will give construction companies the possibility to build low-cost houses.

Each of these systems has advantages and disadvantages. But we can mention general advantages of 3D-printing in construction. They are the following:

- Faster and accurate construction – a 3D printer transfers the digital model into a physical one; errors that arise can only be due to faults in the digital model or the materials that are used. The condensed time frame and automation will reduce the man hours required for each project, both for direct labor and supervision;
- Reduced labour cost – a 3D printer does most of the work with minimal human effort;
- Reduced waste generation – components can be printed to order during the construction phase; those that are not used can be recycled;
- Reduced health and safety risks – by replacing dangerous workplaces on more safe environments, for example to programming;
- Environmental – recycled products can be used to produce the construction materials used in 3D printers.

As technology develops, there are not only advantages, but also disadvantages. Such as:

- Shortage of workplaces – reduced employee numbers in the industry, since the 3D printer does most of the work;
- A limited number of materials can be used, since the same printer might not be able to print the required multiple materials;
- Transportation – getting the printers for large in situ components to and from the site;
- Storage of the printer on site;
- Higher risks – any errors in the digital model can result in problematic issues on site during the printing/construction phase;
- Falling of demand – conventional product manufacturing companies and plant renting companies could suffer as their products are no longer required.

The potential of 3D printing technology for the construction industry is significant. If it continues to be developed, it may revolutionize the construction process, resulting in acceleration and less expense. However, as described above, the technology implementation is not possible without challenges. Solving them makes it progress and develop. The growth rate of technological progress is very high nowadays and we cannot reject the thought that soon we will be able to see 3D construction in the streets of our cities.



**SUBSTATION 220 KV “TAIGA” CONSTRUCTION AND SUBSTATION 220 KV  
“RAZDOLINSKAYA” UPGRADING**

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The Krasnoyarsk Territory is the first in Russia in terms of gold mining. In North-Yenisei and Motyginisky regions a lot of working and still developing gold mining companies are located, the largest of which are:

- "Polyus" - the main activities of this Krasnoyarsk business unit is the Olimpiada deposit development. The ore comes to the substations “ZIF-1,2,3” for the further processing. “Polyus” plans to introduce new businesses onto the field site "Blagodatnoye" (ZIF-5) and to work out new deposits on the Panimbinskaya and Razdolinskaya areas;

- "Sovrudnik" - it deals with the extraction of lode ore using “open way” method and processing the ore in gold mining factory. The company is among the top ten gold mining companies in the country and ranks second in terms of gold in the Krasnoyarsk Territory. Now the main raw material base of the company is the deposits of "Eldorado", "Soviet", "Alexander Ageevskoe";

- Razdolinskayapericlase factory – this factory specializes on the extraction and processing raw magnesite.

The forecast of maximum energy load in North Yenisei and Motyginisky regions has been formed. It is shown in Table 1.

Table 1. The forecast maximum energy load in the North-Yenisei and Motyginisky regions

The name of indicators	2011*	2014	2019	2024
Maximum energy load, MW	158,7	226	365	396
Growth, %		12,51	10,06	1,64
*- fiscal year				

The increase in the maximum energy load for the North-Yenisey and Motyginisky regions will be 237 MW in 2011 - 2024 years. It is due to the development of the gold industry (the development of existing fields and the development of new ones) increasing the household load.

The North-Yenisei and Motyginisky regions of Krasnoyarsk energy system (ES) are scarce in terms of power and in electric energy throughout the forecast period. The power shortage has been increasing throughout the period under consideration. It was 161.7 MW in 2014 and will grow up to 332.2 MW in 2024. As for the electricity generated, it was 1222 million kWh in 2014 and it is supposed to increase up to 2,572 million kWh in 2024. The power and electricity shortage will be avoided by power supply from other sections of the Krasnoyarsk ES.

At present, the electricity consumers, mining complexes and villages located in Motyginiskiy and North-Yenisey regions of the Krasnoyarsk Territory, are supplied by the 220 kV Razdolinskaya Substation at voltages of 110 kV in the double-circuit transmission line Razdolinskaya – Partizanskaya - Bryanka - N.Eruda - Sovrudnik (273 km), which is partitioned



on the 110 kV buses of the Substations Partizanskaya, Bryanka, New Yeruda. From the 110 kV New Yeruda Substation via the 110 kV double circuit transmission line and the 110 kV Olympiadinskaya, the ZIF-1,2 and the ZIF-3 Substations the electricity is supplied to the consumers by Joint Stock Company "Polyus". The 110 kV transmission line in the area of Razdolinskaya – Partizanskaya – Bryanka, New Yeruda – Sovrudnik and New Yeruda – Olympiadinskaya is made of wire with cross section AC-120, (in area Bryanka - New Yeruda is made of wire with cross section AC-185) with a maximum capacity of about 70 MW (375 A), that limits the development of existing customers and the ability to connect the new ones. In addition, in the 110 kV Partizanskaya Substation the current transformers with the nominal current of 300 A are installed.

In some 110 kV substations the reactive power sources are installed: ZIF-1,2 – BSK-2\*1,35 Mvar, : ZIF-3 - BSK-2\*1,35 Mvar, Sovrudnik - BSK-2\*3,15 Mvar.

In the North-Yenisei region the "Polyus" power generation sources are installed, to work in parallel with the grid:

- Electric central heat -1 - 18 MW (3x6 MW), DES-1 - 3.2 MW, DES-2 - 17.3 MW - at the site of the 110 kV Olympiadinskaya Substation;
- Electric central heat -2 - 24 MW (3\*8 MW) - at the site of the 110 kV Blagodatnoye Substation.

When disabling one circuit of 110 kV line or one autotransformer at 220 kV Razdolinskaya it is necessary to limit the power supply to the existing customers.

Using all available sources of reactive power and using the 6th antsapfy RPN on AT 220/110 kV 220 kV Razdolinskaya ( $K_t = 1,818$ ) the voltage levels on the distant 110 kV substations for this area are of 102-106 kV, which is unacceptable for ensuring the quality of power supply to the consumers. In this situation, the connection of new consumers can be implemented only after amplification of the area electrical connections with the grid.

The commissioning of 220 kV Substation Taiga with 220 kV Razdolinskaya – Taiga transmission line is planned for 2019.

The perspective scheme of the electric networks of the territory takes into account:

- strengthening the backbone connections;
- new customers power supply and the increase of the reliability of power supply to the existing ones;
- elimination of "bottlenecks";
- modernization and reconstruction of power grid facilities.

Today gold mining industry is the basic sector of the Lower Angara Region on the territory of which about 20% of Russian gold is produced. In terms of gold production the Krasnoyarsk Territory ranks first in Russia.

According to the 220 kV Razdolinskaya Substation reconstruction project there will be two redundant 220 kV cells for connection of 220 kV Razdolinskaya - Taiga transmission line. The scheme of the 110 kV switchgear in the 220 kV Taiga Substation is recommended to be done according to 110-9 scheme «One working sectionalized by the switch bus system.»

Considering the promising growth of consumer loads and the difficulties in the delivery of large equipment, it is recommended to install immediately two autotransformer with capacity of 125 MVA at the starting step at 220 kV Taiga Substation.

In accordance with the number of connections (2 transmission lines + 2 autotransformers) and based on the requirements of reliability, at the first stage it is enough to make 220 kV switchgear scheme according to the 220-5N scheme "Bridge with the switches in the lines circuits". In this scheme in case of the power autotransformer failure we also lose one line.



However, this occurs for a short time and is determined by the routine switching. In addition, AT failure rate of the considered voltage is relatively low (parameter of failure flow is 0,005-0,021 / year). With an increase of loads to avoid limiting of consumers and unacceptable overload of an autotransformer during the emergency stopping of the another one it is recommended to set the third AT-125 MVA at in 220 kV TaigaSubstation. Third AT must be connected to switchgears 220 kV and 110 kV via the fork from the two switches. The section switch is used as the second one. Simultaneously with the introduction of the third AT the reconstruction of 220 kV circuit up to the one of number 220-9 «One working sectionalized by switch bus system" with the installation of switches in circuits 1AT and 2AT at 220 kV TaigaSubstation must be performed. In the substation switchgear 220 kV should provide two redundant cells for the future connection of 220 kV transmission line in the area of the North-Yeniseisk.

For reliable power supply to existing consumers in the North-Yenisei and Motygin sky regions and the possibility to connect new 110 kV New Yeruda – Sovrudnik transmission lines there is a need to have buses 110 kV in the 220 kV Taiga Substation according to "Entry-exit" scheme and to join in parallel the 220 kV Razdolinskaya - Taiga with 110 kV Razdolinskaya - Partizanskaya - Bryanka - New Yeruda – Taiga lines.

To maintain voltage levels on the buses 110, 220 kV at the TaigaSubstation and in the adjacent network, the reactive power balance in normal and post-emergency conditions at 220 kV TaigaSubstation it is recommended to install the SVC in the amount of two CSR 25 MVAR and four BSK 26 Mvar at bus 110 kV.

The choice of 220 kV Razdolinskaya – Taiga cross wires is made according to the designed loads for the 5 years period from the lines that are planned to be put into service. The wire size is made based on the normalized generalized indicators. The indicators of the normalized values of economic current density are used. In accordance with the Regulations for Electrical Installation (PUE, 2007) for transmission line 220 kV with bare aluminum wire and the annual number of hours of the maximum load (max T) more than 5000 hours / year, the normalized value of the current density is 1.0 A / mm<sup>2</sup>. The determining factor is the normal operating mode of the projected transmission line. The maximum load for 220 kV Razdolinskaya - Taiga falls on the winter peak mode. The flow along one circuit of the 220 kV Razdolinskaya – Taiga line will be up to 84.9 MW (218 A) in 2019.

Thus, the 220 kV Razdolinskaya - Taiga wire section is 275 mm<sup>2</sup> and the nearest standard cross section for power transmission lines 220 kV is 300 mm<sup>2</sup>. The chosen wire cross section is AC-300/39. The selected cross section 220 kV Razdolinskaya - Taiga is subject to verification with the permitted continuous current for heating during the most severe conditions.

In normal download of the projected 220 kV Razdolinskaya - Taiga the maximum winter load will be 18.1 MW (63 A) for each circuit. The maximum load mode during emergency shutdown of one AT 220 kV Substation Taiga will be 35.6 MW (102 A).

In the above post-emergency conditions: disabling one circuit of 220 kV Razdolinskaya – Taiga line as well as, disabling one AT 220 kV of TaigaSubstation, the remaining load in the circuit does not exceed the long-admissible.

At 110 kV Partizanskaya the current transformers are installed with the nominal current of 300 A, which limits the capacity of 110 kV Razdolinskaya -Partizanskaya - Bryanka. It is offered to replace the current transformers at 110 kV Partizanskaya with the new ones with the 600A rated current.

In 2019 the projected increase of the maximum load will be 132 MW in the area. In the period of 2015-2019, the building of 220 kV field Razdolinsk, 110 kV Panimba, 110 kV Noybinskaya, 110 kV Vusokaya, 110 kV Amikan is proposed for this region.



**THE SEMANTICS OF THE WORD «СМЕХ»  
in the L.N. ANDREEV'S STORY «THE RED LAUGH»**

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The science of language personality – linguistic personology – is one of the most important and rapidly developing fields of linguistics. It focuses on an individual and his emotions, feelings, experiences. Linguistic personology integration with semantics is one of the effective ways to develop the former. This direction is usually described as «semantic linguistic personology». In accordance with the modern anthropocentrically-oriented linguistics, we research how laugh is presented in the L.N. Andreev's picture of the world through the semantic analysis of nouns and verbs denoting this concept because they represent the basic ideas of linguistic picture of the world and they are keys to understand some specific features of the author's picture of the world. L.V. Karasev writes: «Осмехе нужно писать интересно, либо не писать вообще» / «Laugh should be written about with interest» [Карасев, 1996, с.5]. Later the author explains that «writing with interest» means revealing some new and unexpected connections.

In ancient times laugh was just a ritual, for example, a mockery of death. Myths show gods not crying but laughing, because laugh «относится к целокупным и неизменно движущимся полотнам ... всеобъемлющей энергии» / «laugh is a whole and continuously moving matter of all-embracing energy» [Аверинцев, 1997, с.71]. Maksim Gorky highlighted that the ability to laugh belongs only to humans.

The Russian word "смех" is defined in dictionaries approximately unambiguously:

- «хохот, невольное, гласное проявление в человеке чувства веселости, потехи, взрыв веселого расположения духа» (Даль, Толковый словарь живого великорусского языка),
- «короткие характерные голосовые звуки, выражающие веселье, радость, удовольствие, а также насмешку, злорадство и другие чувства» (Ожегов, Словарь русского языка),
- «культурно-психологический феномен, в котором выражается способность человека к обнаружению комических ситуаций, содержащихся в жизни и искусстве» (Фило-софская энциклопедия),
- «прерывистые звуки, вызываемые короткими и сильными выдыхательными движениями как проявление радости, веселья, удовольствия и т.п.» (Ефремова, Современный толковый словарь русского языка).

In general, the evaluation of the standard semantics of the word «смех» can be described as positive or positively colored. Laugh is a human reaction to something funny and joyful. Happy people being relaxed usually laugh.

Meanings mentioned above make the semantic core of the word «смех». However opposite meanings can be realized in a language picture of the world of a native speaker.

The subject of our research is the semantic shift which can be observed in the L.N. Andreev's story «The Red Laugh» (compared to the standard semantics of this word in his diaries 1914-1919).



The story was written in 1904 and published in 1905. It represents a collection of the protagonist manuscript fragments, where he excerpts from the diaries of his brother. Written in an expressionist style, the story describes horrors and madness of the war and all its terrible inanity.

L.N. Andreev makes this bloody madness symbolically embodied in the phrase «the красный смех» and eventually heads the story with it. It appears 19 times in the text, while the word «смех» without this adjective - only 11 times.

The noun «смех» in the common, positive meaning mentioned only twice, and both times in the scenes describing the family atmosphere: «...но радость снова вернулась ко мне, когда не стали готовить постель – настоящую постель, на красивой кровати, на кровати, которую я купил перед свадьбой, четыре года тому назад. Постлали чистую простыню, потом взбили подушки, завернули одеяло – а я смотрел на эту торжественную церемонию, и в глазах у меня стояли слезы от смеха» [Андреев, 2013, с.152]; «И сплю я в столовой, куда перебрался совсем: тут спокойнее, и воздух как будто хранит еще следы разговоров, и смеха, и веселого звона посуды» [Андреев, 2013, с.171].

These cases come along with verb forms found in the descriptions of family scenes and also possessing the traditional meaning:

- «На правой ноге я качал сына, и он смеялся, а теперь...» [Андреев, 2013, с.146]
- «Я засмеялся. – Чего ты? – спросил брат. – Так» [Андреев, 2013, с.149]
- «Брат громко засмеялся и сказал: – Мы не молчим [Андреев, 2013, с.150]
- «Все громче смеясь, сестра поспешно вышла, а брат сказал уверенно и спокойно: – Да. Ты мало изменился. Плысел немного» [Андреев, 2013, с.151]

In other situations where the author describes the war, the laugh is a symbolic image, which incorporates death and fear of death, blood and violence. In some fragments the phrase «красный смех» is repeated several times in a single paragraph and it creates the effect of semantic richness and enhances the effect on the reader.

Here are a few examples of this semantic shift in the meaning of the word «смех»:

- «И в этом коротком, красном, текущем продолжалась еще какая-то улыбка, беззубый смех – красный смех. Я узнал его, этот красный смех. Я искал и нашел его, этот красный смех. Теперь я понял, что было во всех этих изуродованных, разорванных, странных телах. Это был красный смех. Он в небе, он в солнце, и скоро он разольется по всей земле, этот красный смех!» [Андреев, 2013, с.125]
- «Это красный смех. Когда земля сходит с ума, она начинает так смеяться. Ты ведь знаешь, земля сошла с ума. На ней нет ни цветов, ни песен, она стала круглая, гладкая и красная, как голова, с которой содрали кожу. Ты видишь её?» [Андреев, 2013, с.173]
- «Красный смех! – закричал я, перебивая. – Спасите! Опять я слышу красный смех!» [Андреев, 2013, с.148]
- «Друзья! У нас будет красная луна и красное солнце, и у зверей будет красная веселая шерсть, и мы сдерем кожу с тех, кто слишком бел, кто слишком бел... Вы не пробовали пить кровь? Она немного липкая, она немного теплая, но она красная, и у нее такой веселый красный смех!..» [Андреев, 2013, с.148-149]
- «Какой-то кровавый туман обволакивает землю, застилая взоры, и я начинаю думать, что действительно приближается момент мировой катастрофы. Красный смех, который видел брат» [Андреев, 2013, с.166]

In the end of the story this image is personified in some apocalyptic deity of bloody horror and this is indicated by a proper name: «Туданельзя! – крикнул брат. – Туданельзя. Взгляни,



что там! ... За окном в багровом и неподвижном свете стоял сам Красный смех» [Андреев, 2013, с.190].

Describing the uses of the lexeme «смех» out of the connected phrase one can note that the negative connotations do not disappear: the laugh is «meaningless», «irresistible», «creepy», «heavy», «fire». Consequently, changing of the word's meaning onto the opposite one is a reflection of the L.N. Andreev's plan and a similar semantic shift points to features of the author's linguistic picture of the world.

Despite of the apparent antinomy between the dictionary meaning of the word «смех» and the author's semantics it is possible to trace the similarity of Andreev's word semantics with the definition of a form of laugh – the «sardonic laugh» («сардонический смех»).

In the modern sense it is a sarcastic, scornful laugh. But if we look at the etymology, in ancient times sardonic laugh is «laughter of sacrifice, loss or renunciation». In Greece this laugh described people laughing at the time of their death and later became a proverb.

The etymology of the phrase «sardonic laugh» is given by Pausanias in the description of the Sardinia nature: according to the author, on the island near the springs grows a plant similar to celery and people who ate it died laughing [Павсаний, 2002, с. 919]. Another legend says that ancient inhabitants of Sardinia had a custom to sacrifice old men. The ceremony took place under laugh, moreover an individual being sacrificed laughed too.

There is an interesting fact that it is possible to trace the fundamental differences between the semantics of the word «смех» in L.N. Andreev's stories and in his diaries. While in the stories the word «смех» has a strong negative connotation, in the diaries the word is used in its normal, standard meaning.

For example, describing the situation in a playful conversation with his mother Andreev says:

«Курьезная жизнь! А вчера вечером вез из домика мать на тачке, и оба мы хохотали: это была репетиция беженства, как мы будем удирать отсюда, когда отберут лошадь. Чуть не вывалили ее от смеха» [Андреев, 1994, с.99]. Here the noun meaning is «person manifestation of cheerfulness» and does not have any negative connotations.

