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Solutions to the Problem of Designing a Hydraulic Construction Organization

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Abstract: This article discusses solutions to the problem of designing a hydraulic construction organization, including what needs to be built, in what order it should be built, what technology to use and what is necessary according to the construction organization project and work plans. And also how it is developed at the construction stage and how design work should be treated, in what time frame and with what resources should be used.

Keywords: hydraulic engineering construction, construction and installation work, construction organization project, working designs developed at the construction stage, feasibility study of investments, transport schemes, construction period, hydroelectric power station units, construction organization.

Introduction. The organization of hydraulic construction is a system of interrelated organizational and technological decisions, activities and work aimed at ensuring efficient and high-quality construction of the facility at the planned pace and on time. Organizational and technological decisions – decisions on the organization and technology of hydraulic engineering construction, adopted in organizational and technological documents. Organizational and technological documents are the construction organization project and working designs developed at the construction stage. The construction organization project and working projects developed during the construction phase answer the questions: what to build, in what order, what technology to use, in what time frame and with what resources.

Methods. We studied this research using the methods "Problem Situation", "Venn Diagram", "Brainstorming", "Discussion" and "Project". In this case: through our first method: a problematic issue was identified, the history of its occurrence was studied, the consequences were considered, ways of solving it were considered and determined; the second method was to construct a Venn diagram; Using the following methods, the article shows the current problem, expresses opinions and ideas, and presents specific analyzes and project schedules.

Results. Documents on the organization of construction and the execution of work include the section "Project of the organization of construction", developed at the design stage of work projects developed at the construction stage, and work projects developed at the construction stage in accordance with [1]. The facility is based on the construction organization project and working designs developed during the construction phase.

It is prohibited to carry out construction and installation work according to the project approved by the construction organization and work projects developed at the construction stage. Deviation from the decisions of the construction organization project is not allowed without agreement with the organizations that developed and approved it in the construction organization

project [2]. When performing work, deviations from the working designs developed during the construction phase are not allowed without agreement with the organization that developed it and the person who approved the working designs developed during the construction stage.

When constructing a facility in difficult natural and geological conditions, as well as during the construction of unique buildings and structures, the construction organization project and working designs developed at the construction stage must include special measures to ensure the strength and stability of the constructed and existing buildings and structures during the construction process and structure.

Requirements for the project of organizing the construction of a hydraulic structure. A project for organizing the construction of a hydraulic structure is the order and sequence of construction of main structures and temporary facilities, a scheme for skipping construction costs, the type and design of temporary hydraulic structures. As well as technological construction schemes that define organizational and technological documents for the implementation of main structures and work, transport schemes, construction timeframes, individual stages of construction (start-up kits) and the timing of commissioning of hydroelectric power station units, a consolidated construction calendar plan and other construction plans (schedules), financing plan, logistical and labor requirements for resources. Construction organization project is a section of working projects developed during the construction stage, an important part of it. It was developed by the design organization and approved together with the working designs developed during the construction phase.

At the initial design stage, within the framework of the feasibility study, a section "Construction Organization" was developed, which, due to the incompleteness of the development compared to the construction organization project, should be called a section and not a construction organization project.

Construction organization project is one of the main sections of the detailed design developed at the construction stage, which constitutes the estimated cost of construction. In order to reduce the risk of incorrect calculation of the cost of construction of a hydropower facility, this section must be completed in full, take into account the actual construction conditions and propose technically and economically sound methods for its organization. The economic indicators of the construction of a hydroelectric complex, its economic efficiency, reliability and operational safety throughout its entire service life largely depend on the level of design decisions made in the construction organization project.

The construction organization project, approved as part of a hydropower facility, is a mandatory document for contractors and other organizations involved in the construction of the facility. In connection with changes in construction conditions, it is necessary to analyze the impact of changes in individual parts of the construction organization project on the further development of the construction of the facility. Before implementation, they must be agreed upon with the lead design organization and the developer (technical customer).

The construction organization project is developed by the head design organization or a specialized design organization under an agreement concluded with it. Sections (points) of a construction organization project related to special work, as a rule, should be developed with the participation of specialized design organizations. The cost of developing a construction organization project is included in the cost of developing a construction organization project.

