EROSION PROBLEMS

By

Franz A. Aust,
Associate Professor of Landscape Design
University of Wisconsin

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In the earlier science of highway construction little thought was given to the appearance of alignment, vertical curves, and streamlines, but since the year 1932 a great deal of emphasis has been placed not only upon these but also upon the sub-grade in relation to the permanence and efficiency of modern highways. Greater care has been taken that the design of the highway conform to the contours of the ground and the geological and ecological forces which formed and shaped that ground; in other words, the countryside as a whole. The engineer has dug deeper into the problems of highway construction, but at the same time his field of activity and his interests have also widened, with the result that problems outside the right of way are becoming important as well as those immediately beneath the highway and those within the legal limits of the right of way.

Prevention of erosion has three distinct aspects: human comfort, human safety, and human happiness - in other words utility, safety, and beauty. It is well known that slippage and deposition of soil and rock due to erosion increase maintenance costs and often create traffic hazards. It is only in recent years, however, that we have come to think of these problems in relation to beauty. A very large proportion of the use of our highways is for the purpose of recreation, and a primary reason for pleasure-touring is enjoyment of scenery. Such scenery is not limited to shoulder slopes and fence lines. The eye takes in the hills, the mountains, the lakes and rivers, the plains and the valleys, sunlight and the shadow of passing clouds, the masses of trees and the stretches of wildflowers. This scenery does something to us. It brings joy and happiness to the soul. It repairs broken-down tissue; it recreates; it inspires. We come back from our trip refreshed and ready to take up again the menial tasks of every-day life. We have been invigorated and strengthened by our travel.

The Innate Longing for Beauty

There is a deep social significance in this inner urge to get back to nature, to enjoy the beauty of the countryside. Getting back to the primitive is one of the fundamental longings of mankind. Governments, regardless of their political doctrines, are all stressing the

importance of this significant fact. If we are to provide food for the souls of men as well as for their dietary needs, we must consider that the art values along our highways are things worth striving for and conserving at all costs. This applies especially to the natural beauty of rural scenery.

There are many different types of natural beauty found along our highways, and each has its own place, for we must provide variety to fit the needs of the touring public. Some like the forest, some woodlands, others like the dunes, sweeping sands or the dashing waves; others like the marshy odors of the bogland with its many flowers, reeds, and rushes, its animal and bird life.

Some Problems of Erosion Control

So often these problems of scenery are intimately related to the problem of highway construction and the prevention of erosion. Adequate and timely protection against erosion will result in a material saving of construction costs in connection with regrading and resurfacing. Earlier experiments have definitely determined the fact that through erosion control maintenance costs can be greatly reduced. Scars on the landscape left by construction operations can be healed and the landscape again restored to its natural beauty. Rock cuts and deep fills may be made stately and glorified by the use of native vines. The Virginia Creeper, the Wild Fox and River Grape, the native Clematis, all may be used in this work. "The best roadside development will always be that which shows Nature the least disturbed". When all the cut and fill slopes are graded for maximum safety, the tops carefully rounded to prevent frost action and stabilized with native sod cut from adjacent meadows and banks, many of our roadsides will clothe themselves in a comparatively short space of time. The native sod brings with it not only the indigenous grasses but also sedges and mosses, wildflowers and ferns, even wild roses and low-growing shrubs.

It is now time that the roadbuilder, the engineer, and the designer not only fit the highway into the countryside, but also restore some of the charm of the countryside that was ours in pre-automobile days.

When we look at erosion problems from the standpoint of beauty, we must see them in relation to the landscape as a whole. A satisfactory solution entails not only engineering, construction, maintenance, alignment and streamlining, but also a planting scheme which unites, blends, and harmonizes the highway with the countryside of which it is a part. When we are building our highways, we are building roadways back to nature. Someone has observed that engineering is a combination of brains and materials, the less brains the more materials. Perhaps we might add; the more brains and intelligent planning the less material but the more beauty. In a solution of the problems of utility, safety, and beauty as they relate themselves to erosion control, we must coordinate as well as engage the best thought coming from engineering, soil conservation, ecology, geology, and landscape design. We are fortunate in now having all of these merged in a cooperative project.

Cooperative Agencies

Last December the Sub-committee placed special emphasis upon erosion control as it relates to highway construction and maintenance. This cooperative project is being sponsored by the U. S. Bureau of Public Roads, the Soil Conservation Service, Highway Research Board, Tennessee Valley Authority, and various State Highway Departments. The demonstrations and researches will be located in key areas and selected from those regions where the urgency of the problem will insure the best cooperation.

