

REPORT OF SUBCOMMITTEE  
ON  
SLOPE EROSION

Professor Franz A. Aust, Chairman,  
University of Wisconsin

Arnold Davis, Soil Conservation Service  
Dr. C. R. Hursh, Appalachian Experiment Station  
D. W. Levandowsky, National Park Service  
R. L. Williams, Wisconsin State Highway Commission  
John L. Wright, Connecticut State Highway Department

\* \* \*

The past decade has brought many improvements in highway design, and in highway construction and maintenance practices which have reduced erosion of surface soils on or immediately adjacent to the highway. These include improvements in the design of highway drainage and other structures to aid in solving soil erosion problems. The work of the Subcommittee on Erosion since its organization in 1934 has been largely concerned with surveys of the field of highway soil erosion control and with studies of existing practices in various regions.

↳ [Perhaps the outstanding achievement of this decade in the solving of highway soil erosion problems, is the "streamlining" of the highway cross section. The old type railroad cross section so prevalent in earlier highway construction practice has been replaced by a more functional design, with earth slopes flattened and rounded to fit local conditions of soil and topography. Well flattened and rounded earth-work cross sections have reduced construction and maintenance costs because they facilitate the use of motorized grading, mowing and snow removal equipment. The improved cross section reduces guard rail requirements on fills and makes for a safer and more attractive highway, blending the roadside into the adjacent countryside. /AUTHOR/

In any research program a simple classification of the factors effecting solution of the problem to be studied is essential. Among factors which effect highway slope erosion are:

Topography. Typical cross section designs have been worked out by the Committee on Roadside Development which can be applied to any region. Topography has been divided into three broad classes: (1) Smooth or easy; (2) Moderate or rolling; (3) Rough or mountainous. (See Proceedings of Highway Research Board, Vol. 19, 1939, pages 238-247). Cut and fill slopes, which are mainly controlled by topography, are divided into five classes. (See Appendix III, page 61 "Typical Cross Section Sheet for Erosion Control Report.") Variation in Methods of Highway Slope Erosion Control will logically be based upon these general slope classes which are in turn subject to topographic, soil, and climatic controls.

Soil Types. Soil types have been roughly classified as:

- A - Permeable: Sand, sandy gravel, sandy loam, et cetera.
- B - Impermeable: Clay, clay loam, silty clay loam, et cetera.

(See Report of Subcommittee on Plant Ecology, Proceedings of the Highway Research Board, Vol. 19, 1939, pages 254 and 255). It is the consensus of the members of the Committee on Roadside Development however, that a simple soil classification based, if possible, on relative erodibility should be worked out. Unfortunately this character of erodibility varies with climatic regions and rate of annual rainfall, with average degree of slope and with other varying local factors, as well as with the basic texture of soils. The fact remains that the present technical classification of soils, based on geologic origins and horizons, as well as texture, includes some 6,000 recognized types. Such a detailed soil classification is too complicated for practical use in the classification of slope erosion control projects. It is thought that a simplified classification based upon 9 or 10 textural classes between sand and clay may serve the purposes of the Committee.

Climate. Three broad types of climate are found in North America in what may be called cool humid, warm humid and arid regions. A classification of 32 climatic regions in which plant growth conditions are relatively similar will be found on the map, by F. L. Mulford, to be found on page 249 of the 1939 Proceedings of the Highway Research Board, (Vol. 19).

For convenience in administration and in recording of results highway erosion control projects have been carried out through the State highway departments in the various Public Roads Administration districts\* in cooperation with the Soil Conservation Service.

During the coming year results of highway soil erosion control work as a part of the roadside development program will be reported by each of the coordinating officers in the Public Roads Administration districts. In addition to the regular roadside program, results of the special highway soil erosion projects performed by cooperation between the State highway departments and the Soil Conservation Service will be also covered as far as possible in the respective reports of the district roadside coordinators. (See Appendix II, page 50 for chart showing flow diagram). The above information when tabulated should be assembled in brief outline form and made available for the use of engineers and landscape foremen in the field. Eventually, it is hoped a handbook on the subject of slope erosion control practice will be drawn up with special recommendations for each Public Roads Administration district and for regions within such districts where plant growth conditions are similar.

---

\*See Appendix II, Pages 50 and 52 for chart and map showing Public Roads Administration Districts.