The starting materials for developing a construction organization project should be:

- characteristics of the construction area: climatic conditions, roads, railways and waterways, the presence of a network of construction industry enterprises, the possibility of using local labor, etc.;
- engineering research materials and observational data: meteorological, hydrological, hydrogeological, geological, seismological, environmental, etc.;

- materials of design and technical justification at the previous stages of facility design (scheme of territorial planning of hydropower facilities, justification of investments in the construction of the facility);
- diagrams of hydropower complex structures, space-planning and design solutions for buildings and structures, division of construction into separate stages and commissioning of complexes developed at the stage of detailed designs developed during the construction phase;
- directive documents defining the construction time frames for individual stages of construction and commissioning of hydroelectric power plants;
- special requirements for the construction of complex and unique facilities;
- information about the conditions for performing construction and installation work at sites subject to reconstruction;
- information about the availability of construction equipment from the contractor participating in the construction of the facility by decision of the developer (technical customer);
- Other necessary information related to the construction features of the facility.

The construction organization project must be developed for the full size of the structure provided for by the work plans developed during the construction phase. When constructing a facility in separate stages, the project for organizing the construction of the first stage of construction must be developed taking into account the implementation of construction for full construction.

At the design stage, the "Construction Organization" section must be implemented to a sufficient extent in order to estimate the cost of the work based on the collected indicators. At the stage of work projects developed during the construction stage, the construction organization project is carried out in a sufficient volume to estimate the cost of work in unit prices.

The structure and content of the construction organization project may change taking into account the complexity and characteristics of the objects being designed, this depends on the space-planning and design solutions, the level of integration and typification of these solutions, the need to use special auxiliary means such as structures, fittings, fixtures and fittings, the characteristics of individual types works, as well as the conditions for the delivery of materials, structures and equipment to the construction site.

For complex objects and buildings that are being used for the first time: a fundamentally new production technology that has no analogues; unique technological equipment; new construction structures, as well as enterprises and structures, the construction of which is planned in extremely difficult geological or natural conditions, the construction project includes, in addition to those indicated:

- a comprehensive detailed plan (table), reflecting the relationship between all construction participants, defining: the duration of the main stages of construction of the facility and preparation of the facility, the composition and timing of the work; the preparatory period; the procedure for the construction of individual buildings and structures as part of the work phase (commissioning complex), conditions for the supply of technological equipment;
- instructions on the priority and timing of the necessary research work, tests and scheduled observations to ensure the quality and reliability of structures, buildings and structures under construction;
- Instructions on the specifics of constructing a geodetic leveling base and methods of geodetic control during the construction process, as well as other instrumental control of the quality and reliability of constructed structures, buildings and structures.

Project for organizing the construction of reconstruction and technical re-equipment of existing

water management structures, buildings and structures included in them:

- display of the amount of work performed without stopping the production process and work associated with a complete or partial stop of the production process;
- Determination of the priority and procedure for joint execution of construction and installation work, indicating the areas and workshops where the technological processes of the main production are changed during construction and installation work, as well as areas and workshops where construction work is carried out during construction and installation work. Planned technological production. Stopping main production;
- in the general construction plan: indicate existing buildings, structures and utility networks, the reconstruction of which will not be carried out; newly constructed buildings, structures and laid networks; reconstructed and dismantled buildings and structures; dismantled and modified utility networks; places where new networks join existing networks; crossing the territory; instructions for the safe passage of construction workers;
- In the explanatory note.

In the explanatory note:

- indicate the list and scope of work performed in narrow and dangerous conditions;
- operational management of reconstruction work;
- measures to ensure joint activities of the enterprise and the construction organization;
- enterprise services for creating production conditions for builders, information about lifting and transport equipment in factories and workshops of enterprises transferred to builders during reconstruction;
- fire and explosion safety measures;
- measures to ensure the stability of preserved structures during installation and dismantling;
- Category and volume of generated construction waste.

When constructing facilities in harsh natural conditions, the construction organization project, in addition to the requirements, must take into account the possibility of the influence of the following physical, geographical and economic factors influencing the preparation, organization and implementation of construction:

- for the northern construction-climatic zone:
- the duration of seasons with low air temperatures, strong winds and snow, as well as low natural light in the area;
- permafrost soils;
- remoteness of construction sites from industrialized centers and centralized logistics supply bases;
- dependence of the provision of material and technical resources on (seasonal) modes of navigation on inland waterways and coastal transport lines;
- limited local energy sources;
- the need to use special types of transport;
- exposure of ecological systems to the influence of economic activities and their difficult restoration, as well as an increased need for the elimination of waste that cannot be disposed of in production;
- treatment, purification, disinfection and capture of wastewater and atmospheric waste elements;

- the difficulty of organizing a construction site in marshy and flooded areas;
- the need to regulate the temperature of the concrete mixture and the necessary installations for this regulation;
- The difficulty of organizing the provision of workers with sanitary and living conditions.
- *For mountain and highland regions:*
- low atmospheric pressure, which requires compliance with operating modes specially adapted for builders;
- increased risk of strong winds and lightning;
- avalanches, mudflows, avalanches and landslides;
- Impassable terrain (high slopes, elevation changes).