The following statement of purpose was outlined in the 1935 report: "The prevention of erosion along highways is a problem widespread throughout the nation. Soil treatment to prevent erosion has often proved very costly, and in many cases has not been entirely successful. The solution of this problem involves engineering questions pertaining to cross section, methods of drainage, construction of stabilizing structures, problems of location and necessary drainage structures with respect to topography. Also involved are forestry, agronomic and soils problems dealing with the establishment of most effective plant growth for erosion control".

The objective set forth was as follows: "To study methods and demonstrate practices, materials, structures, and plants best adapted for the prevention of erosion along highways under varying conditions of cross section, soil type, and climate. The study should include relative initial cost as well as subsequent maintenance".

Method of Cooperation

The Soil Conservation Service has offered two types of work to the State Highway Departments: (1) Research work which is conducted on State highways will go forward under an agreement between the State department and Soil Conservation Service only. (The Bureau of Public Roads will act as consultant). (2) On Federal Aid Routes, the Soil Conservation Service will enter into a three-party agreement; The State department, U. S. Bureau of Public Roads, and the Soil Conservation Service.

The Soil Conservation Service will also advise with the State departments on State roadside improvement projects where erosion is a major factor in such roadside development.

The above outline will suggest many different combinations and possibilities to the various State departments. It offers the best engineering skill available in the field, and this year should see us in full swing in several different localities.

Up to the present, considerable time has been spent in coordinating the viewpoints of the different cooperating agencies. These matters were quite fully discussed at the St. Louis Meeting. Early in

September there was set up in the Arkansas area a project aggregating five miles. Other projects have been definitely started, one in La Crosse County, Wisconsin. The work has benefitted by earlier efforts along this line in the Tennessee Valley. The writer has personally visited and is familiar with the details of the La Crosse County project, and has observed the various experiments and demonstrations along the freeway at Norris, Tennessee, a project now going into its third year.

Erosion Control in the TVA

Many interesting approaches to the problem have been undertaken and worthwhile results have been obtained. A general outline of the erosion studies is as follows:

Erosion (1) on cut and fill slopes; (2) in highway ditches; (3) in waterways below highway drainage structures; (4) in waterways above and leading down into highway drainage structures.

Erosion on cut and fill slopes is perhaps the most obvious type of preventive work. The work which the engineer has done in streamlining the highways and in rounding back the slopes, instead of leaving the usual railroad engineering angles and scars, has contributed much to the solution of some of the problems. There are definite methods which have been tried in the TVA area which will be extended over a wider range of territory and are certain to bring fruitful results. Particularly among those are the methods of establishing grass or equivalent ground cover. It is extremely difficult and often a long procedure on the part of Nature to cover a slope (either fill or cut) which is too steep. Mulching with straw or marsh grass, covering this with brush to prevent slippage and washing away, and sowing grass seed directly upon the mulch have proved to be satisfactory and quick methods of treatment. The use of fertilizers to build up raw soils before seeding operations are started has also proved effective. Sodding and spot sodding have proved successful on certain types of the heavier soils. Bermuda Grass, Virginia Bent, and Brome Grass lend themselves particularly well to the spot sod method. Sodding is an expensive procedure, but where the steeper slopes are absolutely essential, sodding is the method which must be used.

In any method ofseeding and sodding, a very important factor is the exposure of the slope. Experimental work has clearly demonstrated that what is often successful on an east and north exposure will not be at all satisfactory on slopes which face south and west. Also the season of the year is an important factor in the method to be tried. Sudden thawing and freezing which prevails on the south and west exposures would have little or no detrimental effects on north and east exposures. In the use of mulch and brush, ways and means must be devised to lessen fire hazards. One may hope that the research projects going forward may result in definite recommendations and standardized methods of practice for each particular area, soil type, and exposure within that area. It is obvious that no general blanket order or recommendation could be made which would apply

equally well over an area of any great extent. Even in Wisconsin we would have to divide the State into four or five regions. In some cases they might follow the natural highway divisions; in others they would cut across boundary lines.

When we turn to the prevention of erosion by means of planting trees, shrubs, and vines, less definite information is available. Certain techniques have been developed, namely, the use of wattles, the seed spot method of planting trees, and the selection of species for different soil types, but these are still very decidedly in the experimental stage.

