

## Soil and Water Conservation Scheme for China's Construction Projects: A Discussion on Compilation Techniques

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*Abstract: With the rapid development of China's economy, the environmental problems brought by soil erosion have become increasingly prominent and problems such as land desertification and soil fertility decline have become more and more serious. Therefore, continuous improvement of national soil erosion prevention standards and a series of technical specifications and review points have been promoted. The introduction of the soil and water conservation program report serves as an important technical guidance document for the implementation of soil and water conservation work and plays an important leading role in controlling the soil erosion caused during the production and construction process and the further deterioration of the ecological environment in the project area. How to compile a soil and water conservation scheme in the feasibility study stage is the most important concern of all design units and related personnel. This paper discusses the water and soil conservation program preparation technology of the construction project and points out the main points of the soil and water conservation plan and the problems that need attention in order to provide reference for the soil and water conservation compilation of the construction project.*

*Keywords:* Soil and water conservation; construction project; sustainable development; compilation techniques.

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### 1. INTRODUCTION

Water and soil are the basic conditions for human's survival and development and they are the basic irreplaceable resources and the foundation of economic and social development as well [1]. At present, the serious problem of soil erosion has raised widespread concern in all

countries of the world. The United Nations has also listed soil erosion as one of the three major environmental problems in the world. Soil and water conservation are the foundation of land remediation. Protecting precious land resources from external erosion is not only the basic connotation of soil and water conservation, but also the main content of utilization and protection of land resources. From the perspective of protecting land resources and alleviating soil degradation, soil and water conservation has a positive effect on the utilization and protection of land resources. In order to prevent soil erosion, protect and make use of water and soil resources rationally, reduce the disasters of water, drought, wind and sand, improve the ecological environment and ensure the sustainable development, from the state to the local governments corresponding laws and regulations and local regulations have been formulated, which all point out that large and medium-sized development and construction projects must report water and soil conservation plans and organize the implementation after the approval of the department of water administration[2]. The compilation of soil and water conservation plan is the premise and technical basis for the prevention and control of soil erosion in construction projects, so it is particularly important.

Soil and water conservation are not only the main body of ecological environment construction, but also the foundation of ecological environment construction, which is at the forefront of ecological environment construction. At present, controlling soil erosion and promoting the construction of ecological environment vigorously have become an important task in China's economic and social development. In order to deepen the understanding of the compilation of soil and water conservation programs, this paper discusses the water and soil conservation programming techniques for construction projects, points out the main points of water and soil conservation planning and issues that need attention to provide the soil and water conservation programs compilation of construction projects with reference.

## **2. GENERAL RULES OF COMPILATION**

The general rules of compilation should include the purpose, significance, the basis and depth of compilation, the design level years and so on, in which the compilation basis mainly consists of laws and regulations, ministry regulations, regulatory documents, normative standards and main technical materials and related documents. The water and soil conservation program are designed to prevent soil erosion, protect and make use of water and soil resources rationally, mitigate water, drought, wind and sand disasters, improve the ecological environment and ensure the sustainable development. However, from the perspective of soil erosion controlling, the soil and water conservation program is mainly to prevent man-made soil erosion, that is, humans utilize land irrationally, reclaim steep slope land, cultivate slope, overgraze, disturb surface materials, destroy surface vegetation, stack solid waste arbitrarily and so on during the production and construction activities, which accelerate the erosion. At the same time, if the project spans different regions, it's supposed to consider whether to implement different standards in segments.

