Slope Landscape Classification and Application Security in the Special Section of Western

Wang Song¹,a, Zhao yongguo¹,b, Gu xiaoxu²,c, Liu xiaoning¹,d
¹CCC First Highway Consultants Co... LTD, Xi’an, China
²School of highway/Chang’an University, CCCC First Highway Consultants Co... LTD, Xi’an, China
atougao-ws@qq.com, b 351683511@qq.com, c39831632@qq.com, d360594697@qq.com

Abstract
This paper analyses a question of poor landscape ecology on high slope, proposes objectives and principles of high slope landscape design, and sums up the high slope construction techniques of landscape protection, combined with common features of ecological slope protection technology. According to the actual slope characteristics of some a road in Shannxi, we proposes slope safety classification research methods, and ultimately lays down a suitable landscape program of high slope.

© 2011 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of National University of Singapore.

Keywords: Road; high slope; landscape security; Ecological slope protection;

1. Introduction
Slope landscape is an important part of highway landscape, and the high slope landscape design is a key part of the slope. Compared with the general slope, these characteristics of high slope are that: the lower visual effect, the more slope disease, and the more demanding on security and stability of the structure. These high slopes often used for larger masonry protection methods, such as mortar rubble, cement mortar plastering and so on. Some part of the slope use ecological protection with safety fence protection, but these effects are still unsatisfactory, leading to a large number of barren slope. Thus, a special section of the slope landscape reasonable design to achieve "best green" is a real beauty, according to the actual situation in the form of protection.

2. The Objective And These Principles Of Landscape Design On High Slope
2.1. The Objective of Landscape Design on High Slope

On the basis of the security and stability of high slope, high slope landscape design goal is to harmonize safety protection with natural landscape, blend with the natural environment, and produce a highlight on the road.

2.2. These Principles of Landscape Design on High Slope

For the present, road landscape on high slope is usually in the form of an integrated protection, such as hanging net seeding, sash and other forms of protection. Different plants constitute a rich and varied slope landscape because of diverse forms and diverse colors of plants. In order to create a rich landscape of high slope, these following principles:

a) To Secure a Solid Basis
The primary function of slope protection is safety. On the basis of insecurity to make many high slopes "full-greened", these do not make any sense, so the slope landscape design should ensure the security and stability which is the basis of the slope landscape construction.

b) To Natural Recovery as a Priority
In the process of slope excavation, on the one hand, for the better and the more old trees on its base and top of these slopes, such as arbors and boulders, we should take reasonable measures to protect as much as possible. On the other hand, we should accurately analyse the surrounding natural landscape of all original slopes, with a reasonable use of indigenous plant, and natural transition of the original topography, in order to create a harmony with the surrounding landscape slope, weakening the artificial marks.

c) To Regional Culture as a Highlight
Normally, a road come across some different regions, with different geographical characteristics and cultures. So a landscape design of high slopes should fully consider them, and shape a slope landscape with a strong regional characteristics.

d) To Interdisciplinary as a Key Point
The landscape design of a road is comprehensive, particularly, a landscape design of high slope will be accomplished with landscape planning, road-based engineering, landscape engineering, ecology and other aspects of professional knowledge, which need to work together with multi-disciplinary professional staffs.

e) To Economy as a Root
Except for ecological benefits and social benefits, we consider that a landscape of high slope should design economically and objectively, and improve scientifically and practicability.

3. Common Ecological Slope Protection Technology

3.1. Hang Nets Hydroseeder Technology

Hang nets hydroseeder technology includes nets and hydroseeder. It creates a porous stable structure which can make plant grow better and not wash planting matrix by hardening jet objects adding special substance, such as three-dimensional vegetation network, vegetation-growing concrete, guest earth broadcasting technology.

Application: weathered rock, soil-less rock, nutrient-less soil, hard soil, very steep slope, and erosion significantly soil, as Figure 1.