For desert and semi-desert areas and regions with particularly hot climates:

- high air temperature during the day;
- lack of local sources of water supply over large areas and, in connection with this, the need to implement special measures for purification, desalination, transportation, cooling and storage of water;
- The need to comply with measures to preserve the vegetation cover of weakly resistant sandy soils;
- The need to regulate the temperature of the concrete mixture and the necessary installations for this regulation.

When constructing facilities in areas where hazardous geological processes have occurred, the construction organization project, in addition to the requirements, must take into account the following requirements:

- it is necessary to ensure the priority implementation of special measures for the organization of drainage, the installation of temporary water supply systems and their use during the construction of objects built on soils with specific characteristics (swelling, etc.), the prevention of uneven soil moisture, as well as systematic monitoring of sedimentation and its prevention ;
- during the construction of facilities located in permafrost zones, decisions on the order, timing and technology of work should be made taking into account the forecast of changes in temperature, permafrost-soil and hydrogeological conditions during soil development;
- Construction and installation works and operation of facilities.

When constructing objects in special natural conditions, in addition to the materials specified in the construction organization project, landslide and fall protection structures must be present (See Figure - 1.):

- forecast of activity and intensity of landslides and landslides during the construction period;
- measures to ensure the stability of slopes and slopes during the construction of protective structures;
- construction calendar plan (table), drawn up taking into account the strict order and timing of all work, depending on the need to complete or temporarily stop excavation work before the start of the rainy seasons of the year;
- solutions for the placement and storage of soil, preventing the construction of landfills in landslide zones;
- Solutions for organizing drainage, water reduction and special methods of soil strengthening.

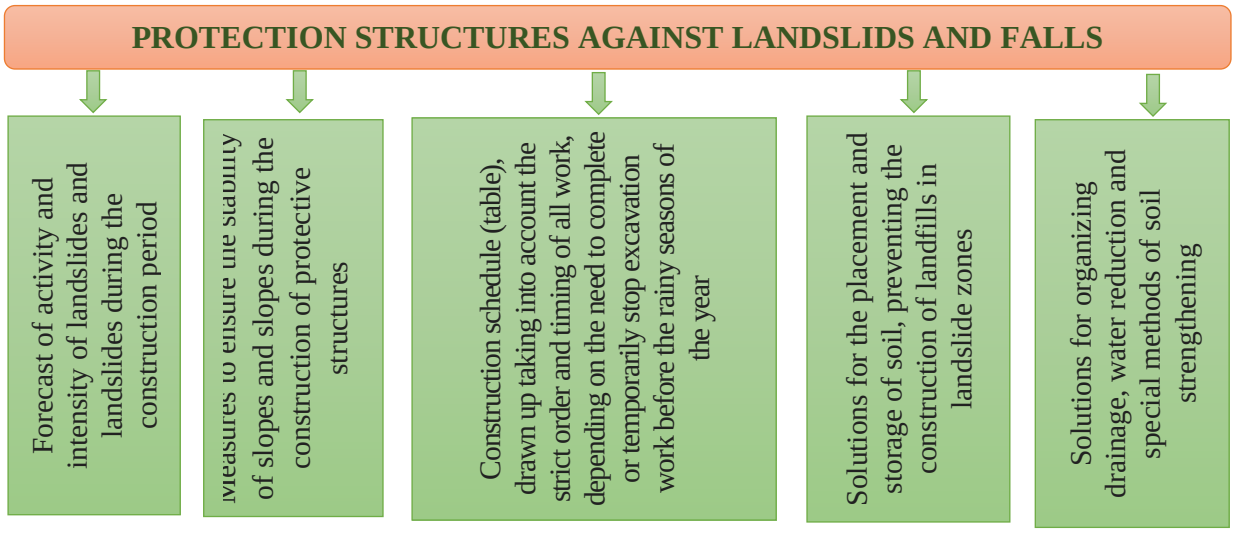

Figure - 1. Landslide and Fall Protection Structures.