There are examples with the same meaning:

- «В сущности, они совсем лишены смеха и серьезны» [Андреев, 1994, с. 80]
- «Где-то и смех слышен» [Андреев, 1994, с. 100]
- «...вспышки головной боли при кашле, даже смехе...» [Андреев, 1994, с.51]
- «Был хороший вечер, красиво под горою темнели леса, и возле дачи слышались веселые, молодые голоса, смех» [Андреев, 1994, с.127]
- «А потом среди этой толпы и шума, смеха, представлений и танцев...» [Андреев, 1994, с.161]
- «...где продолжался смех и музыка» [Андреев, 1994, с.161]
- «Опыт говорит, что пройдет оно, и будут дни мира, смеха, искусства, любви и жизни» [Андреев, 1994, с.178]

Thus the comparative analysis shows that the semantics of the word «смех» in the Andreev's literature discourse differs from the semantics of this word in his diaries. In «The Red Laugh» the title became the embodiment of total madness of the bloody war and it is semantically comparable with the words «death», «blood», «fear», «madness», «murder», but in the Andreev's notes there are no significant changes in the semantics of the word.

This leads to the conclusion that the language personality of Andreev-writer differs from the language personality of Andreev-everyman.



## BACTERIA POWER PLANTS

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### Introduction

Researchers at Biodesign Institute are using the smallest organisms on the planet to make electricity. It is a bacterium. In a new study featured in the journal *Biotechnology and Bioengineering*, leading author Andrew Kato Marcus and colleagues Cesar Torres and Bruce Rittmann have explained that a promising microbial fuel cell (MFC) technology are viable.

"We can use any kind of waste, such as sewage or pig manure, and the microbial fuel cell will generate electrical energy," (5) as Marcus said on the website of *Science Daily*. He is the graduate student of Civil engineering and Engineering environment protection and the member of the Center of institute of Ecological Biotechnology. The microbial fuel cell can process a variety of water-based organic fuels unlike conventional fuel cells that rely on hydrogen gas as a fuel source.

"There is a lot of biomass out there that we look at simply as energy stored in the wrong place. We can take this waste, keeping it in its normal liquid form, but allowing the bacteria to convert the energy value to our society's most useful form, electricity. They get food while we get electricity," said director of the center Bruce Rittmann(5).

### Wastelessness

It is possible to find a bacterium which processes practically any waste. For example, scientists have found a two-for-one deal in bacteria that will eat toxic chemicals 24/7 and make electricity to boot. "The bacteria are capable of continuously generating electricity at levels that could be used to operate small electronic devices,"(1) says Charles Milliken of the Medical University of South Carolina, who conducted the research with colleague Harold May. "As long as the bacteria are fed fuel they are able to produce electricity 24 hours a day". (1)

The new study involved *Desulfitobacteria*, already known for their ability to breakdown and detoxify some of the most problematic environmental pollutants, including PCBs and some chemical solvents. "These bacteria are very diverse in their metabolic capabilities, including the food that they can consume. That means that these bacteria can convert a large number of different food sources into electricity,"(1) says Milliken. "The technology could be used to assist in the reclamation of wastewaters, thereby resulting in the removal of waste and generation of electricity."(1)

By linking bacterial metabolism directly with electricity production, the MFC eliminates the extra steps necessary in other fuel cell technologies. "We like to work with bacteria, because bacteria provide a cheap source of electricity,"(5) said Marcus.

There are many types of MFC reactors, but all reactors have the same operating principles. All MFCs have are composed of a pair of battery-like terminals (an anode and cathode electrodes). The electrodes are connected by an external circuit and an electrolyte solution to help conduct electricity. The difference in voltage between the anode and cathode, along with the electron flow in the circuit, generate electrical power.

In the first step of the MFC, an anode respiring bacterium breaks down the organic waste to carbon dioxide and transfers the electrons to the anode. Next, the electrons generate electrical energy to travel from the anode through an external circuit. Finally, the electrons are taken up by oxygen and hydrogen ions to form water on the cathode.



### **Clean electricity**

British scientists have made an important breakthrough in the quest to generate clean electricity from bacteria. Findings published today show that proteins on the surface of the bacteria can produce an electric current by simply touching a mineral surface.

The study has therefore found for the first time that it is possible for bacteria to lie directly on the surface of a metal or mineral and transfer electrical charge through their cell membranes. This means that it is possible to carry bacteria directly to electrodes - creating an efficient microbial fuel cells or bio-batteries. Researchers from the University of East Anglia are working with marine bacteria called «*Shewanella oneidensis*» (5). They knew that bacteria could transfer electricity into metals and minerals, and that the interaction depends on special proteins on the surface of the bacteria. But it was not been clear whether these proteins do this directly or indirectly through an unknown mediator in the environment."(6)

The research showed that these proteins can directly touch the mineral surface, produce an electric current, and conduct electricity through their cell membranes. This was the first time that they actually saw how the components of a bacterial cell membrane were able to interact with different substances, and understood how differences in metal and mineral interactions could occur on the surface of a cell.(6)

### **Production of electricity through the use of wastewater**

Researchers from the University of Pennsylvania (Pennsylvania State University) have created a prototype toilet working as a power station, which produces electricity due to the decomposition of organic waste. Started up in the case where bacteria, which are conventional in the wastewater. These bacteria feed on organic matter, releasing carbon dioxide. When this chemical reaction occurs in the transfer of electrons between atoms. Scientists have managed to break into the process and make these electrons escape to bypass - through an external circuit.

When the tube was pumped through the impurity in the chain between the central and peripheral rods current goes. However, capacity is only a few milliwatts. But Bruce Logan (Bruce Logan), one of the sponsors, said that the team is working to increase capacity.(4) Perhaps, toilets, power plants will be able one or two bulbs, saving energy. In addition, the widespread introduction of new items would contribute to the further purification of wastewater.

The importance of electrical potential is well known in a traditional fuel cell, but its relevance to bacterial metabolism was less clear. Bacteria will grow as long as there is an abundant supply of nutrients. Jacques Monod is one of the founding fathers of molecular biology. He developed an equation for bacteria bathed in a rich nutrient broth, but the challenge was to apply the Monod equation to the anode, a solid.

Previously it was believed that the rate of bacterial metabolism at the anode increases when the electrical potential of the anode increases. The researchers could now think of the electrical potential as fulfilling the same role as a bacterial nutrient broth. It appeared that the electrical potential was proportional to the concentration of electrons which transition from bacteria to the anode. The researchers developed a new model, the Nernst-Monod (5) equation, to describe the rate of bacterial metabolism taking into account the "concentration of electrons" and the electrical potential.

### **Promise meeting potential**

The team identified: the amount of waste material (fuel), the accumulation of biomass on the anode, and the electrical potential in the biofilm anode. The last factor was absolutely new term in MFC research. Modeling the potential in the biofilm anode it was predicted how much voltage they got and how to maximize the power output by tweaking the various factors.



Thickness was one of the factors. Biofilm produced more current when the biofilm thickness was not too thick or thin.

The innovative model is used to optimize performance and power output. The bacteria perform their useful tasks while in spore form, a dormant stage of growth that can handle extreme heat, radiation and lack of water -- all useful traits for an organism that might be employed in some of the worst manmade environments.

### **Conclusion**

The bacteria perform their useful tasks while in spore form, a dormant stage of growth that can handle extreme heat, radiation and lack of water -- all useful traits for an organism that might be employed in some of the worst manmade environments.

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## THE USAGE OF HYDROGEN AND ITS ISOTOPES IN ELECTRICAL POWER ENGINEERING

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### Introduction

Each year, around 15000 Mtoe (million tons of oil equivalent) of primary energy supply are produced. About 80% of those come from non-renewable sources. This scenario faces us with the need to change the energy production matrix, for the simple reason that non-renewable sources are finite and eventually will run out.

In this context, Hydrogen-based energy production comes as a potential alternative. Methods of such obtaining energy can be assorted in two large groups: Thermonuclear and Combustion/Electrochemical. The problems and prospects that arise from these methods will be discussed separately in the following sections.

### Hydrogen

Hydrogen is the smallest and lightest element of the periodic table. It is the most common element of the universe, since about 90% of the atoms are hydrogen. It has 3 naturally occurring isotopes, only one being radioactive. The first isotope is called protium, its nucleus is formed by just one proton. Since it is the most common isotope (99.98%) it is usually referred as hydrogen. The second isotope, called deuterium, has a nucleus that consists of one proton and one neutron. About 0.012% of hydrogen atoms are deuterium. The last isotope is called Tritium. Its nucleus consists in one proton and two neutrons. It has a half life of 12.32 years. It has trace isotopic composition in the total amount of hydrogen.

### Production Methods based on Thermonuclear Reactions

Thermonuclear methods consist in nuclear fusion of different combinations of hydrogen isotopes.

Deuterium (the second isotope) is used as a side component for existing nuclear reactors and is already in use. But it can be used as a reagent in fusion reactions.

The D-D reaction (the fusion of 2 Deuterium atoms) has the benefit that Deuterium is (relatively) easy to isolate from hydrogen, and the reaction emits less harmful radiation. On the other hand, it has the disadvantage that the radiation emitted generate side reactions which diminish the performance of the process. Additionally, this reaction requires very high temperatures to occur, and in result, has a very high energy contribution.

This leads to consider the D-T reaction (Deuterium-Tritium fusion). This reaction has the advantage of being easier to initiate, which means it requires a much lower temperature than the D-D reaction. Also, the reaction produces as much as four times the energy produced by D-D. However, it emits a lot more harmful radiation. In addition, Tritium has an elevated production cost (about US\$ 30.000.000 per kilogram).

Considering this, the D-T reaction looks promising, but still needs much development before it is viable.

### Production Methods based on Combustion/electrochemical Reactions

In this section will be discussed present problems for the implementation of combustion and electrochemical energy production methods.



Hydrogen combustion consists in the implementation of hydrogen as fuel for combustion engines.

Electrochemical methods make use of hydrogen to power RedOx chemical reactions to generate electricity. The electrochemical cells are called fuel cells.

Both methods require molecular hydrogen ( $H_2$ ) to work. This way, two large groups of problems can be identified: issues related to the energy production and issues related to hydrogen production.

The main problem related to hydrogen production can be synthesized as not having a cheap, renewable-source based method for producing large amounts of hydrogen. Currently, the cheapest process to produce hydrogen is based in methane, which is a non-renewable source. That is why a lot of effort is being put on research to develop new processes that are based either in clean energy sources and/or renewable feedstock. There are several processes being developed, but none of them has yet reached the efficiency required to make possible the transition to a hydrogen-based system.

Another problem that arises from dealing with hydrogen is its storage. Because of its small size, hydrogen has the property to diffuse through materials, scaping its container and damaging the material in the process. In that aspect, methods for storing hydrogen are being researched.

The main drawback for applying hydrogen to a combustion system is its low energy density. The combustion of hydrogen is a very energetic reaction, but due to the low density of hydrogen at atmospheric pressure, the gas would need to be pressurized. This has two major disadvantages. The first one is the storage of pressurized hydrogen, as discussed before. The second would be the increase of the weight due to the large amount of hydrogen needed. The second drawback is only applicable to using hydrogen as fuel for vehicles, since if the engine is fixated, the weight is not an issue.

There are three major problems regarding hydrogen fuel cells. They are expensive to produce, have a poor power/weight ratio and need technical grade hydrogen (99.999% purity), which again is still difficult to produce in economic quantities.

### Conclusions

Nevertheless, fusion reactors could provide with a massive flow of energy, which makes the improvement of Thermonuclear methods a priority.

Considering the facts gathered and exposed for this article, the conclusion drawn is that a hydrogen based energy matrix is not only possible but likely to happen in a future not so distant. Nevertheless, development has not yet achieved a level such as to allow the transition from the current fossil fuel based system into a clean energy system. This lack of technical development demands not only monetary investment but also the popularization of hydrogen related research topics.

In this regard, thermonuclear methods require still the development of technology inexistent so far. Overcoming this needs the scientific community to devote to the task.

On the other hand, Combustion/Electrochemical methods are closer to achieving viability. The technology for implementing this methods has already been developed, but needs improvement. The main difference between the stages of development of Thermonuclear and Combustion/Electrochemical methods is that Thermonuclear requires theoretical and technical development and Combustion/Electrochemical requires further technical development.

Hydrogen produced energy does not compete with other clean, renewable energy sources. They complement each other allowing the energy production industry to have versatility. Only



with commitment and cooperation will the goal of clean energy be achieved. The lack of technical development (both in thermonuclear and Combustion/electrochemical methods).

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## THE PROSPECTS OF THE ELECTRIC VEHICLE.

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As you know a new thing is a well forgotten old thing. And this phrase is suitable for the rapid development of the electric vehicles, because they were the first self-propelled vehicles. And now they are breaking into our life and changing it radically. Just imagine that you do not need to come every day at the gas station, you do not hear how the engine of your car works, and the most important thing is that it does not produce any harmful emissions. But is presently electric displacing from our lives ICE (internal combustion engine)? Are they able to compete with the giants who control everything around? And finally whether they meet all our needs? I decided to reflect these and other issues in my project.

Scientists from different countries created electric vehicles.

Hungarian Anos Jedlick in 1828 created a tiny car; it looked like a skateboard with the first embodiment of the electric motor. Between 1828 and 1839 years Scotsman Robert Anderson invented the first coach driven by electricity. A small car was designed and built by the Dutch Stratyn Groningen and his assistant Christopher Becker in 1835.

To search new improvements modern automakers began to resort to the use of electric motors. You can see more and more hybrid cars on the road and fully electric cars are not uncommon.

Such manufactures as Chevrolet, Fisker Automotive, Ford, Toyota, BMW, Volkswagen, and Tesla Motors started producing electric cars.

Tesla model S produced by Tesla Motors was admitted as the car of the Year 2013 by the magazine Motor Trend. It was and it is one of the fastest American four-door sedan. It behaves like a real sportcar: the rapid, agile, responsive, but it has the same comfort as Rolls Royce, it is as roomy as Chevrolet Equinox, and it is more efficient than the Toyota Prius. Tesla Model S is a truly wonderful model which is the most impressive of all the modern luxury cars, starting with the Lexus LS 400.

Body model is lightweight, thanks to the all-aluminum construction, but strong and rigid. Front and rear suspensions are mostly made of aluminum.

AC motor induction type is located between the rear wheels. It should be noted that the production of the motor does not use expensive rare earth metals, so this improves the overall ecological model.

In terms of active safety, Model S is one of the leaders in its class. The center of mass of the car is very low, so the Model S has excellent resistance on the road, and immediately achieved motor torque makes the car fast and responsive in motion and when overtaking. Dynamic Stability Control and anti-lock are calibrated according to the unique high-torque force of the motor and the use of regenerative braking system, which is typical for electric vehicles.

The model is equipped with all standard passive safety systems, including 8 airbags. To improve safety the body is designed in the form of double front and rear octagons, as well as a reinforced roof protects the driver and passengers. The company claims that the security level Model S exceeds standards. The tests were performed at a speed of 80 km / h.

With a base price of \$ 58.570, Model S is equipped with 40 kWh battery which is a competitor to the entry-level Mercedes-Benz E-Class, BMW the fifth series and Audi A6. A new car



with a battery of 85 kWh is sold for \$ 106,900 and costs exactly the same as the BMW M5 and Mercedes CLS63 AMG.

Both cars are five-meter hatchbacks, their basic versions cost more than 5.5 million rubles, they are very unusual technically, they have the drive to the rear wheels, and more than 400 "horses" capacity of 2.1 tons of weight.

Tesla's interior details are not quite monolithic, and the front panel of the expensive car sometimes creaks. Materials and finishing are good, but in comparison with a Porsche Tesla looks like Renault Logan.

Interiors of Porsche and Tesla are different worlds. Porsche is much more luxurious and more comfortable, although it has only two seats behind.

To talk about the Tesla's dynamic it is not enough to say "4.4 seconds to hundred". The electric car rushes forward instantly, inexorably, with a slight buzzing and whistling. Acceleration is not interrupted - it can only end, because there is no gearbox, and the motor produces a maximum thrust until the batteries have at least some stock.

Panamera S E-Hybrid is predictably excellent in driving. Luxury hatch rides majestically and unshakably. Weight is felt, but the chassis is configured so that 2095 pounds do not represent any problem. Adjustable air suspension helps to avoid bumps. Finally, there is a rear-wheel drive.

Hatchback survived about 60 "combat" kilometers during the test drive, where the cycle of acceleration and braking was alternated by board system study, panoramic roof and other resource-intensive tasks. Within five hours, the car did not rest for a minute, and after the event it could do about 130 kilometers! Following the instructions of the manufacturer, the owner charges that car up to 80% of the battery capacity every day. This gives about 360 kilometers of the projected path.

During the test Panamera showed consumption of gasoline at the level of 7.5-8 liters when driving on suburban highway and about 10 liters per hundred, with moderate urban traffic. Porsche offers many tools for analyzing the effectiveness of the movement: data is available on computer board. The central display multimedia system shows time, mileage, running on electricity, average speed and consumption.

Despite the fact that electric vehicles can compete with automobiles, there are things to improve. Firstly, I believe that electric cars will become much more popular if people solve the problem with the charging time. Filling the tank with gasoline takes 10 minutes, while charging the battery lasts a few hours. Secondly, the interior and dashboard look quite modest, for a very expensive car. Third, manufacturers should lower the price of electric vehicles, because a few people can afford them, it is possible with using new materials, developing parts of machines and so on.

Despite the constant development conducted in this area, the electric cars still can't replace automobiles. All this is due to the reluctance of most car owners to replace their usual car with the electric car. We are accustomed to internal combustion engines, despite the stench of exhaust, dirt and expensive service of modern cars.

But soon everything will change. Nowadays you can see electric cars on the roads of Russia. There are already free charging stations across Europe. People buy electric and travel through Prague, Paris, Berlin and Amsterdam without charging. There are such stations in Russia.

Electric transport is coming into our lives whether we like it or not. In the nearest future there will be no gas stations in your city. The air will become cleaner and the city will be quieter. Once when one will come out of the house he will find himself in a completely different world. It will be a world of electric vehicles, the beginning of a new era of industry and mechanical engineering.



## POSSIBILITY OF ADVANTAGEOUS SOURCES OF ENERGY

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### Introduction

Relation between welfare of society and development of power generation is well known. Energy makes a great contribution to welfare of society, providing the areas of consumption, such as heating, lighting, cooking, and also energy provides necessary resources to various branches of production and transport. A great increase in energy consumption is expected during the next decades, because of economic development and population growth. This fact will lead to increase in pressure on the power supply system and it will require a lot of attention to energy efficiency. This problem of using efficient sources of energy is one of the major problems of humanity. Nowadays, the main sources of energy are gas, coal and oil. Such sources of energy are polluting environment, what is more they are limited sources of energy. Scientists predict that oil reserves will be enough for 40 years, coal for 395 years, gas for 60 years.