Characteristics of Hang Nets Hydroseeder Technology

- Construction technology is more difficult, and quantity is bigger than other technology.
- Landscape effects are better than ordinary green effects.
- Not confined by geological condition
According to the site condition, we can choose reasonable sprayed matrix material thickness. If sprayed matrix material thickness is very thin, it will Chipping off shells; If it is very thick and heavy, Hang nets are off easily.

The initial function of nets is beneficial for vegetation growth. With the formation of vegetation, its main function is to help the grassroots system enhance the ability to resist natural soil erosion.

Plant selection gives priority to grass seed and small shrubs.

3.2. Comprehensive Protection Technology (Framework Protection + Slope Protection with Grass and Bush)

Synthetical protection includes engineering protection and plant protection, meanwhile engineering protection comprises concrete, mortar rubble, plasma build by laying bricks or stones eggs (gravel) stone, and plant protection comprises planting grass and bush or turfing.

Application: soil slope slowed in 1:0.75 and fully weathered rock slope. When slopes are in serious or humid pluroision, slope should be slowed in 1:1, as Figure 2.

Comprehensive Protection Characteristics:

- Combination with biological protection and engineering protection, it is a simple construction, and the effect is better than others.
- Frame protection can prevent soil slope avoid producing groove under pluroision, while protecting these plants in frame space far from rainy.
- Plant protection achieve a good landscape effect and soil and water conservation
- Plant selection gives priority to grass seed and small shrubs.

3.3. A Soil Bacterium Permanent Greening Method

A soil bacteria greening method will rock weathering or soil genesis process accelerated tens of thousands of times with many effective soil bacterias, meanwhile it independently absorbs nutrients from the rock and the atmosphere, and restores and improves surface of biological activity, in order to make the rock of plant growth and its permanent greening become possible. So a core technology is to effectively reengineer a soil layer with soil bacterias, and gains natural circulation and balanced among restore rock, soil, microbe and plant.

Application: It is hard to afforest place, such as rock slope greening, barren land, saline and alkaline land, slag, architectural abandon slag, tail ore, desert, high slope and mortar concrete, as Figure 3, Figure 4.

The soil bacterium permanent greening method characteristics: According to different region characteristics, we manually produce an active soil bacteria, and meet local plant survival conditions, which is beneficial for the growth of plants. Because of non-uniform, it is a natural green method, and a very economic greening methods not to damage the ecological environment.

- Slope surface laid barbed wire, and it is a simple construction method, and it is a simple and economy construction method, and saves large amount manpower.
- Soil microorganism break up leaves and twigs around these plants, and produce a large number of organic and inorganic nutrients, improve these plants’ ecological environment, and promote the growth of plants.
- Generally speaking, rock greening is only the rock face greening, and plant roots do not reach rock inside. However, a soil bacterium greening method can make rock pedogenesis, and promote these plants’ roots developed. So it plays a positive role for the stability of these slopes and preventing erosion.
- It creates a growth of natural environment in accord with surrounding environment by soil bacteria greening, which is beneficial for other species migrating and survival.
Plant selection gives priority to afforestation with grass seed, small shrubs and macrophanerophytes. So these plants will grow better and better, and form forest landscape after many years.

4. The Protection Main Techniques Of High Slope Landscape In Construction

The protection main techniques of high slope landscape in construction:

a) Construction design specification gives advanced design ideas, so in construction, construction personnel should understand design concepts, and grasp design principles on site. According to different actual conditions, they should deeply analyze high slopes which may produce diseases, prevent copy and apply mechanically in light of design papers, and conduct flexibility construction.

b) After excavation, high slopes should prevent and control landslide slope, and surface and subsurface drainage is most important. They can dredge and pave intercepting ditch, drains and natural grooves, in order to form good drainage grid system, and reduce water hazards for slopes.

c) Make smooth and evasive for top and toe of a slopes, and form concave shape curves, as far as possible sleek and natural transferion.

d) These excavated slopes should be timely covered humus, and ensure these thickness and quality of humus.

e) Three-dimensional Vegetation Network Protection: we should pay attention to choose good herb and shrubs seeds of native species, fix network packets of fillings with soil particles, nutritional soil and grasses and so on, and prevent soil erosion because of rainwash.