Use of Foreign Materials Questionable

The use of Japanese Honeysuckle is being accepted generally in certain sections of the country, but there is reason to be dubious about the results. When we see the disastrous effects --- the choking out of large blocks of native vegetation ---- due to dissemination of this plant in the Pennsylvania and Virginia areas, we must of necessity be in doubt. This may lead to acceptance of the principle that only native and indigenous plants, or those which have been thoroughly tried over a period of at least a century, should be used for the prevention of soil erosion. The promiscuous dissemination of introduced foreign or immigrant plants may be the source of many troubles in the years to come. Dr. Frederic E. Clements, of the Carnegie Institution of Washington, and consulting ecologist for the Soil Conservation Service, gives the following practical consideration as a guide in roadside development: "(1) By the use of native plants the cost of maintenance is reduced to the lowest possible point. (2) They require lower costs in time and cash outlay. (3) A definite ecological succession can thus be established. (4) Greater returns to the individual and to the community of a closer acquaintance and greater sympathy with the outdoor environment in which recreational and spiritual values are to be secured".

Erosion in highway ditches is distinctly an engineering problem, and efforts toward its solution are well under way in many sections of the country. Here again, emphasis should be placed upon the very best that is known in design so that the principles of beauty and art may be recognized throughout. Structures which do not conform to the general terrain and the geological and erosive forces at work will soon be washed out and prove ineffective. When we work with Nature and according to her laws, we usually find a simple and easy solution to our problems. When we work against Nature and violate the principles established, we usually find that our problems are difficult and our attempts at solution inadequate if not futile.

Erosion in waterways below highway drainage structures has two distinct aspects: that of engineering and that of landscaping and forestry. An important observation which is coming into the consciousness of highway engineering is that the problems of erosion do not terminate

with the legal limits of the highway. It is often necessary to set up projects in cooperation with adjacent property owners. The changing of the water-table by highway construction methods often creates difficult land-use problems for the adjacent and sometimes unsuspecting farmer.

Erosion in waterways above and leading down into highway drainage structures likewise has its engineering, forestry, and landscaping aspects. In the solution of the two latter problems it might be observed that adequate land-use and zoning are important factors. If definite areas adjacent to the highway could be set aside for tree growth and maintained under good woodlot practices, very often much of the work of erosion control would be simplified. Thus we see that problems which appeared to be only problems of erosion soon carry us into the broader field of rural and regional planning. There rests upon the highway engineer an ever-widening responsibility, and it would seem he is virtually becoming his brother's keeper. The welfare of farming depends upon farm-to-market roads as well as upon through highways, but what the engineer does with the drainage system he establishes may also be important in determining what is good farming practice.

As a designer of landscapes and a user of public highways, the writer is very much concerned with the problems of the future. Many of our major highways will at least have two-lane traveled ways for traffic in each direction, having a dividing strip with carefully grouped plantings to minimize traffic hazards. These dual multi-lane highways for the separation of opposing streams of traffic may be on different levels and at various distances apart to follow the natural contours of the adjacent terrain. If the heavily traveled roads of the future are to be freeways of these proportions, our erosion problems will be tremendously magnified and our landscape possibilities very much extended. Thus it behooves the highway engineer and the landscape designer to urge the importance of these research studies. This work which is being sponsored by the Highway Research Board of the National Research Council is timely, but it would seem that its program must be accelerated in order to keep up with even the present demands for information along these lines.

Committee Recommendations

I. We urge upon the various State highway departments the importance of availing themselves of the opportunity of roadside demonstrations in soil erosion prevention, and also of such as the research studies of this project.

1. Outstanding climatic conditions.
2. Special nature of surface and subsoil conditions.
3. Variety of exposure to sunlight.
4. Seasonal nature of planting and seeding; i. e., spring and autumn.

II. We urge the cooperation of the State highway departments in the collection of obtainable data either of an engineering or landscaping nature which is of value in the field of erosion control.

III. The basic factors of selection of plants for erosion control on the highway and adjacent erosive areas where the run-off affects highway maintenance and protection are as follows:

1. The indigenous character of the adjacent landscape should be accentuated and preserved.

2. Native plants, those found in the area before the advent of the white man, should be used and restored wherever possible.

3. The highways should be "roadways back to nature".

4. Native plants have acquired resistance to fungus diseases and attack.

5. Being a part of the balance established by nature, epidemics of disease or insect attack are balanced by diversified groups of plants.

6. Exotic species, because they are out of balance with other plant life, if used too extensively may be wiped out in the future by an epidemic of insects or disease.

7. The conservation and restoration of native plants offer better protection, food, and nesting places for song and insectivorous birds as well as small game. All of these are essential in the maintenance of the balance established by nature.

8. The application of these basic principles for the preservation and restoration of nature's balance will assure economical highway maintenance. The problem of erosion when thoroughly understood becomes very simple.

References

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