### And what will happen then?

The traditional world energy system has huge problems. Also, there are other kinds of energy sources, such as wind energy, solar energy, water energy etc. Despite the fact that scientists believe by 2050 alternative energy sources will be the main once, they have their own disadvantages. For example, solar energy requires large areas of land for building solar power stations; what is more, building materials are very expensive and inaccessible. With regard to the energy of the water, there are also some weaknesses. Construction of electric power stations influences negatively climate, migration of animals, flooding the surrounding area.

Also, there are wind power stations, which are widely used in Denmark, Portugal, Ireland, Spain and Germany. Despite the fact that such stations have many advantages (inexhaustible, availability, ecological) unfortunately, they have disadvantages too, such as noise produced during the rotation of the blades and danger for birds. However, there is a wind generator, devoided of these shortcomings.

### History of the Dutch Windwheel

Wind energy is promising area of energy, due to the fact that wind energy content is more than 100 times greater than hydropower reserves of all the world's rivers. Necessity of working with wind power is obvious. The main task of scientists was getting rid of all disadvantages of wind energy and benefit from wind generator during no wind periods, because wind energy is unregulated source of energy. Scientists and engineers from Holland coped with this task. It comes to creating unique, innovative windwheel – The Dutch Windwheel.

Dutch Windwheel Corporation plans to build a wind power plant in Rotterdam Dutch Windwheel, whose work will be based on technology EWICON (Electrostatic wind energy converter), the essence of which is that the turbines convert wind energy into electricity by means of a skeleton of steel pipes, which have no moving parts, no noise, no spinning shadows. The new technology recently developed in Delft Institute of Technology.

The Dutch Windwheel is a full residential complex, combined with a huge windwheel. Construction of the Dutch Windwheel already has a lot of titles. This is the most innovation «windwheel» in the world, the most ecological source of energy and accelerator development of



renewable energy. The Dutch Windwheel is future symbol of the Netherlands and future landmark of the largest European ports - Rotterdam.

### **EWICON technology**

The EWICON technology was developed by a consortium including the TU Delft and Wageningen University in the context of government innovation program. This pioneering wind turbine converts wind energy with a framework of steel tubes into electricity without moving mechanical parts. The result is: less wear, lower maintenance costs and no noise or moving shadow. This makes the Dutch Windwheel the most innovative 'windmill' in the world.

The technology EWICON is the motion of charged particles against the direction of the electric field. In the outer ring Dutch Windwheel role of such particles will perform positively charged water droplets. Using special nozzles scattered throughout the inner surface of the ring, these droplets will be lifted into the air, and wind blew into chase them along the electrodes, as dotting the inner surface. Due to this constant potential difference is created and generated electric current.

The water will be extracted from the soil, which is around an innovative "water mill" will be swamped, including by rain, which will run down the outside curve of the Rings. This technology is good because in the mechanism of power will not be moving parts. This means that nothing will wear out and break. It is planned to heat the space in the building using biogas from organic waste.

### **Structure of Dutch Windwheel**

The Dutch has long been using windmills to harness wind energy. The new concept proposed for the city of Rotterdam, is certainly one of the most difficult windmills ever developed. Dutch wind wheel is a huge circular wind energy converter in which there are apartments, hotels and huge roller coaster.

The concept is intended to be an icon of energy, and also a part of a tourist attraction in the city. This 174-meter high building contains two large rings, which rely against each other. Inner ring accommodates 72 apartments, a 160-room hotel, a panoramic restaurant and a viewing platform. The outer ring of the building has 40 mobile booths that can move around the ring and provide an excellent overview of the terrain height for everyone. In the center there is the turbine EWICON.

### **Economic engine**

Dutch Windwheel has a great business case. Based on the current number of visitors to the Netherlands and Rotterdam it is expected that around 1.5 million people will visit the Dutch Windwheel per year. This ensures that the project will be profitable within 10 years. Extra visitors to the city (and the Netherlands) provide an additional boost to the economy and employment. Netherlands will be more attractive for tourists and the city of Rotterdam and its surrounding area benefit from this.

Realization of the Dutch Windwheel will involve various organizations: developers, investors, operators, authorities and marketing organizations. All the players needed to shape this development are present within the country's borders. The development of the Dutch Windwheel also means a huge boost for employment, both during development and in the exploitation period, when Dutch companies showcase their knowledge and innovations through the Dutch Windwheel to the world.



## **Conclusion**

In conclusion it is necessary to answer the main question of the article, if the source of energy without disadvantages is possible. The answer is yes, it is possible and this investigation confirms it. There are so many sources and kinds of energy, and it is amazing, that progress came to such advanced technologies. Dutch Windwheel is truly a unique invention, devoid of any defects and performing so many functions. This brilliant idea should be realized in different countries of the world.

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## **DEVELOPMENT OF CAD / CAM / CAE IN MODERN ENGINEERING**

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New technology is always exciting but not always it is affordable. With many new innovations, prices started high, then decreased rapidly. In 1990, Mark Miller, president of MicroCIMM systems, attempted to make a CAD/CAM software package designed for lathes available for only one tenth of the market value. Because of the huge change in price, the program appealed widely to first-time CAD users and small companies. Today, affordable CAD and CAM software is completely main-stream among dependent industries – software is readily available from a variety of companies and free demos and downloads aren't hard to find.

It is necessary to consider all the latest trends in the development technologies of the automation to address the main requirements of the customers, basic of which are:

- automated systems are not separate problems to solve, and the process of design and manufacture as a whole, which leads to increased specialization of jobs and the quality of work;
- developing the systems of electronic interaction with customers to improve co-operation and allow to give quick respond to changing customer requirements and market.

The most promising are dialects of Language "Express", which is explained by the general character of the standards STEP (STandard for Exchange of Product model data), their orientation on a variety of applications, as well as for use in today's distributed design and manufacturing systems. Indeed, such formats as IGES (Digital Representation for Communication of Product Definition Data – two-dimensional / three-dimensional vector graphics format, used by many CAD-programs.) or DXF (Drawing eXchange Format – open file format for the exchange of information between graphical CAD applications.), describe only the geometry of objects, while the exchanges between CAD and subsystems include data on various properties and attributes of the products [1].

Economics of developing countries more and more invests in infrastructure, year by year increases the use of metal constructions elements with variable cross section, especially for large-span constructions. However, without special means the process of developing large and complex structures may be delayed. For specific of engineering tasks light CAD / CAM products are created, such as Advance Steel.

Advance Steel can facilitate and speed up the design of such constructions with the new tool "profile of variable cross section"; it helps to create objects with variable cross-section with the additional conditions on each segment (fixed or variable length, parallel shelves, etc.). Moreover, the user also has the opportunity to design the hollow boxes of variable section. All nodes are automatically created and applied to new profiles of variable cross section. Thereby, Advance Steel allows to obtain the necessary drawings and specifications for this type of constructions.

Consider a company "Bee-pitron" representing the widely known in the world PDM / CPC-system "Smarteam." This system provides a unified information space with any of the complex organizational structure and implementation of the concept of the extended enterprise, which integrates into a single information environment of suppliers and customers. Using "Smarteam" allows you to organize information at all stages of the product life cycle, electronic archive development projects, to automate workflow, provide access for managers and specialists



in information workplaces, improve communication and mutual control in the performance of projects, to carry out the design of processes, calculations of labor and material standards, to solve the problems of planning and management on the basis of objective data, etc. This system is based on single database structure [2].

Currently, the integration of CAD- and PDM-systems for enterprises has truly strategic importance. A key feature of the latest versions of CAD / CAM software "Cimatron E" is embeddedness of its core PDM / CPC SmarTeam. On the one hand, it gives clear benefits to experts and provides the organization of collective work on the projects, but on the other hand – not only allows enterprises to use a set of specialized modules, but also to organize at the present level the existing processes of design and manufacture as a whole.

One of the problems to be solved in the design of the product is building its geometric models. It uses the following technologies:

- product design three-dimensional modeling techniques, or the development of geometric models based on customer's documentation;
- import of customer data, presented in a form of bulk geometric models from different CAD-systems;
- development of geometric models based on the prototype of the product using coordinate-measuring equipment.

For the design of assembly units and parts "Cimatron E" provides a set of advanced tools for modeling and geometric analysis. The system is based on hybrid geometric kernel, which enables the construction of models using the most advanced technology of parametric modeling, integrated into a unified design environment means wireframe, solid and complex surface modeling. This enables the construction of geometric forms of any complexity.

For the analysis of geometry "Cimatron E" offers not only the simple tools of dimensional analysis and dynamic cross sections obtained models – big effect is given such special means as a quick calculation of the moments of inertia, volume and mass of details, squares and the projected surface squares, lines and surfaces of connector tooling, instant generation of forming surfaces of equipment with the animation moving parts, color visualization of undercuts and angles relative to the slope of the models given directions connector at all.

Effective implementation of other modern technology for production models is the construction of models based on measurement data (reverse engineering) – it provides subsystem "ReEnge" [3].

When you import volume of geometric models most CAD-systems for solving the following tasks require the inspection of geometric correctness, as well as adjustments and transformations in the solid state view, which takes a lot of time. Hybrid kernel of "Cimatron E" allows you to start solving problems pre-production immediately after receipt of the initial data from any system, even if the models have a gap between the surfaces. This is extremely important property of this system.

Development of CAD-systems as a basis is very important, and not a part of a single system process. But this is a very difficult problem. It is very difficult and very heavy for automation.

Universal format for sharing 3D models is the most important and a very interesting topic now. This format allows programs to communicate easily among themselves without losing data. At present, the export-import is a large ground work for programmers. Programs for data exchange between CAD-systems are more expensive than CAD-systems programs.

Thus, CAD / CAM / CAE are closely connected and every year their development progresses. The ways of the development are:



- automated systems orientation toward the process of design and manufacture as a whole;
- universal data format solution;
- simplicity and accessibility of software.

The development of computer-aided technologies is carried through continuous improvement of software quality of output materials, ergonomics, cost factors (the ratio of price to performance). This trend continues today.

In general, gradual decline of systems cost is expected, which is due to the increase in commercial devices and programs, as well as new technologies for their manufacture.

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## **ADVANTAGES OF REPLACEMENT STEEL LINEAR GUIDANCE SYSTEM FOR MACHINE TOOLS TO THE POLYMER COMPOSITE MATERIALS**

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### Introduction.

Designing products based on advanced composite materials with high strength-to-weight ratio, wear resistance, the ability to operate at low temperatures is essential to improve the operational and economic performance of products and equipment. One of the promising directions in solving these problems is the extension of composite materials usage based on polymers. The main distinctive properties of polymeric composite materials (PCM) are a wide functional and technological opportunities, increased wear resistance, increased stiffness, high shock strength, low coefficient of friction, corrosion resistance, the ability to operate at different temperatures, and also high strength-to-weight ratio all these characteristics reduce the weight of products with the simultaneous increase of reliability and increase of resource of work. It allows significantly to increase reliability and weight efficiency, to reduce resource-demanding of the created structures (parts, components and products).

In this paper the possibility of replacing metallic linear guides to polymer composites for machine-tools is shown.

Polymeric materials, formed on the basis of high-molecular compounds, usually multicomponent and multiphase, are widely used in all industries. The facilitation of construction is provided by using polymeric materials, as a result a resource and lifetime, strength-to-weight ratio of products are increased, noise and vibration of equipment are reduced, the amount of material wastes is reduced, the labor consuming character and energy loss are decreased, and the number of productive cycles is reduced (totally - prime cost and cost of good).

The correct choice of polymer material is one of the factors for the optimal set of mechanical and performance properties. This matrix binds the fibers together, creating a solid construction material. Continuous matrix perceives external loads and distributes them to the second-phase particles. Therefore it is necessary to pay attention to the properties of the matrix such as strength, stiffness, ductility, fracture toughness, impact strength, water - and weather resistance, chemical resistance. Also, when choosing the material of the matrix, you must take into account its processing properties: the time and the kinetics of curing, viscosity and pressure of the processing, wettability, etc. Often, these properties can be decisive. Also essential process of obtaining and processing of products from PCM.

On the basis of analysis of physical, mechanical and operational characteristics of polymeric materials and their practical application areas, it was decided to use organic (formed with organic radicals) thermoplastic (when heated changing its solid state to a liquid one) carbon-chain (macromolecules have "skeleton" built of carbon atoms) polymer for engineering purposes, as a matrix, which is capable of operating at low temperatures when exposed to impact loads.

As an example we'll consider the physical and mechanical characteristics of conventional materials used for making the guide rails, and several kinds of PCM-based carbon fibers (table 1).



Table 1. Comparison PCM with other materials

Type of material	Strength, MPa	Modulus of elasticity, GPa	Density, g. / cm <sup>3</sup>
Composite based on the carbon mid-strong fiber (S - Strength)	1900	135	1,6
Composite based on the carbon high strength fiber (HS - High Strength)	3000	154	1,6
Composite based on the carbon high modulus fiber (HM - High Modulus)	2400	> 230	1,6
Composite based on the fiberglass S class	870	40	1,8
Aluminum Alloy (2024 - T4)	450	73	2,7
Titanium	950	110	4,5
Mild Steel (55 grade)	450	205	7,8
Stainless steel (A5-80)	800	196	7,8
High speed steel (17/4 N900)	1241	197	7,8

Analysis of the physical and mechanical characteristics shows that, compared with conventional structural materials (aluminum, steel etc.), polymer composite materials (PCM) based on hydrocarbons have extremely high performance (table 1) - the durability, modulus of elasticity, in times greater than the analogical performance of steel at a substantially lower weight. A combination of strength and modulus of elasticity of reinforced PCM with unidirectional fiber orientation substantially exceed all modern metal construction materials. These advantages are even more significant if we take into account the low density of the PCM (1.5 ... 2.0 g / cm<sup>3</sup>).

#### Conclusion

Polymer composite materials possess the necessary and sufficient properties to withstand the stresses acting on the linear guide rails in machine tools. The main advantage of PCM as compared to traditional materials - a unique combination of properties. Modern PCM can be created for specific operating conditions of the exploitation of final product and designed for its production technology.

The possibility of increasing the strength-to-weight ratio of the products when replacing alloyed steel, nonferrous metals and alloys PCM led to a rather widespread use of PCM as a construction material, thermal insulation, heat, anti-friction, corrosion-resistant and other appointments. Many of them lighter and stronger than the best aluminum and titanium alloys, and their use to reduce product weigh.



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## COMPARATIVE APPROACH TO ORGANIC ELECTRONICS

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Currently the world of electronic devices is growing rapidly. One of the most promising areas is organic electronics. In this article, we define what organic electronics is, consider the historical facts of its origin, and analyze its merits and demerits in comparison with the existing electronic technology.

The initial discovery of technologies to produce electronic plastics-based components took place in the late 1970s. Chemists Alan J. Heeger, Alan MacDiarmid and Hideki Shirakawa published their findings which showed that the modified polyacetylene halogens can conduct electricity almost as well as metal. This discovery and other basic researches in the field of organic polymers contributed to the development of organic electronics, which combines the developments in solid-state physics and molecular physics, organic and inorganic chemistry and material sciences, electronics and printed matter. In 2000 the founders of the breakthrough directions received the Nobel Prize in Chemistry "for his discovery of conductivity in polymers."

Organic electronics is a new technology that will produce thin and flexible device. Electronic devices and components can be printed on the printer, if the ink is made of materials with carbon compounds. So it is possible to produce the whole range of electrical and electronic components chips - from transistors, memory and battery to processors, sensors and displays, light emitting polymers printed on plastic, metal or paper films. This «smart» packaging, lighting OLED - OLED, cheap electronic RFID tags RFID, curl up into roll displays, flexible solar cells, disposable devices for diagnosis, flexible touch screens, printed batteries, transistors and memory devices.

Organic electronics will improve the polymer properties inherent to conventional inorganic semiconductors. Organic polymers components can be used to apply solar cells, light-emitting diodes and thin-film transistors.

Polymeric materials have always been associated with revolutionary changes in science and technology. They have long and successfully replaced traditional insulation materials. The variety of polymer compositions and the ability to obtain materials through a wide range of physical and chemical properties have led to their successful use in microelectronics and electrical engineering as a structural material. Conducting polymers are widely used to manufacture electrodes of chemically powerful sources, voltage stabilizers, electrolyte capacitors, to automatically control temperature etc. The discovery and the study of the photoconductivity effect led to the formation of photodetectors based on them. The high «sensitivity» of the spectral characteristics of the polymers to the original structure and the polymer component made it possible to create devices with a wide spectral range. But the scientists do not stop. Nowadays modified polymers with properties of conductivity are being intensively sought, compositions with nonlinear characteristics in field effects are being developed. The success of these studies may lead to the improvement of the main components of electronic equipment.

Using physical principles and technology of «plastic electronics» makes the first natural step towards molecular electronics. The fact is that in the classical solid-state electronics the properties of a crystalline body and active structures are formed in its entirety, while the polymer application takes into account molecule properties. Thus the transition to the molecular



electronics is based on an active element with a single module. The problem is faced by scientists - the choice of technological point (local) method effects of changes in the molecule and its primary chemical structure.

Another problem of «plastic electronics» is quite a low speed (just several hundred hertz) and high operating voltage (hundreds of volts). Consequently, computing devices based on them would be of very low productivity and high energy consumption. However experts are working on this, in particular, the team of professor Henning Sirringhaus from the University of Cambridge managed to achieve a breakthrough in solving this problem. They created an organic chip that runs at hundreds of kilohertz, and its power is a sufficient 9-volt battery. The secret is a new organic material, which greatly simplifies the technical process. The problem is that the chips need to be printed in two dissimilar active materials, and a substance formed by them has just ambipolar properties. Now the new plastic schemes cannot yet be used in high-power computing devices, but they will create a number of exciting new products that will be cheap, easy to manufacture and easy to use.

Inorganic electronics provides high order layers and transitions, which cannot be ensured by organic and polymeric materials. But organic electronics has advantages over inorganic, which is gradually coming to its physical limits. Compared to the production of silicon electronics it is much cheaper in the long term (the cost of the equipment is ten times lower than in the microelectronics industry), environmentally-friendly production (printing technologies) of organic elements, their universal qualities such as light weight, flexibility, transparency, long shelf life and reliability, the ability to print many components of electronic devices simultaneously. It is not necessary to use expensive vacuum processes. The main advantage of organic electronics is that the ink jet printer on a roll, gravure printing or other means are applied in all the components of the roll motion and the rate can reach 10 meters per minute. This indicates a high performance and low cost. One can quickly and cheaply implement any idea of the circuit, first perform it on the computer and then print on the substrate.