f) Comprehensive Protection: we should choose reasonable collocation of good herb and shrubs. Meanwhile, the collocation of native species on upper slope emphasizes landscape effects, and the collocation of native species on lower slope emphasizes landscape effects.

g) Hang Fouble Nets Injection Organic Substrate Afforestation: According to convex parts of excavated slopes, we should adjust the thickness of injection organic base material, and build natural harmonious slopes. When spraying seeds, we should uniformly hydoseeder in organic substrate. According to rainy seasons of construction sites, we add timely grass seeds, and achieve a good coverage rate.

h) Soil Bacterium Permanent Greening Method: reasonable choice of soil bacteriums, adoption of herb, shrubs and macrophanerophytes, improve some kinds of quantity, and accelerate restore vegetation to a natural state.

5. Application Of Ecological Slope In Engineering

"Yulin-jiaxian" highway is an important part of highway planning nets in shaanxi province, and it is 81.143 kilometers through Yu Lin city, bounded with Tai-jia highway. The natural geographical environment along the road is special for a desert scenery and a loess plateau with a lower vegetation coverage rate. On original scheme, road slope in desert take measure of grass pane protection and vegetation protection. Loess high slope take measure of retaining types and protective types, such as parapet, top retaining wall, earth-retaining wall, facing wall, mortar rubble masonry pavement, skeleton protection, three-dimension vegetation nets planting protection and so on.

In my opinion, a landscape design of high slope shall take reasonable analysis of steps in landscape safety graded and gradually in-depth research them. Firstly, we adopt advanced testing instruments for scientific analysis, judgement different sections slope stability and classify research then make a scientific and rational landscape plan.

a) A foundation of landscape design on high slope is safety. Security should be embodied in the early stage, and we accurately judgment the possibility of slope by all sorts of slope test equipments. According to these test results, we take reasonable protective measures to eliminate hidden dangers. At present, some main measures are taken in our country: microwave testing equipment, micro deformation measurement system, slope automatic monitoring system, and radar rapid non-destructive testing equipment etc.
b) Combined with region construction experience and detection results, appraisal is divided three levels. First, high slope safety and stability is good, and take ecological protective measures. Second, high slope safety and stability is poorer, and takes appropriate protective measures to prevent a part of slope slump and soil erosion, such as skeleton protection, three-dimension vegetation nets planting protection. Thirdly, high slope safety and stability is worst, we need to adopt hard measures to prevent wide-spread decline, for example, prestressed anchor costalia wall and sheet-pile wall.

c) According to different security classification, we lay down rational landscaping measures. Firstly, for good stable slopes, ecological protective measures can be adopted as the guest earth broadcasting technology and the soil bacteria greening method. Secondly, poor stable slopes can be adopted comprehensive protective measures, for example hang nets hydroseeder technology, and measures with ecological protection and engineering protection. Plant selection gives priority to shrubs and large amount of grass, and native flowering shrubs are adding on the upper slope. Thirdly, for these worst safety and stability high slopes, we shall take creeper plants and branches drooping plants for naturally shelter from top of slopes, toe of slopes, and stages for heating soil and broken rock.

d) For a good safety, stability and landscape effect demand, scope of slope on tunnel can use soil bacteria greening method. Plant selection gives priority to a lot of macrophanerophytes and shrubs, bond with a few of grass, as possible as choosing some plants to harmonize the natural surrounding landscape, and at last it will have reached late good landscape effect.

6. Conclusion

Through analysis, the beauty of high slope landscape design is not blindly seek "whole green", but we shall take scientific and reasonable detection and analysis for slope, and adopt different protective measures to make slope "green" up on the basis of safety. Finally, it is the most real beautiful that protective measures achieves a most appropriate green and a most fitting beauty.

References

Figure 1: Three-dimensional vegetation network

Figure 2: Comprehensive protection

Figure 3: Soil Bacterium Permanent Greening Method

Figure 4: The plants growing effect after four years (Soil Bacterium Permanent Greening Method)