### **3. PROJECT OVERVIEW**

When introducing the project overview, it is necessary to explain the geographical location, scale and grade of the project, the method and process of the construction, the planning and layout of the project, the land occupation and the construction progress, etc. In the project scale and grade chapter, there should be a project property list, including the name, scale and grade of the project, the site, unit, period of the construction, project composition, floor space, earthwork volume, and project investment, etc. The construction method and process mainly refer to the construction technology and methods directly related to soil and water conservation, such as foundation excavation, diversion method, excavation of earth and stone, backfilling, transportation and storage methods, etc., to find out the possible construction activities and processes that cause soil erosion. Especially when calculating the balance of earthworks, you can't simply use the method of excavation— filling = abandoning or borrowing. The construction time series, the standard section and other factors should be fully considered. After comprehensive analysis, the engineering quantity calculation table and the earthwork flow balance diagram should be drawn.

### **4. OVERVIEW OF THE CONSTRUCTION PROJECT AREA**

The general overview of the construction project area mainly includes the overview of the natural environment, social and economic conditions, the present situation of soil erosion and soil and water conservation. The overview of natural environment mainly includes meteorological hydrology, topography, water system, geology, soil, vegetation and soil utilization status. The meteorological overview requires a series of measured data (temperature, rainfall, evaporation, wind speed, etc.) from nearby weather stations, and the maximum rainfall intensity value at 6h and 12h with a certain frequency. The present situation of land use needs to describe the land use situation of the project clearly according to the land occupation of the project.

Socioeconomic conditions need to investigate the land, population, economic development status, people's living standards, development direction of the project area or along the area, whether it is necessary for immigration, etc., the role and impact of the project on the surrounding areas should be paid attention to the scope of control and too large scope of information is not permitted. The current situation of soil erosion can simply describe the topography and vegetation of the project. According to the results of remote sensing investigation, list and explain the soil erosion type and the area and proportion of erosion intensity in the area and analyze the soil erosion of the project area to determine the allowable value of soil erosion in the project area. The current situation of soil and water conservation can be understood by the local water conservation department for the water and soil conservation work carried out in the past few years (the effect of building terraces, pond dams, small watershed management, terminating economic forests, water conservation forests, etc., preservation status, and returning soil erosion).

## **5. ANALYSIS AND EVALUATION OF SOIL AND WATER CONSERVATION IN MAIN PROJECTS**

Analysis and evaluation of soil and water conservation in main works should include soil and water conservation constraints and evaluation, overall project layout and program comparison analysis and evaluation, project land occupation type, area and land occupation property analysis and evaluation, engineering excavation earthwork balance and construction process evaluation, main body analysis and evaluation of soil and water conservation in engineering design, analysis of impacts of engineering construction and operation on soil erosion, concluding observations, requirements and recommendations these seven parts. In the actual project, it is necessary to analyze the impact of soil erosion caused by the project and determine the prevention and control of soil erosion in combination with the construction characteristics of the main projects. A combination of engineering measures, plant measures and temporary measures should be adopted to formulate a thorough prevention and control system for soil erosion. There are many measures for soil and water conservation, such as isolation belts and retaining walls. In the process of compiling the project, the layout of the project area should be optimized according to the characteristics of the main project and the composition, so that the project's floor space is reduced as much as possible, the layout is more reasonable, and the earthwork deployment during the construction process is as reasonable as possible, making it possible to reduce the amount of soil erosion. The practicability of the scheme should be taken into account, that is it can reduce soil erosion within the scope of prevention and control, improve the project area and surrounding environment and have certain ecological benefits, economic benefits and social benefits after the implementation of the scheme. The ecological environment of the construction area can be restored and there is no impact on the local soil erosion work.

## **6. RESPONSIBILITY SCOPE AND PREVENTION DIVISION OF SOIL EROSION PREVENTION**

The project shall be based on the provision of the Technical code on soil and water conservation of development and construction projects (GB50433-2008) to take responsibility for soil erosion prevention and control combined with the characteristics of the project construction. The scope is divided into project construction area and direct impact area. The project construction area mainly refers to the area where the production and construction are disturbed, including the land acquisition scope, land occupation scope, land use scope and the scope of permanent and temporary land acquisition involved in the project scope. The directly affected area refers to the area outside the project construction area, the scope of the disturbed land may exceed the project construction area and cause soil erosion and its direct damage due to the construction of the project. The directly affected area is the area that the construction unit should be responsible for, and the construction unit should take effective measures to prevent and control it. The purpose of the prevention and control division is to design services for subsequent soil erosion prediction and soil and water conservation measures. The difference in

topography and geomorphology will lead to different levels of disturbance and control measures.