Thus, electronics is on the verge of «polymer revolution». In the coming years it will be possible to print electronic products. They will create full color screens and displays, solar cells and light panels on the white LED, electronic paper, and more. New electronic products based on polymer materials, which will appear in the near future, will dramatically change the conditions of electronic equipment application, will enhance the ability of information technology. Nowadays they are creating preconditions of the coming transition to new principles of business, lifestyle and entertainment.



## **ROBOT CONTROLLED BY BRAIN - A KIND OF MAGIC**

### **Power of thought**

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Is there any miracle? Man exists on the Earth as long as he believes in miracles. And every year, every decade, every era people debunk these miracles. They match them into formulas, laws, axioms, and record them in scientific journals with gold lettering. So, the tale becomes approximate to real life.

"There is nothing impossible!" said the scientist and invented a magic carpet, or you can call it a plane, fire-breathing dragons in other words are fireworks, a time machine is just a video tape and so on. By this time, the scientists have made a step further and learnt a real magic, we mean control system. It is something from telekinesis, hypnosis, magic, voodoo and other unexplained phenomena. However, there is no any magic.

Robots are not magic creatures. We can imagine how robots are looking like. Robot is a programmed heap of iron, which can perform complex and monotonous tasks with accuracy of Swiss watches. When we talk about robots, we also keep in mind the phenomenon of automation. Automation is the lack of physical impact. Everything is controlled by flicking of a switch, pressing a button. But just a moment! What if we replace the control panel by human mind? What if the robots control will be operated without any keyboard, but by human own power of thought?

The idea is not new. Moreover, it is not even a science fiction. For about ten years, scientists around the world have been developing systems based on the robotics and neuroscience technologies that could solve problem of brain control. Within a few years in our lives came intelligent prostheses, automated systems without a keyboard controller. British scientists proposed ambitious project of implementation of artificial intelligence in the armed forces of the United Kingdom. Terminator is already on the doorstep, can you see him?

However, these developments are far from the idea of brain control. Let me explain the idea. When we talk about bionic prostheses, we mean the direct brain control. Yes, it is true, but we are missing an important aspect of this issue, which is called surgery. People with disabilities, that is, who lost a limb because of an accident still have the "scraps" of nerve endings that recall accumulated over his life movement and reflexes. By implanting a bionic prostheses nerve endings connected to the electronic system of bionic prostheses we create a closed electrical circuit similar to the human nervous system. It is possible due to the implanted electrodes in the limb. All this is easily accomplished because the impulses of the brain are electrical in origin. Brain sends an impulse; the impulse reaches its target and sends a command to the body. Advantages are evident.

Are there any disadvantages in these prostheses? Yes, there are yet, we are not talking about the economic side of the issue, the project is rather expensive. The problem of bionic prostheses is that scientists cannot implant a prosthetic limb when a person is deprived from or paralyzed from birth. In these cases, we do not have an access to the nerve endings of the patient or nervous system is not able to perform tasks correctly.

Therefore, there are special robots which activate neutrally controlled robotic arm. These robots are similar to industrial robots. They have a base trunk, the manipulator and control



system. As usual it is stationary system. And it is impossible to implant such system to a person. These robots have a special sensor that monitors the user's eye movements and their direction. These robots perform simple operations like gripping. Their functionality is limited, but this robot can bring enormous benefits to a disabled person. But, frankly speaking, you need special training to work with such robotic system. Practice requires special training, minimum about five months.

So does this mean that the control by mind is just a beautiful metaphor, and we simply deceive? No. Brain control is real. We already know that human brain gives command impulses. Thought is also electrical impulse of brain. When we recall our childhood, when we look at a beautiful painting, hug a lover, worry about coming exams, experience related to fear of a spider, our brain emits different impulses. There is special equipment, special helmet that reads brain activity of neurons. Later, these signals are analyzed and converted into a wave chart. At first glance, if you look at a chart, you will not understand anything. But after analyzing the data, you can identify some patterns and relationships. According to this principle were developed sensors that can track these patterns and respond appropriately.

The scheme is as follows:

Helmet scans brains activity and prints the map of brain. Once a chart is formed, this picture is encoded into a sequence of zeros and numbers which are sent to a special sensor of the robot. The robot receives the sequence of signals, restores and analyzes it, and picks up the necessary options in its database.

It's quite simple; we have a robot that can perform only two functions: go ahead and go back. When a user thinks about the step forward, he assumes, that brain associates the signal as a positive phenomenon associated with the development, rise and light, for example. Brains curve on the chart becomes smoother. And on the contrary, when a person thinks about a step back, his brain emits a pulse similar to situation when a person is scared; when he has something suddenly seen he performs repulsive movements. And the chart itself depicts more frequent fluctuations. As a result, when a person thinks about moving forward, the robot is moving forward, and when a person thinks about moving back, the robot moves in the opposite direction.

Direct contact is not necessary in this case. People can be located at a distance of ten, a hundred, a thousand meters from the performer. User has to think clearly about the commands.

The creation of such a system depends on two sciences. First, it is neuroscience and the second one is the creation of artificial intelligence. In the case of neuroscience, we address issues related to memory, consciousness and perception of the user. When we connect the mind control with neuroscience, we'll be able to combine human and robot together. Well, it's like idealistic utopian option.

Replacement of a human expert for artificial intelligence systems, in particular expert systems, of course, where this is acceptable, can significantly accelerate the process to reduce the cost of production. Brain control system is always objective and its results do not depend on the mood of the moment and a number of other subjective factors that are inherent in a man.

Robot control non-contact method is the future of robotics. And it's a step towards the creation of artificial intelligence.

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## THE NEW TYPE OF SOLAR CELL

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*Abstract: The given article shows the advantages of using the new type of solar cell – dye-sensitized solar cell. The structure of DSSC is described.*

*Key words: Dye-sensitized solar cell; photovoltaic; nanotube; solar cells*

The dye-sensitized solar cell elements (DSSC- elements) have many advantages of the solar cells that were made on the basis of silicon. The DSSC has a number of attractive features; it is simple to make using conventional roll-printing techniques, is semi-flexible and semi-transparent which offers a variety of uses not applicable to glass-based systems, and most of the materials used are low-cost. Development of new types of solar cells will open the number of new applications for photovoltaic.

According to Tributsch H., dye-sensitized solar cells are thin-film devices that can be fabricated from inexpensive and widely available compounds using relatively straightforward electrochemical processes. The structure of a DSSC itself is also quite simple, consisting of an anode and cathode immersed in an electrolyte. The anode of DSSCs is typically made of a mixture of a dye to absorb light and generate free positive and negative charges, and titanium dioxide to act as a conduit that allows the charges to travel to their respective electrodes and produce an electrical current [2].

Dye-sensitized solar cell elements on the basis of thin-film devices can be made from inexpensive and widely accessible connections with the use of relatively simple electrochemical processes. The structure of DSSC also is simple enough. Light is caught by dye on the basis of ruthenium that passes to his energy the electron of semiconductor, in this case -  $\text{TiO}_2$ . Getting energy, an electron is pushed from a semiconductor. Passing on a chain, an electron accomplishes work and gets in a catalyst layer that provides his passing to the electrolyte. An electrolyte contains triiodide anions. At the receipt of electron of triiodide transform in iodide. Iodide passes the electron of  $\text{TiO}_2$  and goes back into an initial form. A cycle is closed.

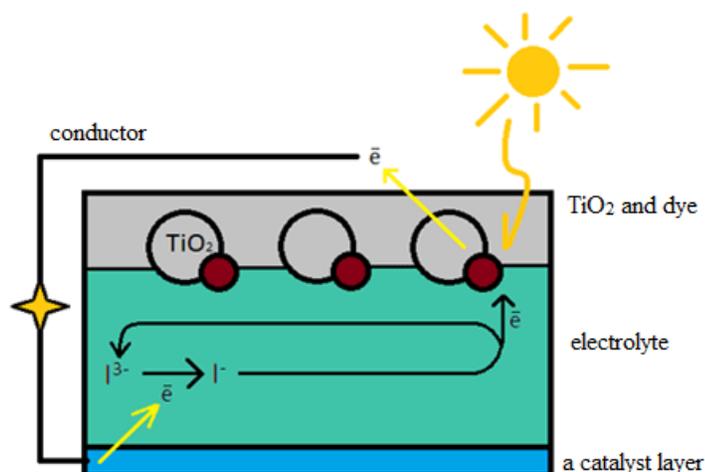
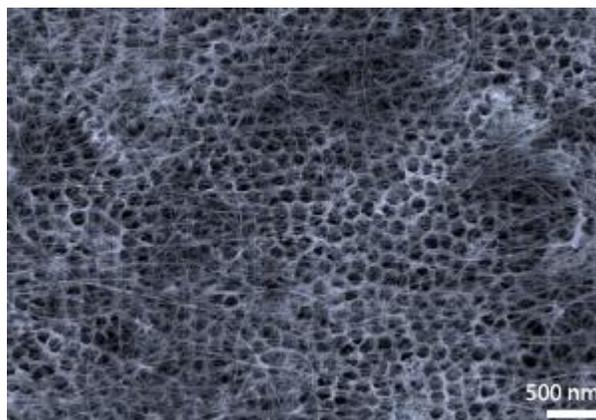


Fig.1. DSSC circuit



Anyuan Cao, Zuqiang Bian and colleagues from Peking University in Beijing, have presently extended the spectrum of possible applications of DSSCs by development of design of unifilar solar cells that can be collected in a large bunch. Dye-sensitized solar cells as wires also will be the base for photoelectric textile. Cao, Bian and their colleagues offered the miniature constructions of DSSC in the scale of micronic separate wires by a pack round the titanic wire (anode) of the tubes of titania, filled by a paint. An external layer is executed from the net of carbon nanotubes, that serves as a cathode (fig. 2). Carbon nanotubes are electrically conductive and have the benefit of being almost transparent, making them ideal for maximizing the amount of light that can reach the dye.



*Fig. 2. Scanning electron microscopy image of a DSSC wire showing the carbon nanotube network© 2011 ACS*

According to investigations of Chinese scientists, the wire-based DSSCs displayed promising solar conversion efficiency, at 1.6% for each wire. Although these levels of efficiency remains far below the benchmark results for DSSCs, significant improvements are expected by optimizing the wire design, notes Bian. For example, the electrical conductivity of the carbon nanotube layer could be enhanced, and multiple wires could be integrated into a single device to produce larger wire meshes. As reported by Bian and his colleagues, the possible applications of this DSSC structure could include photovoltaic ‘textiles’. “The use of fiber-shaped cells would provide flexibility and the cells could be easily integrated into items such as clothes, bags and curtains,” [1]

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**MACROSCOPIC MODEL OF QUANTUM MECHANICS**

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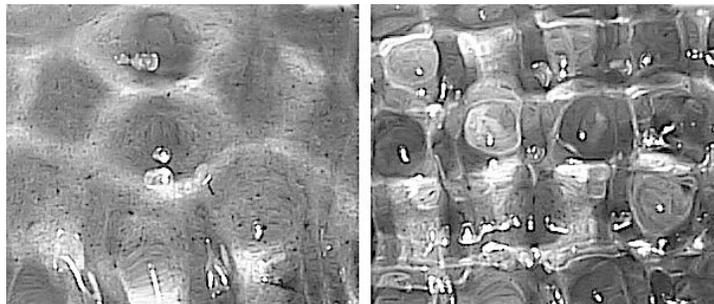
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The article describes macroscopic quantum effects, which are difficult or even impossible to visualise. For the last decade there was no any experimental proof of quantum effects, which could be apparent in macro world. The pilot wave theory was developed by Louis de Broglie and David Bohm, then later overtaken by the Copenhagen interpretation as a standard view of quantum mechanics, thus, there was no macroscopic pilot wave analog to draw upon. Now there is one. A droplet bouncing on a liquid bath can self-propel due to its interaction with the wave it generates. The resulting “walker” is a dynamical association where, at a macroscopic scale, a particle (the droplet) is driven by pilot - wave field.

We know, that the idea of the wave - particle duality was originated when Isaac Newton and Christian Huygens suggested conflicting theories. The Newton applied that light consist of corpuscles in contrast to the Huygens, who determined the wave theory of light. Concepts of light theory have changed a lot since the last century. Today light particles are known as photons. Reviewing the investigations of many scientists, we conclude, that current scientific theory holds such microparticles as photons, electrons and even molecules, which are able to be particles and waves at the same time.

According to this idea, de Broglie proposed the pilot wave theory and later it was developed by David Bohm. Due to this theory, particles are guided by waves. The pilot - wave theory restores determinism and realism in quantum mechanics, but the physical nature of the guiding wave field remains unclear. So, at that time the theory of de Broglie - Bohm was overtaken by the interpretation of probabilistic approach, because there was no macroscopic pilot wave analog to draw upon. Now there is one. Yves Couder and colleagues found a macroscopic pilot system that demonstrates properties, which previously were peculiar to the microscopic world

When a bath with a fluid is vibrated in the periodic mode, we are able to find the critical vibration frequency, above which the flat hydrostatic surface becomes unstable to a regular pattern of standing millimetric Faraday waves (fig. 1). The critical value of acceleration depends on the depth of liquid, surface tension and viscosity.



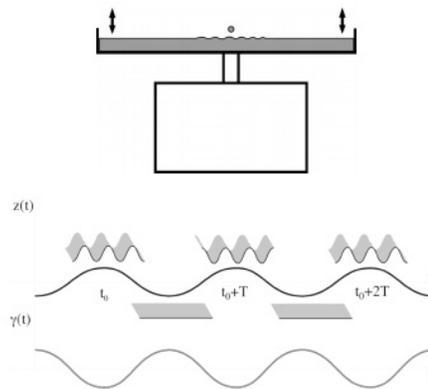
*Fig. 1. Snapshot of Faraday waves on a the fluid surface induced by driving the bath vertically in a periodic mode*



Here is investigated the situation when a droplet of the same fluid is placed on the surface (fig. 2) of the vertically oscillating (1) bath [1]. The diameter of the droplet is about 1 mm.

$$\gamma(t) = \gamma_m \cos(\omega t) \quad (1)$$

where  $\omega = 2\pi f_0$ ;  $\gamma_m = -A\omega^2$  - amplitude of acceleration.



*Fig. 2. Small cell containing a liquid is subjected to a vertical sinusoidal acceleration (1)*

Liquid droplet usually disappears rapidly (a few tenth of a second) when it falls on the same liquid surface. The forcing acceleration is made to exceed  $g$  (the gravitational acceleration) in order to avoid this coalescence. The collide period of time becomes shorter than the time, which is required to break the air film between the droplet and fluid surface. Thus, before the distance becomes critical to merger by van der Waals forces, the droplet lifts off again and can be maintained for an unlimited time in a kind of “levitation” on the surface [2].

The experiment includes a droplet, placed on a bath of silicone oil in the vibrating regime between the Faraday threshold and threshold of bouncing. Depending on the droplet size, it is possible to achieve the result, when a droplet could remain bouncing infinitely. Its bouncing emits damped surface waves (fig. 3).



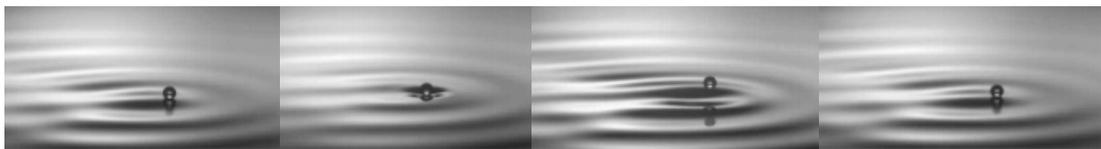
*Fig. 3. Three photographs demonstrate a droplet, bouncing on the surface of a bath, when the same liquid oscillating vertically*

These waves are able to be a mediator among multiple bouncers on the surface. When pair of neighbouring walkers stuck together, they may be locked into orbit around each other (fig. 4 Left). This set of equal - sized droplets can form structure corresponding to Archimedean tilings (fig 4 right) [3].



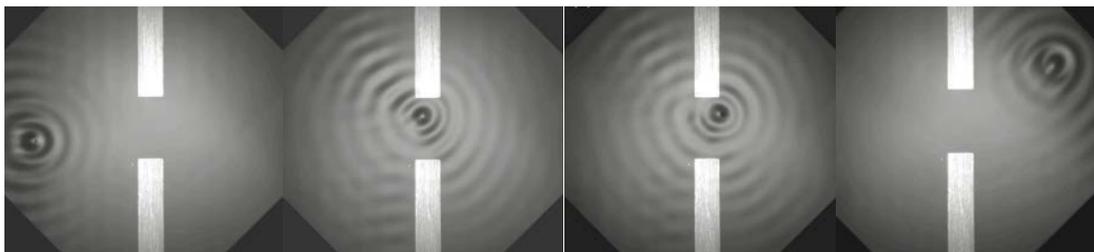
*Fig 4. Left: A pair of walkers lock into collective orbit.  
Right: Side-view snapshot of a hexagonal lattice aggregate of bouncing droplets*

The waves, which are generated by the bouncer, create an irregularity of the surface (waves). When the droplet lands on the sloping surface, it rebounds out of the vertical bouncing state and slides along the horizontal plane [4]. As a result, the droplet is piloted by its wave field (fig. 5). We should, also, notice that this motion depends on the depth of the liquid, the bigger the height of these waves, which are generated, more readily the droplet moves.



*Fig. 5. The droplet, touching the sloping surface of the wave, generated by the previous collisions*

If a metal strip is put on the bottom of the bath so that the liquid layer is above the strip(subsurface barrier), creating the equivalent of the barrier for the moving bouncer (walker). It replicates the single - particle single- and double-slit experiments in macroscopic realm (fig. 6). The experiment demonstrates the way the droplet is launched into the direction of the slit.



*Fig. 6. A walker passes through the slit.  
The complex pilot wave field when the droplet is in the slit region*

When the droplet gets closer to the slit region, the wave propagation is distorted by interference between the reflected and direct waves, as depicted in fig. 6. The statistics of the deviations is investigated in fig. 7 in terms of many independent realization, where it duplicates the classical diffraction pattern of microscopic particle proved by Taylor in 1909.

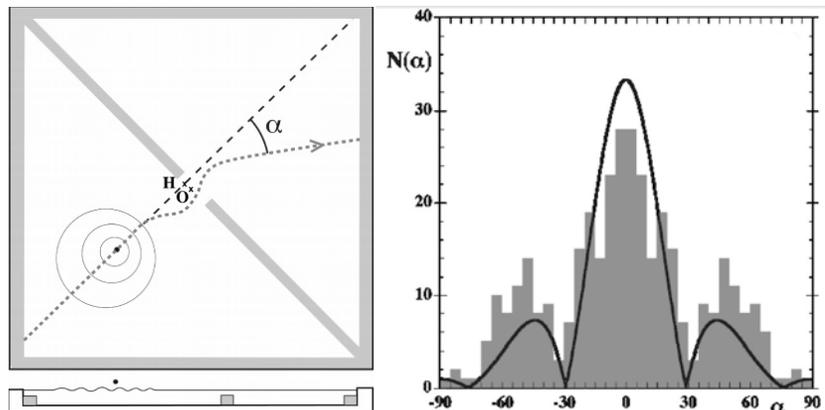


Fig. 7. The droplet trajectory passes through the slit and the histogram for 125 successive events

In the double - slit experiment while the droplet passes through the first slit, the generated wave has time to pass through the both slits, where the wave velocity is higher than the velocity of the moving droplet. These waves interact after the slits, creating the interference.