The committee is pleased to report progress on a moving picture by the Soils Conservation Service entitled, "Roads and Erosion," which shows the methods of highway erosion control used on the various State highway systems. This film should soon be ready for distribution and use.

The information in "Graphic Solution of Highway Ditch Design for Erosion Control" published in connection with the Committee's report of April, 1940, has been very helpful to engineers, but it is hoped that the material can be simplified for use by field men whose knowledge of hydrology is limited.<sup>1</sup>

The continuation of the evaluation and study of various projects now under way and directed by Mr. Arnold M. Davis of the Soil Conservation Service, has gone forward with special reports on these projects coming from Region 2, South Atlantic States, consisting of Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, and Mississippi.

We have a special report dealing with the extended use as well as detailed study of earlier uses of the Kudzu vine; Lespedeza Sericea; Bermuda grass, and three different kinds of grass seed mixtures. Besides this there is a detailed report on such subjects as seed, berm, and tail ditches; sodded drop inlets, and shoulders.

One of the outstanding features of this report is the indicated limitations of Bermuda grass in the South Atlantic region. On slopes steeper than 3:1 there has been some difficulty in maintaining a Bermuda grass sod. In numerous cases it was observed during the past year where Bermuda grass had survived for three seasons and established an almost complete ground cover, failure was observed especially on the top half of the slope. The failure may have been due to extreme low temperature during the winter of 1939 and 1940. However, in the opinion of most observers the failure was due to lack of moisture and plant nutriment, and possibly lack of maintenance. In most areas the agronomist is looking to other plants that survived during this past year which were planted under the same conditions and time as when the Bermuda grass control covers were established.

Kudzu has been the most effective plant for use on slopes ranging steeper than 3:1. The best ground cover has been established by planting the kudzu in trenches about 12 inches deep supplied with commercial fertilizer.

In some soils 16 per cent superphosphate, at the rate of 200 lb. per acre and compost, placed in the trench rows proved very successful. It is thought that the moisture retention factor of the trench method is responsible for the success of this planting method.

Lespedeza Sericea has been a very satisfactory cover on slopes.

---

<sup>1</sup> - Roadside Development, Part II, Final Report, Subcommittee on Erosion, Issued April, 1940, by the Highway Research Board.

Bermuda Grass is effective on slopes. Various methods of establishing Bermuda grass can be found in previous committee reports which apparently have not been improved on in the past year.

Another fact came to light in these studies, namely, that three-year-old seedings seemed highly satisfactory. Cultural care was negligible; there was no mowing or fertilization of these areas. On a similar situation in the same soil type slope and exposure, a five-year stand seemed to be failing rapidly. Two years previously this stand was comparable to the one described above, namely, the three-year-old stand. Failure is probably due to a lack of clipping and proper maintenance fertilization, and because of upheaval during periods of freezing and thawing.

Region 3 - Upper Ohio River, consisting of the States of Kentucky, Ohio, Tennessee, Michigan and Indiana. From this region we have two very interesting reports.

One report deals with improved methods of planting; discussion of the success and failure of old methods, new plant materials, and ground cover plantings.

Improved methods of planting bush honeysuckle and sweet fern have been developed in the Michigan area. Quack grass has been established in the northern parts of this region very successfully. However, at the present time in some States this grass is considered a noxious weed, and further developments will have to be limited by this factor. However, it appears to be one of the finest plant materials for this section where grass is considered a desirable type of vegetative cover.

Live sod check dams in ditches have proved very effective in the middle portion of the Upper Ohio Region.

Mulch has been very effective, especially on the steeper slopes. Hay, straw, and other local materials have been successfully used in this work.

There appears to be a lack of cooperation on the part of personnel of various highway departments in the value of making grass and legume seedings at the proper season and according to the best prescribed methods. In other words, some highway departments do not follow the latest proved method of establishing ground cover. There is evidence in some States that too many seedings are made at the time convenient to the contractor, and not at the time when the seeding if performed would be most successful. Until these conditions are remedied through proper education and sympathetic administrative control it is going to be difficult to obtain higher percentages of plant survival.