## **7. SOIL EROSION PREDICTION**

Soil erosion prediction is divided into five parts: soil erosion factor analysis, prediction range and prediction period, prediction content and method, soil erosion prediction, prediction conclusion and comprehensive analysis. The main factors of soil erosion are natural factors and human factors. The natural factors affecting soil erosion mainly include precipitation, soil, vegetation and topography and so on. The human factors are mainly abandoned waste soil waste generated by development and construction activities. Once exposed to heavy rain and surface runoff, loose and bare land will also occur strongly, which will cause serious harm. The prediction range of soil erosion is the disturbance area of each disturbed area. The prediction unit shall be the period time in which the engineering construction disturbs the surface, the disturbance form is generally the same and the disturbance intensity and the characteristics are generally consistent. According to the specifications of the Technical code on soil and water conservation of development and construction projects (GB50433-2008), the prediction period of soil erosion is divided into three periods: construction preparatory period, construction period and natural recovery period. According to the requirements of the Technical code on soil and water conservation of development and construction projects (GB50433-2008), forecast contents of soil erosion prediction mainly includes five aspects: excavation disturbing the surface of the earth, destroying the area of land and vegetation; the area and quantity of damaged soil and water conservation facilities; the amount of soil spoil; the amount of soil erosion that may be caused; the possible damage caused by soil erosion. And the prediction method should use different methods according to the prediction content. For example, predicting the permanent and temporary land occupation during the construction period, excavating the disturbed surface, the type of land and the damaged vegetation, the area and the amount of earthwork excavation during the construction period, backfilling earthwork and spoil can be consulted by design drawings and technical data and partitioning determines the surface area of the disturbance. Predicting the amount of soil erosion that can be caused by using the analogy analysis method to predict the soil erosion modulus and formulating the soil loss by formula. It is predicted that the soil and water loss hazard may be caused by on-site field investigation and comprehensive analysis of the prediction results of soil erosion.

## **8. PREVENTION AND CONTROL OBJECTIVES AND PREVENTION MEASURES**

Soil erosion control objectives and prevention measures include the prevention and control objectives of soil and water conservation, the layout principles of soil erosion control measures, prevention and control measures system and overall layout, zoning control measures and typical design, construction organization design, construction methods and precautions and construction schedule. The principles for the layout of soil erosion control measures should

meet the principles of regional governance, complementarity, key emphasis, priority of benefits, and principles of greening and beautification. According to the layout principle of soil erosion control measures, the results of prevention and treatment division, the different parts and strengths of soil erosion and the effectiveness of soil and water conservation measures, the water and soil loss prevention measures are arranged in the opposite direction, and systematic prevention measures are taken to form a complete soil erosion control system and preventive measures. The layout of soil and water conservation measures should be carried out in a comprehensive view, so that the first overall situation, the latter part, the first focus, the general, and the priority should be treated differently. The organic combination of engineering measures and plant measures is consistent with the prevention and control of soil erosion on the points, lines and surfaces, giving full play to the control and timeliness of engineering measures, ensuring that soil erosion is curbed or reduced in a short period of time, and reusing land and forest and grass measures to cover water, protect soil, achieve complete prevention and control soil erosion. When zoning measures, it pays attention to the characteristics of soil erosion in each sub-area, corresponding prevention measures, prevention and control priorities and requirements and pays attention to the relevance, continuity, integrity, system and science of each prevention and treatment subdivision.