Quantum tunneling is a quantum mechanic phenomenon when a particle tunnels through a barrier that it classically could not surmount. Exploring a droplet interaction with a barrier, we can see a macroscopic model of quantum tunneling. In the macroscopic experiment a bouncing droplet is confined by walls around, above which the droplet could jump over, but not walk (fig. 8). However, the probability of tunneling decreases exponentially with increasing width of the barrier [5].

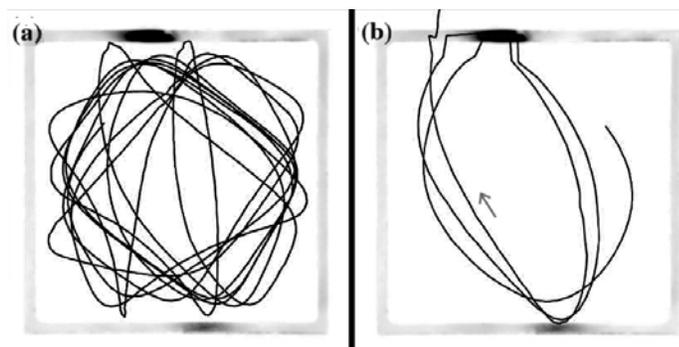


Fig. 8. The recorded path of the droplet inside the square trap,  $e$  – barrier width (2,5 mm),  $P$  – probability of escape.  $V$  – velocity of motion  
 a)  $V=11,8$  mm/s,  $P\approx 10\%$ ; b)  $V=13,2$  mm/s,  $P\approx 30\%$ ;

In conclusion, we should notice that scientists are fully confident, that quantum and classical realms are totally different. Due to the experiment with vibrating droplet, which demonstrates the similarity of the wave - particle duality between quantum and classical scales. The system remains deterministic in contrast to quantum world. The system is two - dimensional, but the system is received energy by the third dimension. Here may be the clue for solving the problem of probabilistic understanding of current quantum theory. Probably the solving is

hidden in one more dimension whose nature remains unclear. This system provides a great number of questions which are difficult or even impossible to answer.

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## CONSTRUCTION IN SEISMIC AREAS OF IRKUTSK REGION

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The demand for residential buildings remains stably high in all regions of our country. The regional center and the coastal area of Lake Baikal, the world famous unique natural monument, are being built up the most actively.

The presence of high demand for housing and infrastructure in this case is primarily due to the weak residential areas' security of the population. Nevertheless, the natural human desire to have a dwelling built in a beautiful location is substantial enough. Baikal is one of the most beautiful places not only in Siberia, but also throughout Russia. At the same time, the region is considered to be one of the most active seismic area, and it essentially complicates a problem of the constructions' erection capable long to preserve durability and causes the necessity of working out the new construction methods for seismic countries as well as the integrated approach in the problems' decision.

The researchers, designers and builders are responsible for the consequences of the earthquake, and as it is known, people are killed not by earthquakes - falling buildings kill them. How to protect buildings and people inside them from destructions during seismic hazard?

The continuous monitoring and analysis of seism tectonic processes in large areas and over long periods are required to prevent the destruction and to form the source data for earthquake resistant design and construction.

The engineering analyzes buildings and structures located in this territory, and evaluate the effects of earthquakes. Currently one of the main tasks in construction is not only the construction of seismically safe buildings, but also improving the sustainability of buildings built in the 60s-70s of the last century. Development of the region in these years was carried out in spite of the level of seismic activity. In accordance with the regulatory maps OSR-97, Irkutsk region belongs to the group of regions with seismic intensity of 7-10 points. Buildings and structures built to the specification of the seismic hazard, have significant deficit of seismic resistance, their destruction by earthquakes can lead to enormous human and material losses.

Another important task is the development of maps of seismic risk. Nowadays, seismic risk maps of the cities of Angarsk, Shelekhov, and Baikalsk have already been made.

In addition, the category of priority includes the development of earthquake-resistant construction techniques, technologies of seismic isolation, seismic and seismic strengthening: it is necessary to implement the innovations developed in the practice of engineering more actively.

Compliance with the earthquake-resistant construction requires significant financial investment. Calculated on a seven-point earthquake, the building will cost 4% more than usual. Moreover, to create a reserve of strength to the structure that will be able to withstand a nine "shaking", you have to spend 12% more than conventional construction.

Economic criteria on the basis of which can be selected a degree of seismic reinforcement, which provides, on the one hand, a given level of reliability of structures, and on the other hand, the minimum value of the costs associated with the liquidation of consequences of the earthquake, is very important now.

It would be possible to construct buildings that are to withstand strong earthquakes without any damage. The main requirement in these conditions is to ensure public in safety.



Scientists-seismologists together with engineers are searching for new ideas for improvement of already available technologies in seismic building and annually introduce the most effective plans in new projects. Aseismic buildings and constructions of each generation becomes more and more safe, they effectively resist to earthquakes and other threats connected with seismic activity of the Earth.

Cutting-edge technologies developed specifically for seismic construction, designed to reduce the impact of the earthquake activity in two, three, and in some cases even more times. They dictate to the developers to lay an improved durability for objects with a high degree of responsibility even at the design stage. Thus, an additional safety factor is added to the normal calculation, which increases the seismic resistance of the structure.

The main material that provides the greatest seismic safety in construction is metal. It is not fragile, quite flexible and tolerates seismic load. During an earthquake it can scattered and "swim", but the construction created from this material will not crumble and bury people under. The steel frame is pliable and allows the structure to perceive the impact of earthquakes well.

The special shotcrete, dry concrete mixed by adding chemical additives and polymer fibers, is used instead of conventional concrete construction in seismic. This combination gives the shotcrete the increased strength compared to conventional concrete. Concrete reinforced with metal that is concrete, also performed well in seismic construction. However, the brick is not suitable material in seismically active areas. Even in the construction of interior partitions, drywall is preferable. Unlike brick, it is lightweight, which means that in case of collapse of structures it will have less injury.

Along with special strength, for structures in seismic active zones a certain degree of mobility and the ability to amortize are provided. Due to these characteristics, the construction is not hard on the ground, and acquires a certain freedom of movement, allowing it to absorb the earthquake and resist to the collapse.

Despite all damping characteristics, the building should have certain standards of rigidity in order not to be destroyed during the seismic activity of the Earth. The cores of rigidity have this function, which are usually made in the form of the columns. These vertical cores are fixed to the base of the building and carry the whole frame. Besides, reinforced concrete beams for additional strengthening of a design connect the cores of rigidity with each other. They are rigidly fastened with powerful metal trusses that hold the facade and the roof. On the other hand, trusses are established on deformation bearers, which allow them to move in case of seismic, blow to several centimeters. Thus, in seism building the balance between rigidity of a design and its amortization possibilities is reached.

What technologies are used in the construction of buildings and structures on the territory of Irkutsk region? A great example of various innovative techniques in earthquake-resistant construction in the Russian Federation are the Olympic facilities in threat seismic standards of Sochi. The Ice Palace "Bolshoi" is built on a massive concrete foundation having a thickness equal to 120 cm. However, it is not monolithic, and divided into segments, like a pie into pieces. Due to this construction approach, the sports facility will be able to absorb the seismic vibrations of the Ground.

Another good example of seismic construction in Sochi is the Russian international Olympic University. During the construction of this seventy-metre building the method of seismic isolation structures was used.

Technically this method is a set of tools, which achieve high compliance design and the ability of the grounds and the building itself to be displaced relatively to each other. There have not been such objects in Pribaikalye yet.



To prevent earthquakes is impossible as well as they cannot be predicted with accuracy, there is only one-way to withstand the elements - to build well. Therefore, it is necessary to build with safety, and this requires continuous monitoring and analysis of seismotectonic processes that need reliable seismic zoning maps, the necessary engineering and technical analysis of existing buildings and structures, it is necessary to implement cutting-edge technology in new construction developed for seismically active areas more actively. The solution of these complex and large-scale problems requires the active participation of all branches of the government on Federal, regional and municipal levels.



## ON THE ISSUE OF LEGAL PRESUMPTIONS

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The legal presumption is one of the most important subjects studied by scientists, who considered this rule of law in separate branches of law.

Basic presumptions were formulated by ancient Roman jurists. The Russian pre-revolutionary legal scholars D. I. Meyer, G.F. Dormidontov played a big role in the study of presumptions including civil law presumptions. Later presumptions were investigated by theoreticians of law (V. Babaev) and academic criminologists (V.I. Kaminskaya, M.S. Strogovich).

The presumption is one of those legal categories which has a long history in the legislative and law-enforcement practice. Legal presumptions were actively used by ancient Romans and many of them e.g. the presumption of conscientiousness, the presumption of knowledge of law, the presumption of paternity and others can be found in current legislation of practically all legal systems. In the Middle Ages the theory of presumptions was thoroughly developed due to dominance of the concept of formal or predetermined evidence when the authorities trusted judges little and judges' conclusions about specific circumstances of a case were pre-determined by law. During this period the doctrine of the presumption covered the whole field of the proof theory and division into factual assumptions and legal presumptions lost its value. The selection of the presumption as a separate category required the development of its own theory of legal presumptions and determination of its nature and place in the law which was done by scientists. The existing variety of ways of understanding the presumption could not but lead to contradictions and different views on the nature of the presumption.

There were such radical opinions that denied the role of the presumption in the law. The famous Russian lawyer Spasovich commented on presumptions as follows: "The essence of the legal presumption is evil which should be avoided in every possible way. Jurisprudence carries crutches called presumptions only when it is not able to bring an issue to a close directly and naturally and should cut it at random and artificially". Similar views were widespread in the Soviet period. S.A. Golunsky, rejecting the presumption of innocence, said: "All sorts of presumptions whatever they may be are an attempt to create the abstract truth separated from specific circumstances of a case". B.S. Tadevosyan was of the same opinion. He wrote that "in the Soviet Socialist society and state, in the laws of the USSR there are no preset assumptions about the guilt or innocence of citizens, there is no need in any preconceived assumptions, presumptions". Scientists explained the denial of the existence of presumptions in the law by their close link with formal evidence: "risky proximity of presumptions to formal evidence makes their application in the criminal process extremely dangerous". In special literature on the theory of law, civil law and civil procedural law there is no agreement on the meaning, content and types of presumptions despite their long-term existence.

A presumption is an idea that is taken to be true on the basis of probability. An assumption is a thing that is accepted as true until adverse is proved.

A presumption is a conclusion about the existence of any provisions, facts, the subject's rights on the basis of proof of other facts, provisions, and the subject's rights. The basis of assumptions (presumptions) is the link between objects or phenomena that is confirmed by the



previous practice. The frequency of occurrence of processes, phenomena, withdrawn from the practice allows people to make assumptions about the truth of these specific findings, i.e. presumptions. Presumptions represent the most common order of things and phenomena and have objective justification to be accepted as truth without evidence. It turns out that the link between established and presumed facts is considered to be true and not to be proven. Therefore, the presumption by its logical nature is an assumption about the presence or absence of an object or phenomenon, the relationships between them, based on the relationships between phenomena confirmed by the previous experience. The presumption in this sense exists indifferent areas of law.

D.I. Meyer identified the presumption as “recognition of a fact which exists in probability”.

M.S. Strogovich understands the legal presumption as “the general rule obliging the court to recognize some fact accepted or not accepted if another fact is established with which this rule relates a certain consequence. This definition is not complete, because it is correct only for non-rebuttable presumptions that the law body applying them considers as the law.

Ya.L. Shtutin asserted that the presumption is “a logical trick which allows the court to recognize the true existence or nonexistence of the fact without requiring proof from the party that refers to it, and put it into the base of the judgment if this legal fact based on public practice by hypothesis is the direct result or cause of the evidentiary fact (facts) and is not disproved at a trial in cases provided for by law or when it is naturally derived from the meaning of the law”.

Yu.K. Osipov gives this definition of presumptions: “any assumption is an inference based on some known facts about the probable existence of other facts”.

Yu.K. Osipov’ and Ya.L. Shtutin’ definitions take into account the existence of factual presumptions, but do not take into account the existence of non-rebuttable presumptions, since these presumptions expressed not a probability but a special kind of credibility which is conventional credibility that is based not on a particular individual’ life experience and socio-historical practice of mankind but on the desire of people to live in a fair and predictable society by means of use of various social norms including norms of law in which non-rebuttable presumptions – fictions are embodied.

V.P. Volozhanin thinks that the legal presumption “is an assumption of the existence or non-existence of some fact which gives the party the right not to prove this fact if other facts are proven” because of the causal connection between them. This definition reflects an important feature of presumptions as a regulator of allocation of the burden of proof between the parties. But it is correct only for rebuttable presumptions. Non-rebuttable presumptions have no effect on the burden of proof as their proof does not occur, they are accepted as an axiom by the court. There is also no reference to the legal nature of the presumption in the definition. The most perfect is the definition of legal presumptions given by Kallistratova according to which presumptions are assumptions of a certain fact in the proof of a different fact, since there is a relationship between them, tested and proven by practice. It should be said that this definition is not without flaws (e.g. there is no indication of legal nature of presumptions, etc.).

E.B. Vaskovsky gave the following definition of the presumption: “Legal assumptions are conclusions about proof of known facts involving other facts required by law”.

V.K. Babaev defines presumptions as law-fixed assumptions about the presence or absence of legal facts, based on the links between them and the existing facts and confirmed by the previous experience”. There were critical comments of this definition in literature stating that not only legal facts may be an object of an assumption, moreover, this definition does not specify the purpose of such an assumption. Babayev also notes that the presumption is a category



that has the inductive nature of formation. If two subjects or phenomena of the material world are similar in some characteristics, they would likely to be similar in others, that's the rule we use to presume facts which are inductive by nature. The inductive method is used with the methods of synthesis, abstraction, etc. in order to create truly scientific abstractions in drawing general conclusions, determining regularities, forming concepts. And the same is in the law you can never be sure that this assumption is true.

A.K. Sergun considers that the presumption is a statutory assumption that a fact exists, if some other facts related with it are proven.

A.K. Sergun' and B.K. Babayev' definitions take into consideration the existence of non-rebuttable presumptions. However, these definitions do not cover all factual presumptions despite the fact there are legal and factual presumptions.

The following circumstances should be taken into account in determining legal presumptions. Firstly the definition should include reference to logical nature of the presumption. Secondly the presumption should be characterized as a supposition. Thirdly it is necessary to specify legal nature of legal presumptions. Fourthly, presumptions should not be limited to the role and place of the presumptions in the evidentiary process, because they are a sign of rebuttable presumptions.

A complete and logically correct definition of presumptions that is used in law enforcement can be described only as quite a mouthful, because the concept itself expresses a complex phenomenon of the spiritual world relating to the sphere of human thought. However, in view of the points mentioned above the legal presumption can be defined as a directly or indirectly enshrined in law assumption about the presence or absence of legally significant facts, and evidence of other associated facts.

Speaking about presumptions it is necessary to say about their classifications. It was suggested distinguishing presumptions according to the fact of their fixation in norms of law:

1. Factual presumption. Factual presumptions are assumptions that are widespread in society but do not have the legislative framework.

2. Legal presumptions. Legal presumptions are assumptions fixed in the law with all their above-mentioned consequences.

Selection of factual presumptions is not universally accepted. Such presumptions cannot be directly used by the court and influence the evidentiary activities (redistributing the evidentiary burden or filling in the gap), but their selection and consideration in legal science has the right to exist.

Firstly a number of such assumptions were eventually enshrined in the legislation. For example, the legislator's actual assumption of a person's misunderstanding of their actions before a certain age based on the worldly experience of generations, which has subsequently been adjusted in the light of available data of medical and psychological sciences, contributed to the legal rules, which set the age of delictual capacity. Secondly proving is an activity including logic so it is not deprived of opportunities for immediate use of actual assumptions by the court.

Presumptions can be classified according to the way of their fixation in operative rules of law. They can be divided into:

1. Direct presumptions. A direct presumption is directly defined by a norm of law. For example in clause 4 of article 12 of the Act of the Russian Federation "On protection of consumer rights" the presumption of lack of consumer knowledge is established: "when considering the customer's requirements for compensation for damages caused by incorrect or insufficient information about the goods (work, service), you must assume the consumer's lack of special knowledge about the properties and characteristics of the goods".



2. Indirect presumptions. An indirect presumption is not fixed in a norm of law but can be derived from it in the process of interpretation.

Indirect presumptions are difficult to use because of their non-obviousness to be regarded in law enforcement. Indirect presumptions are first defined in the relevant branch of science, sometimes in explanations of higher courts and then find a wide application in judicial practice. There is also a possibility for the legislator to transform indirect presumptions into direct presumptions with time.

Depending on the possibility of refuting legal presumptions can be classified into:

1. Rebuttable presumptions. Rebuttable presumptions are such presumptions which may be rebutted. Rebuttable presumptions are divided into general rebuttable presumptions and special rebuttable presumptions.

2. Non-rebuttable presumptions. Non-rebuttable presumptions are assumptions of the existence of a fact established by law and not subject to refutation. In other words, even if someone would disprove this presumption, i.e. justify that the content of the law assumption is not true that rationale has no legal significance and does not entail any legal consequences.

Non-rebuttable presumptions are divided into general non-rebuttable presumptions and special non-rebuttable presumptions.

The question of the existence of non-rebuttable presumptions is controversial. Moreover, if we recall the structure and the proposed definitions of the presumption, it must be concluded that there is no non-rebuttable presumptions as for any suggestions you can find at least one exception. At the same time, the legislator sometimes uses this kind of reception of legal technique, which can be treated differently (consider a non-rebuttable presumption or formulation requirements in presumptive terms).

Despite the fact that existence of non-rebuttable presumptions is regarded to be debatable, their selection has some theoretical and practical significance. Firstly for their separation from each other and correct decision by the court about allocation of evidentiary burden. Secondly in view of the fact that changes in legislation may lead to transformation of a non-rebuttable presumption into a rebuttable one with all the ensuing consequences. For example, with the adoption of the Criminal Code of the Russian Federation the non-rebuttable presumption of correspondence of the person who has attained the legal age to the generally recognized level of development has been transformed into the rebuttable one. There are other classifications of presumptions that are not widespread nowadays.