For flood protection structures: where necessary, solutions for transferring floods and flood flows through unfinished structures, ensuring their safety; decisions on the reasonable seasonality of certain types of work, taking into account local conditions; indicators in the construction calendar about the periods of possible flood occurrence according to forecasts based on research materials; recommendations for placing observation points for the formation of flood flows and ensuring their stable connection with the construction control center; decisions on the location of production facilities, settlements and access roads in a safe zone, as well as possible evacuation routes for people and construction equipment; requirements for operating condition during floods.

In the near future, construction of hydropower facilities is expected in the mountainous regions of the North Caucasus, Siberia and the Far East. To do this, it is necessary to conduct high-quality engineering surveys to identify areas at risk of flooding and potential landslides, and then develop measures against floods and landslides when designing a construction organization. It should be noted that methods of protection against floods and landslides are not sufficiently reflected in the existing technical literature [6].

Discussion. A flood flow can destroy buildings, structures and cause the death of people at the place of passage, as well as block the economic channel with the formation of backwater in the upper reaches of the river. For flood protection, the following is required (See Figure - 2.):

- identification of flood risk zones at the stage of engineering surveys;
- do not design or construct buildings and structures in places subject to flood currents;
- organization of constant monitoring of the condition of flood-prone areas located near water bodies;
- Creation of flood dams, traps and other protective structures.

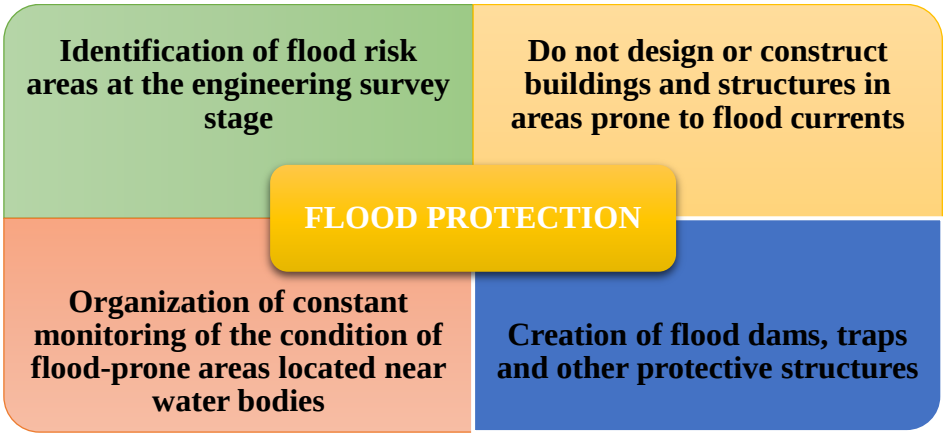

Figure – 2. Flood Protection.

A negative example is the flood during the construction of the Golovnaya Zaramagskaya hydroelectric power station, which led to the death of people and the destruction of a temporary village in the area of the hydroelectric power station. Landslides can cause: destruction of buildings and structures located at a height above or below it; blocking the internal channel of the river by flooding and inundating the hydroelectric power station building located in the upper part of the river; clogging of the hydraulic system reservoir (divided into two parts) creates the risk of unpredictable breakdown and hydrodynamic destruction; release of large quantities of water through a dam with catastrophic consequences. Possible landslide protection measures (See Figure – 3.):

1. identification of landslide areas at the stage of engineering and survey work;
2. landslide reduction by removing the upper part of the landslide zone and increasing the gentleness of the slope;
3. creating a plug under the landslide;
4. fastening the landslide (if possible) to a stable part of the massif with pre-tensioned anchors or bored piles;
5. bypassing the landslide zone using a tunnel located outside the landslide;
6. organization of monitoring of landslides located near water bodies;
7. Implementation of other possible protective structures. The following examples can be given.

A tunnel was designed and built to divert the river in the event of a landslide at the Golovnaya Zaramagskaya HPP. When the reservoir of the Zaramagskaya hydroelectric power station was filling, the road along the left bank slipped and cracks appeared. In order to eliminate landslide processes, they were secured with drilled piles tied to a stable mountain range.

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While the reservoir of the Gotsatlinskaya hydroelectric power station was filling, the road on the left bank, connecting three regions of mountainous Dagestan, began to slide and cracks appeared in several places. Traffic was stopped, a network of observation signs was created, and measures were taken to ensure safety and stabilize landslides. A month later, traffic was restored [7].