The area control measures and typical design should be based on plant measures, and the combination of engineering measures and plant measures. Stick to the principle of economy, safety, reliability and operability of soil and water conservation programs. Plant measures should select afforestation species by analyzing the site conditions of the afforestation soil in the project area and based on the biological and ecological characteristics of the tree species. Tree species choose to adhere to the following principles:

Adapt to local conditions and adapt to the tree. The tree species should be fully considered in the process of tree species selection to ensure the sustainable and stable performance of afforestation projects.

- (2) Achieve organic combination of solid soil, greening function and economic benefit.
- (3) In the process of selecting afforestation trees, it is necessary to highlight the overall temperament of the main tree species and the landscaping effectiveness of the protection project.
- (4) Fully consider the ecological control of pests and diseases in afforestation projects and achieve long-term and short-lived collocation combined with arbor and bush in the tree species planning process, ensuring ecological protection projects and continuously and effectively exerting benefits. At the same time, it achieves the ecological control objectives of pests and diseases.

The selection principle of grass species is that the root system is developed, the grass is tight, the expansion ability is strong, the trampling resistance is strong, the climate soil condition has strong adaptability, the pest damage is light, the survival rate is high, easy to manage, and has certain ornamental value and develop a harmonious whole with the surrounding environment

## **9. SOIL AND WATER CONSERVATION MONITORING**

Soil and water conservation monitoring includes 10 parts: monitoring objectives, monitoring principles, monitoring content, monitoring time, monitoring scope and points, monitoring methods, frequency and requirements, monitoring workload, monitoring units and costs, monitoring management and monitoring results.

The purpose of monitoring is to assist the construction unit to implement the soil and water conservation plan, strengthen the design and construction management of soil and water conservation, optimize the prevention and control measures of soil erosion, coordinate the progress of the construction of soil and water conservation projects and the main projects; grasp the soil erosion status and prevention effects of production and construction projects timely and accurately and propose improvement measures for soil and water conservation, reduce man-made soil erosion; timely identify potential hazards of major soil erosion, propose countermeasures for soil erosion prevention and control; propose technical basis for soil and water conservation supervision and management and public supervision basic information and promote effective protection and timely restoration of ecological environment in the project area. The monitoring content mainly includes the monitoring of soil erosion modulus, the monitoring of soil erosion factors, the monitoring of soil erosion status and the monitoring of soil erosion control effects.

Soil and water conservation monitoring begins from the preparatory period of the construction period and the monitoring period is the entire construction period. The frequency of monitoring is once a month in the rainy season and once every 2 months in the non-rainy season. And the additional test is performed when the 24h process rainfall is greater than 75mm. Soil and water conservation monitoring has two methods: positioning monitoring and investigation monitoring. As for different types of surface disturbances, we should monitor erosion intensity, set up corresponding observation facilities on the ground, obtain relevant data through regular and irregular observations and calculate soil erosion intensity. The monitoring of the terrain, landform and water system, the land area occupied by the construction project, the surface area of the disturbed ground, the excavation and filling of the project, the amount of abandoned slag and the area of the piled pile are monitored by actual survey, GPS investigation and combined design data method. At the same time, the inspection unit should conduct statistics, collation and analysis of the monitoring data and monitoring results in a timely manner. After the completion of the monitoring project, comprehensive analysis and evaluation of the monitoring work should be made.

## **10. INVESTMENT ESTIMATION AND BENEFIT ANALYSIS**

Investment estimation and benefit analysis are mainly divided into four parts: investment estimation, soil and water conservation investment overview, benefit analysis, and soil and water conservation profit and loss analysis. As an important part of the main project, the soil and water conservation project, the compilation basis of the cost estimate, the price level years, the cost calculation, etc. are consistent with the main project and cannot meet the requirements

and select the water conservancy industry standard. The analysis of soil and water conservation profit and loss refers to the loss of soil and water conservation caused by the construction of the project and the benefits arising from the implementation of soil and water conservation measures. The five impact factors of the project's footprint and impact range, disturbance intensity on the surface, impact time, total amount of soil erosion and irreversible ratio are cut in in the profit and loss analysis, standardized, and the final impact index is calculated according to which to guide and improve the engineering design.