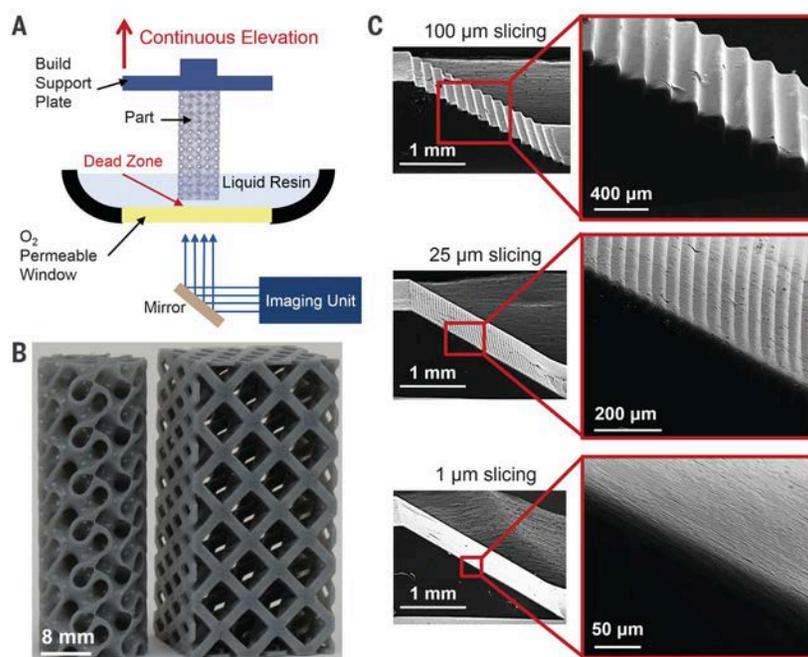
## CONTINUOUS LIQUID INTERFACE PRODUCTION OF 3D OBJECTS

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Additive manufacturing processes such as 3D printing use time-consuming, stepwise layer-by-layer approaches to object fabrication. This form demonstrates the continuous generation of monolithic polymeric parts up to tens of centimeters in size with feature resolution below 100 micrometers. Continuous liquid interface production is achieved with an oxygen-permeable window below the ultraviolet image projection plane, which creates a “dead zone” (persistent liquid interface) where photopolymerization is inhibited between the window and the polymerizing part. We delineate critical control parameters and show that complex solid parts can be drawn out of the resin at rates of hundreds of millimeters per hour. These print speeds allow parts to be produced in minutes instead of hours.

Although three-dimensional (3D) printing is now possible using relatively small and low-cost machines, it is still a fairly slow process. This is because 3D printers require a series of steps to cure, replenish, and reposition themselves for each additive cycle. Tumbleston et al. devised a process to effectively grow solid structures out of a liquid bath. The key to the process is the creation of an oxygen-containing “dead zone” between the solid part and the liquid precursor where solidification cannot occur. The precursor liquid is then renewed by the upward movement of the growing solid part. This approach made structures tens of centimeters in size that could contain features with a resolution below 100  $\mu\text{m}$ .



*Fig.1 A illustrates the simple architecture and operation of a 3D printer that takes advantage of an oxygen-inhibited dead zone.*



CLIP proceeds via projecting a continuous sequence of UV images (generated by a digital light-processing imaging unit) through an oxygen-permeable, UV-transparent window below a liquid resin bath. The dead zone created above the window maintains a liquid interface below the advancing part. Above the dead zone, the curing part is continuously drawn out of the resin bath, thereby creating suction forces that constantly renew reactive liquid resin. This nonstop process is fundamentally different from traditional bottom-up stereolithography printers, where UV exposure, resin renewal, and part movement must be conducted in separate and discrete steps (fig. S2). Even for inverted top-down approaches in which photopolymerization occurs at an air-resin interface (i.e., the part is successively lowered into a resin bath during printing), these steps must be conducted sequentially for the formation of each layer. Because each step takes several seconds to implement for each layer, and because each layer of a part has a typical thickness of 50 to 100  $\mu\text{m}$ , vertical print speeds are restricted to a few millimeters per hour. By contrast, the print speed for CLIP is limited by resin cure rates and viscosity (discussed below), not by stepwise layer formation. For example, the gyroid and argyle structures shown in Fig. 1B were printed at 500 mm/hour, reaching a height of  $\sim 5$  cm in less than 10 min (movies S1 and S2). An additional benefit of a continual process is that the choice of 3D model slicing thickness, which affects part resolution, does not influence print speed, as shown in the ramp test patterns in Fig. 1C. Because CLIP is continuous, the refresh rate of projected images can be increased without altering print speed, ultimately allowing for smooth 3D objects with no model slicing artifacts.

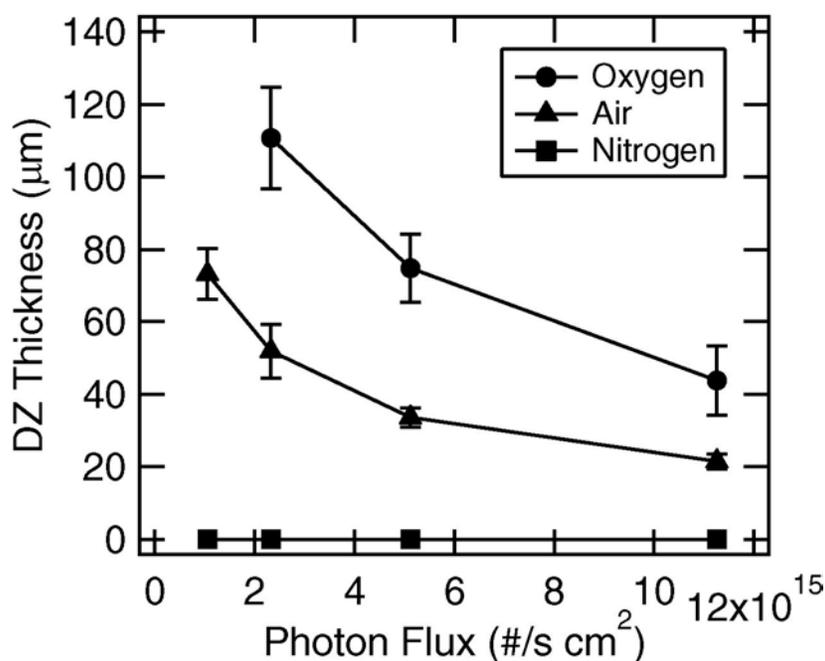
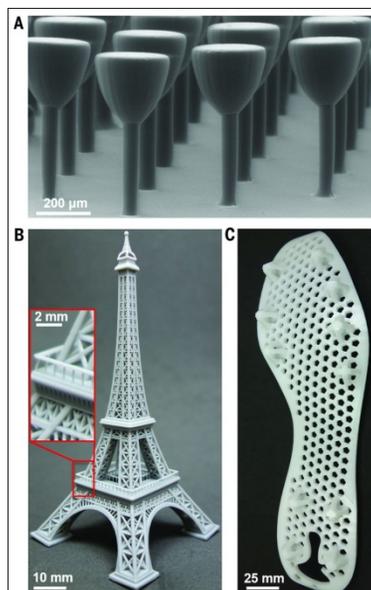


Fig.2

The dead zone is created by oxygen permeation through the window in Fig. 2. Dead zone thickness is shown as a function of incident photon flux. When pure oxygen is used below the gas-permeable window, the dead zone thickness increases. When nitrogen is used, the dead zone vanishes, resulting in adhesion of the cured resin to the window. Error bars represent SD of 10 measurements of the same conditions.





*Fig. 3*

Thus, using this process control framework, Fig.3 shows an array of expediently produced parts ranging in size from undercut micro paddles with stem diameters of  $50\ \mu\text{m}$  (Fig. 3A) to full-size shoe cleats 25 cm in length (Fig. 3C). The Eiffel Tower model illustrates that fine detail is achieved even in macroscale parts (Fig. 3B): The horizontal railing posts (diameter  $<500\ \mu\text{m}$ ) are resolved on this 10-cm-tall model. This ratio of scales (1:200) confirms that the CLIP process enables rapid production of arbitrary microscopic features over parts having macroscopic dimensions. For these parts, the speed-limiting process is resin curing; however, for other part geometries, the speed-limiting process is resin flow into the build area. For such geometries with comparatively wide solid cross sections, parameters that affect resin flow (e.g., resin viscosity, suction pressure gradient) become important to optimize.



## DEPTH AND DIAMETER MEASUREMENT INSTRUMENT OF FUNNEL CHEST

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**Introduction.** Funnel chest deformity (foveated chest, funnel breast, pectus excavatum) is various in shape and depth curvature of sternum and front part of ribs which leads to a chest capacity reduction, mediastinum compression or displacement, resulting in functional disorders of cardiovascular and respiratory systems. A principal cause of the disease is a disturbance in joining two halves of sternum in fetal period (between 6<sup>th</sup> and 9<sup>th</sup> weeks).

Pectus excavatum is the prevailing deformity of chest which accounts for 91% of all the breast malformations in this or that level of severity [1]. It refers to congenital malformations of chest and is found in one time in hundred newborn. In 90% of cases the deformity becomes apparent till the age of 2. Funnel chest is most frequently found in children with asthenic type of constitution and progresses as far as a child grows. The deformation impairs at the age of 7-9 and 12-14. 70% of disorders occur in male [1-2].

**Theories of funnel chest origin.** The main point of funnel chest formation turns out to be an inborn dysplastic inferiority of costal cartilages, nevertheless together with this disorder secondary dystrophic changes may occur. The reason of these changes is basically in chronic hypoxia and metabolic disturbance.

In Russian-language sources the sternocostal dysplasia theory is clearly described in a monograph of Urmonas and Kondrashin (1983). According to their hypothesis a genetic susceptibility or some other factors, which are not revealed yet, lead to a synthesis induction of enzymes, which are responsible for connective and especially cartilaginous tissue differentiation. This process starts in a fetal period. In accordance with a majority of researchers we can observe the autosomal dominant type of inheritance in 30% of funnel chest patients. Also there is a theory which attributes the pectus excavatum disorder to a diaphragm changes: shorting and development lagging of its sternum part, presence of truncated sternodiaphragmatic ligament. Eclectic theories have reason to exist, they explain the funnel chest formation through an irregular fetal lie combining with oligohydramnios or infectious processes of mediastinum [3].

All the conditions above as well as the funnel chest itself are phenotypic manifestation of connective tissue dysplasia. Since the connective tissue composes up to 80% of human body mass, the disorders in its structure result in an imbalance of development and functioning of the whole organism.

**Classification (according to N.Kondrashin).** By intensity of deformation there are 3 stages: 1<sup>st</sup> stage – depth of funnel is up to 2 cm, no heart displacement; 2<sup>nd</sup> stage – depth of funnel is up to 4 cm, heart displacement within 2-3 cm; 3<sup>rd</sup> stage – depth of funnel is more than 4 cm, heart displacement is more than 3 cm.

By clinical course three stages are marked out: compensated stage – cosmetic defect is only presented, no functional disorders or its minimum; subcompensated stage – weakly expressed functional disorders of cardiovascular and respiratory systems; decompensated stage – considerable functional disorders.

By shape of deformation the funnel chest could be ordinary and flat; symmetric and asymmetric, the last could be right-sided and left-sided.



**Clinical presentations.** The funnel breast mainly cause the following conditions: hypertension in pulmonary circulation; chronic hypoxemia; functional disturbances of thoracic organs; changes in acid-base balance and water-salt metabolism; atrophy, lost of elasticity and tonus and degeneration of muscles which are responsible for breathing due to the change of insertion site; reduction of breast elasticity and flexibility, decrease of chest excursion, development of permanent paradoxical respiration; bronchus compression; mediastinum displacement; torsion of great vessels. Thus the functioning of cardiovascular and respiratory system is disturbing.

**Diagnostic methods.** Nowadays visual examination of a patient, X-ray imaging, computed tomography of chest with 3D reconstruction of sternum and ribs and thoracometry can be referred to diagnostic techniques. For thoracometry it was previously used an instrument, which was composed of two supporting planks with handles and 50 free-moving graduated bars 11 cm long. The measurement starts from the 3<sup>rd</sup> pair of ribs up to 8<sup>th</sup> pair. After each segment measurement the deposition should be taken from all the bars and construct the final figure. The number of segments to be measured depends on the deformation length (patent RU for invention №2175522 from 10.11.2001 – authors: V.Shamik, S.Osipochev, G.Chepurnoy) [4]. However while carrying out the measuring a number of limitations may be revealed: lack of accuracy, duration, necessity in calculations.

**Aim.** Creation of a high precision instrument for depth and diameter measurement.

*Instrument:* a useful model is made of stainless steel. The instrument is composed of a support to which a vertical graduated plank is fixed movingless. At a proximal end of this plank there is a handle. At this vertical plank the horizontal free-moving horizontal plank is installed within a hole in a horizontal plank. A string is movingless attached to the support, the string passes through two holes at the ends of the horizontal plank and through a hole in the handle. The vertical and horizontal planks have a centimeter graduation.

*Utilization:* holding a handle of the instrument an examiner should set up the support in the depth of the funnel chest and move a horizontal plank up to the chest. The string provides an even movement of the horizontal plank. According to the centimeter graduation at both planks the physician can measure the depth and the diameter of the funnel chest.

**Practical importance.** The useful model is anthropometric medical measuring equipment. It can be helpful in different fields of medicine: orthopedics, traumatology, radiology, forensic medicine, exercise therapy.

**Result.** Absence of necessity in extra investigations (for example, X-ray imaging), the accuracy of measurement is improved, so there is a possibility to estimate a dynamic of funnel chest formation or treatment progress. The method is simple in use and doesn't require additional measuring. We took out a patent for this useful model №138973.



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## TYOLOGICAL ASPECTS OF SKATE PARKS' DESIGNING

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Let's assume for the moment that your campaign to build a free public skatepark has met with success. The city has pledged its support, a majority of the community is behind the idea and there are hard earned fundraising dollars sitting in the bank waiting to be spent. For miles in every direction skaters anxiously await their brand new skatepark. Congratulations, now is the time for design and construction. The skate community needs to get involved with the project and remain involved until the job is complete. When it comes to building a concrete skatepark, your city needs pro-active guidance.

### What Exactly are We Talking About?

A skatepark is an athletic facility. Designed and constructed specifically for skateboarders, in-line skaters and arguably freestyle BMX riders. It offers a place to congregate, relax and perform skills in a safe environment. Ideally, it should have a fence to protect spectators. Lighting is a great addition.

For skateparks, concrete is the way to go. A concrete park offers a permanent and virtually maintenance-free solution to a cities skatepark needs. Plus, the majority of skaters prefer concrete parks. A ramp park, whether fabricated from wood, steel or other materials should be considered only if the municipality already has an unused basketball, tennis court or parking lot available. These types of ramp structures are for short term use only. There is no good reason to build this type of facility if there are sufficient resources for a permanent facility. Under no circumstances should a city pour a slab of concrete to build temporary ramps as the funds would be much better spent building a permanent concrete skatepark to begin with.

Most concrete skateparks will cost between 20 and 25 dollars (USD) per square foot to build. (\$270 USD per meter) That cost figure typically includes all design fees and services, construction materials and labor. However, that is just the skating surface. That cost will not include common amenities, such as bringing water and power to the site, fencing, lighting, bathrooms or landscaping. In general, parks worth building cost a minimum of \$250,000. Compared to the cost of other athletic facilities, that is quite reasonable.

A skatepark designed to meet all skill levels will be between 18,000 and 25,000 square feet. A park of 10,000 square feet is the absolute minimum recommended. It is important not to directly combine beginner and intermediate/advanced areas as this design approach tends to be unsafe and leads to more collisions. It is best to determine the variety of events and features required for each skill level and then design buffer zones between each riding area. We know it can be a blast to zip full tilt around a park that really flows. But, it is more important to be realistic and make the skatepark safe for all users at all times of day.

### Ten Quick Rules for Design

1. Simplicity
2. Smoothness of Surface
3. No Kinks
4. Flat bottom
5. No Overcrowding



6. PushingRoom
7. NoLedgesOverYourBellybutton
8. EdgesthatGrind
9. Pump-ableHips
10. Lights

### Design Basics.

#### 1. Flatbottom.

Any skatepark design must have a minimum of ten feet of flatbottom between obstacles and opposing transition.

#### 2. Transition.

Transition between flatbottom and inclined surfaces can be accomplished in either of two designs: round with a perfect radius curve like a swimming pool, or banked with a tighter transition curve to a flat bevel like a modified drainage ditch.

#### 3. Lips, Edges and Coping.

The edges of any wall, bank or skateable pool must be hard and grindable. Skaters are looking for something to grind or slide on when they get to the top of a wall. You can't be on the edge if there is no edge.

#### 4. Curbs, Blocks, Steps and Walls.

Everyday street elements such as these can and should be included in modern skatepark design. Curbs, blocks and steps function best in a park situation when used judiciously in combination with other elements.

### Contracting Designers

First off, try and convince the city to contact professionals from within the skatepark industry. There are many existing businesses that specialize in skatepark design and construction. Experienced teams of professional skatepark designers should be the first avenues explored by any community considering that type of facility. Almost all of these teams will have skaters on their crews. Professional teams also tend to have the skate experience required to determine what skater's ideas will work together and in what arrangement. While contracting with a professional designer may cost the city more in the short term, these teams consistently build some of the best skateparks around.

### Engineering Services

Engineering services are often perceived to have no direct bearing on a skatepark. The truth is, they are critical to the longevity of the facility. While a park may look great when it is first built, if it is not engineered correctly to withstand the forces of nature, it may not last for long.

### Construction Drawings

Once you have decided upon a location for the park, have a finished design, the results of the property survey and soil borings, it is time to turn it all over to someone that can turn the plan into a set of construction drawings. These blueprints are accurate delineations of the park design that guide the contractor during construction. It includes all details pertinent to the construction of the skatepark. The accuracy of the construction documents is essential to the bid process, because it allows the builders to bid accurately and correctly. Therefore, all builders will need to see the construction documents in order to bid as accurately as possible.

### Future Additions

There will always be chances to improve the skatepark. Some additions will make the skatepark more attractive to the city, as well as to skaters and bikers. For example, landscaping



will make the park more attractive to all. Adding trees can provide welcome shade after a session. See if you can get donated services of a landscape architect or a local gardening club. Request materials from local nurseries or other shops that sell plants. Consider things like spectator seating, drinking fountains, restrooms, playground equipment, public pay phones or even a snack shop.

#### Exclusive Use and Liability Waivers

Once the skatepark is built, the city government may want to regulate its use for special events. This may include a fee or specific procedures for obtaining exclusive use of the skatepark for competitions. The city may also consider a rate schedule for the use of the skatepark for corporate promotions. Liability issues will vary from state to state and town to town. The only legal advice that I have to offer is “consult the attorneys”. Decisions of this nature are among the most serious and should rightfully be made by the city council in cooperation with the city attorney.