The second report coming from Region 3 deals with "Lake Bluff Erosion Control." This project is of special interest inasmuch as it was the result of cooperative effort of various organizations and individuals including the Berrin County Road Commission, and the Michigan State Agricultural College staff. It is illustrative of the types of work which may be encouraged more frequently on the part of the State and County highway officials, where their problems are taken direct to their State Experiment Stations for study and solution. Public agencies are in this way contributing to the educational and research programs of their State institutions, and bringing particular problems which are a challenge to the senior and graduate students for study and solution.

The report deals with six different types of treatment to prevent erosion of the clay bluffs leading down to the shores of Lake Michigan. Here the erosion obviously is due to surface erosion and wave action. The six different methods consist of:

1. Mulch held in place by used cattle fencing and willow stakes.
2. Partial stabilization by native vegetation.
3. Contour wattles and seep area control.
4. Corn stover, brush, and manure used as mulch.
5. Post and board dams.
6. Contour wattles.

Like all research problems, studies will have to be continued over a period of years before any definite conclusions can be made.

Region 6, semi-arid section consisting of Kansas, extreme Western Oklahoma, East Colorado, New Mexico and Northwest Texas.

This report deals explicitly with vegetative control, cross section, and treatment of adjacent lands by means of diversion ditches.

In the semi-arid portions of the United States it has been found that the area to be controlled should be seeded first with a non-competitive cover crop such as sorghums. This cover crop should not be allowed to seed, but should be mowed prior to seeding and left on the ground as a mulch. The cover crop should be planted with deep-furrow drill or a lister. Broadcasting or drilling of grass seed with regular grain drills has not proved to be successful.

Crested wheat in this area is the only imported grass that has given much promise of success.

Region 7, Northern Great Plains, consisting of North Dakota, South Dakota, Nebraska, Wyoming and Montana.

In this region there has been considerable work done to control grasshoppers by attempting to destroy the grasshoppers after they have hatched. The research project that is being established in this area is to advance means for destroying the eggs before they are hatched. Apparently the eggs are not laid in dense ground cover, consequently, in those areas that are not cropped attempts are being made to establish dense covers such as on head lands and on highway ditches and slopes. It is thought that if the head lands and road right-of-way can be covered with dense ground cover and all the cultivated area disturbed just before hatching time, the eggs will be destroyed. This project, if successful, will tend to emphasize the importance of ground covers on highway slopes and ditches.

The erosion control demonstration projects are being extended on county and township roads and in those areas where county highway officials are interested in such educational work.

The rapid development of soil conservation districts in the United States as shown on the map in Appendix II, page 60 is most encouraging. These legally constituted districts will prove a valuable aid to a work program developed to control erosion, especially on county and farm roads. These districts are organized and governed by local people for the purpose of controlling erosion on lands within the district. The control of erosion on agricultural land is the primary objective, but most of the districts recognize that the control of erosion on highways are inescapably a part of controlling erosion on agricultural land, and they have recognized this problem in their general over-all program and work plan.

It is the intention of the Committee to keep in touch with the operation of these districts, and to give them the benefit of the research work that is being considered by the Committee.

The Public Roads Administration has appointed five individuals to assist with establishing demonstrations and erosion control works on all roads within their jurisdiction, who are available when requested by county authorities, to provide technical advice on erosion problems. The development of erosion control projects on the secondary road systems will prove very beneficial in preventing damage due to erosion on this type of road.

The Project Committee on Erosion wishes to acknowledge the contribution made by the Michigan Department and the Agricultural Experiment Station in connection with their studies of bluff erosion along the east shores of Lake Michigan, in cooperation with the Soil Conservation Service. Likewise, they are grateful for assistance which has been rendered the National Park Service in connection with experimental work in bringing raw soils up to a state of productivity.

The Committee further wishes to express their appreciation of the cooperation extended by Commissioner MacDonald of the Public Roads Administration in appointing technical coordinators in some of the Public Roads Administration districts. These men are proving very worthy, and making valuable contributions to the research program of the committee. The committee is planning for increased efficiency on their part in cooperating with these technical coordinators.

Further appreciation is expressed to the Executive Coordinating Committee of the American Association of State Highway Officials and the Highway Research Board, Committees on Roadside Development. The machinery which they are initiating for the collection of information, as well as bringing to the Research Board problems which require technical study, will go far in bringing about a more universal use of the results of the Research studies of this agency.