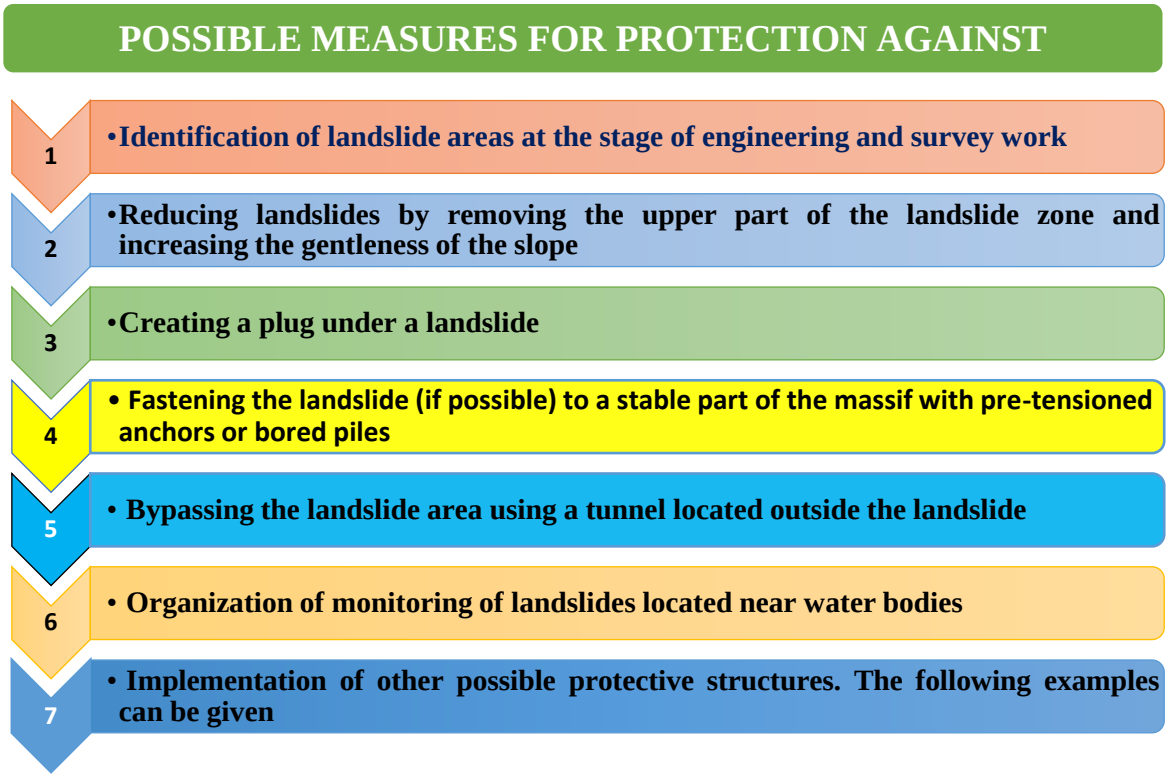

FIGURE - 3. POSSIBLE LANDSLIDE PROTECTION MEASURES.

On October 9, 1963, a major accident occurred at the Vajont Dam in Italy. A landslide with a volume of 240 million m3 hit a reservoir with a volume of 169 million m3. More than 50 million m3 of water spilled through the dam. A wave 90 m high washed away several settlements in 15 minutes, killing more than 2 thousand people.

Conclusion. From the above studies, it follows that during the design of the Boguchanskaya HPP; a potentially unstable mass was discovered on the right bank at the location of the hydroelectric complex. To prevent a landslide, this massif was lowered (its upper part was cut off), and at the base it was reinforced with a prism of spilled soil.

In December 2018, a landslide occurred at the reservoir of the Bureysky hydroelectric complex in the Khabarovsk Territory, as a result of which the reservoir was divided into two parts due to the landslide. The distance from water management facilities to the site of the collapse on the river is 120 km. The length of the dam at the top is 740 m, the width is from 180 m to 500 m. The height of the dam is up to 60 m above the reservoir level. The height of the top of the landslide-lintel is different from the height. The height is 258.0 m. 311.1 m, which is significantly higher than that of the NSL. The approximate volume of the collapsed rock mass, according to various estimates, is 25-34 million m3, of which 4.0-4.5 million m3 is located on the surface of the reservoir. At the time of the incident, the depth of the reservoir in the area where the landslide occurred was 65 meters. This created a threat of flooding of the village of Chekunda, located 70 km above the landslide, and flooding of engineering structures. Baikal-Amur Mainline. At an altitude of 113 km above the landslide reservoir there was a railway and road bridge across the river.

Bureya near the village of New Urgal. As soon as possible, i.e. within a month and a half, a channel 240 m long, 100-150 m wide and more than 23 m deep was built in the landslide [3].

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