## **THE PRODUCTION OF COPPER FROM THE METAL MANUFACTURING WASTES**

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**Language supervisor: Senior lecture, Antolinovskaya V.M.**

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Currently in the world there is an acute problem of waste processing.

Wastes are substances (or mixtures of substances) unsuitable for further usage within existing technologies, or after consumer use of products.

So, in my report I would like to talk about wastes in metallurgy.

One of the major problems in the metallurgical industry is the disposal of waste products, among which the main proportion of metallurgical slag formed during smelting. Slags are products of high-temperature interaction of components of raw materials (fuel, ore, smoother and gas environment). Their chemical composition and structure vary depending on the composition of waste rock, the type of steel produced, the characteristics of the metallurgical process, the cooling conditions, etc.

There are billions of tons of slag ferrous and nonferrous metallurgy in slag dumps, occupying a huge area of land that degrades the environment.

Currently billions of tons of industrial waste from ferrous and non-ferrous metallurgy have accumulated in Russia. Only 15 - 30% metallurgical waste is recycled aimed at the extraction of valuable elements of composition. About 20 - 30% of industrial waste from ferrous and non-ferrous metals used in the construction industry. The main part of waste materials stored in stockpiles (seams, unfit for production), slurry on fields, etc. According to the environmentalists, the size of the Russian territory, occupied by industrial waste metallurgical enterprises, is over 1300 sq km. Waste materials are often stored on the fertile lands. It's clear that industrial wastes are full of toxic substances, and these substances are able to migrate huge distances. Therefore, the environment within a radius of 200 km from the place of burial of metallurgical waste is contaminated. The evidence of toxicity metallurgical waste is the fact that within a radius of 70 km from areas of heavy contamination in the Norilsk industrial district all woody vegetation was destroyed. In the centre of this powerful industrial pollution Nickel content in plants exceeds the rate in the 31 - 470 times. And the concentration of copper in the same plant exceeds background indicators in 17 - 156 times. At distance of 80 - 140 km from places of especially strong pollution in Norilsk the industrial region the excess of nickel concentration is in 1,5 – 2,7 times, and excess of level of the content of copper is in 1,3 times.

In the twentieth century the amount of waste production and consumption grew so quickly that the generation of waste has become an important problem in big cities and large enterprises. Along with a large amount of waste the questions about the lack of natural resources are acute problems of today. Selective collection and the subsequent use of secondary resources partially help to reduce the impact on the environment and to resolve the issue with additional raw materials

Final step of copper production is electrolysis, with the help of which we obtain the cathode (pure) copper.

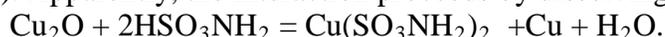


The basic impurity elements concentrate in electrolysis slags and electrolyte. The basis of slags is made by oxides and sulfides of copper (I) and (II). The basis of sludge comprise oxides and sulfides of copper (I) and (II). During storage of the wet middlings may be formed of copper hydroxycarbonate form (II).

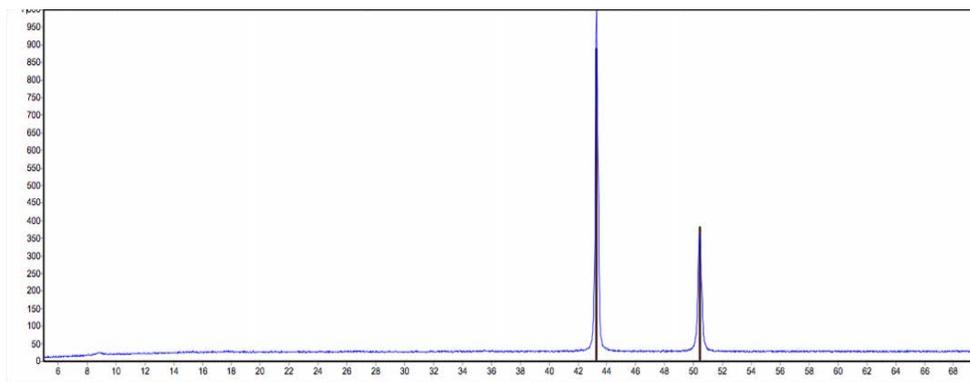
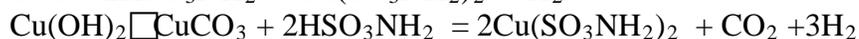
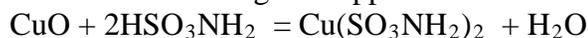
In connection with the high maintenance of valuable components in slimes of electrolysis of copper and hydroxide precipitation these products must be recycled.

In the first stage of research conducted to study the interaction of copper oxide (I) and Cu (II), basic copper carbonate and copper hydroxide with a 10% solution of sulfamic acid in a ratio of S: L = 1: 20 at room temperature. Injectate mass was 5g, the volume of solution to 100 ml. The duration of the interaction of 30 minutes with constant mechanical stirring of the pulp. The solubility of copper compounds was calculated from the mass loss of sample. Possible changes in the phase composition of insoluble precipitates was determined by x-ray diffraction (XRD).

When interacting with Cu<sub>2</sub>O sulfamic acid is found in the precipitate metallic copper (100%). Apparently, the interaction proceeds by dissolving:



The phase composition of the deposits by reacting CuO and Cu(OH)<sub>2</sub> □ CuCO<sub>3</sub> with sulfamic acid has not changed. Copper in the form of Cu(SO<sub>3</sub>NH<sub>2</sub>)<sub>2</sub> goes into solution:



*Pic.1. Radiographs of the insoluble residue after dissolution in Cu<sub>2</sub>O sulfamic acid*

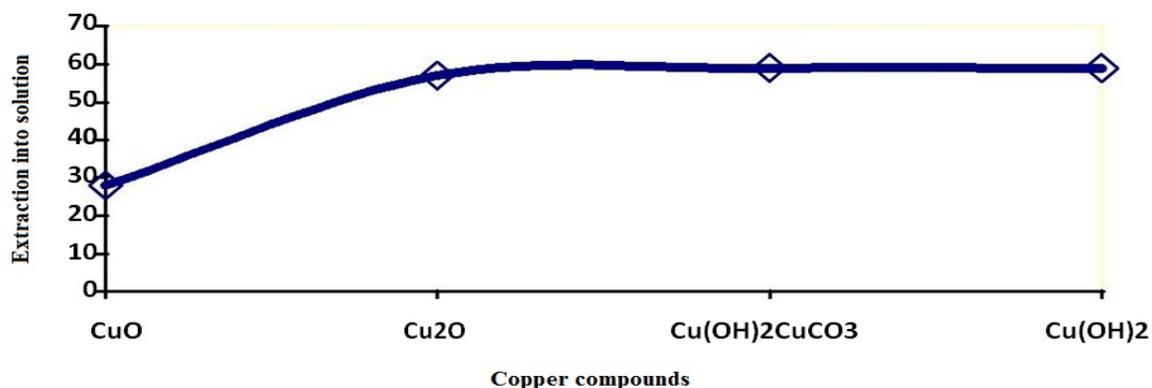
Established that the maximum concentration of copper in solution is sulfamic acid (g / l): 11.2 when dissolved CuO, 25,4 - Cu<sub>2</sub>O, 17,0 - Cu(OH)<sub>2</sub> □ CuCO<sub>3</sub> and 18,9 – Cu(OH)<sub>2</sub>.

Table 1. The change in mass of copper in the sample solution of sulfamic acid (t = 25 °C, S: L = 1: 20, □ = 30min, C (HSO<sub>3</sub>NH<sub>2</sub>) = 10%)

Substance	The initial mass, g	The final mass, g	The degree of transition in solution, %
CuO	5	3,6	28
Cu <sub>2</sub> O	5	2,14	57
Cu(OH) <sub>2</sub> □ CuCO <sub>3</sub>	10	4,1	59
Cu(OH) <sub>2</sub>	8,9	3,66	59



The highest solubility is observed at sulfamic acid  $\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$  and  $\text{Cu}(\text{OH})_2$ , reaching 59%.



*Pic.2. The degree of extraction of copper in the sulfamic acid solution*

Thus, the interaction of copper oxide compounds with a solubility of sulfamic acid, is better seen in  $\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$  and  $\text{Cu}(\text{OH})_2$ , wherein the phase composition of the precipitate is not changed. At dissolution of  $\text{Cu}_2\text{O}$  in solution to sulfamic acid there is a formation of metal copper that is confirmed by the X-ray phase analysis.

Using this technology in the future it is possible to give to copper electrolysis waste "the second life" by separating out of it the metallic copper. Further processing of waste of copper electrolysis by the enterprise, can increase the yield of the final product, and increase revenue the company as a whole, due to the low prices of sulfamic acid. And the principal value in that, the enterprises will throw out less waste that is very important from the ecological point of view.



## **METHODS OF RAISING FUNDS IN THE CONSTRUCTION INDUSTRY IN CONDITIONS OF ECONOMIC CRISIS**

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Economic crisis, as a rule, have negative effect on the potential of industrial enterprises: investments are reduced, fixed assets wear out, scientific-and-technological stock dwindles, the most qualified staff leaves, etc.

The modern development of construction Krasnoyarsk reflected in two key urban planning documents - General plan of the city, designed for long term - until 2020, and the Rules of land use and development, approved in 2007. It should develop rational - within the city limits. It is also planned to increase the available area within the industrial and communal zones on the left bank and decrease on the right bank of the Yenisei River.

Rise in price of mortgage loans and a sharp decrease of crediting activities is blow to the construction industry. At the same time in December last year in Krasnoyarsk there was some excitement for the purchase of apartments, which partly continues today. However, it will be over soon, and already in the III quarter of the construction market may begin serious problems.

The causes of our financial troubles were unusual monetary policy moves, unwise regulations, and misguided federal housing policies. These poorly chosen policies distorted interest rates and asset prices, diverted loanable funds into the wrong investments, and twisted normally robust financial institutions into unsustainable positions.

With regard to our country, companies in the construction sector remain the most vulnerable to the crisis, both in terms of legislation and economic and social measures, economic recovery and also the recovery of the construction sector, which the Government delays to implement.

Financing for construction companies in conditions of economic crisis is carried out in several directions:

1. Raising funds from individuals at the expense of organizations savings funds;
2. Mortgage lending banks with a flexible system of client selection;
3. Raising funds through a system of discounts and bonuses;
4. Cooperation with real estate agencies;
5. Different tenders for participation in the public housing program.

Each of these methods has both advantages and disadvantages. Accordingly, the construction companies choose their strategies for action and ways to raise funds.

Thus, it can be noted that currently the main sources of financing the construction in Russia are bank loans, individual investors, Russian mutual funds, real estate agencies and private equity funds.

Experts refer to the advantages of installments - flexibility (in other words the individual conditions of the developers - this is not in the standard bank credit products). Another advantage of installment is the lack of payment for the additional "option": assessment, insurance package, the fee for issuance.

Moreover, any buyer, regardless of the form of income verification can take advantage of installments with no restrictions on the maximum value of the site and at home.



Another option - with investment mortgage (compensation of part of interest rate). Analysts believe that this method of concessional lending could potentially become a popular addition to the mortgage.

For buyers who purchase suburban areas with the aim of investments, may be offered installment with repurchase. This will enable investors to acquire land plots in installments and take profits at a convenient moment. In this case, the legal and real estate support is carried out by the developer.

However, the most popular variant is to increase the term of installment - up to two, and in some cases even up to 4 years. For the opportunity to break the payments to pay interest will still have - from 7 to 12% per annum - which is less than the mortgage. Developers offer a long-term program of budget accommodation, because they the largest share of mortgage transactions.

Public participation in construction projects associated with the presence of a number of risks:

- risk that house will not be put into operation in the planned term;
- risk that house will not be completed (one cannot exclude the situation where in the course of the construction project investors (equity holders) will fulfill their obligations to transfer funds in full). In other words, contractors will use these funds, but in fact construction will not be completed)
- risk of increase in construction costs (the cost of building materials and works depends on market conditions and the rate of inflation);
- risks associated with poor quality of financial policies pursued by the developer.

For instance, developer may take on non-market conditions, i.e. taking actions that may affect on his financial position and cause of bankruptcy, and, as a consequence, to distract him from the project;

- the risk of unscrupulous developers.

To illustrate one of the above situations, I can give the following example:

«Mortgages will require of buyer to 15 years obligations for payment of a debt. Installment for more than 3 years is considered extremely rare. You must have a serious income to compensate for this difference in timing or be able to provide an initial contribution. In mortgage lending is the most common threshold of 30 per cent cost. When installment more than 50%, more than 75%. And this is the difference, measured in millions».

Also, during the crisis period it is advisable to apply installments for those categories of clients who, because of certain circumstances cannot make use of mortgage programs banks, but are willing to make an initial payment or to save it through construction investment funds.

Another method to raise additional funds in the period of shortage of working capital is to establish discounts on already fully built construction projects in the luxury real estate, as it allows you to attract customers with cash.

Similarly, in times of crisis it is reasonable to build prefabricated bearing-wall houses because they can decrease construction time and make it possible to build quickly housing objects.

So, even during the economic crisis price factors may actively influence on the development of the construction industry and a successful replenishment of working capital of construction companies.

Nevertheless, according to some experts, in Krasnoyarsk, regardless of how the measures will be implemented state support, we should expect slowdown of interest rates by at least 10 percent





УДК 811.111-26

**WAYS OF DEVELOPMENT OF THE POWER ENGINEERING  
IN RUSSIA AND ABROAD**

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**Language supervisor: N.Y. Maksimova**  
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**Efficiency of Power Plants and Power Plant Systems.**

Improving the efficiency of existing coal plants could potentially result in large reductions of CO<sub>2</sub> emissions per unit of electricity produced. Since GHG emissions from electricity generation are

essentially composed of CO<sub>2</sub> emissions, improvements in efficiency are a direct means of reducing GHG emissions. The performance of a power plant can be expressed by a number of measures, including heat rate (i.e., the efficiency of conversion from fuel energy input to electrical energy output), and thermal efficiency. In its simplest form, a plant's heat rate (for a particular period) can be defined as

follows:

$$\underline{HR} = F / E$$

where,

$\underline{HR}$  = heat rate (Btu/kWh)

$\underline{F}$  = heat energy input supplied by fuel to the power plant for a period (BTU)

$\underline{E}$  = energy output from the power plant in a period (kWh)

Since the equivalent BTU content of a single kWh of electricity is 3,412 BTU, thermal Efficiency 18 can be calculated as:

$$TE = (100) (3412) / HR$$

where,

$TE$  = thermal efficiency (%)

As an example, using the average heat rate in 2011 of 10,444 BTU/kWh for coal-fired power plants (i.e., all coal types), the average efficiency for coal-fired plants was 33%.

A lower heat rate represents a more efficient generating unit, since it requires less heat input to generate a kWh of electric energy. A generating unit can thus improve its efficiency by reducing the fuel it uses relative to a specific amount of electricity generated, thus reducing the amount of CO<sub>2</sub> emitted.

A percentage improvement in heat rate is nearly equivalent to an equal percentage improvement in the emissions rate in terms of the change in CO<sub>2</sub> emissions. The difference stems from the small variation in carbon per Btu across coal varieties. The heterogeneity in heat rates across coal-fired generation units can partly be explained by technical characteristics determined at the time of plant construction that cannot be changed without a major overhaul. This category includes size, age, firing type, and the technology employed.

Higher efficiency is generally associated with plants that are used more heavily because efficient units are less costly to operate.

A second factor is how the boiler is used. The relationship between the heat rate and utilization is nonlinear, as efficiency tends to be lower at very low and very high levels of utilization ... Units with lower utilization may be ramped up and down more frequently, which requires additional fuel input as temperature in the boiler fluctuates. The result could involve efficiency losses at least partly outside the control of plant decision makers. Plant managers



control several other factors that affect heat rates. Techniques, management, or technology may improve the efficiency of the plant by targeting the major components of the coal combustion process: oxygen, temperature, and pressure. Excessive deviations in any of these areas may decrease efficiency through waste or shortfalls ...Maintenance and performance testing are also critical for identifying and preventing losses.

Therefore, in practical terms, a power plant's heat rate can be affected by a number of factors and power plants systems. Heat rate may present one measure of efficiency, but when considering power plant GHG emissions, measuring carbon dioxide emissions per unit of energy output (i.e., per kWh or per MWh of generation) may provide a more useful measure.<sup>21</sup>

Each power plant thus presents a unique opportunity when looking at the issue of increasing efficiency, and reducing emissions. **Figure 1** illustrates a relationship between efficiency improvement and CO<sub>2</sub> emissions (for CFPPs using bituminous coal) highlighting the lower emissions of higher pressure CFPPs. Upgrading from subcritical operation to supercritical steam conditions (with required pollution technology) could add at least 20 years to a plant's service life,<sup>22</sup> depending on the regulatory and environmental regime in place. A subcritical plant could achieve at best 40% efficiency (on an LHV basis), while a supercritical steam plant could potentially achieve an efficiency two points higher and emit 4% less CO<sub>2</sub>.<sup>23</sup> Advancing the technology from a supercritical to an advanced ultra-supercritical CFPP could see an efficiency of 46% to 48%, which could mean as much as 18% to 22% less CO<sub>2</sub> per MWh generated than an equivalent-sized subcritical PC unit.<sup>24</sup> However, «Major plant upgrading involving conversion of subcritical to supercritical or ultra-supercritical ... has seldom progressed beyond studies because of the high cost»

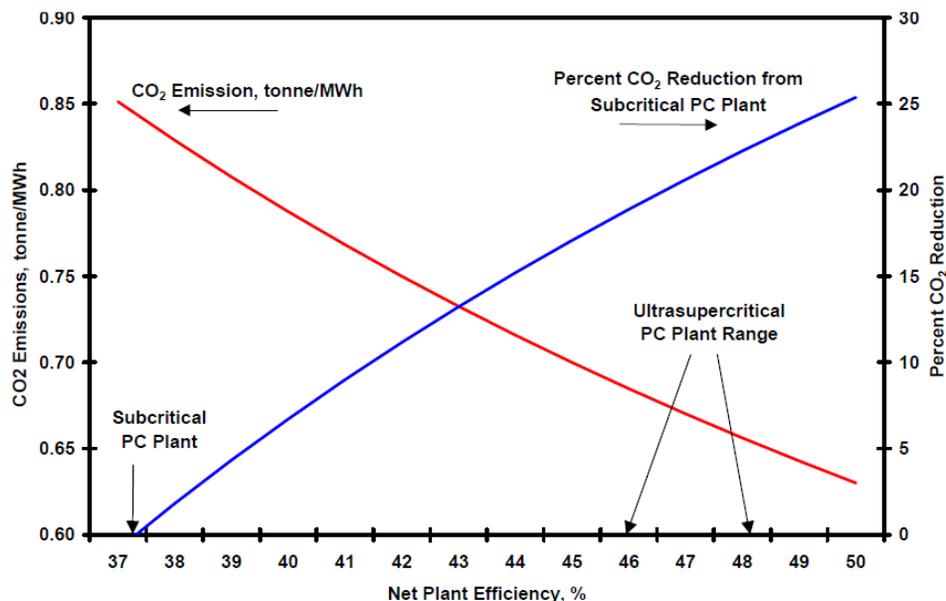


Figure 1. Carbon Dioxide Emissions vs. Net Plant Efficiency

### Efficiency Improvements to Reduce GHG Emissions.

As coal-fired power plants age, they lose efficiency. Much of this loss in efficiency is due to mechanical wear on a variety of components resulting in heat losses, as can be seen in **Figure 2**. Lower power plant efficiency results in more CO<sub>2</sub> being emitted per unit of electricity



generated. The mode of operation also has a large effect on efficiency and fuel use. The options most often considered for increasing the efficiency of CFPPs include equipment refurbishment, plant upgrades, and improved O&M schedules. Cost of the improvements is often compared to the expected return in increased efficiency as a primary determinant of whether to go forward with a program.