Soil and water conservation benefits include economic benefits, ecological benefits and social benefits. The water and soil conservation program are mainly responsible for restoring and improving the ecological environment, ensuring the safe operation of production and construction. The soil and water conservation benefits are generally reflected in the contribution to the society and the natural environment. For the enterprises themselves, they are concentrated on ensuring construction and safe production, that is, no major economic losses are caused by soil erosion, so that the overall efficiency of the enterprise is maximized. Benefit analysis should first consider ecological benefits, guaranteeing production and construction safety benefits and social benefits, follow the principle of "ecological social benefits first" and should incorporate its economic benefit analysis into the overall benefits, using the enterprise's full investment benefit evaluation method, namely financial economy evaluation analysis. The project is feasible as long as the overall benefits are high even if the economic benefits of soil and water conservation are not obvious.

## **11. COMPREHENSIVE CONCLUSIONS AND RECOMMENDATIONS**

The comprehensive conclusions should clarify the constraints of the construction of the unrestricted project, the concluding opinions on the comparison of the main project plan, the soil and water conservation evaluation of the existing project of the main project design and the renovation and expansion project, the soil erosion prediction result, the overall plan of soil and water conservation, main soil and water conservation measures and engineering quantities, engineering investment and benefits. In the proposal, it is necessary to put forward the requirements for soil and water conservation of the main construction organization, the requirements for the subsequent design of the soil and water conservation project, problems to be further studied in the next stage.

## **12. CONCLUSIONS AND OUTLOOKS**

This paper discusses the compilation technology of water and soil conservation planning for the construction project and points out the main points of water and soil conservation planning and the problems that need attention. With the development of soil and water conservation, the prevention and control technology of soil erosion has gradually deepened from the design level to the research level and the basic research has entered a higher level. As an important technical guidance document for many projects in soil and water conservation work, the water and soil conservation plan of the production and construction project provides good countermeasures

for the prevention and control of soil erosion in the main project construction and the rescue of land and water resources, provides technical support for the treatment and reconstruction of the regional ecological environment for production and construction, provides technical guidance for the development of unit water conservation work and plays a very important role in the comprehensive management of soil erosion in the main project. Only when we fully recognize the importance and particularity of the compilation of soil and water conservation programs[3,4], continuously improve the compilation procedures, keep pace with the times, gradually solve new problems from prevention and control of soil erosion, restoration of vegetation, environment and sustainable development, combine the ease of use of resources, mixed forest agriculture, drought prevention, land conservation, etc., carefully prepare the soil and water conservation plan, can we compile a realistic and high-quality soil and water conservation plan report. At the same time, the national government departments should tighten the supervision and management of the water and soil conservation plan report as well, so that the soil and water conservation plan report can be implemented in time to serve the development, construction projects and serve the national economic development, so that Chinese ecological environment will become better.

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## REFERENCES

- [1] Yongjun Zhao. Soil and Water Conservation Plan Compilation Technology for Development and Construction Projects[M]. China Land Publishing House, 2007.
- [2] Huiping Zhao. Brief Discussion about Several Problems in the Preparation of Soil and Water Conservation Program[J]. Soil and Water Conservation in China, 2004(10):29-30.
- [3] Pujin Yuan, Fu Cheng and Xubiao Gao. Discussion on Technical Review of Soil and Water Conservation Plan for Production and Construction Projects[J]. Soil and Water Conservation in China, 2017(2):4-7.
- [4] Dewen Jiang, Yingchao Tian, Jie He et al. Soil and Water Conservation Classification and Classification Management Countermeasures for Production and Construction Projects [J]. Bulletin of Soil and Water Conservation, 2015, 35(3):116-120.