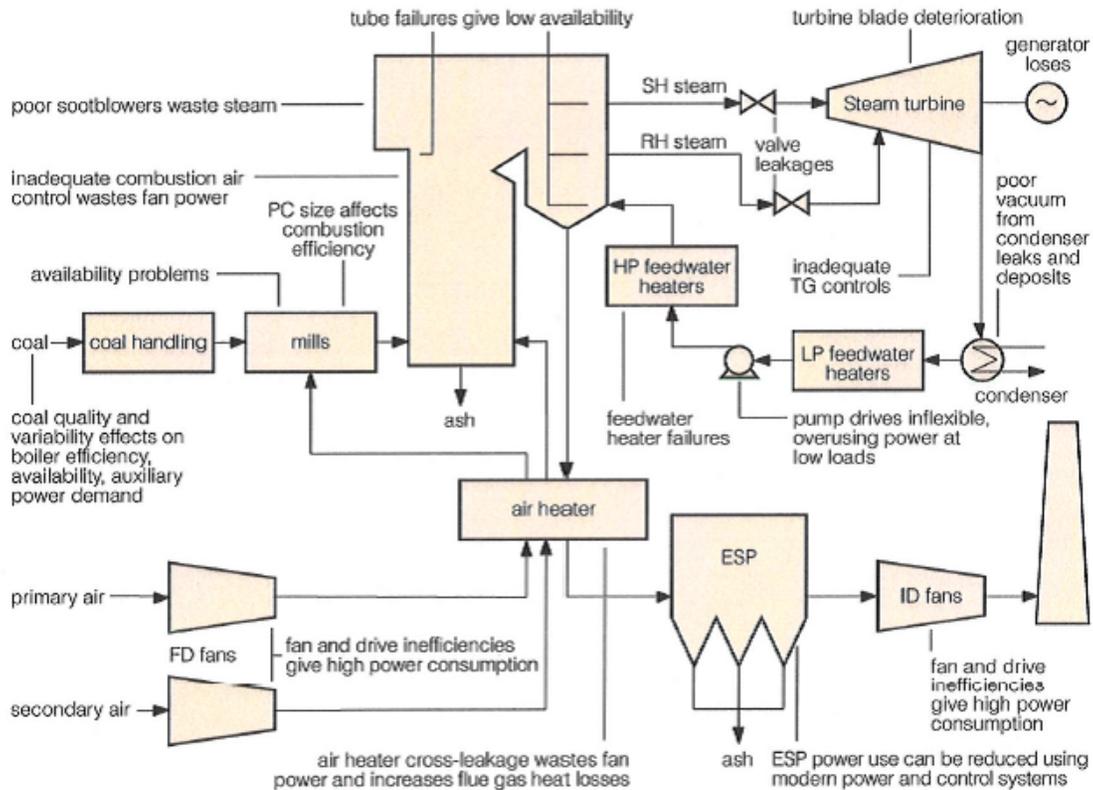


Figure 2. Areas of a Pulverized Coal Plant where Efficiency Loss Can Occur

In 1999, the APEC region was responsible for 59% of the world's carbon dioxide emissions from fossil fuel combustion. Pulverized coal technologies accounted for 94% of coal-fired capacity in the region. The 21 countries comprising APEC include Australia, Canada, China, Japan, the United States, and Russia. According to an Asia-Pacific Economic Cooperation Working Group (APWG) study in 2001, projects to improve combustion, steam cycle, and O&M required low to medium costs, and these expenditures were predicted to produce as much as a 3.5% net overall efficiency improvement.

These improvements could also result in the largest overall reduction in CO<sub>2</sub> emissions of all the scenarios considered by the APWG study, since lower cost improvements were more likely to be adopted. However, if reduction of carbon intensity is the goal (measured in grams of CO<sub>2</sub> emission per kiloWatt-hour of generation), the study found that switching of CFPPs to biomass ranked highest among the options considered (as biomass was considered carbon neutral), followed by fuelsing to natural gas.

A subsequent APWG study found that many older power plants in the Asia-Pacific region were operating well below their design efficiency. However, the study found that replacing the



older CFPPs with new power plants was not practical because the expenditure for a new plant could not be justified by the improved performance. Instead, efficiency and operational improvements were seen as a possible alternative considering a range of equipment upgrades and refurbishment options to various CFPP systems.

#### Combustion Control Optimization.

Combustion controls adjust coal and air flow to optimize steam production for the steam turbine/generator set. However, combustion control for a coal-fired EGU is complex and impacts a number of important operating parameters including combustion efficiency, steam temperature, furnace slagging and fouling, and NOX formation. The technologies include instruments that measure carbon levels in ash, coal flow rates, air flow rates, CO levels, oxygen levels, slag deposits, and burner metrics as well as advanced coal nozzles and plasma assisted coal combustion.

#### **Reported Efficiency Increase 0.15% to 0.84%.**

##### Flue Gas Heat Recovery.

Flue gas exit temperature from the air preheater can range from 250 to 350°F depending on the acid dew point temperature of the flue gas, which is dependent on the concentration of vapor phase sulfuric acid and moisture. For power plants equipped with wet FGD systems, the flue gas is further cooled to approximately 70°C as it is sprayed with the FGD reagent slurry. However, it may be possible to recover some of this lost energy in the flue gas to preheat boiler feedwater via use of a condensing heat exchanger.

#### **Reported Efficiency Increase 0.3% to 1.5%.**

##### Low-Rank Coal Drying.

Subbituminous and lignite coals contain relatively large amounts of moisture (15% to 40%) compared to bituminous coal (less than 10%). A significant amount of the heat released during combustion of low-rank coals is used to evaporate this moisture, rather than generate steam for the turbine. As a result, boiler efficiency is typically lower for plants burning low-rank coal. The technologies include using waste heat from the flue gas and/or cooling water systems to dry low-rank coal prior to combustion.

##### Steam Turbine Design.

There are recoverable energy losses that result from the mechanical design or physical condition of the steam turbine. For example, steam turbine manufacturers have improved the design of turbine blades and steam seals which can increase both efficiency and output (i.e., steam turbine dense pack technology).

#### **Reported Efficiency Increase 0.84% to 2.6.**



## CONCEPT OF COLOR AND ITS ROLE IN ARCHITECTURE

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Color has always played a large role in human society. The environment and its colors are perceived, and the brain processes and judges what it perceives on an objective and subjective basis. That's why when color is used in architecture and interior design, it means much more than just an aesthetic choice. As known that a large part of how we interact with our environment comes down to the perception of color — our psychological and physiological states can be extremely influenced by the colors around us.

In color harmony in architectural space, considers Physical, Aesthetics, Physiology and Sociology associated sciences affecting the effect of color on man. On this basis was tried establishing the laws of harmony, raised by simultaneous color sensations. No common theoretical basis has been developed so far for a uniform approach to problems like “what is the role of color in the architectural” space, and “how color composition affects the space sensation”. But the theory of architecture is expected to do it.

Harmony is regarded as the outcome of various components, such as:

- the color of the complex;
- the environmental involvements of these colors;
- their relation to man, who “observes” the colors;
- the various levels of visual processing are included in a generalization model of color harmony, tentatively summarized below.

Level of interaction among color and sensations, color to man and color to environment, in particular, wavelength, scales, color adaptation, constancy, contrast; color preference, associations and psychosomatic effects, spatial position, expression of functions, illumination.

Fundamental conditions are relations among hue and color, complex, Saturation and brightness, aesthetic function of the complex.

Accessory conditions are color shifts by adaptation, color memory, feelings, syn-esthetic effects, etc.

And now I would like to consider several options for the use of color in the organization of architectural space.

First of all, let's talk about **achromatic colors**.

Currently in the only almost completely achromatic (colorless) architectural era, and it isn't very good.

Achromatic means without color, and contemporary architecture is just that; white, grey or black, and sometimes, with a glass surface. If only a few of the modern buildings were achromatic, it wouldn't be a problem, but when districts after district are filled with colourless buildings, we have a problem.

The thing is, the human body and mind originally belongs out in nature. And we all know how colourful our nature is, and the thing is, we need colour. Different colours feed us with different kinds of energy, and without them, on a conscious or sub-conscious level, we get depressed, lazy, uncomfortable, uncreative and sometimes, just sad.



Another issue with achromatic architecture, is that colourless buildings put together in a large group (no matter how artsy and elegant they look), have serious difficulty creating a warm and cozy atmosphere.

Traditional architecture on the other hand, often uses color palettes consisting of 3-5 colors, put together with the idea of creating something beautiful. Sometimes (probably often) there's not even a plan, it just feels warm and cozy because of the colors, but also the details and ornamentation.

Also the combination of **warm and cool colors** is very important in architecture.

The play between warm and cool colors in architecture is more or less new. It has been used in design and practice since the late 18th century and it is still used in contemporary architecture today.

Warm colors are made with orange, red, yellow and combinations of them all. As the name indicates, they tend to make you think of sunlight and heat. Warm colors look as though they come closer, or advance (as do dark colors), which is why they're often used to make large space look cozier.

Cool colors such as blue, green and light purple have the ability to calm and soothe. Where warm colors remind us of heat and sunshine, cool colors remind us of water and sky. Unlike warm colors, cool colors look as though they recede, making them great for small rooms you want to look larger. If you have tiny space that you want to visually enlarge try painting a color such as light blue to make it look bigger.

An important thing to remember when dealing with warm and cool colors is that no object should have just one. If you want your object to be cozy have warm colors as the dominant colors and then add a few elements that incorporate cool colors (and vice versa). Like with all elements of decorating it's important to have some balance and contrast.

When choosing colors to use for your object it's important to think about the mood you want to create.

The use of **tints and shades** is also quite an interesting method.

A tint contains a somewhat larger proportion of a hue or neutral in its white base than does an off-white. Tinted walls can infuse color for a building while maintaining high light reflectance. Because of the quantity of color they bring to a building and because of surfaces reflecting into one another, tints can be as powerful as smaller amounts of strong color, such as in a painting or on a single colored wall.

White dilutes a hue but does not tone it down. Regardless of the amount of white in the intermix, the hue remains saturated until grayed or softened. Although pale, high-saturation tints can have a lively, fresh quality, somewhat stronger tints on wall surfaces can appear gaudy or even vulgar (e.g., "pink, paink, or punk," as described by a wag). Tints of basic or leading hues are more complex than tints of fundamental hues, and are generally, although not always, to be preferred. Grayed tints can sometimes impart a quality of mistiness.

Because of the sometime association of light tints with weak sentiment, they may be considered inappropriate for some uses, such as a bank. Complex, toned-down tints can be more substantial, yet maintain high light reflectance, the critical factor being its complexity.

At maximum Saturation violet-blue or purple pigments can be so black that white must be added to them to make the hue apparent. Shades of middle- and high-value hues are created by intermixing the hues with a toner, usually the complement or perhaps black. Dark shades of yellow or yellow-dominant inter-mixtures lose the essence of their yellowness.

Any deep color is livelier and more luminous with the presence of even an infinitesimal amount of its complement in the intermix. Darkened hues can be incredibly rich on interior wall



surfaces. They may be whitened somewhat and still be considered shades, although whitening them might produce a chalky appearance, which may not be desired. Dark low-saturation hues as well as brighter dark hues can be an effective foil for brilliant accent hues and whites.

The amount of dark wall surface may need to be limited unless the sense of an enveloping enclosure is desired or unless the space is well illuminated. When used on an individual wall or as an accent color in an otherwise neutral space, the value contrast can produce dramatic effects. Because dark colors absorb so much light, they need brighter illumination than do colors of higher value.

And finally, I should be noted that To plan appropriate color environment, it will be helpful to know the relation between color composition of a cityscape and our visual impression. Previously, data had been recorded by the use of the peculiar representation of the color arrangements in the city named color mosaic. That is, for every scene, a synthetic image is produced by using three or nine colors. Now these data are compared to the impressions reported by looking at some selected photographs of various areas of the city. The evaluation of the impressions is performed by scoring the responses along three dimensions: activity (active, calm); organization (orderly, chaotic); preference (harmonious, disharmonious). In conclusion, the colors that occupied large areas in the cityscape were commonly selected as representative colors. Highly saturated and conspicuous colors were also selected. In some cases the color selection was influenced by the context of the cityscapes. The color arrangements composed by the observers gave similar visual impressions as the photographs of the. However, some cityscapes giving similar visual cityscapes having traditional buildings or textures gave very different results for the photographs and the color arrangements.



## **DEVELOPMENT AND PROSPECTS OF WATER SUPPLY SYSTEM AND SEWERAGE IN KRASNOYARSK**

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Despite of the difficult economic situation in the country and our region, the pace of construction in Krasnoyarsk is increasing. The water supply system and sewerage are developing too. What prospects will Krasnoyarsk expect in the future? To answer this question we've spent a research, which showed a rich history of Krasnoyarsk water supply system and sewerage.

The construction of pipeline in Krasnoyarsk started in 1913. Krasnoyarsk administration decided to build a pipeline themselves. The first water and electric station was set up on the coast of the river Yenisey opposite Posadny island. At the same time, on Posadny island there was constructed an infiltration water intake well. The construction was done by a famous pipeline company "Neptune", but all the works on the construction site were controlled by an engineer Boleslav Yulianovich Getsen.

The mainstream pipeline laying began in March, 1913. Initially, the pipeline consisted of the five-inch wooden pipes, connected with couplings. These pipes were laid in the trenches with a depth of 4,5 arshins (1 arshin is 0.7 m) and were covered with chernozem soil.



*Fig1. Construction of the first pipeline*

The pipe canal through the Yenisey channel, connecting water intake with the town water supply system, was constructed from solid-drawn steel pipes. Their diameter was 12 inches (1 inch is 2.54 cm) and they could withstood pressure of 50 atmospheres.

The pipeline was tested on September, 14 in 1913 by a fire brigade. Firemen connected fire hoses with the hydrants and produced water fireworks, which gave a lot of delight to the citizens. Finally, the pipeline was launched on December, 28 in 1913.



*Fig2. A pumping station of second rising*



*Fig3. The first municipal water intaking pump on Posadny island*

The first supervisor of a water and electric station became Boleslav Getsen. The pipeline enclosed the old town perimeter and had a length of 12 kilometres. 90 manholes, a water tower in Nikolayevskaya sloboda and two water intaking pumps were arranged. The water pumping efficiency was 500 thousand buckets per day. Up to 1928 the pipeline was an essential part of the water and electric station and it was increased from 12 km to 30 km for 15 years. In 1928 the station became a part of a municipal trust “Vodosvet”, which had the water and electric station, the town pipeline system, public baths and a brick factory.

When industrialization had started, water utilities became an independent industry, “Water sewerage” trusts appeared. On September, 7, 1936 the trust “Vodosvet” was reorganized into two independent companies: the Central power network and the municipal trust “Water sewerage” (“Vodokanalizatsiya”). It is the moment when Krasnoyarsk plumbing system began.

Then, the construction of town sewerage stopped because of World War II and was closed down temporarily. It resumed in the late 1940s – early 1950s. At that time treatment facilities were introduced. By the end of the 20<sup>th</sup> century “Vodokanal” was a modern technical equipped company. In 2005 the municipal company “Vodocanal” was reorganized and it became a part of a management company “Krasnoyarsk housing and municipal complex” (“KrasKom”).

The history of water supply and sewerage development in Krasnoyarsk is closely connected with “Vodokanalproyekt”. Since 1958 its highly-skilled experts have developed construction documentation of six water intakes for our city, two treatment facilities on the left and right banks of the Yenisey river, the environmental systems of all city districts and industrial buildings have already been built and have still been constructed in Krasnoyarsk for the last half of the century. In other words, actually all operating water supply and sewerage systems (except those which had been constructed up to 1958) were designed by the specialists of this institute. These days the institute is introducing new modern technologies into city water supply and sewerage. Sterilized wastewater systems on Kazachiy island and Gremyachiy Log island water intakes were reconstructed by these engineers. This new system avoids using of chlorination what makes drinking water safer and improves its quality.

As for water quality Krasnoyarsk isn’t a bad place. Being situated on the both banks of the Yenisey river, Krasnoyarsk has been using water of excellent quality for more than 100 years. The chemical underground water composition is formed with the help of the Yenisey surface water and is usually stable. Tap water in Krasnoyarsk almost doesn’t require any treatment because of its purity. But Sanitary Codes and Regulations (“SanPiN”) demands of tap water chlorination.



The taste of Krasnoyarsk water earned a gold medal and 3 silver medals at the competitions “Pure Water” held in Nizhniy Novgorod in 2003 and 2004. Also, according to Moscow Protection of Customers Fund and the exhibition “Water and Health – 2004” Krasnoyarsk intake water is ready to be bottled without any treatment.



*Fig4. The medals at the competitions*

Nowadays there are several water sources both for drinking and domestic and industrial demands:

1) underground water of the alluvial deposits of the Yenisey river. The capping is done with water-supply wells which are situated on the islands: Kazachiy, Posadniy, Tatishev, Otdikha and Nizhne-Atamanovskiy;

2) the surface water of the Yenisey river. Water intakes at the river bed take water and send it to the treatment plant “Gremyachiy Log”.

At present the right bank and the left bank of Krasnoyarsk have got their own drinking water supply systems. The left bank is supplied with water by 3 underground intakes (Kazachiy, Posadniy and Tatishev) and by 1 surface intake (Gremyachiy Log). The right bank of the city is supplied with water by 2 underground intakes (Tatishev and Nizhne-Atamanovskiy).

To sum up we could say that the increasing construction industry challenges water supply system. Increase in productivity of infiltration water intakes should be done. Conveyance capacity and spillway capacity of the mains should be also increased. Besides, the amount of drinking water also needs to be greater because of the thermal power stations.

